

## Foreword

Dear customer,

As it is our ambition to be the worldwide leader in fastening technology, we are continuously 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 specifically excluded.

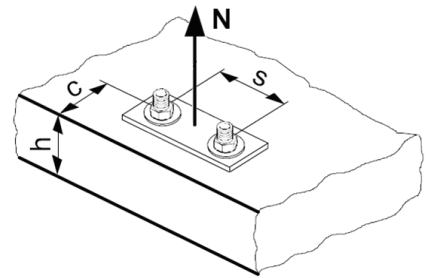
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**FL-9494 Schaan**  
**Principality of Liechtenstein**  
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## Anchor technology and design

Anchor selector  
Legal environment  
Approvals  
Base Material  
Anchor design  
Design examples  
Corrosion  
Dynamic loads (seismic, fatigue, shock)  
Resistance to fire



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## Mechanical anchoring systems

Heavy duty anchors  
Medium and light duty anchors  
Insulation fasteners



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## Adhesive anchoring systems

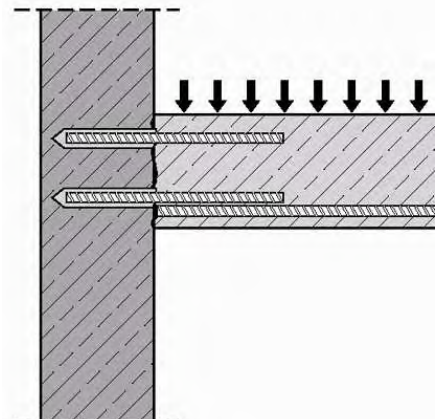
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## Post-installed rebar connections

Basics, design and installation  
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## Anchor technology and design

Anchor selector

Legal environment

Approvals

Base Material

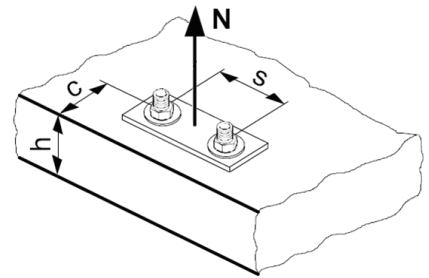
Anchor design

Design examples









Corrosion

Dynamic loads (seismic, fatigue, shock)

Resistance to fire












# 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	
<b>Mechanical anchor systems</b>														
<b>Heavy duty anchors</b>														
HDA-T/ -TR/TF/-P/-PR/-PF undercut anchor 	•	•						•	•	•	•	•	Anchor fastening for high loads e.g. in steel construction and plant construction	
HSL-3 heavy duty anchor 	•	•						•	•	•	•	•	Fastening heavy loads e.g. from columns, high racks, machines	
HSL-GR heavy duty anchor 		•											Fastening heavy loads	
<b>Medium and light duty anchors</b>														
HSC-A(R) /-I(R) safety anchor 	•	•						•				•	•	Safety relevant fastening at facades and ceilings where short embedment depth is required
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
HLC sleeve anchor 		•			•								•	Temporary fastenings in concrete (e.g. formwork), fastening in base material of low density











• = 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
<ul style="list-style-type: none"> <li>Automatic undercutting</li> <li>High load capacity</li> <li>Approved for all dynamic loads</li> </ul>	Drill bit dia.: 20 – 37 mm Anchor size: M10 – M20	•	•		•		•		•	•	72
<ul style="list-style-type: none"> <li>Integrated plastic section to telescope and pull down tightly</li> <li>The bolt can be retorqued</li> </ul>	Drill bit dia.: 12 – 32 mm Anchor size: M8 – M24	•					•			•	88
<ul style="list-style-type: none"> <li>Integrated plastic section to telescope and pull down tightly</li> <li>The bolt can be retorqued</li> </ul>	Drill bit dia.: 12 – 28 mm Anchor size: M8 – M20				•						100
<ul style="list-style-type: none"> <li>Automatic undercutting</li> <li>Small edge distances and spacings</li> <li>Small setting depth</li> </ul>	Drill bit dia.: 14 – 20 mm Anchor size: M6 – M12	•			•		•	•	•		110
<ul style="list-style-type: none"> <li>Quick and simple setting operation</li> <li>Setting mark</li> <li>Safety wedge for certain follow up expansion</li> </ul>	Drill bit dia.: 8 – 24 mm Anchor size: M8 – M24	•			•	•	•		•	•	130
<ul style="list-style-type: none"> <li>Three setting depths</li> <li>Setting mark</li> <li>Extremely ductile steel for high bending capacity</li> </ul>	Drill bit dia.: 6 – 20 mm Anchor size: M8 – M24	•	•		•		•		•	•	140
<ul style="list-style-type: none"> <li>Quick and simple setting operation</li> </ul>	Drill bit dia.: 8 – 16 mm Anchor size: M8 – M16	•					•		•	•	158
<ul style="list-style-type: none"> <li>Short setting and removing operation</li> <li>Good loads in green concrete</li> <li>Bridging of gaps</li> </ul>	Drill bit dia.: 6,5 – 20 mm Anchor size: M5 – M16	•					•		•	•	168

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	
<b>Medium and light duty anchors</b>													
HAM hard sleeve anchor 		•			•							Secure fastenings in various base materials	
HUS-HR screw anchor, stainless steel 	•	•			•			•				• Fastening channels, brackets, racks, seating	
HUS screw anchor, carbon steel 	•	•		•	•			•	•			• Fastening channels, brackets, racks, seating	
HUS- 6 screw anchor, redundant fastening 	• 1)	•					•	•				• Fastening channels, brackets, racks, seating	
HUS 6 / HUS-S 6 screw anchor 	• 1)	•	•	•	•	•		•				• Fastening light channels, brackets, interior panelling or cladding	
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	
HUD-1 universal anchor 		•	•	•	•	•						Various applications	
HUD-L universal anchor 		•	•	•	•	•						Various applications	

• = 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	
<ul style="list-style-type: none"> <li>Wings to prevent spinning in the bore hole</li> <li>Plastic cap in cone to prevent dust entrance</li> </ul>	Drill bit dia.: 12 – 20 mm Thread: M6 – M12	•						•	•	174
<ul style="list-style-type: none"> <li>Screw driven straight into base material</li> <li>Forged on washer</li> <li>Matched system of screw anchor and screw driver</li> </ul>	Drill bit dia.: 6 – 14 mm				•				•	176
<ul style="list-style-type: none"> <li>Screw driven straight into base material</li> <li>Forged on washer</li> <li>Matched system of screw anchor and screw driver</li> </ul>	Drill bit dia.: 8 – 14 mm	•							•	192
<ul style="list-style-type: none"> <li>Screw driven straight into base material</li> <li>Forged on washer</li> <li>Matched system of screw anchor and screw driver</li> </ul>	Drill bit dia.: 6 mm	•					•		•	216
<ul style="list-style-type: none"> <li>Screw driven straight into base material</li> <li>Small drill bit diameter</li> <li>Matched system of screw anchor and screw driver</li> </ul>	Drill bit dia.: 6 mm	•					•		•	222
<ul style="list-style-type: none"> <li>Visual verification of full expansion</li> <li>Small setting depth</li> </ul>	Drill bit dia.: 8 – 25 mm Anchor size: M6 – M20	•			•		•	•		228
<ul style="list-style-type: none"> <li>Visual verification of full expansion</li> <li>Small setting depth</li> </ul>	Drill bit dia.: 8 – 20 mm Anchor size: M6 – M16	•					•	•		250
<ul style="list-style-type: none"> <li>Fast setting</li> <li>Flexibility of screw length</li> <li>An anchor for every base material</li> </ul>	Drill bit dia.: 5 – 14 mm							•	•	254
<ul style="list-style-type: none"> <li>Fast setting</li> <li>Flexibility of screw length</li> <li>An anchor for every base material</li> </ul>	Drill bit dia.: 6 – 10 mm							•	•	260

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	
<b>Medium and light duty anchors</b>													
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)	•			•	•	•	•					• On most hollow and solid base material
HPS-1 impact anchor 		•	○	•	•	•							Fastening wood battens, components for electrical and plumbing installations
HHD-S cavity anchor 						•							Fastening battens, channels panels
HCA coil anchor 		•											Temporary external fastenings
HSP/HFP drywall 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

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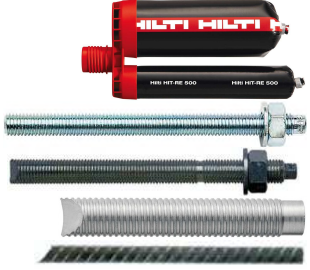



Advantages	Drill bit diameter resp. anchor size	Specification							Setting		Page
		Steel, galvanised	Steel, sheradised, hot dipped galv.	Stainless steel A2 (1.4303)	Stainless steel A4 (1.4401)	HCR steel (1.4529)	External thread	Internal thread	Pre-setting	Through-fastening	
<ul style="list-style-type: none"> <li>Flexibility of screw length</li> <li>Resilient toggling action to suit every base material</li> </ul>	Drill bit dia.: 10 mm								•		264
<ul style="list-style-type: none"> <li>Preassembled with screw</li> <li>Screw of steel strength 5.8 or stainless steel A4 (1.4401)</li> </ul>	Drill bit dia.: 10 and 14 mm	•			•					•	268
<ul style="list-style-type: none"> <li>impact and temperature resistant</li> <li>high quality plastic</li> </ul>	Drill bit dia.: 8 – 10 mm	•			•					•	274
<ul style="list-style-type: none"> <li>impact and temperature resistant</li> <li>high quality plastic</li> </ul>	4 – 8 mm	•		•			•			•	292
<ul style="list-style-type: none"> <li>Controlled setting</li> <li>Deliverable with or without prefitted screw</li> </ul>	Drill bit dia.: 8 – 12 mm	•							•		296
<ul style="list-style-type: none"> <li>Re-usable</li> <li>Removable</li> </ul>	Drill bit dia.: 16 mm										298
<ul style="list-style-type: none"> <li>Self-drilling tip</li> <li>One bit for anchor and screw</li> <li>Removable</li> </ul>	-								•		300
<ul style="list-style-type: none"> <li>Quick and easy setting</li> <li>Automatic follow up expansion</li> </ul>	Drill bit dia.: 8 mm	•							•		302
<ul style="list-style-type: none"> <li>Small drill bit diameter</li> <li>Quick setting by impact extension</li> <li>Automatic follow up expansion</li> </ul>	Drill bit dia.: 6 mm	•								•	306
<ul style="list-style-type: none"> <li>No risk of distortion or forces of constraint</li> <li>Expansion cone can not be lost</li> </ul>	Drill bit dia.: 8 – 10 mm	•								•	310

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		
<b>Medium and light duty anchors</b>														
HK ceiling anchor 	●	●						●				●	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
<b>Insulation fasteners</b>														
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	
<ul style="list-style-type: none"> <li>Small bore hole</li> <li>Quick and easy setting</li> </ul>	Drill bit dia.: 6 mm M6	•						•		•	314
<ul style="list-style-type: none"> <li>Approved (DIBt)</li> <li>Fire resistance</li> <li>Immediately loadable</li> </ul>	Without predrilling Thread: M6 – M10	•						•		•	320
<ul style="list-style-type: none"> <li>Approval for single point fastenings</li> <li>Approved for sprinkler systems</li> </ul>	Drill bit dia.: 10 – 14 mm Thread: M6 – M10	•						•		•	326
<ul style="list-style-type: none"> <li>Load carried by strong metal channel and screw</li> <li>Convincing simplicity when setting</li> </ul>	Drill bit dia.: 13 – 14 mm									•	330
<ul style="list-style-type: none"> <li>One piece element</li> <li>Corrosion resistant</li> <li>No heat bridge</li> </ul>	Drill bit dia.: 8 mm insulating material thickness 10 – 150mm									•	334
<ul style="list-style-type: none"> <li>Corrosion resistant</li> <li>No heat bridge</li> <li>Reliable bonding of plaster</li> </ul>	Drill bit dia.: 8 mm insulating material thickness up to 180mm									•	338
<ul style="list-style-type: none"> <li>One piece element</li> <li>Corrosion resistant</li> <li>Fire resistant</li> </ul>	Drill bit dia.: 8 mm insulating material thickness up to 150mm	•		•						•	342

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	
<b>Adhesive anchor systems</b>												
<b>Foil capsule systems</b>												
HVZ adhesive anchor 	•	•						•		•	•	Heavy-duty fastenings with small spacing and edge distances
HVU adhesive anchor 		•						•				• Heavy duty fastenings with small spacing and edge distances
<b>Injection mortar systems</b>												
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		
<ul style="list-style-type: none"> <li>▪ No expansion pressure</li> <li>▪ Small edge distances and spacing</li> <li>▪ A strong and flexible foil capsule</li> </ul>	M10 – M20	•			•	•	•		•		348	
<ul style="list-style-type: none"> <li>▪ No expansion pressure</li> <li>▪ Small edge distances and spacing</li> <li>▪ A strong and flexible foil capsule</li> </ul>	HAS M8 – M39 HIS-M8 - M20 Rebar dia. 8 – 40 mm	•			•	•	•	•	•		360	
<ul style="list-style-type: none"> <li>▪ No expansion pressure</li> <li>▪ Long working time</li> </ul>	HIT-V M8 – M30 HIS-M8 - M20 Rebar dia. 8 – 32 mm	•			•	•	•	•	•		380	
<ul style="list-style-type: none"> <li>▪ No expansion pressure</li> <li>▪ Long working time</li> </ul>	HIT-V M8 – M39 HIS-M8 - M20 Rebar dia. 8 – 40 mm	•			•	•	•	•	•		422	
<ul style="list-style-type: none"> <li>▪ No expansion pressure</li> <li>▪ Flexibility in terms of working time</li> <li>▪ No styrene content</li> <li>▪ No plasticizer content</li> <li>▪ Environmental protection due to the minimized packaging</li> </ul>	HIT-V M8 – M30 HIS-M8 - M20 Rebar dia. 8 – 32 mm	•			•	•	•	•	•		488	

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	
<b>Injection mortar systems</b>													
HIT-HY 150 MAX 	•	•	•					•				Adhesive anchor in cracked concrete	
HIT-CT 1 		•						•				Hilti Clean technology adhesive anchor	
HIT-HY 150 		•	•									• Adhesive anchor	
HIT ICE 		•										Adhesive anchor for low installation temperatures	
HIT-HY 70 		•			•	•						• Universal mortar for solid and hollow brick	

• = 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	
<ul style="list-style-type: none"> <li>No expansion pressure</li> <li>No styrene content</li> <li>No plasticizer content</li> <li>Environmental protection due to the minimized packaging</li> </ul>	HIT-V M8 – M30 HIS-M8 - M20 Rebar dia. 8 – 25 mm	•			•	•	•	•	•	558
<ul style="list-style-type: none"> <li>No expansion pressure</li> <li>Environmentaly and user friendly: clean of critical hazardous substances</li> </ul>	HIT-V M8 – M24									614
<ul style="list-style-type: none"> <li>No expansion pressure</li> <li>No styrene content</li> <li>No plasticizer content</li> <li>Environmental protection due to the minimized packaging</li> </ul>	HIT-V M8 – M30 HIS-M8 - M20 Rebar dia. 8 – 25 mm	•			•	•	•		•	630
<ul style="list-style-type: none"> <li>No expansion pressure</li> </ul>	HAS M8 – M24 HIS-M8 - M20 Rebar dia. 8 – 25 mm	•			•	•	•	•	•	672
<ul style="list-style-type: none"> <li>No expansion pressure</li> <li>mortar filling control with HIT-SC sleeves</li> </ul>	Drill bit dia.: 10 – 22 mm Thread: M6 – M12	•			•	•	•		•	706

## 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 Technical Approval Guidelines

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.

### **Post-installed rebar connections**

The basis for the assessment of post-installed rebar connections is set out in the 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

## Approvals

### European Technical Approvals: Europe

Anchor type	Description	Authority / Laboratory	No. / Date of issue	Languages		
				g	e	f
HDA / HDA-R	Self-undercutting anchor made of galvanised or stainless steel (Valid until: 25.03.2013)	CSTB, Paris	ETA-99/0009 17.12.2010	•	•	•
HSL-3	Torque controlled expansion anchor of galvanised steel (Valid until: 10.01.2013)	CSTB, Paris	ETA-02/0042 10.01.2008	•	•	•
HSC / HSC-R	Self-undercutting anchor made of galvanised or stainless steel (Valid until: 20.09.2012)	CSTB, Paris	ETA-02/0027 20.09.2007	•	•	•
HST / HST-R / HST-HCR	Expansion stud anchor made of galvanised, stainless or highly corrosion resistant steel (Valid until: 19.02.2013)	DIBt, Berlin	ETA-98/0001 17.06.2011	•	•	•
HSA / HSA-R	Expansion stud anchor made of galvanised or stainless steel (Valid until: 19.07.2017)	CSTB, Paris	ETA-11/0374 19.07.2012	•	•	•
HUS-HR 6/8/10/14 HUS-H 6/8/10 HUS-A/-I-P 6	Screw anchor made of stainless steel or carbon steel, deltatone coated (Valid until: 12.12.2013)	DIBt, Berlin	ETA-08/307 21.01.2011	•	•	•
HUS 6	Screw anchor made of carbon steel, deltatone coated (Valid until: 23.04.2015)	DIBt, Berlin	ETA-10/0005 23.08.2011	•	•	•
HKD / HKD-R	Deformation controlled expansion anchor made of galvanised or stainless steel (Valid until: 14.03.2016)	DIBt, Berlin	ETA-06/0047 14.03.2011	•	•	•
HKD / HKD-R	Deformation controlled expansion anchor made of galvanised or stainless steel (Valid until: 12.10.2012)	DIBt, Berlin	ETA-02/0032 22.04.2010	•	•	•
HRD	Frame anchor made of polyamide, screw made of galvanised or stainless steel (Valid until: 17.09.2012)	DIBt, Berlin	ETA-07/0219 01.02.2011	•	•	•
DBZ	Wedge anchor made of galvanised steel (Valid until: 14.09.2016)	DIBt, Berlin	ETA-06/0179 14.09.2011	•	•	•
HK	Ceiling anchor made of galvanised steel (Valid until: 23.04.2014)	DIBt, Berlin	ETA-04/0043 30.06.2010	•	•	•
HVZ / HVZ-R / HVZ-HCR	Adhesive anchor, rod made of galvanised, stainless or highly corrosion resistant steel (Valid until: 01.10.2013)	DIBt, Berlin	ETA-03/0032 29.09.2008	•	•	•
HVU with HAS / HAS-R / HAS-HCR HIS-N / HIS-RN	Adhesive anchor, rod made galvanised steel, stainless steel or highly corrosion resistant steel (Valid until 20.01.2016)	DIBt Berlin	ETA-05/0255 23.06.2011	•	•	•

Anchor type	Description	Authority / Laboratory	No. / Date of issue	Languages		
				g	e	f
HIT-RE 500-SD with HIT-V/ HIS-N/ HIT-V-R/ HIS-RN/ HIT-V-HCR/ rebar	Injection adhesive anchor, rod made of galvanised, stainless or highly corrosion resistant steel (Valid until 08.11.2012)	DIBt Berlin	ETA-07/0260 12.01.2009	•	•	•
HIT-RE 500-SD	Injection adhesive for reinforcing bar connections (Valid until: 08.05.2013)	DIBt Berlin	ETA-09/0295 14.09.2009	•	•	•
HIT-RE 500 with HIT-V/ HAS-(E)/ HIS-N/ HIT-V-R/ HAS-(E)R/ HIS-RN/ HIT-V-HCR/ HAS-(E)HCR/ rebar	Injection adhesive anchor, rod made of galvanised, stainless or highly corrosion resistant steel (Valid until 28.05.2014)	DIBt Berlin	ETA-04/0027 20.05.2009	•	•	•
HIT-RE 500	Injection adhesive for reinforcing bar connections (Valid until: 08.05.2013)	DIBt Berlin	ETA-08/0105 30.07.2008	•	•	•
HIT-HY 200-A with HIT-Z / HIT-Z-R	Injection adhesive anchor, rod made of galvanised or stainless steel (Valid until 10.02.2017)	DIBt Berlin	ETA-12/0006 04.04.2012	•	•	
HIT-HY 200-R with HIT-Z / HIT-Z-R	Injection adhesive anchor, rod made of galvanised or stainless steel (Valid until 10.02.2017)	DIBt Berlin	ETA-12/0028 04.04.2012	•	•	
HIT-HY 200-A with HIT-V/ HIS-N/HIT-V-R/ HIS-RN/ HIT-V-HCR/ rebar	Injection adhesive anchor, rod made of galvanised, stainless or highly corrosion resistant steel (Valid until 23.12.2016)	DIBt Berlin	ETA-11/0493 08.08.2012	•	•	•
HIT-HY 200-R with HIT-V/ HIS-N/HIT-V-R/ HIS-RN/ HIT-V-HCR/ rebar	Injection adhesive anchor, rod made of galvanised, stainless or highly corrosion resistant steel (Valid until 06.02.2017)	DIBt Berlin	ETA-12/0084 08.08.2012	•	•	
HIT-HY 200-A	Injection adhesive for reinforcing bar connections (Valid until: 23.12.2016)	DIBt Berlin	ETA-11/0492 08.08.2012	•	•	•
HIT-HY 200-R	Injection adhesive for reinforcing bar connections (Valid until: 06.02.2017)	DIBt Berlin	ETA-12/0083 08.08.2012	•	•	
HIT-HY 150 MAX with HIT-TZ / HIT-RTZ	Injection adhesive anchor, rod made of galvanised or stainless steel (Valid until 23.09.2014)	DIBt Berlin	ETA-04/0084 09.12.2009	•	•	•
HIT-HY 150 MAX with HIT-V/ HAS-(E)/ HIS-N/ HIT-V-R/ HAS-(E)R/ HIS-RN/ HIT-V-HCR/ HAS-(E)HCR/ rebar	Injection adhesive anchor, rod made of galvanised, stainless or highly corrosion resistant steel (Valid until 18.12.2013)	CSTB, Paris	ETA-08-352 01.04.2010	•	•	•
HIT-HY 150 MAX	Injection adhesive for reinforcing bar connections (Valid until: 24.07.2013)	CSTB, Paris	ETA-08/0202 24.07.2008	•	•	•

Anchor type	Description	Authority / Laboratory	No. / Date of issue	Languages		
				g	e	f
HIT-CT 1 with HIT-V	Injection adhesive anchor, rod made of galvanised, stainless or highly corrosion resistant steel (Valid until 30.09.2016)	CSTB, Paris	ETA-11/0354 30.09.2011		•	•
HIT-HY 70 with HIT-V/ HIT-V-R/ HIT-V-HCR	Injection adhesive anchor, rod made of galvanised, stainless or highly corrosion resistant steel (Valid until 28.09.2014)	DIBt, Berlin	ETA-09/0265 28.09.2009	•	•	

## Additional National European Approvals

### France

Anchor type	Description	Authority / Laboratory	No. / Date of issue	Languages		
				g	e	f
HIT-HY 70	Injection adhesive, rod made of galvanised steel (Valid until: 30.06.2015)	SOCOTEC, Paris	YX 0047 06.2012			•

### Switzerland

Anchor type	Description	Authority / Laboratory	No. / Date of issue	Languages		
				g	e	f
HDA-P HDA -PF HDA -PR HDA-T HDA -TF HDA -TR	Undercut anchor for shockproof fastenings in civil defence installations (Valid until: 31.10.2019)	Federal Office for Civil Protection, Bern	BZS D 09-601 21.10.2009	•	•	
HSL-3 HSL-3-G HSL-3-B HSL-3-SK HSL-3-SH	Heavy duty anchor for shockproof fastenings in civil defence installations (Valid until: 30.06.2018)	Federal Office for Civil Protection, Bern	BZS D 08-601 30.06.2008	•	•	
HSC-I(R) HSC-A(R)	Safety anchor for shockproof fastenings in civil defence installations (Valid until: 31.07.2016)	Federal Office for Civil Protection, Bern	BZS D 06-601 10.07.2006	•	•	
HST / HST-R	Stud anchor for shockproof fastenings in civil defence installations (Valid until: 31.12.2018)	Federal Office for Civil Protection, Bern	BZS D 08-602 15.12.2008	•	•	
HVZ / HVZ-R	Adhesive anchor for shockproof fastenings in civil defence installations (Valid until: 31.10.2019)	Federal Office for Civil Protection, Bern	BZS D 09-602 21.10.2009	•	•	
HIT-RE 500-SD	Adhesive anchor for shockproof fastenings in civil defence installations (Valid until: 31.10.2019)	Federal Office for Civil Protection, Bern	BZS D 08-604 21.10.2009	•	•	

**Germany**

Anchor type	Description	Authority / Laboratory	No. / Date of issue	Languages		
				g	e	f
HDA	Self-undercutting anchor made of galvanised steel for unusual actions (loads) – for use in Nuclear power plants (Valid until: 31.05.2013)	DIBt, Berlin	Z-21.1-1696 16.02.2011	•	•	
HDA- Dynamic	Self-undercutting anchor made of galvanised steel for dynamic loads (Valid until: 01.10.2016)	DIBt, Berlin	Z-21.1-1693 01.10.2011	•		
HRD	Frame anchor made of polyamide, screw made of galvanised or stainless steel (Valid until: 31.10.2012)	DIBt, Berlin	Z-21.2-599 16.09.2009	•		
HRD 10	Frame anchor made of polyamide, screw made of galvanised or stainless steel (Valid until: 30.04.2014)	DIBt, Berlin	Z-21.2-1952 31.10.2011	•		
HPD	Aerated concrete anchor made of galvanised steel (Valid until: 31.05.2016)	DIBt, Berlin	Z-21.1-1729 31.05.2011	•	•	
HKH	Hollow deck anchor made of galvanised steel (Valid until: 31.10.2016)	DIBt, Berlin	Z-21.1-1722 31.10.2011	•		
HVZ-Dynamic	Adhesive anchor, rod made of galvanised steel (Valid until: 01.11.2016)	DIBt, Berlin	Z-21.3-1692 07.03.2012	•		
HIT-RE 500	Injection adhesive for reinforcing bar connections (Valid until: 31.03.2014)	DIBt, Berlin	Z-21.8-1790 16.03.2009	•		
HIT-HY 150 MAX	Injection adhesive for reinforcing bar connections (Valid until: 30.11.2014)	DIBt, Berlin	Z-21.8-1882 13.08.2010	•		
HIT-HY 70	Injection adhesive anchor for masonry, rod made of galvanised, stainless or highly corrosion resistant steel (Valid until: 31.05.2015)	DIBt, Berlin	Z-21.3-1830 08.11.2011	•		
HIT-HY 200-A	Injection adhesive for reinforcing bar connections (Valid until: 25.06.2017)	DIBt, Berlin	Z-21.8-1948 25.06.2012	•		

## Additional US Approvals

### USA

Anchor type	Description	Authority / Laboratory	No. / Date of issue	Languages		
				g	e	f
HDA-P HDA -PR HDA-T HDA -TR	Evaluation report of Hilti HDA Metric Undercut Anchor (Valid until: 01.03.2014)	ICC-ES	ESR-1546 01.03.2012		•	
HSL-3 HSL-3-G HSL-3-B HSL-3-SK HSL-3-SH	Evaluation report of Hilti HSL-3 Heavy Duty Anchor (Valid until: 01.03.2014)	ICC-ES	ESR-1545 01.03.2012		•	
HIT RE 500-SD	Evaluation report of Hilti HIT RE 500-SD Adhesive Anchoring System (Valid until: 01.04.2014)	ICC-ES	ESR-2322 01.02.2012		•	
HIT-HY 150 MAX	Evaluation report of Hilti HIT-HY 150 MAX adhesive anchor (the report is subject to renewal 2 years after date of issue)	ICC-ES	ESR-2262 01.07.2012		•	



## 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.

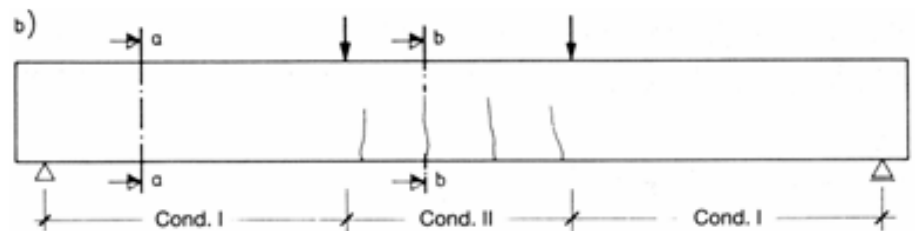
The main building materials suitable for anchor fastenings have been described in the following.

### Concrete

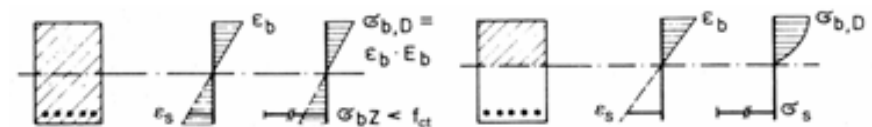
A mixture of cement, aggregates and water

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 with conditions 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.  $w \approx 0.3\text{mm}$ , 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,  $f_{ck, \text{cube}, 150}$ , is between 25 and 60 N/mm<sup>2</sup>. 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/dm<sup>3</sup> and the compressive strength 2 to 6 N/mm<sup>2</sup>. 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/m<sup>3</sup>, 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.

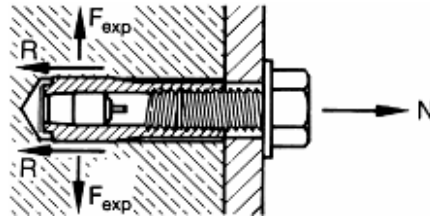
Jobsite tests

## Why does an anchor hold in a base material?

### Working principles

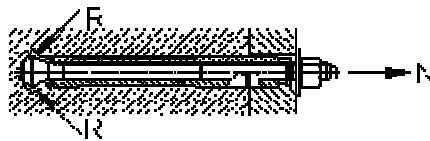
There are three basic working principles which make an anchor hold in a building material:

#### Friction



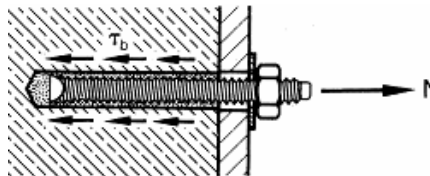
The tensile load,  $N$ , is transferred to the base material by friction,  $R$ . The expansion force,  $F_{exp}$ , is necessary for this to take place. It is produced, for example, by driving in an expansion plug (HKD).

#### 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.

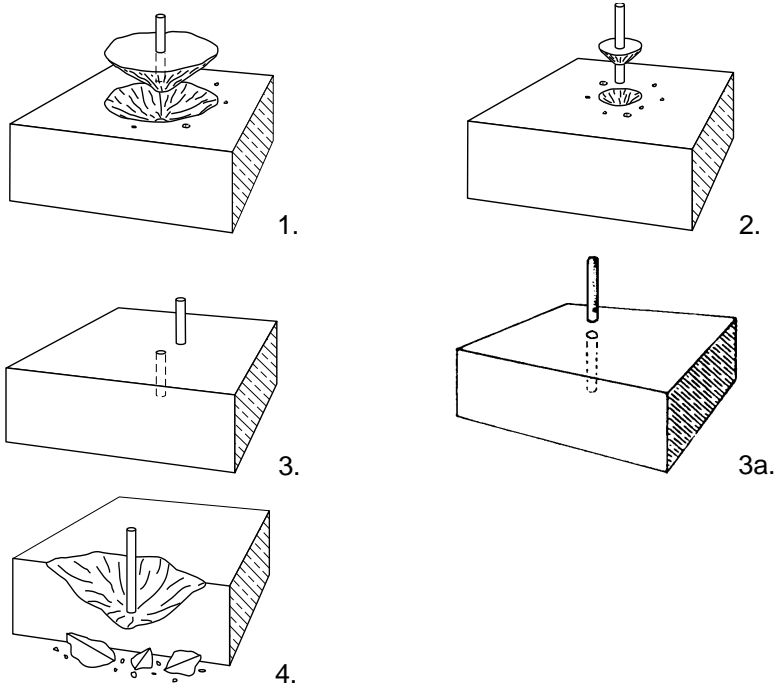
#### Adhesive/resin anchor

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

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



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.

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.

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.

Causes of failure

Combined load

Shear load

### 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).

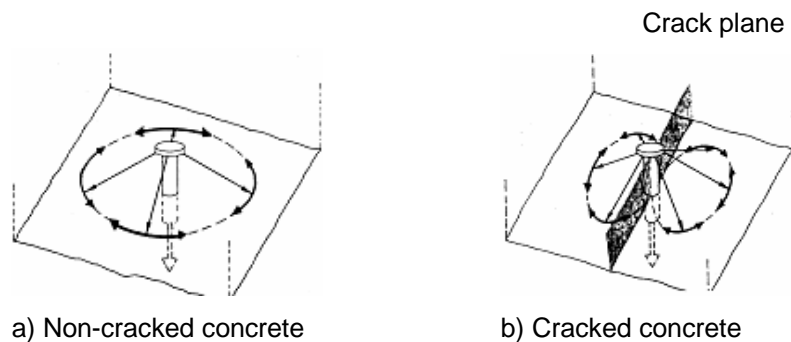
Efficient utilisation of reinforcement

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.

Loadbearing mechanisms

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.

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 by the crack reduces the loadbearing capacity of the anchor system.



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.

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. 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.

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.

Pretensioning force in anchor bolts / rods

Loss of pretensioning force due to cracks

Seismic loads and cracked concrete

# Anchor design

## Safety concept

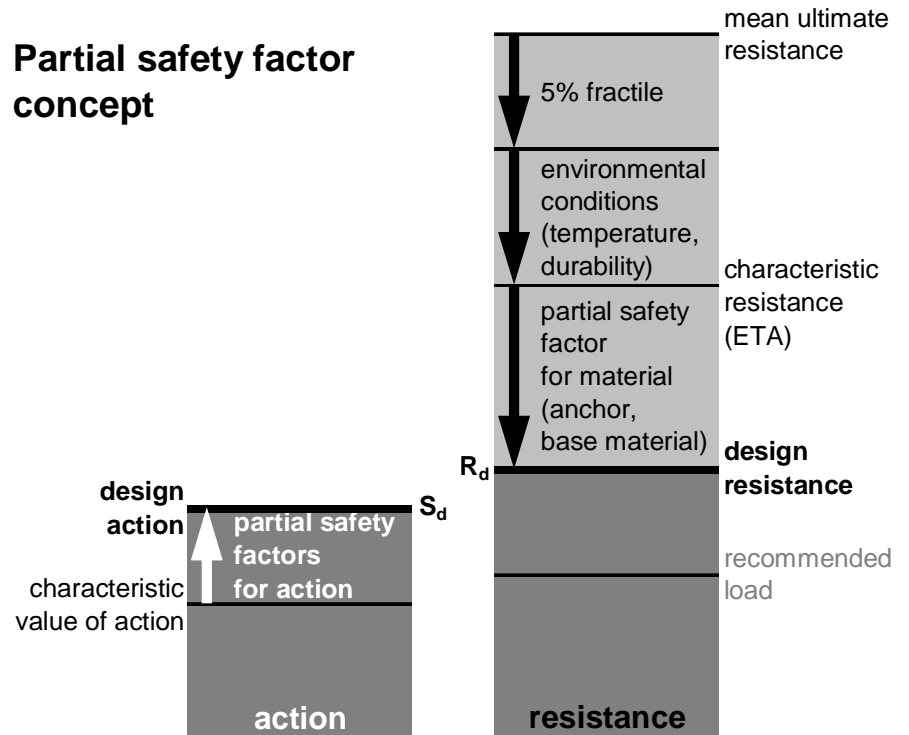
Depending on the application and the anchor type one of the following two concepts can be applied:

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:  $S_d \leq R_d$ .

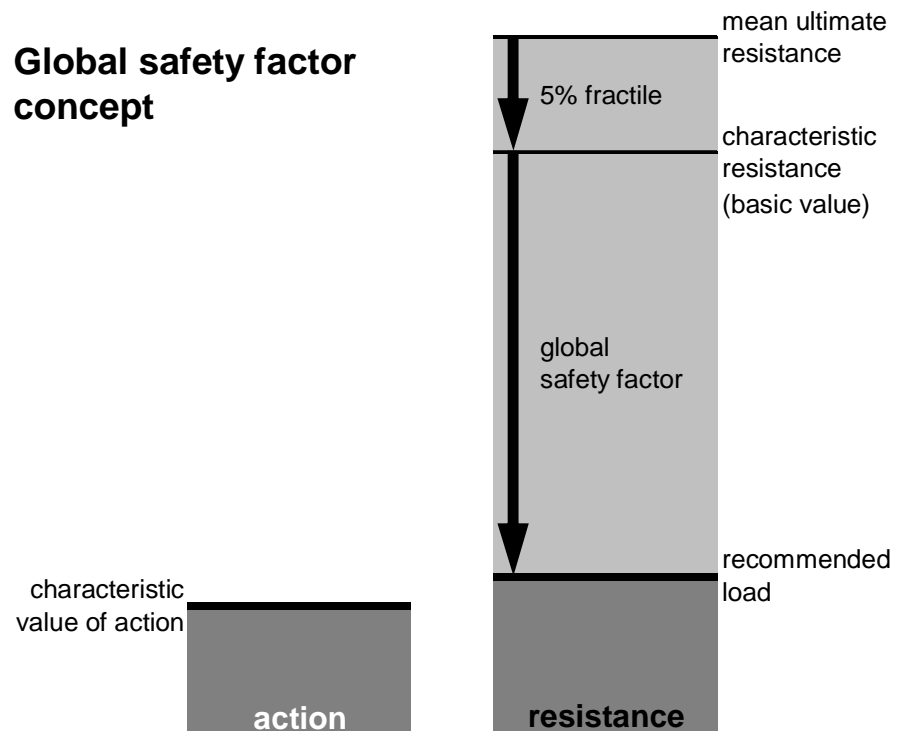
For the characteristic resistance given in the respective ETA, reduction factors due to e.g. freeze/thaw, service temperature, durability, creep behaviour and other environmental or application conditions are already considered.

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

### Partial safety factor concept



### Global safety factor concept



For the global safety factor concept it has to be shown, that the characteristic value of action does not exceed the recommended 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 safe side. Tables with basic load values and influencing 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, geometry, environmental conditions) are observed.

### Redundant fastenings with plastic anchors

Design rules for redundant fastenings 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)

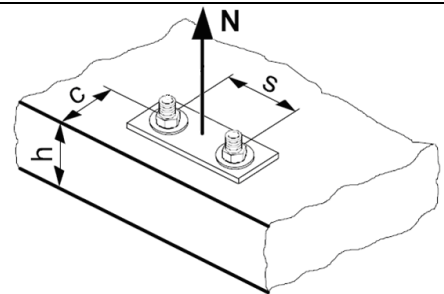
The differences to the design method given in the guideline are shown in the following.

## 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  $N_{Rd,p}$   
(Design combined pull-out and concrete cone resistance for bonded anchors)
- 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

$$N_{Rd,s} = N_{Rk,s} / \gamma_{Ms}$$

- \*  $N_{Rk,s}$ : characteristic steel resistance
- \*  $\gamma_{Ms}$ : partial safety factor for steel failure

\* Values given in the relevant ETA

Simplified design method

$$** N_{Rd,s}$$

\*\* 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

$$N_{Rd,p} = (N_{Rk,p} / \gamma_{Mp}) \cdot \psi_c$$

- \*  $N_{Rk,p}$ : characteristic pull-out resistance
- \*  $\gamma_{Mp}$ : partial safety factor for pull-out failure
- \*  $\psi_c$ : influence of concrete strength

\* Values given in the relevant ETA

Simplified design method

$$N_{Rd,p} = N_{Rd,p}^0 \cdot f_B$$

- \*\*  $N_{Rd,p}^0$ : 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

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

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

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

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

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

\*  $\gamma_{Mp}$ : partial safety factor for combined pull-out and concrete cone failure

+  $A_{p,N}^0$ : 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

\*  $\psi_c$ : influence of concrete strength

\*  $d$ : anchor diameter

\*  $h_{ef}$ : (variable) embedment depth

\*  $\tau_{Rk}$ : 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 concrete

= 3,2 in non-cracked concrete

$f_{ck,cube}$ : 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 relevant ETA (details of calculation see TR 029. The basis of the calculations may depend on the critical anchor spacing).

#### Simplified design method

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

\*\*  $N_{Rd,p}^0$ : 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 = being on the save side.

**Design concrete cone resistance  $N_{Rd,c}$** 
**Annex C of ETAG 001 / EOTA TR 029 and relevant ETA**

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

 $\psi_{ec,N}$ 

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

\*  $\gamma_{Mc}$ : partial safety factor for concrete cone failure

+  $A_{c,N}^0$ : 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 relevant ETA (details of calculation see Annex C of ETAG 001 or EOTA TR 029)

**Simplified design method**

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

\*\*  $N_{Rd,c}^0$ : 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

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

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

- \*  $\gamma_{Mc}$ : partial safety factor for concrete cone failure
- ++  $A_{c,N}^0$ : 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 relevant ETA (details of calculation see Annex C of ETAG 001 or EOTA TR 029)

++ Values of  $A_{c,N}^0$  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

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

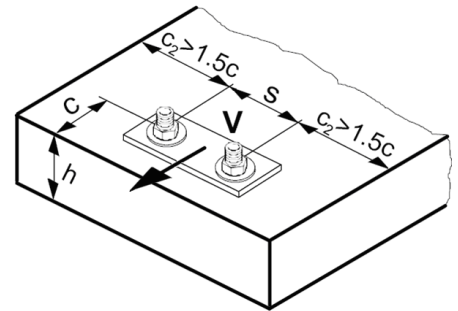
- \*\*  $N_{Rd,c}^0$ : Basic design concrete cone resistance
- \*\*  $f_B$ : influence of concrete strength
- \*\*  $f_{1,sp}, f_{2,sp}$ : influence of edge distance
- \*\*  $f_{3,sp}$ : influence of anchor spacing
- \*\*  $f_{h,N}$ : influence of base material thickness (concrete member depth)
- \*\*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

$V_{Rd,s} = V_{Rk,s} / \gamma_{Ms}$   
 \*  $V_{Rk,s}$ : characteristic steel resistance  
 \*  $\gamma_{Ms}$ : 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

**Simplified design method**

\*\*  $V_{Rd,s}$   
 \*\* 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

$V_{Rd,cp} = (V_{Rk,cp} / \gamma_{Mp/Mc}) = k \cdot N_{Rd,c}$   
 $N_{Rd,c} = N_{Rk,c} / \gamma_{Mc}$   
 $N_{Rk,c}$ : characteristic tension resistance  
 for concrete cone failure (see design concrete cone failure)  
 \*  $\gamma_{Mc}$ : 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**

$V_{Rd,cp} = k \cdot N_{Rd,c}$   
 \*\*\*  $N_{Rd,c}$ : 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

$V_{Rd,cp} = (V_{Rk,cp} / \gamma_{Mp/Mc}) = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$   
 $N_{Rd,p} = N_{Rk,p} / \gamma_{Mp}$   
 $N_{Rd,c} = N_{Rk,c} / \gamma_{Mc}$   
 **$N_{Rd,p}$ :** characteristic tension resistance for combined pull-out and concrete failure (see design combined pull-out and concrete cone failure)  
 **$N_{Rk,p}$ :** characteristic tension resistance for concrete cone failure (see design concrete cone failure)  
 \*  **$\gamma_{Mp}$ :** partial safety factor for combined pull-out and concrete cone failure (see design combined pull-out and concrete cone failure)  
 and  
 \*  **$\gamma_{Mc}$ :** partial safety factor for concrete failure (see design concrete cone failure)  
 \*  **$k$ :** influence of embedment depth  
 \* Values given in the relevant ETA

#### Simplified design method

$V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$   
 **$N_{Rd,p}$ :** 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**

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

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

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

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

- \*  $\gamma_{Mc}$ : partial safety factor for concrete failure
- +  $A_{c,v}^0$ : 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 proportionally to the member thickness as assumed by the idealised ratio  $A_{c,v} / A_{c,v}^0$
- ++  $\psi_{\alpha,v}$ : 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 relevant 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**

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

- \*\*  $V_{Rd,c}^0$ : Basic design concrete edge resistance
- \*\*  $f_B$ : influence of concrete strength
- \*\*  $f_{\beta}$ : 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 = being on the safe side.

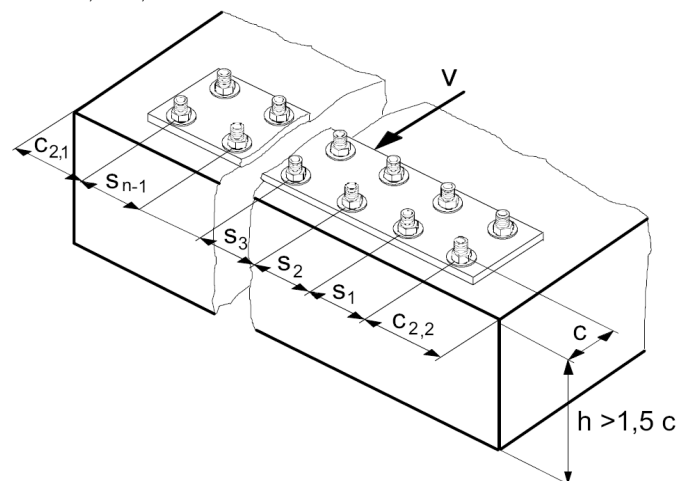
**Special case: more than 2 anchors close to an edge**

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).

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

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

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



### Combined tension and shear loading

The following equations must be satisfied

$$\beta_N \leq 1$$

$$\beta_V \leq 1$$

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

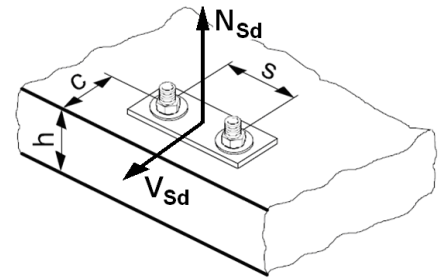
With

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

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

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

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



#### Annex C of ETAG 001

$\alpha = 2,0$  if  $N_{Rd}$  and  $V_{Rd}$  are governed by steel failure

$\alpha = 1,5$  for all other failure modes

#### Simplified design method

Failure mode is not considered for the simplified method

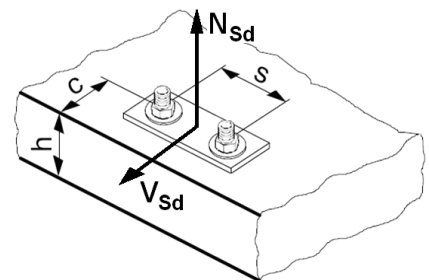
$\alpha = 1,5$  for all failure modes (leading to conservative results = being on the safe side)

# 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	$\beta$	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	



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)

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	

### 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
		$\rightarrow c_{cr,sp} =$	142 mm

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

### General remarks

Accordinging 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

$N_{Rd,s} =$	<b>28,0 kN</b>
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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				$N_{Rd,p}^0$	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
$N_{Rd,p} = N_{Rd,p}^0 f_{B,p} f_{1,N} f_{2,N} f_{3,N} f_{h,p} f_{re,N} =$					<b>17,1 kN</b>	

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

#### Design concrete cone resistance

basic resistance				$N_{Rd,c}^0$	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
$N_{Rd,c} = N_{Rd,c}^0 f_B f_{h,N} f_{1,N} f_{2,N} f_{3,N} f_{re,N} =$					<b>21,1 kN</b>	

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				$N_{Rd,c}^0$	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
$N_{Rd,sp} = N_{Rd,c}^0 f_B f_{h,N} f_{1,sp} f_{2,sp} f_{3,sp} f_{re,N} =$					<b>15,0 kN</b>	

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.

<b>Tension design resistance: lowest value</b>	$N_{Rd} =$	<b>15,0 kN</b>
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## Shear loading

### Design steel resistance

$V_{Rd,s} =$	<b>16,8 kN</b>
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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 $N_{Rd,c}$	$V^0 =$	<b>17,1 kN</b>
$h_{ef} = 70 \text{ mm}$	$\rightarrow k$	<b>2</b>
$V_{Rd,cp} = k V^0 =$		<b>34,3 kN</b>

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

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.

<b>Shear design resistance: lowest value</b>	$V_{Rd} =$	<b>12,3 kN</b>
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## Combined tension and shear loading

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

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

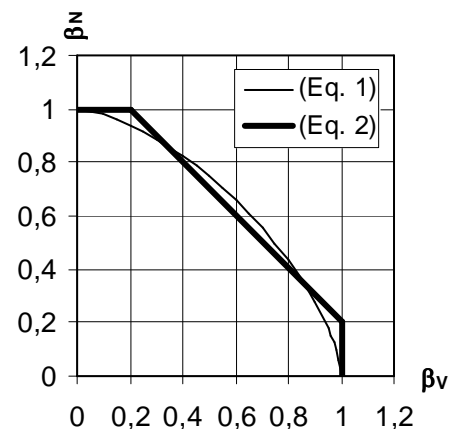
$\beta_N$  ( $\beta_V$ ) ratio between design action and design resistance for tension (shear) loading

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

$$(Eq. 2) \quad \beta_N + \beta_V \leq 1,2 \quad \text{and} \quad \beta_N \leq 1, \beta_V \leq 1$$

### Example (load values are valid for one anchor)

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





## Corrosion

### Material recommendations to counteract corrosion

Application	General conditions		Recommendations
<b>Initial/carcass construction</b>			
<i>Temporary fastening:</i> Forming, site fixtures, scaffolding	Outside and inside applications		Galvanised or coated
<i>Structural fastening:</i> Brackets, columns, beams	Dry inside rooms, no condensation		Galvanised 5-10 microns
	Damp inside rooms with occasional condensation due to high humidity and temperature fluctuations		Hot-dipped galvanised / sherardized min. 45 microns
	Frequent and long-lasting condensation (greenhouses), open inside rooms or open halls / sheds		A4 (316) steels, possibly hot-dipped galvanised
Composite construction	Protection due to alkalinity of concrete		Galvanised 5-10 microns
<b>Interior finishing</b>			
<i>Drywalls, suspended ceilings, windows, doors, railings / fences, elevators, fire escapes</i>	Dry inside rooms, no condensation		Galvanised 5-10 microns
<b>Facades / roofing</b>			
Profiled metal sheets, curtain wall cladding, insulation fastenings, facade support framing	<i>Rural atmosphere</i> (without emissions)	Inside application	Galvanised 5-10 microns
		Outside application	Hot-dipped galvanised / sherardized min. 45 microns
		Insulating materials	Dacromet / plastic, A4 (316) steels
	<i>Town / city atmosphere:</i> High SO <sub>2</sub> and No <sub>x</sub> contents, chlorides from road salt can accumulate/ concentration on parts not weathered directly	Inside application	Galvanised 5-10 microns
		Outside application	Hot-dipped galvanised / sherardized min. 45 microns, Hilti-HCR if chlorides exist
		Insulating materials	A4 (316) steels
	<i>Industrial atmosphere:</i> High SO <sub>2</sub> content and other corrosive substances (without halides)	Inside application	Galvanised 5-10 microns
		Outside application	A4 (316) steels
		Insulating materials	A4 (316) steels
	<i>Coastal atmosphere:</i> High content of chlorides, combined with industrial atmosphere	Inside application	Galvanised 5-10 microns
		Outside application	Hilti-HCR
		Insulating materials	Hilti-HCR

Application	General conditions	Recommendations
<b>Installations</b>		
Conduit installation, cable runs, air ducts  <i>Electrical systems:</i> Runs, lighting, aerials  <i>Industrial equipment:</i> Crane rails, barriers, conveyors, machine fastening	Dry inside rooms, no condensation	Galvanised 5-10 microns
	Damp inside rooms, poorly ventilated rooms, cellar / basement shafts, occasional condensation due to high humidity and temperature fluctuations	Hot-dipped galvanised / sherardized min. 45 microns
	Frequent and long-lasting condensation (greenhouses), non-enclosed inside rooms or open sheds / buildings	A4 (316) steels, possibly hot-dipped galvanised
<b>Road and bridge construction</b>		
Conduit installation, cable runs, traffic signs, noise-insulating walls, crash barriers / guard rails, connecting structures	Directly weathered (chlorides are regularly washed off)	Hot-dipped galvanised / sherardized min. 45 microns, A4 (316) steels, Duplex steel or austenitic steel with approx. 4-5% Mo
	Frequently heavy exposure to road salt, highly relevant to safety	Hilti HCR
<b>Tunnel construction</b>		
Tunnel foils / sheeting, reinforcing mesh, traffic signs, lighting, tunnel wall cladding / lining, air ducts, ceiling suspensions, etc.	Secondary relevance for safety	Duplex steel, poss. A4 (316) steels
	Highly relevant to safety	Hilti-HCR
<b>Dock/harbour/port facilities / off-shore rigs</b>		
Fastenings to quaysides, dock / harbour	Secondary relevance for safety, temporary fastenings	Hot-dipped galvanised
	High humidity, chlorides, often a superimposed "industrial atmosphere" or changes of oil / sea water	Hilti-HCR
	On the platform / rig	A4 (316) steels
<b>Industry / chemical industry</b>		
Conduit installation, cable runs, connecting structures, lighting	Dry inside rooms	Galvanised 5-10 microns
	Corrosive inside rooms, e.g. fastenings in laboratories, galvanising / plating plants etc., very corrosive vapours	A4 (316) steels, Hilti-HCR
	Outside applications, very heavy exposure to SO <sub>2</sub> and additional corrosive substances (only acidic surroundings)	A4 (316) steels
<b>Power plants</b>		
Fastenings relevant to safety	Dry inside rooms	Galvanised 5-10 microns
	Outside applications, very heavy exposure to SO <sub>2</sub>	A4 (316) steels

Application	General conditions	Recommendations
<b>Smokestacks of waste incineration plants</b>		
Fastening of, for example, service ladders, lightning conductors	In lower section of stack	Hot-dipped galvanised/sherardized min. 45 microns A4 (316) steels
	In top section of stack, condensation of acids and often high chloride and other halide concentrations	Hilti-HCR
<b>Sewage / waste water treatment</b>		
Conduit installation, cable runs, connecting structures etc	In the atmosphere, high humidity, sewage / digester gases etc.	Hot-dipped galvanised/sherardized min. 45 microns A4 (316) steels
	Underwater applications, municipal sewage / waste water, industrial waste water	Hilti-HCR
<b>Multi-storey car parks</b>		
Fastening of, for example, guard rails, handrails, balustrades	Large amounts of chlorides (road salt) carried in by vehicles, many wet and dry cycles	Hilti-HCR
<b>Indoor swimming pools</b>		
Fastening of, for example, service ladders, handrails, suspended ceilings	Fastenings relevant to safety	Hilti-HCR
<b>Sports grounds / facilities / stadiums</b>		
Fastening of, for example, seats, handrails, fences	In rural atmosphere	Hot-dipped galvanised / sherardized min. 45 microns
	In town / city atmosphere	Hot-dipped galvanised / sherardized min. 45 microns A4 (316) steels
	Inaccessible fastenings	A4 (316) steels

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.

### Metal couples

Fastener Fastened part	El.-chem. Galvanised	Hot-dipped galvanised	Aluminium alloy	Structural steel	Stainless steel	Brass
	Zinc	○	○	○	○	○
Hot-dipped galv. steel	○	○	○	○	○	○
Aluminium alloy	●	●	○	○	○	○
Cadmium coating	●	●	○	○	○	○
Structural steel	●	●	●	○	○	○
Cast steel	●	●	●	●	○	○
Chromium steel	●	●	●	●	○	●
CrNi(Mo) steel	●	●	●	●	○	●
Tin	●	●	●	●	○	●
Copper	●	●	●	●	●	●
Brass	●	●	●	●	●	○

- Slightly or no corrosion of fastener
- Heavy corrosion of fastener
- Moderate corrosion of fastener

## Dynamic loads (seismic, fatigue, shock)

### Dynamic design for anchors

Detailed informations are available from your local Hilti partner or in the brochures:  
 Hilti engineering for earthquake applications, Hilti AG, 2011  
 Dynamic Design for Anchors, Hilti AG, 2001

#### 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 simple tests with specimens.

#### 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



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.

#### Anchors suitability under seismic loading

For a properly designed fastening, anchors subjected to seismic loading shall be designed and additionally pre-qualified for seismic load scenarios. In view of this, suitability tests for tension and shear are carried out according to ACI 355.2 with the ICC acceptance criteria AC193 and AC308. As a consequence of this procedure, for the suitable anchors, technical data is published and an evaluation technical report (ESR) is released.

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 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.

### Typical seismic applications

For a sound seismic design of a post-installed anchorage the first step begins with the correct definition of the acting loads. In the United States ASCE/SEI 7-05 establishes the provisions for the definition of the seismic action, and the anchor performance shall be evaluated in accordance with ACI 318-08, Appendix D. Pre-qualification reports, created in accordance with published testing procedures and acceptance criteria, (ACI 355.2 with ICC-ES AC193 and AC308) provide sound data in a proper format for design.

### Seismic anchor design regulations landscape

Following the same design flow, in Europe the action definition is available through the EN 1998:2004 (Eurocode 8) and the resistance evaluation can be defined by the CEN/TS 1992-4:2009. However, the anchor's seismic pre-qualification testing description is still under development. As such, the European framework is not yet harmonized in order to allow the design of a post-installed anchorage under seismic conditions.

Under seismic loading the performance of an anchored connection is crucial either to the stability of a structure or in order to avoid major casualties and/or economical impacts consequence of non-structural elements collapse. Therefore, to consent in Europe the design of anchors subjected to seismic action, the resistance evaluation may utilize the provisions and technical reports existing in the United States.

### Engineering judgment on the design procedure

By an in-depth analysis and comparison of the code regulations on both continents it is possible to establish a plain harmonization. A comparison of ASCE/SEI 7-05 and Eurocode 8 in terms of the design spectrum, seismic base shear force and also the load combinations concept to account for earthquake action allows for a sound recommendation of this approach.

The above mentioned design exercise is presently the only available and fully operational code based procedure in Europe and can as such be considered state-of-the-art. Upon the development of pre-qualification criteria and technical data for the seismic design of anchors in Europe, a designer will be recommended to reference to most recent published design approach.

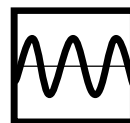
### After an earthquake

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 to guaranty the load combinations for static loading.

## Fatigue loads

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.

### Fatigue



## 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:

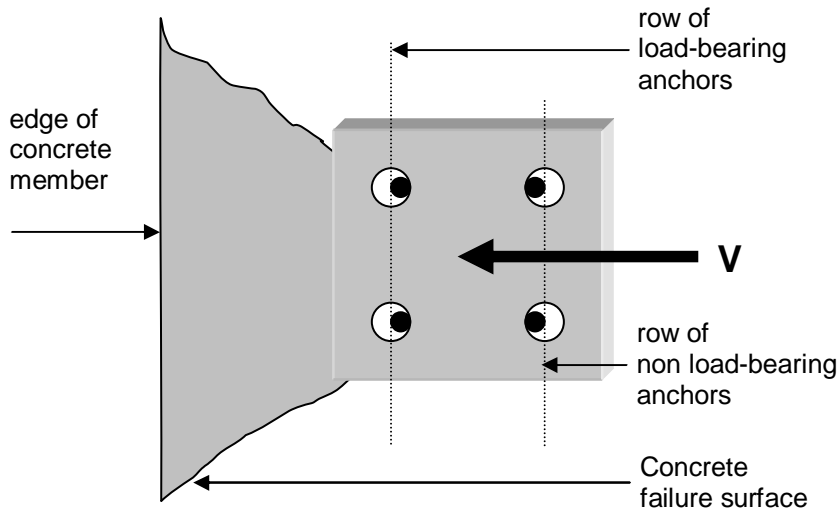
- Deformation is greater when the breaking load is reached
- The energy absorbed by an anchor is also much higher
- Breaking loads are of roughly the same magnitude during static loading and shock-loading tests

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

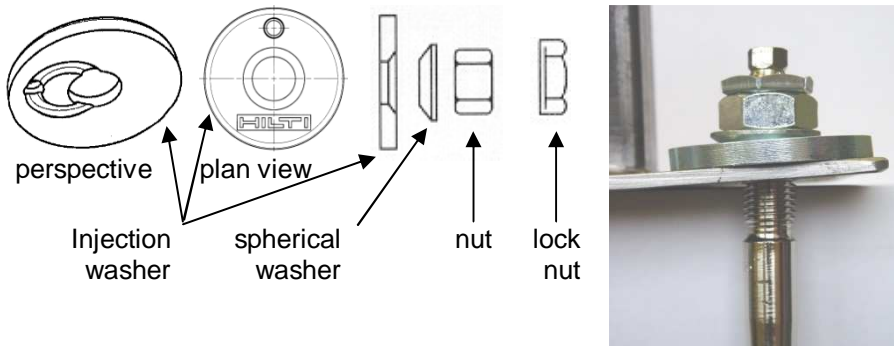
If a multiple-anchor fastening is loaded towards the edge of a concrete member (shear load), the gap between anchor shaft and clearance hole has an important role. An uneven shear load distribution within the anchors in the fastening is the result as the clearance hole is always larger than the anchor 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.

Uneven shear load distribution



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.

Activating the second row of anchors



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.

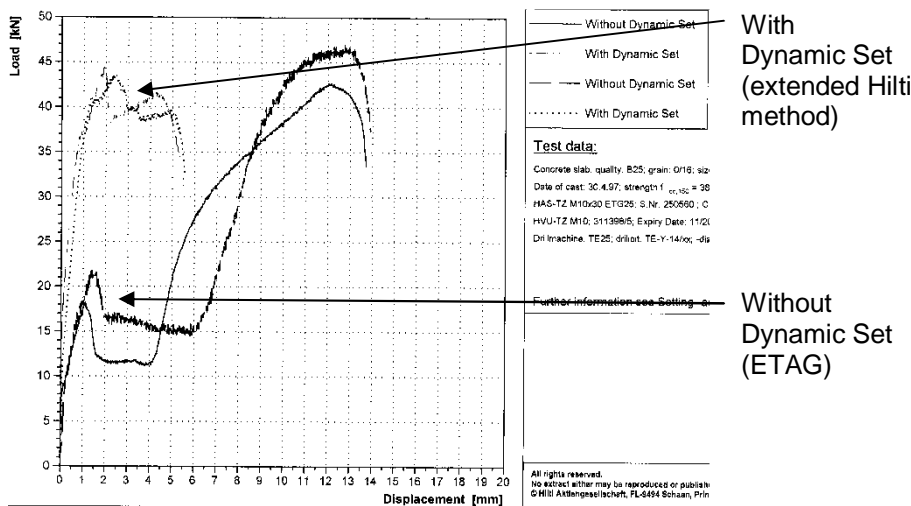
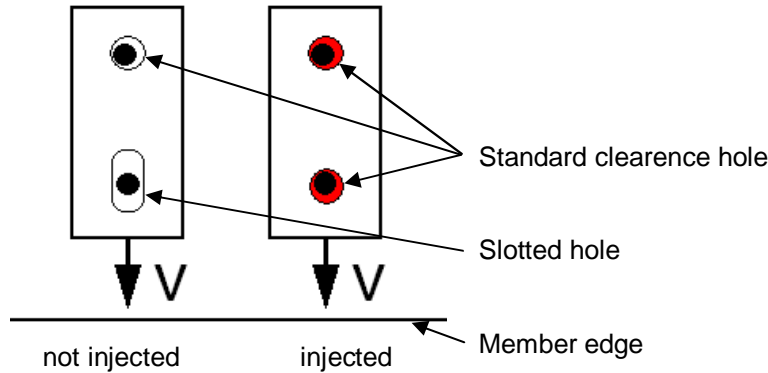
**Lock nut:** Prevents loosening of the nut and thus lifting of the anchoring plate away from the concrete in case of cyclic loading.

Improvements with Dynamic Set

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.



TWU 07/01 Shear Load Capacity with and without Dynamic Set  
 Monotonic shear-tension - HVZ M10 - HAS-TZM10x30  
 Depth of embedment  $h_e = 80$  mm; Edge distance = 60 mm 285 mm

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 farrest row is smaller than the above mentioned 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

<b>MFPA Leipzig GmbH</b> 	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)	
		
	Tested when set in cracked concrete and exposed to flames without insulating or protective measures.	


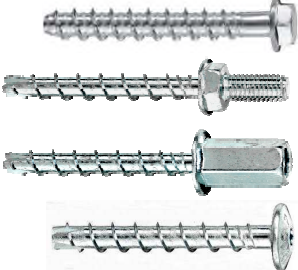
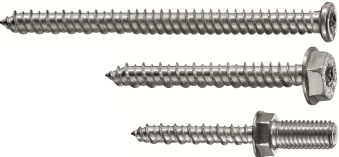


Anchor / fastener	Size	Max. loading (kN) for specified fire resistance time (fire resistance time in minutes)				Authority / No.
		F30	F60	F90	F120	
HDA  Fire resistance data for F 180 please refer to the test reports	M10	4,5	2,2	1,3	1,0	IBMB Braunschweig UB 3039/8151
	M12	10,0	3,5	1,8	1,2	
	M16	15,0	7,0	4,0	3,0	Warringtonfire WF Report No 166402
	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
	M12	10,0	3,5	1,8	1,2	
	M16	15,0	7,0	4,0	3,0	Warringtonfire WF Report No 166402
HDA-R 	M10	20,0	9,0	4,0	2,0	IBMB Braunschweig UB 3039/8151
	M12	30,0	12,0	5,0	3,0	
	M16	50,0	15,0	7,5	6,0	Warringtonfire WF Report No 166402
HSL-3 	M8	3,0	1,1	0,6	0,4	IBMB Braunschweig UB 3041/1663-CM
	M10	7,0	2,0	1,3	0,8	
	M12	10,0	3,5	2,0	1,2	Warringtonfire WF Report No 166402
	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	
<b>HSL-3-G</b> 	M8	3,0	1,1	0,6	0,4	IBMB Braunschweig report No, 3041/1663-CM  Warringtonfire WF Report No 166402
	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	
<b>HSL-3-B</b> 	M12	10,0	3,5	2,0	1,2	IBMB Braunschweig report No. 3041/1663-CM  Warringtonfire WF Report No 166402
	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	
<b>HSL-3-SH</b> 	M8	1,9	1,1	0,6	0,4	IBMB Braunschweig report No. 3041/1663-CM  Warringtonfire WF Report No 166402
	M10	4,5	2,0	1,3	0,8	
	M12	8,5	3,5	2,0	1,2	
<b>HSL-3-SK</b> 	M8	3,0	1,1	0,6	0,4	IBMB Braunschweig report No. 3041/1663-CM  Warringtonfire WF Report No 166402
	M10	7,0	2,0	1,3	0,8	
	M12	10,0	3,5	2,0	1,2	
<b>HSC-A</b> 	M8x40	1,5	1,5	1,5	-	IBMB Braunschweig UB 3177/1722-1  Warringtonfire WF Report No 166402
	M8x50	1,5	1,5	1,5	-	
	M10x40	1,5	1,5	1,5	-	
	M12x60	3,5	3,5	2,0	-	
<b>HSC-I</b> 	M8x40	1,5	1,5	1,5	-	IBMB Braunschweig UB 3177/1722-1  Warringtonfire WF Report No 166402
	M10x50	2,5	2,5	2,5	-	
	M10x60	2,5	2,5	2,5	-	
	M12x60	2,0	2,0	2,0	-	
<b>HSC-AR</b> 	M8x40	1,5	1,5	1,5	-	IBMB Braunschweig UB 3177/1722-1  Warringtonfire WF Report No 166402
	M8x50	1,5	1,5	1,5	-	
	M10x40	1,5	1,5	1,5	-	
	M12x60	3,5	3,5	3,5	3,0	
<b>HSC-IR</b> 	M8x40	1,5	1,5	1,5	-	IBMB Braunschweig UB 3177/1722-1  Warringtonfire WF Report No 166402
	M10x50	2,5	2,5	2,5	-	
	M10x60	2,5	2,5	2,5	-	
	M12x60	3,5	3,5	3,5	3,0	
<b>HST</b> 	M8	0,9	0,7	0,6	0,5	DIBt Berlin ETA-98/0001  Warringtonfire WF Report No 166402 Data valid for <b>steel</b> 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
	M10	11,8	8,4	5,0	3,3	
	M12	17,2	12,2	7,3	4,8	Warringtonfire WF Report No 166402
	M16	32,0	22,8	13,5	8,9	
	M20	49,9	35,5	21,1	13,9	Data valid for <b>steel</b> failure, for other failure modes see ETA-98/0001
	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
	M10	11,8	8,4	5,0	3,3	
	M12	17,2	12,2	7,3	4,8	Warringtonfire WF Report No 166402
	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
	M8	0,37	0,33	0,26	0,18	
	M10	0,87	0,75	0,58	0,46	Data valid for <b>steel</b> failure, for other failure modes see report 3215/229/12
	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
	8 (M6)	0,9	0,5	0,37	0,3	
	10 (M8)	1,9	0,99	0,6	0,5	Warringtonfire WF Report No 166402
	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
	10 (M8)	1,9	0,99	0,6	0,5	
	12(M10)	3,0	1,5	1,0	0,8	Warringtonfire WF Report No 166402
	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 166402
HLC-EC 	8 (M6)	0,9	0,5	0,37	0,3	IBMB Braunschweig PB 3093/517/07-CM
	10 (M8)	1,9	0,99	0,67	0,5	
	16(M12)	3,0	1,5	1,0	0,79	Warringtonfire WF Report No 166402 & WF Report No 172920












Anchor / fastener	Size	Max. loading (kN) for specified fire resistance time (fire resistance time in minutes)				Authority / No.
		F30	F60	F90	F120	
<b>HUS-HR</b> 	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		
<b>HUS-A/-H/-I/-P</b> 	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	
<b>HUS</b> 	6	0,5	0,5	0,5	0,4	DIBt Berlin Z-21.1-1710
	-H 6	0,5	0,5	0,5	0,5	
	-A 6	0,5	0,5	0,5	0,5	
<b>HUS</b> (aerated concrete, plates and bricks, strength category $\geq 6$ )	6	1,0	0,6	0,4	0,3	IBMB Braunschweig BB 3707/983/11 Warringtonfire WF Report No 166402
	-H 6					
	-A 6					
<b>HKD</b> 	M6x25	0,5	0,4	0,3	0,2	DIBt Berlin ETA-06/0047 acc. Part 6
	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	
<b>HKD-SR</b> <b>HKD-ER</b> 	M6x30	0,5	0,5	0,4	0,3	DIBt Berlin ETA-06/0047 acc. Part 6 Warringtonfire WF Report No 166402
	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-U10 	load angle	Max. load				IBMB Braunschweig UB 3613/3891-1 -Nau-
	10°	1,6	1,6	0,8	-	
	70°	1,6	1,6	1,4	0,8	
HRD-S10 	10°	1,2	0,8	-	-	IBMB Braunschweig UB 3613/3891-2 -Nau-
	70°	1,2	1,4	0,8	-	
	90°	1,2	1,6	0,8	-	
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 166402
DBZ 	6/4,5	0,6	0,5	0,3	0,2	DIBt Berlin; ETA-06/0179 acc. Part 6 Warringtonfire WF Report No 166402
	6/35					
HT 	HT 8 L	0,85	0,44	0,27	0,19	IBMB Braunschweig UB 3016/1114-CM Warringtonfire WF Report No 166402
	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
	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 166402
	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 166402
	M8	1,9	0,95	0,65	0,5	
	M10	3,2	1,6	1,1	0,85	
IDMS/IDMR 	Tested with Tektalan-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	
<b>HVZ + HAS-TZ</b> 	M10	4,5	2,2	1,3	1,0	IBMB Braunschweig UB 3357/0550-1  Warringtonfire WF Report No 166402
	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	
<b>HVZ + HAS-R/HAS-HCR-TZ</b> 	M10	10,0	4,5	2,7	1,7	Warringtonfire WF Report No 166402
	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	
<b>HVU + HAS</b> 	M8	1,5	0,8	0,5	0,4	IBMB Braunschweig UB- 3333/0891-1  Warringtonfire WF Report No 166402
	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	
<b>HVU + HAS-R/HAS-E-R + HVU + HAS-HCR/HAS-E-HCR</b> 	M8	2,0	0,8	0,5	0,4	Warringtonfire WF Report No 166402
	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	
<b>HVU + HIS-N</b> 	M8	1,5	0,8	0,5	0,4	Warringtonfire WF Report No 166402
	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	
<b>HVU + HIS-RN</b> 	M8	10,0	5,0	1,8	1,0	Warringtonfire WF Report No 166402
	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 172920  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 172920
	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 166402 & WF Report No 172920
	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 166402 & WF Report No 172920
	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 166402 & WF Report No 172920
	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.
	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	
	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 150-MAX + HIT-V 	M8	0,70	0,50	0,33	0,21	MFPA Leipzig GS 3.2/09-121 Ä Loads for typical embedment depth, For variable embedment depth see test report.
	M10	1,30	1,00	0,55	0,35	
	M12	2,30	1,80	1,14	0,75	
	M16	6,20	3,22	1,79	1,19	
	M20	9,60	7,80	5,86	3,86	
	M24	13,9	11,2	8,50	7,10	
	M27	18,1	14,6	11,1	9,30	
	M30	22,1	17,8	13,5	11,4	
HIT-HY 150 + HAS/HAS-E/HIT-V 	M8	2,7	1,1	0,5	0,4	IBMB Braunschweig UB 3027/0274-6 & supplement letters Br. 080/Nau & 416/2008  Warringtonfire WF Report No 166402 & WF Report No 172920
	M10	3,6	1,9	1,0	0,6	
	M12	6,0	3,5	2,0	1,2	
	M16	7,0	5,0	3,2	2,0	
	M20	12,5	10,0	7,0	5,0	
	M24	16,0	12,5	10,0	8,0	
	M27	28,5	24,0	14,8	10,2	
	M30	34,5	29,3	18,1	12,5	
HIT-HY 150 + HAS-R/ HAS-ER/ HAS-HCR/HAS-E-HCR/HIT-V-R/ HIT-V-HCR 	M8	2,7	1,3	0,5	0,4	
	M10	3,6	1,9	1,0	0,6	
	M12	6,0	4,6	2,3	1,6	
	M16	7,0	5,0	3,2	2,0	
	M20	12,5	10,0	8,0	6,5	
	M24	16,0	12,5	10,0	8,5	
	M27	29,9	24,0	14,8	10,2	
	M30	36,5	29,3	18,1	12,5	


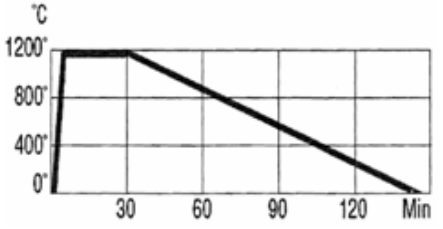
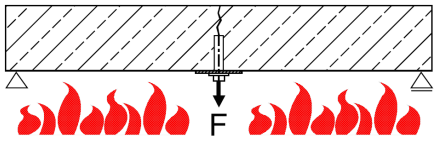
Anchor / fastener	Size	Max. loading (kN) for specified fire resistance time (fire resistance time in minutes)				Authority / No.
		F30	F60	F90	F120	
HIT-HY 70 $h_{ef}$ = 80 mm (HLz, MVz, KSL, KSV) 	M8	2,0	0,4	0,2	-	MFPA Leipzig PB 3.2/12-055-1  Warringtonfire WF Report No 166402
	M10	2,0	0,4	0,2	-	
	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

<p><b>MFPA Leipzig GmbH</b></p> 	<p>Tested according to the german tunnel temperature curve (ZTV-ING, part 5).</p>	
<p><b>iBMB MPA TU BRAUNSCHWEIG</b></p>	<p>Tested when set in cracked concrete and exposed to flames without insulating or protective measures.</p>	
<p><b>Bodycote warringtonfire</b></p>		

Anchor / fastener	Size	Max. loading (kN) for specified fire rating/integrity	Authority/No.
	M10	1,0	IBMB Braunschweig UB 3332/0881-2-CM & supplement letter 13184/2006
	M12	1,5	
	M16	2,5	Warringtonfire WF-Report No 166402
	M20	6,0	
	6	0,20 <sup>a)</sup>	MFPA Leipzig PB III/08-354
	8	0,30 <sup>a)</sup>	
	10	0,50 <sup>a)</sup>	
	14	1,10 <sup>a)</sup>	
	M8	0,5	IBMB Braunschweig UB 3027/0274-4
	M10	0,8	
	M12	2,5	& supplement letter 133/00-Nau- Warringtonfire WF-Report No 166402
	M16	5,0	
	M20	6,0	
	M10	1,5	IBMB Braunschweig UB 3357/0550-2
	M12	2,5	
	M16	6,0	Warringtonfire WF-Report No 166402
	M20	8,0	
	M8	0,5	IBMB Braunschweig UB 3333/0891-2
	M10	1,5	
	M12	1,5	Warringtonfire WF-Report No 166402
	M16	5,0	

a) Tested according tunnel temperature curve EBA



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## Mechanical anchoring systems



Heavy duty anchors

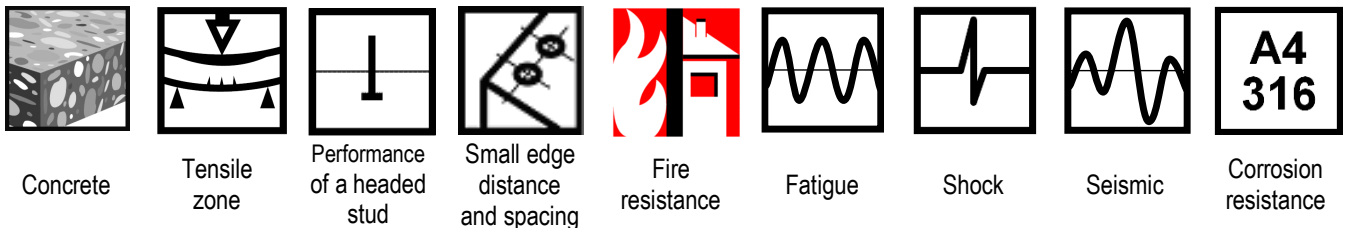
Medium and light duty anchors

Insulation fasteners



## HDA Design anchor

Anchor version	Benefits
 <p>HDA-P HDA-PR HDA-PF Anchor for pre-setting</p>	<ul style="list-style-type: none"> <li>- suitable for non-cracked and cracked concrete C 20/25 to C 50/60</li> <li>- mechanical interlock (undercut)</li> <li>- low expansion force (thus small edge distance / spacing)</li> <li>- automatic undercutting (without special undercutting tool)</li> <li>- high loading capacity, performance of a headed stud</li> <li>- complete system (anchor, stop drill bit, setting tool, drill hammer)</li> <li>- setting mark on anchor for control (easy and safe)</li> <li>- completely removable</li> <li>- test reports: fire resistance, fatigue, shock, seismic</li> </ul>
 <p>HDA-T HDA-TR HDA-TF Anchor for through-fastening</p>	



### Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval <sup>a)</sup>	CSTB, Paris	ETA-99/0009 / 2010-12-17
ICC-ES report incl. seismic	ICC evaluation service	ESR 1546 / 2012-03-01
Shockproof fastenings in civil defence installations	Federal Office for Civil Protection, Bern	BZS D 09-601/ 2009-10-21
Nuclear power plants	DIBt, Berlin	Z-21.1-1696 / 2011-02-16
Fatigue loading	DIBt, Berlin	Z-21.1-1693 / 2011-10-01
Fire test report	IBMB, Braunschweig	UB 3039/8151-CM / 2001-01-31
Assessment report (fire)	warringtonfire	WF 166402 / 2007-10-26

a) All data for HDA-P(R) and HDA-T(R) given in this section according ETA-99/0009, issue 2010-12-17. 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$

For details see Simplified design method

### Mean ultimate resistance

Anchor size	Non-cracked concrete				Cracked concrete			
	M10	M12	M16	M20 <sup>a)</sup>	M10	M12	M16	M20 <sup>a)</sup>
Tensile $N_{Ru,m}$								
HDA-P(F), HDA-T(F) <sup>b)</sup> [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 <sup>b)</sup> [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 <sup>b) c)</sup> [kN]	68,8	84,7	148,2	216,9	68,8	84,7	148,2	216,9
HDA-TR <sup>c)</sup> [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

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

Anchor size	Non-cracked and cracked concrete															
	M10		M12		M16				M20 <sup>a)</sup>							
Shear $V_{Rk}$																
HDA-P, HDA-PF <sup>b)</sup> [kN]	22		30		62				92							
HDA-PR	23		34		63				-							
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 <sup>b)</sup> [kN]	65 <sup>c)</sup>	65	80 <sup>c)</sup>	80	100	140 <sup>c)</sup>	140	155	170	190	205 <sup>c)</sup>	205	235	250		
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 <sup>c)</sup>	71	87 <sup>c)</sup>	87	94	109	152 <sup>c)</sup>	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 ( $t = 5 \text{ mm}$ ) only

**Design resistance**

		Non-cracked concrete				Cracked concrete			
Anchor size		M10	M12	M16	M20 <sup>a)</sup>	M10	M12	M16	M20 <sup>a)</sup>
Tensile $N_{Rd}$									
HDA-P(F), HDA-T(F) <sup>b)</sup>	[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 <sup>a)</sup>					
Shear $V_{Rd}$															
HDA-P, HDA-PF <sup>b)</sup>	[kN]	17,6		24,0			49,6			73,6					
HDA-PR		17,3		25,6			47,4			-					
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 <sup>b)</sup>	[kN]	43 <sup>c)</sup>	43	53 <sup>c)</sup>	53	67	93 <sup>c)</sup>	93	103	113	127	137 <sup>c)</sup>	137	157	167
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 <sup>c)</sup>	53	65 <sup>c)</sup>	65	71	82	114 <sup>c)</sup>	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 <sup>a)</sup>	M10	M12	M16	M20 <sup>a)</sup>
Tensile $N_{Rec}$ <sup>b)</sup>									
HDA-P(F), HDA-T(F) <sup>c)</sup>	[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 <sup>a)</sup>					
Shear $V_{Rec}$ <sup>b)</sup>															
HDA-P, HDA-PF <sup>c)</sup>	[kN]	12,6		17,1			35,4			52,6					
HDA-PR		12,3		18,2			33,8			-					
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 <sup>c)</sup>	[kN]	31 <sup>d)</sup>	31	38 <sup>d)</sup>	38	48	67 <sup>d)</sup>	67	74	81	90	98 <sup>d)</sup>	98	112	119
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 <sup>d)</sup>	38	47 <sup>d)</sup>	47	50	59	82 <sup>d)</sup>	82	85	91	-			

- a) HDA M20: only a galvanized 5µm version is available
- b) With overall partial safety factor for action  $\gamma_F = 1,4$ . 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 <sup>a)</sup>	M10	M12	M16
<b>Anchor bolt</b>							
Nominal tensile strength $f_{uk}$ [N/mm <sup>2</sup> ]	800	800	800	800	800	800	800
Yield strength $f_{yk}$ [N/mm <sup>2</sup> ]	640	640	640	640	600	600	600
Stressed cross-section $A_s$ [mm <sup>2</sup> ]	58,0	84,3	157	245	58,0	84,3	157
Moment of resistance $W_{el}$ [mm <sup>3</sup> ]	62,3	109,2	277,5	540,9	62,3	109,2	277,5
Characteristic bending resistance without sleeve [Nm] $M_{Rk,s}^0$ <sup>b)</sup>	60	105	266	519	60	105	266
<b>Anchor sleeve</b>							
Nominal tensile strength $f_{uk}$ [N/mm <sup>2</sup> ]	850	850	700	550	850	850	700
Yield strength $f_{yk}$ [N/mm <sup>2</sup> ]	600	600	600	450	600	600	600

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

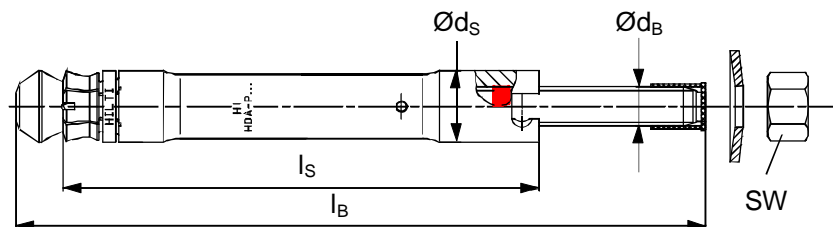
b) The recommended bending moment of the HDA anchor bolt may be calculated from  $M_{rec} = M_{Rd,s} / \gamma_F = M_{Rk,s} / (\gamma_{MS} \cdot \gamma_F) = (1,2 \cdot W_{el} \cdot f_{uk}) / (\gamma_{MS} \cdot \gamma_F)$ , where the partial safety factor for bolts of strength 8.8 is  $\gamma_{MS} = 1,25$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

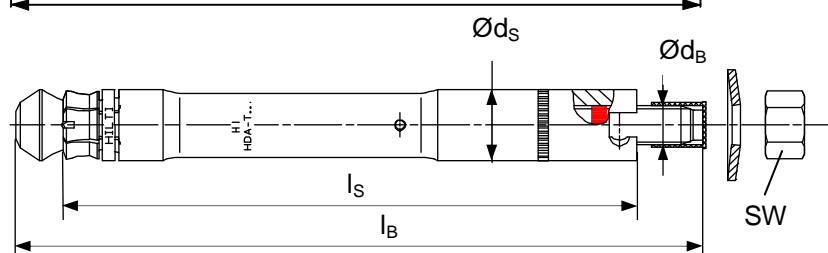
Part	Material
<b>HDA-P / HDA-T (Carbon steel version)</b>	
Sleeve:	Machined steel with brazed tungsten carbide tips, galvanised to min. 5 µm
Bolt M10 - M16:	Cold formed steel, strength 8.8, galvanised to min. 5 µm
Bolt M20:	Cone machined, rod strength 8.8, galvanised to min. 5 µm
<b>HDA-PR / HDA-TR (Stainless steel version)</b>	
Sleeve:	Machined stainless steel with brazed tungsten carbide tips
Bolt M10 - M16:	Cone/rod: machined stainless steel
<b>HDA-PF / HDA-TF (Sherardized version)</b>	
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 x100/20	M12 x125/30   x125/50		M16 x190/40   x190/60		M20 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 bit 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											Setting tool
	TE 24 <sup>a)</sup> TE 25 <sup>a)</sup>	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		
HDA-P/T20-M10x100/20	■		■								TE-C-HDA-ST 20 M10 TE-Y-HDA-ST 20 M10
HDA-P/T 22-M12x125/30 HDA-P/T 22-M12x125/50	■		■	■	■						TE-C-HDA-ST 22 M12 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<sup>st</sup> gear

Anchor											Setting tool
	TE 24 <sup>a)</sup> TE 25 <sup>a)</sup>	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		
HDA-PR/TR20-M10x100/20	■	■	■		■						TE-C-HDA-ST 20 M10 TE-Y-HDA-ST 20 M10
HDA-PR/TR 22-M12x125/30 HDA-PR/TR 22-M12x125/50	■	■	■	■	■						TE-C-HDA-ST 22 M12 TE-Y-HDA-ST 22 M12
HDA-PR/TR 30-M16x190/40 HDA-PR/TR 30-M16x190/60						■	■	■	■		TE-Y-HDA-ST 30 M16

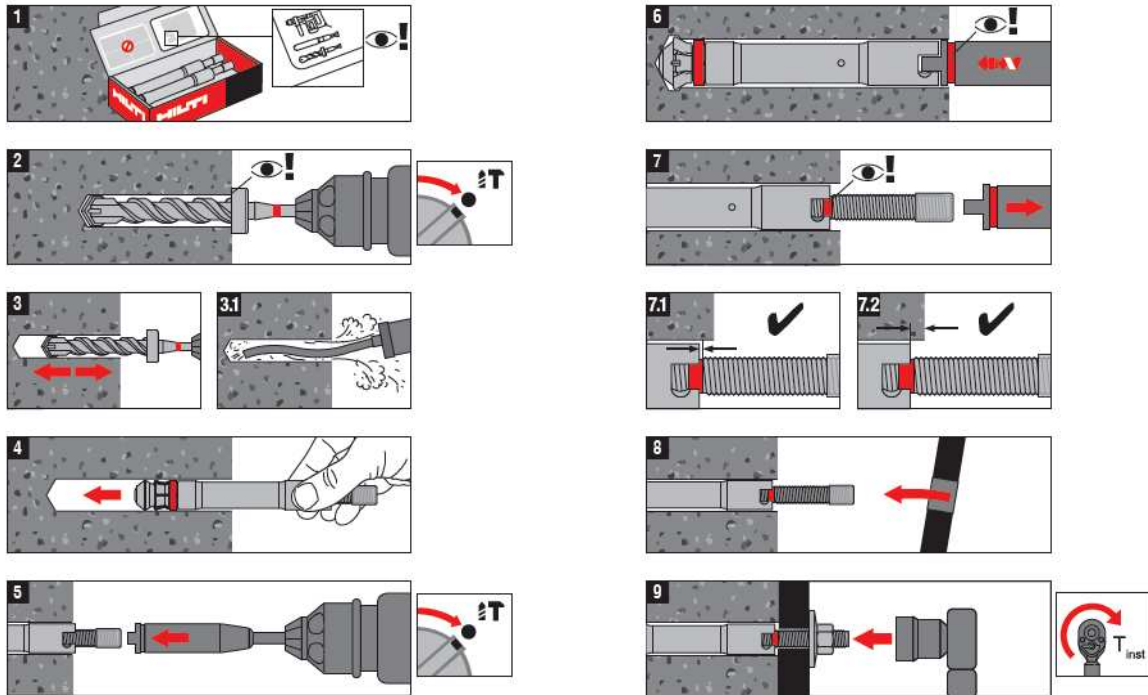
a) 1<sup>st</sup> gear

Anchor											Setting tool
	TE 24 <sup>a)</sup> TE 25 <sup>a)</sup>	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		
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<sup>st</sup> gear

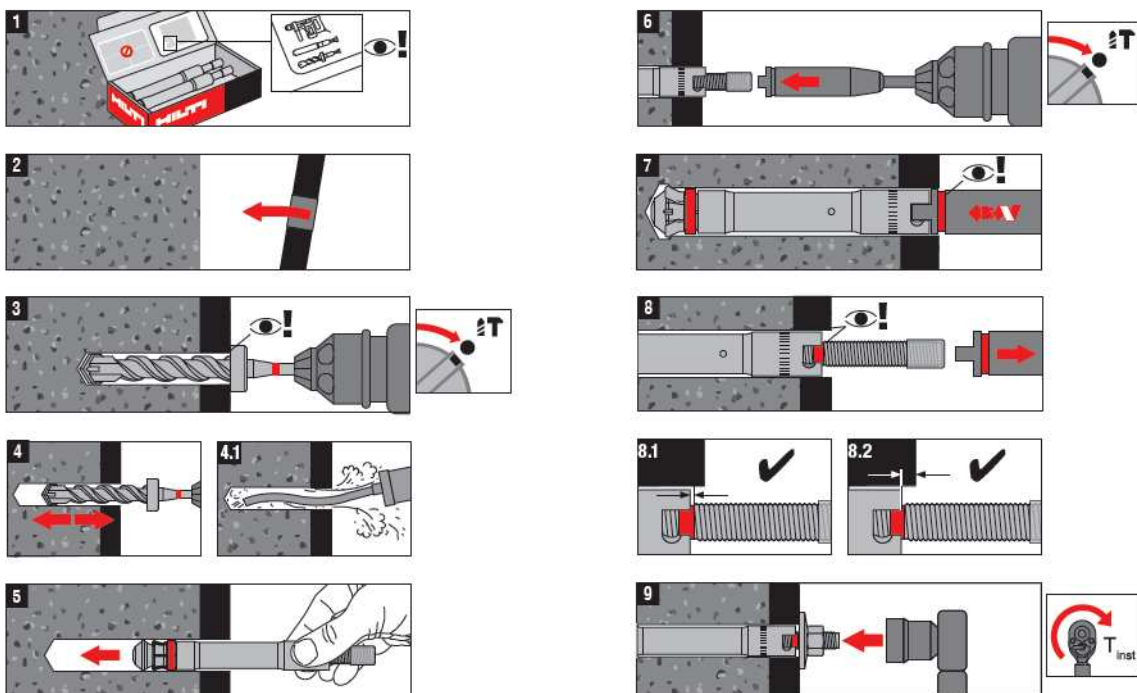
Setting instruction

HDA-P, HDA-PR, HDA-PF



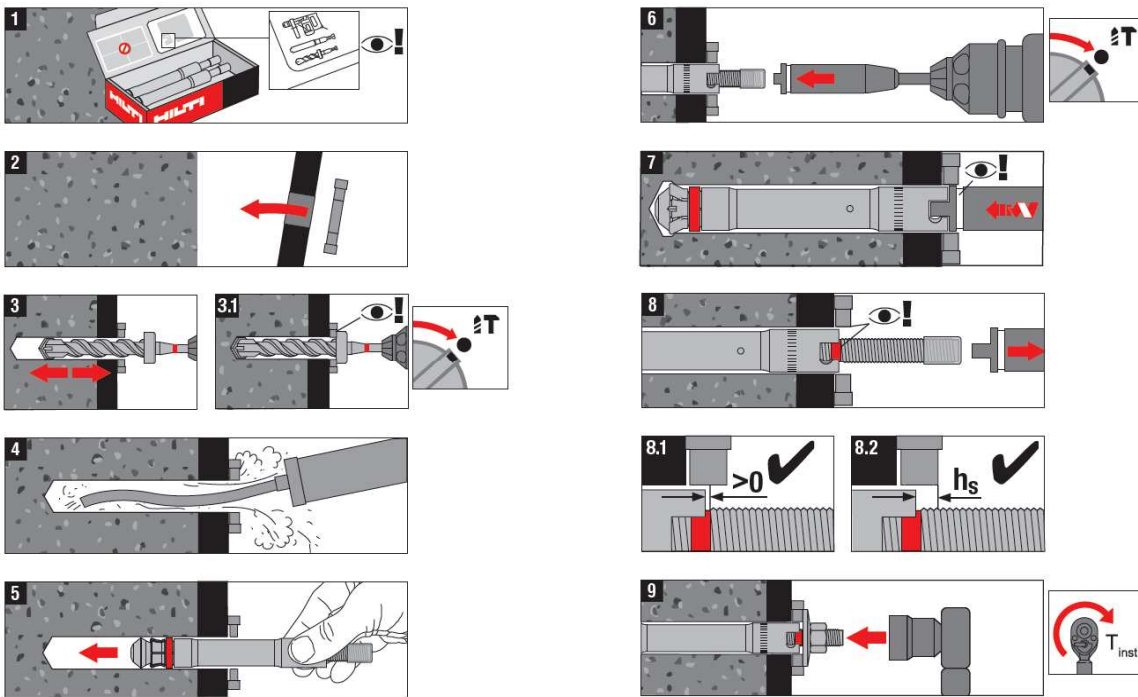
209616-A /05.07

HDA-T, HDA-TR, HDA-TF



209617-A /05.07

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

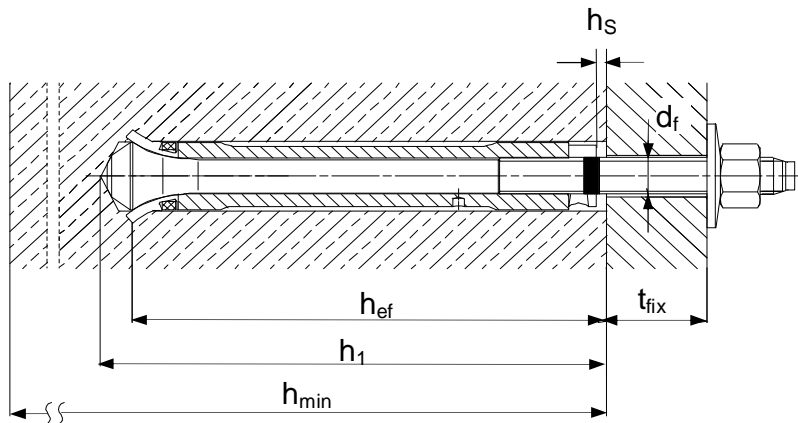


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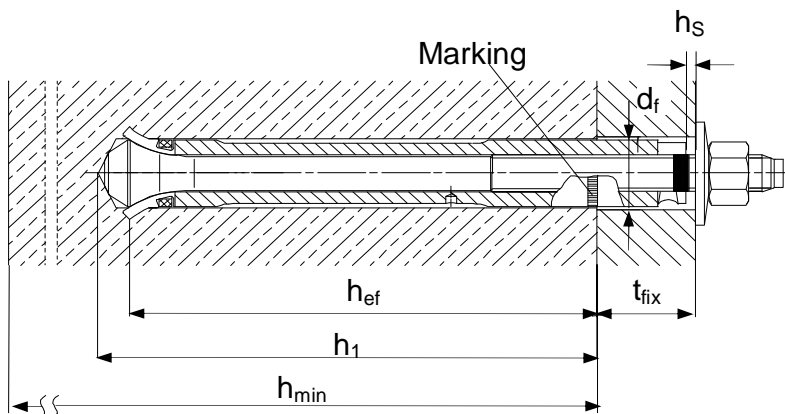
For detailed information on installation see instruction for use given with the package of the product.

### Setting details

#### HDA-P / HDA-PR / HDA-PF



#### HDA-T / HDA-TR / HDA-TF



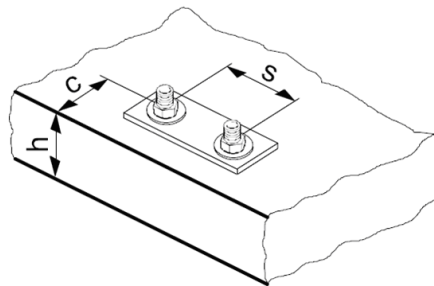
Anchor size	HDA-P / HDA-PR / HDA-PF / HDA-T / HDA-TR / HDA-TF							
	M10 x100/20	M12 x125/30   x125/50		M16 x190/40   x190/60		M20 x250/50   x250/100		
Head marking	I	L	N	R	S	V	X	
Nominal drill bit diameter $d_0$ [mm]	20	22		30		37		
Cutting diameter of drill bit	$d_{cut,min}$ [mm]	20,10	22,10		30,10		37,15	
	$d_{cut,max}$ [mm]	20,55	22,55		30,55		37,70	
Depth of drill hole <sup>a)</sup> $h_1 \geq$ [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		
<b>For HDA-P/-PF/-PR</b>								
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
<b>For HDA-T/-TF/-TR</b>								
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 - <b>without</b> use of centering washer $t_{fix,min}$ [mm]	15	15		20		25	50	
-Shear load - <b>with</b> use of centering washer $t_{fix,min}$ <sup>b)</sup> [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 x100/20	M12 x125/30   x125/50		M16 x190/40   x190/60		M20 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 2010-12-17.

- 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 same 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)

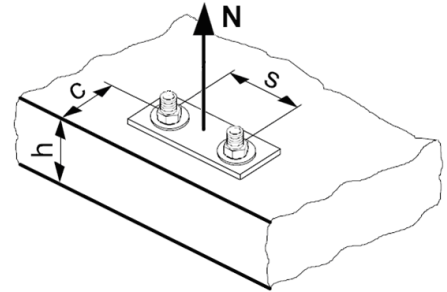
The values are valid for one anchor.

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



## Basic design tensile resistance

Design steel resistance  $N_{Rd,s}$

Anchor size		M10	M12	M16	M20 <sup>a)</sup>
$N_{Rd,s}$	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<sup>a)</sup>  $N_{Rd,p} = N_{Rd,p}^0 \cdot f_B$  (only in cracked concrete)

Anchor size	Non-cracked concrete				Cracked concrete			
	M10	M12	M16	M20 <sup>b)</sup>	M10	M12	M16	M20 <sup>b)</sup>
$N_{Rd,p}^0$ [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  $N_{Rd,c} = N_{Rd,c}^0 \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$

Design splitting resistance<sup>a)</sup>  $N_{Rd,sp} = N_{Rd,c}^0 \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$

Anchor size	Non-cracked concrete				Cracked concrete			
	M10	M12	M16	M20 <sup>b)</sup>	M10	M12	M16	M20 <sup>b)</sup>
$N_{Rd,c}^0$ [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
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ <sup>a)</sup>	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 <sup>a)</sup>

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

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 <sup>a)</sup>

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

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

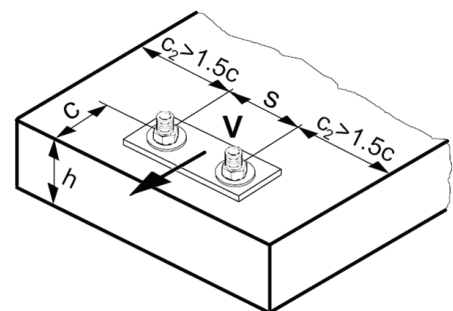
### Influence of reinforcement

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:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{fB} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



**Basic design shear resistance**

**Design steel resistance  $V_{Rd,s}$**

Anchor size		M10	M12	M16	M20 <sup>a)</sup>
$V_{Rd,s}$	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 <sup>b)</sup> [kN]	43,3	53,3	93,3	136,7
	HDA-TR <sup>b)</sup> [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  $V_{Rd,cp} = k \cdot N_{Rd,c}$  <sup>a)</sup>**

Anchor size	M10	M12	M16	M20
k	2,0			

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

**Design concrete edge resistance <sup>a)</sup>  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$**

Anchor size	Non-cracked concrete				Cracked concrete			
	M10	M12	M16	M20 <sup>b)</sup>	M10	M12	M16	M20 <sup>b)</sup>
$V_{Rd,c}^0$ [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
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ <sup>a)</sup>	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 $\beta$	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 <sup>a)</sup> for concrete edge resistance: $f_4$

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sup>a)</sup>

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 2010-12-17. All data applies to concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ . 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  $\gamma = 1,4$ . 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

Anchor size		Non-cracked concrete				Cracked concrete				
		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	
	<b>Tensile <math>N_{Rd}</math></b>									
	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	-
	<b>Shear <math>V_{Rd}</math></b>									
	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

Anchor size		Non-cracked concrete				Cracked concrete				
		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	
	<b>Tensile <math>N_{Rd}</math></b>									
	HDA-P(F), HDA-T(F)	[kN]	25,5	35,9	66,4	100,9	16,7	23,3	47,4	63,3
	HDA-PR, HDA-TR	[kN]								
	<b>Shear <math>V_{Rd}</math></b>									
	HDA-P, HDA-PF	[kN]	10,4	14,8	26,4	41,8	7,3	10,5	18,7	29,6
	HDA-PR	[kN]								
	HDA-T, HDA-TF	[kN]								
	HDA-TR	[kN]								

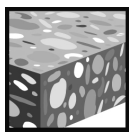
### Double anchor, no edge effects, min. spacing ( $s = s_{min}$ ), shear without lever arm (load values are valid for one anchor)

Anchor size		Non-cracked concrete				Cracked concrete				
		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	
	<b>Tensile <math>N_{Rd}</math></b>									
	HDA-P(F), HDA-T(F)	[kN]	25,8	36,0	67,6	102,1	16,7	23,3	48,3	63,3
	HDA-PR, HDA-TR	[kN]								
	<b>Shear <math>V_{Rd}</math></b>									
	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	-



## HSL-3 carbon steel, heavy duty anchor

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



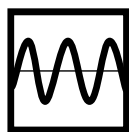
Concrete



Tensile zone



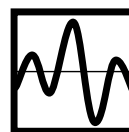
Fire resistance



Fatigue



Shock



Seismic



European Technical Approval



CE conformity



PROFIS Anchor design software

### Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval <sup>a)</sup>	CSTB, Paris	ETA-02/0042 / 2008-01-10
ICC-ES report incl. seismic	ICC evaluation service	ESR 1545 / 2012-03-01
Shockproof fastenings in civil defence installations	Federal Office for Civil 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 166402 / 2007-10-26

a) All data given in this section according ETA-02/0042, issue 2008-01-10.

### 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$

For details see Simplified design method

**Mean ultimate resistance**

Anchor size	Non-cracked concrete						Cracked concrete					
	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 <sup>a)</sup> , HSL-3-SH <sup>a)</sup> [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 <sup>b)</sup> [kN]	36,1	48,1	75,1	118,5	187,0	-	36,1	48,1	68,4	95,6	133,6	-

**Characteristic resistance**

Anchor size	Non-cracked concrete						Cracked concrete					
	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 <sup>a)</sup> , HSL-3-SH <sup>a)</sup> [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 <sup>b)</sup> [kN]	26,1	34,8	54,3	85,7	140,9	-	26,1	34,8	51,5	72,0	100,6	-

**Design resistance**

Anchor size	Non-cracked concrete						Cracked concrete					
	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 <sup>a)</sup> , HSL-3-SH <sup>a)</sup> [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 <sup>b)</sup> [kN]	20,9	27,8	43,4	67,2	93,9	-	20,1	27,8	34,3	48,0	67,1	-

**Recommended loads**

Anchor size	Non-cracked concrete						Cracked concrete					
	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 <sup>a)</sup> , HSL-3-SH <sup>a)</sup> [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 <sup>b)</sup> [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  $\gamma = 1,4$ . 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/mm <sup>2</sup> ]	800	800	800	800	830	830
Yield strength $f_{yk}$ [N/mm <sup>2</sup> ]	640	640	640	640	640	640
Stressed cross-section $A_s$ [mm <sup>2</sup> ]	36,6	58,0	84,3	157	245	353
Moment of resistance $W$ [mm <sup>3</sup> ]	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

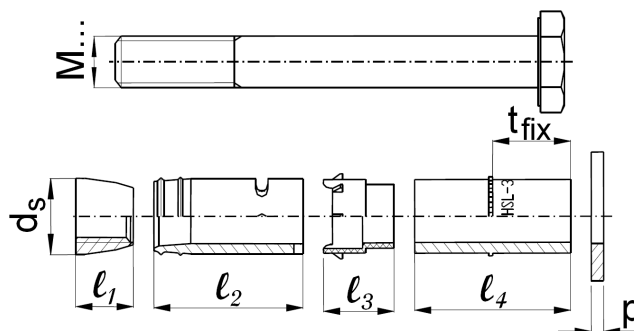
### Material quality

Part	Material
Bolt, threaded rod	steel strength 8.8, galvanised to min. 5 $\mu$ m

## 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	M8	5	200	11,9	12	32	15,2	19	214	2
HSL-3-G	M10	5	200	14,8	14	36	17,2	23	218	3
HSL-3	M12	5	200	17,6	17	40	20	28	223	3
HSL-3-G	M16	10	200	23,6	20	54,4	24,4	34,5	224,5	4
HSL-3-B	M20	10	200	27,6	20	57	31,5	51	241	4
HSL-3	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

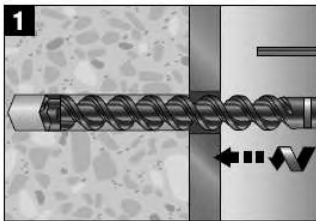


### Setting

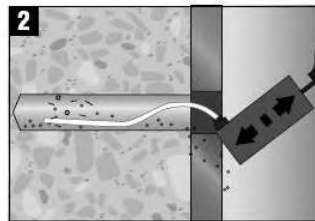
#### installation equipment

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

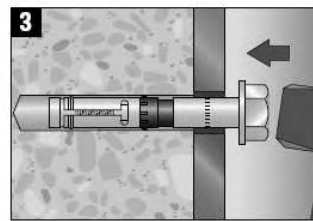
#### Setting instruction



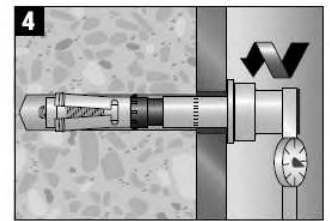
Drill hole.



Blow out dust and fragments.



Install anchor.

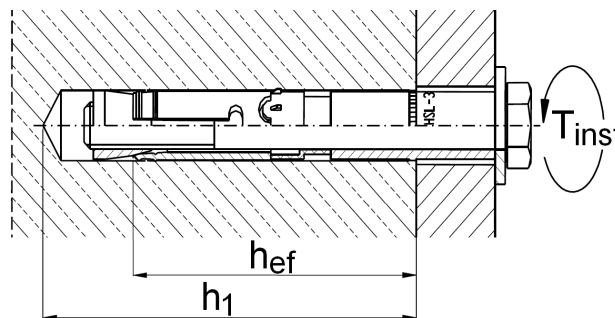


Apply tightening torque  
(for HSL-3-B: no torque wrench is needed)

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 $h_{ef}$



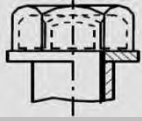
#### Setting details HSL-3

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

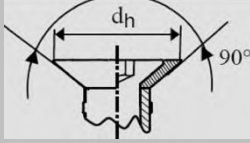
The torque moment is controlled by the safety cap

### 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

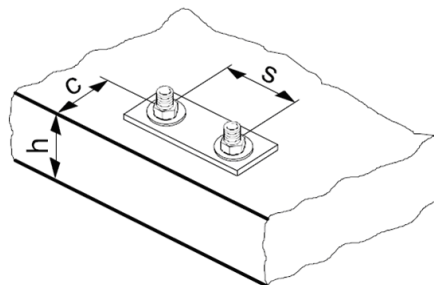


### Setting details HSL-3-SK

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
Size of hexagon socket screw key	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
	$s_{min}$	[mm]	60	70	80	100	125	150
Minimum spacing	for $c \geq$	[mm]	100	100	160	240	300	300
	$c_{min}$	[mm]	60	70	80	100	150	150
Minimum edge distance	for $s \geq$	[mm]	100	160	240	240	300	300
	$s_{cr,sp}$	[mm]	230	270	300	380	480	570
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 2008-01-10.

- 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 same 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)

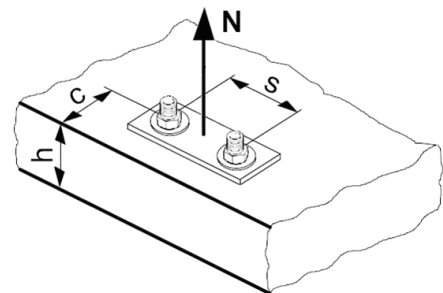
The values are valid for one anchor.

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



## 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 $N_{Rd,p} = N_{Rd,p}^0 \cdot f_B$ (only M8, M10 in cracked concrete)

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

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

### Design splitting resistance <sup>a)</sup> $N_{Rd,sp} = N_{Rd,c}^0 \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$

Anchor size		Non-cracked concrete						Cracked concrete					
		M8	M10	M12	M16	M20	M24	M8	M10	M12	M16	M20	M24
$N_{Rd,c}^0$	[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)

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

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

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

#### Influence of reinforcement

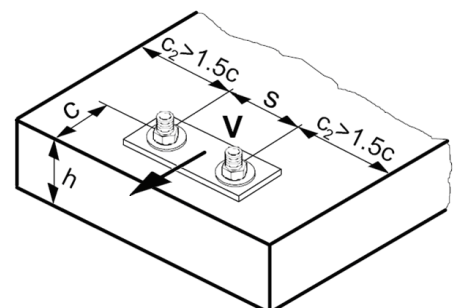
Anchor size	M8	M10	M12	M16	M20	M24
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,8 a)	0,85 a)	0,9 a)	1	1	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



## 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 <sup>a)</sup> , HSL-3-SH <sup>a)</sup> [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 $V_{Rd,cp} = k \cdot N_{Rd,c}$ <sup>a)</sup>

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<sup>a)</sup> $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_\beta \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size	Non-cracked concrete						Cracked concrete					
	M8	M10	M12	M16	M20	M24	M8	M10	M12	M16	M20	M24
$V_{Rd,c}^0$ [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
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ <sup>a)</sup>	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 $\beta$	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 <sup>a)</sup> for concrete edge resistance:  $f_4$** 

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sup>a)</sup>**

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 2008-01-10. All data applies to concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ . 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  $\gamma = 1,4$ . 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		Non-cracked concrete						Cracked concrete					
		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
	<b>Tensile <math>N_{Rd}</math></b>												
	HSL-3, HSL-3-B, HSL-3-S, 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
	<b>Shear <math>V_{Rd}</math>, without lever arm</b>												
	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 ( $c = c_{min}$ )

Anchor size		Non-cracked concrete						Cracked concrete					
		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
	<b>Tensile <math>N_{Rd}</math></b>												
	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
	<b>Shear <math>V_{Rd}</math>, without lever arm</b>												
	HSL-3, HSL-3-B, HSL-3-SK, HSL-3-SH [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
	HSL-3-G [kN]												

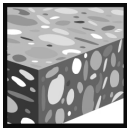
### Double anchor, no edge effects, min. spacing ( $s = s_{min}$ ), (load values are valid for one anchor)

Anchor size		Non-cracked concrete						Cracked concrete					
		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
	<b>Tensile <math>N_{Rd}</math></b>												
	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
	<b>Shear <math>V_{Rd}</math>, without lever arm</b>												
	HSL-3, HSL-3-B, HSL-3-SK, HSL-3-SH [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-3-G [kN]												



## HSL-GR stainless steel, heavy duty anchor

	Anchor version	Benefits
	HSL-GR	<ul style="list-style-type: none"> <li>- suitable for non-cracked C 20/25 to C 50/60</li> <li>- high loading capacity</li> <li>- force-controlled expansion</li> <li>- reliable pull-down of the part fastened</li> <li>- no rotation in hole when tightening bolt</li> </ul>



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,  $f_{ck,cube} = 25 \text{ N/mm}^2$

For details see Simplified design method

### 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 <sup>a)</sup>

Anchor size	Hilti technical data for non-cracked concrete				
	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  $\gamma = 1,4$ . 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/mm <sup>2</sup> ]	700	700	700	700	700
Yield strength $f_{yk}$ [N/mm <sup>2</sup> ]	450	450	450	450	450
Stressed cross-section $A_s$ [mm <sup>2</sup> ]	36,6	58,0	84,3	157	245
Moment of resistance $W$ [mm <sup>3</sup> ]	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

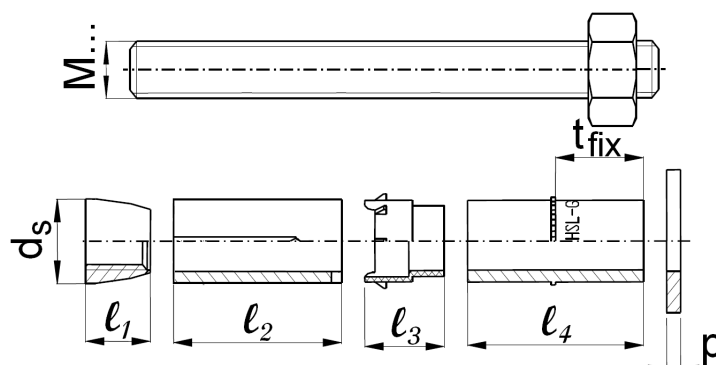
#### Material quality

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

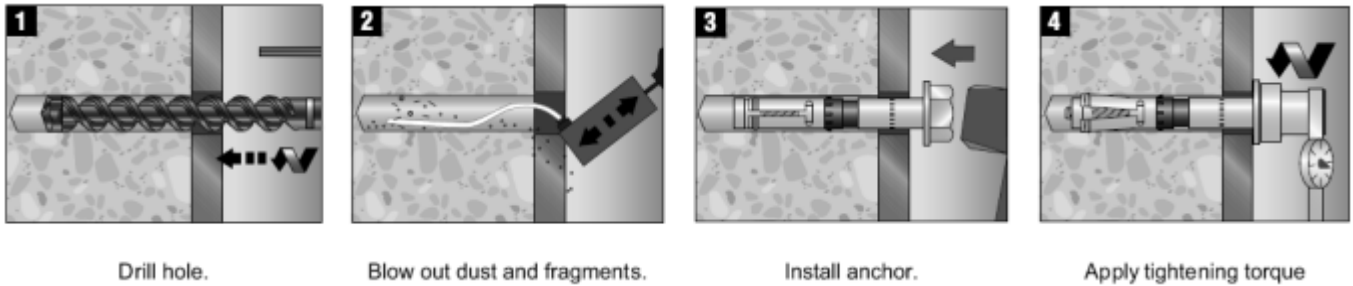


## Setting

### installation equipment

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

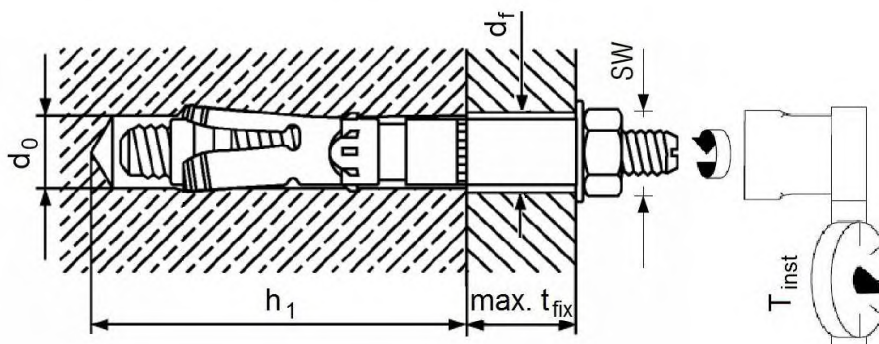
### Setting instruction



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 $h_{ef}$

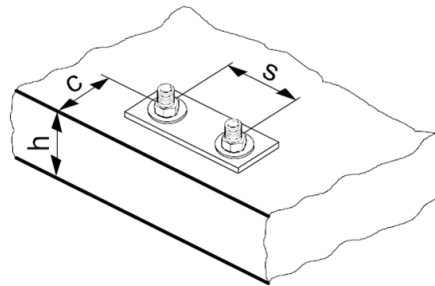


### Setting details

Anchor size	M8	M10	M12	M16	M20		
Nominal diameter of drill bit	$d_0$	[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 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 same 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)

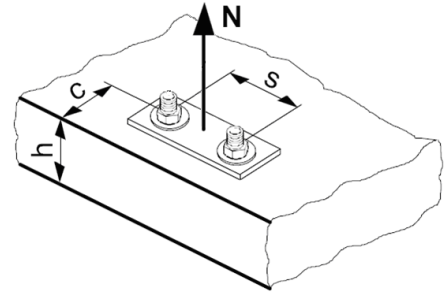
The values are valid for one anchor.

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



## 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 $N_{Rd,p} = N_{Rd,p}^0 \cdot f_B$

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

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

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

Anchor size		M8	M10	M12	M16	M20
$N_{Rd,c}^0$ [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)

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

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 <sup>a)</sup>

$s/s_{cr,N}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$s/s_{cr,sp}$										
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N}) \leq 1$										
$f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp}) \leq 1$	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	$\geq 3,68$
$f_{h,sp} = [h/(2 \cdot h_{ef})]^{2/3}$	1	1,07	1,13	1,19	1,25	1,31	1,37	1,42	1,48	1,5

### Influence of reinforcement

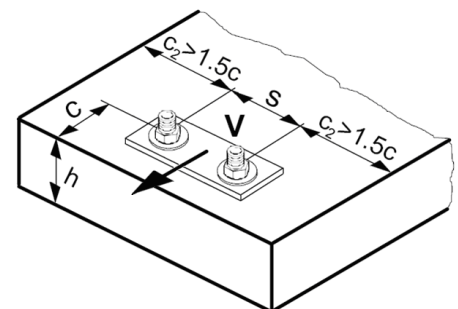
Anchor size	M8	M10	M12	M16	M20
$f_{re,N} = 0,5 + h_{ef}/200\text{mm} \leq 1$	0,8 <sup>a)</sup>	0,85 <sup>a)</sup>	0,9 <sup>a)</sup>	1	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



## Basic design shear resistance

Design steel resistance  $V_{Rd,s}$

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

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

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

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

Design concrete edge resistance <sup>a)</sup>  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size	M8	M10	M12	M16	M20
$V_{Rd,c}^0$ [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 $\beta$	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 <sup>a)</sup> for concrete edge resistance: $f_4$

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sup>a)</sup>

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 2008-01-10. All data applies to concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ . 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  $\gamma = 1,4$ . 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
	<b>Tensile <math>N_{Rd}</math></b>					
	HSL-GR [kN]	13,0	16,4	20,1	28,1	39,2
	<b>Shear <math>V_{Rd}</math>, without lever arm</b>					
	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
	<b>Tensile <math>N_{Rd}</math></b>					
	HSL-GR [kN]	7,8	10,1	12,6	18,4	28,3
	<b>Shear <math>V_{Rd}</math>, without lever arm</b>					
	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)

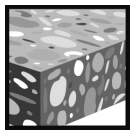
Anchor size		M8	M10	M12	M16	M20
Min. base material thickness $h_{min}$ [mm]		120	140	160	200	250
Min. spacing $s_{min}$ [mm]		100	160	240	240	300
	<b>Tensile <math>N_{Rd}</math></b>					
	HSL-GR [kN]	8,9	12,6	17,3	22,9	31,9
	<b>Shear <math>V_{Rd}</math>, without lever arm</b>					
	HSL-GR [kN]	16,0	25,6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





## HSC-A Safety anchor

	Anchor version	Benefits
	Bolt version	<ul style="list-style-type: none"> <li>- the perfect solution for small edge and space distance</li> <li>- suitable for thin concrete blocks due to low embedment depth</li> <li>- suitable for cracked concrete</li> <li>- self-cutting undercut anchor</li> <li>- available as bolt version for through applications</li> <li>- stainless steel available for external applications</li> </ul>
	HSC-A Carbon Steel version	
	HSC-AR Stainless steel version	



Concrete



Tensile zone



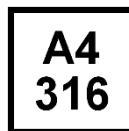
Small edge distance and spacing



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 <sup>a)</sup>	CSTB, Paris	ETA-02/0027 / 2007-09-20
Shockproof fastenings in civil defence installations	Federal Office for Civil 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 166402 / 2007-10-26

a) All data given in this section according ETA-02/0027 issue 2007-09-20

### 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$

For details see Simplified design method

**Mean ultimate resistance**

Anchor size	Non-cracked concrete				Cracked concrete			
	M8x40	M10x40	M8x50	M12x60	M8x40	M10x40	M8x50	M12x60
Tensile $N_{R_u,m}$								
HSC-A [kN]	16,6	16,6	23,3	30,6	13,3	13,3	18,6	24,5
HSC-AR [kN]	16,6	16,6	23,3	30,6	13,3	13,3	18,6	24,5
Shear $V_{R_u,m}$								
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**

Anchor size	Non-cracked concrete				Cracked concrete			
	M8x40	M10x40	M8x50	M12x60	M8x40	M10x40	M8x50	M12x60
Tensile $N_{R_k}$								
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 $V_{R_k}$								
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**

Anchor size	Non-cracked concrete				Cracked concrete			
	M8x40	M10x40	M8x50	M12x60	M8x40	M10x40	M8x50	M12x60
Tensile $N_{R_d}$								
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 $V_{R_d}$								
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**

Anchor size	Non-cracked concrete				Cracked concrete			
	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  $\gamma = 1,4$ . 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/mm <sup>2</sup> ]	-A	800	800	800	800
	-AR	700	700	700	700
Yield strength $f_{yk}$ [N/mm <sup>2</sup> ]	-A	640	640	640	640
	-AR	450	450	450	450
Stressed cross-section for bolt version $A_{s,A}$ [mm <sup>2</sup> ]	-A, AR	36,6	58,0	36,6	84,3
Moment of resistance $W$ [mm <sup>3</sup> ]	-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 $\mu\text{m}$
	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

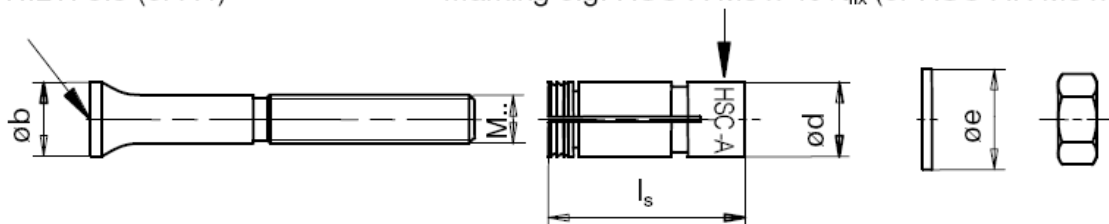
## Anchor dimensions

### 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)

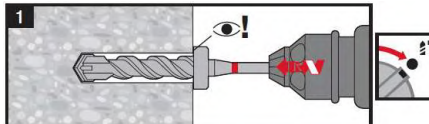


### Setting

#### 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

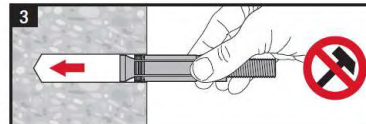


**1.1** HSC-A/AR

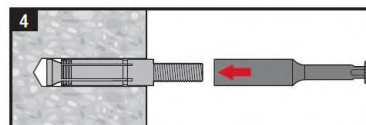
	TE 7 TE 7-A	TE 16 TE 30	TE 25 TE 35	TE 40
M8 x 40/15	✓	✓	✓	✓
M8 x 50/15	✓	✓	✓	✓
M10 x 40/20	✓	✓	✓	✓
M12 x 60/20	✓	✓	✓	✓

**1.2** HSC-A/AR

	TE-C-HSC-B
M8 x 40/15	14 x 40
M8 x 50/15	14 x 50
M10 x 40/20	16 x 40
M12 x 60/20	18 x 60



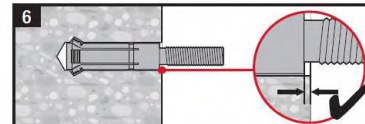
**3**



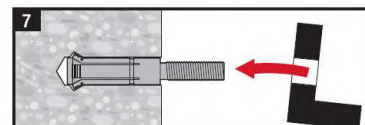
**4**

**4.1** HSC-A/AR

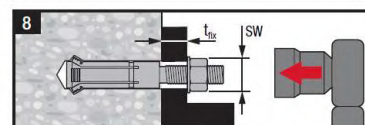
	TE-C-HSC-MW
M8 x 40/15	14
M8 x 50/15	14
M10 x 40/20	16
M12 x 60/20	18



**6**



**7**



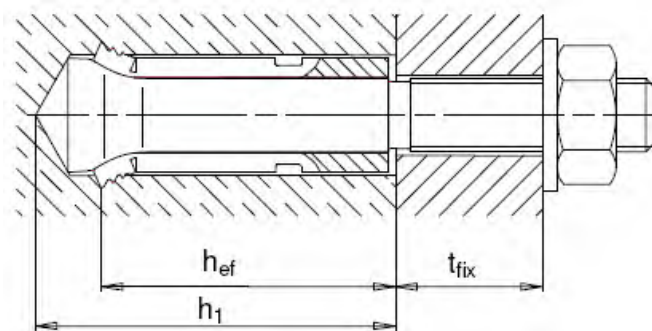
**8**

**8.1** HSC-A/AR

	t <sub>fix</sub>	SW	T <sub>inst</sub>
M8 x 40/15	15	13	10 Nm
M8 x 50/15	15	13	10 Nm
M10 x 40/20	20	17	20 Nm
M12 x 60/20	20	19	30 Nm

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 $h_{ef}$

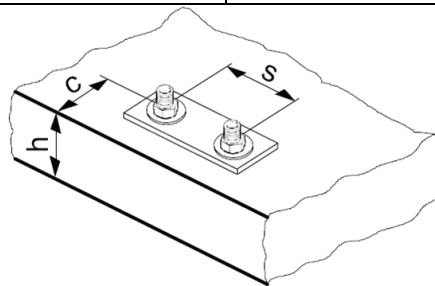


### Setting details HSC-A (R)

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 2007-09-20.

- 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 same 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)

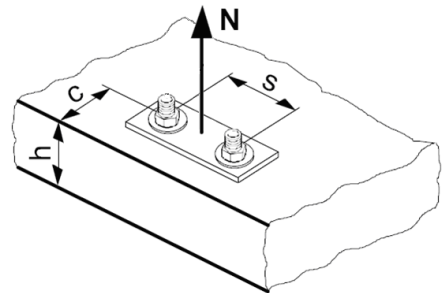
The values are valid for one anchor.

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



### 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 $N_{Rd,p} = N_{Rd,p}^0 \cdot f_B$ for HSC-A and HSC-AR

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

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

#### Design splitting resistance <sup>a)</sup> $N_{Rd,sp} = N_{Rd,c}^0 \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$

		Non-cracked concrete				Cracked concrete			
Anchor size		M8x40	M10x40	M8x50	M12x60	M8x40	M10x40	M8x50	M12x60
$N_{Rd,c}^0$	[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)

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

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

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	$\geq 3,68$
$f_{h,sp} = [h/(2 \cdot h_{ef})]^{2/3}$	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 <sup>a)</sup>	0,7 <sup>a)</sup>	0,75 <sup>a)</sup>	0,8 <sup>a)</sup>

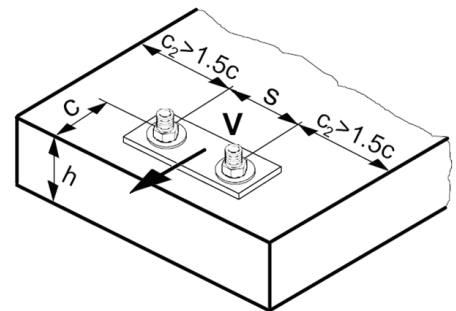
a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  mm, then a factor  $f_{re,N} = 1$  may be applied.



### 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:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_\beta \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



### Basic design shear resistance

Design steel resistance  $V_{Rd,s}$

Anchor size		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  $V_{Rd,c}^a = V_{Rd,c}^0 \cdot f_B \cdot f_\beta \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size	Non-cracked concrete				Cracked concrete			
	M8x40	M10x40	M8x50	M12x60	M8x40	M10x40	M8x50	M12x60
$V_{Rd,c}^0$ [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 $\beta$	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 <sup>a)</sup> for concrete edge resistance: $f_4$

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sup>a)</sup>

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".


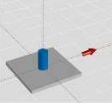
### Precalculated values

Design resistance calculated according ETAG 001, Annex C and data given in ETA-02/0027, issue 2007-09-20. All data applies to concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ .

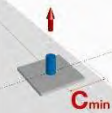
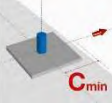
Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action  $\gamma = 1,4$ . The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

### Design resistance

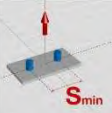
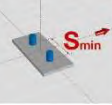
#### Single anchor, no edge effects

		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
	<b>Tensile <math>N_{Rd}</math></b>								
	HSC-A HSC-AR [kN]	8,5	8,5	11,9	15,6	6,1	6,1	8,5	11,2
	<b>Shear <math>V_{Rd}</math>, without lever arm</b>								
	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 ( $c = c_{min}$ )

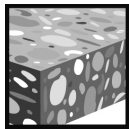
		Non-cracked concrete				Cracked concrete			
Anchor size		M8x40	M10x40	M8x50	M12x60	M6x40	M8x40	M10x50	M10x60
Min. base material thickness $h_{min}$ [mm]		100	100	100	130	100	100	100	130
Min. edge distance $c_{min}$ [mm]		40	40	50	60	40	40	50	60
	<b>Tensile <math>N_{Rd}</math></b>								
	HSC-A HSC-AR [kN]	6,1	6,4	8,3	11,7	4,6	4,6	6,4	8,4
	<b>Shear <math>V_{Rd}</math>, without lever arm</b>								
	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
	<b>Tensile <math>N_{Rd}</math></b>								
	HSC-A HSC-AR [kN]	5,6	5,7	7,7	10,4	4,0	4,0	5,7	7,4
	<b>Shear <math>V_{Rd}</math>, without lever arm</b>								
	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:	<ul style="list-style-type: none"> <li>- the perfect solution for small edge and space distance</li> <li>- suitable for thin concrete blocks due to low embedment depth</li> <li>- suitable for cracked concrete</li> <li>- self-cutting undercut anchor</li> <li>- internal threaded</li> <li>- stainless steel available for external applications</li> </ul>
	HSC-I carbon steel internal version	
	HSC-IR Stainless steel version ((A4))	



Concrete



Tensile zone



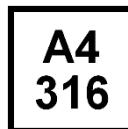
Small edge distance and spacing



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 <sup>a)</sup>	CSTB, Paris	ETA-02/0027 / 2007-09-20
Shockproof fastenings in civil defence installations	Federal Office for Civil 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 166402 / 2007-10-26

- All data given in this section according ETA-02/0027 issue 2007-09-20

### 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$

For details see Simplified design method

### Mean ultimate resistance HSC-I and HSC-IR

Anchor size	Non-cracked concrete					Cracked concrete				
	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**

Anchor size	Non-cracked concrete					Cracked concrete				
	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**

Anchor size	Non-cracked concrete					Cracked concrete				
	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**

Anchor size	Non-cracked concrete					Cracked concrete				
	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  $\gamma = 1,4$ . 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/mm <sup>2</sup> ]	-I	800	800	800	800	800
	-IR	600	600	700	700	700
Yield strength $f_{yk}$ [N/mm <sup>2</sup> ]	-I	640	640	640	640	640
	-IR	355	355	350	350	340
Stressed cross-section for internal threaded version $A_{s,I}$ [mm <sup>2</sup> ]	-I,IR	22,0	28,3	34,6	34,6	40,8
Stressed cross-section for bolt version $A_{s,A}$ [mm <sup>2</sup> ]	-I,IR	20,1	36,6	58,0	58,0	84,3
Moment of resistance $W$ [mm <sup>3</sup> ]	-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

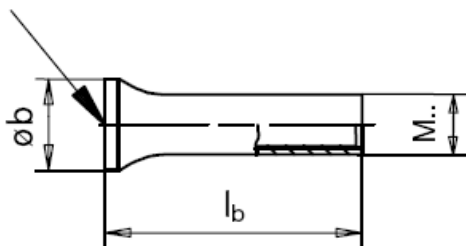
Part	Material	
Carbon steel		
HSC-I	Cone bolt with , with internal or external thread	steel strength 8.8, galvanised to min. 5 µm
	Expansion sleeve and washer	Galvanised steel
	Hexagon nut	Strength 8
Stainless steel		
HSC-IR	Cone bolt with , with internal or external thread	steel grade 1.4401, 1.4571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

### Anchor dimensions

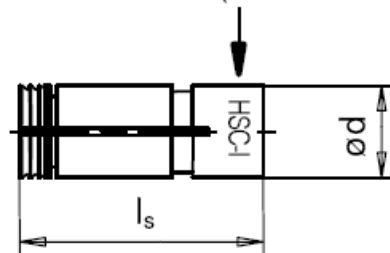
#### Dimensions of HSC-I and HSC-IR

Anchor version	Thread size	b [mm]	l <sub>s</sub> [mm]	d [mm]	l <sub>b</sub> [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

marking HILTI 8.8 (or A4)



marking e.g. HSC-I M6 x 40 (or HSC-IR M6 x 40 A4)



### 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**

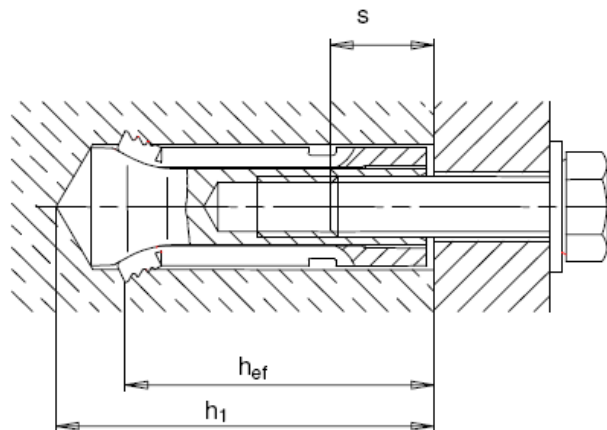
HSC-I/IR	SW	T <sub>inst</sub>
M6 × 40	10	10 Nm
M8 × 40	13	10 Nm
M10 × 50	17	20 Nm
M10 × 60	17	30 Nm
M12 × 60	19	30 Nm

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 $h_{ef}$



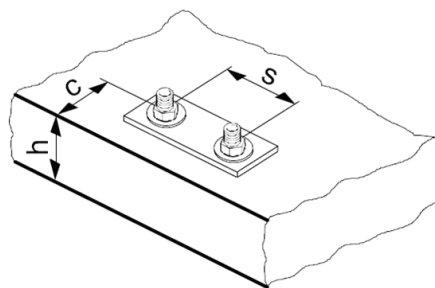


## Setting details

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 2007-09-20.

- 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)

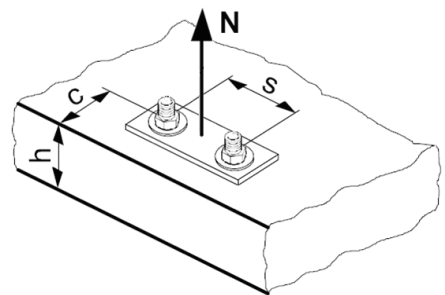
The values are valid for one anchor.

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



### 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 $N_{Rd,p} = N_{Rd,p}^0 \cdot f_B$

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

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

#### Design splitting resistance <sup>a)</sup> $N_{Rd,sp} = N_{Rd,c}^0 \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$

Anchor size	Non-cracked concrete					Cracked concrete				
	M6x 40	M8x 40	M10x 50	M10x 60	M12x 60	M6x 40	M8x 40	M10x 50	M10x 60	M12x 60
$N_{Rd,c}^0$ [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)

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

- 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)

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

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

### Influence of reinforcement

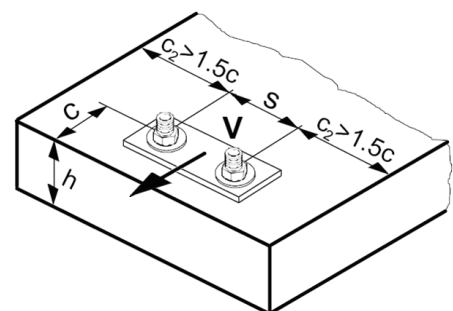
Anchor size	M6x40	M8x40	M10x50	M10x60	M12x60
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,7 a)	0,7 a)	0,75 a)	0,8 a)	0,8 a)

- This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



### Basic design shear resistance

#### Design steel resistance $V_{Rd,s}$

Anchor size		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 $V_{Rd,c}^0 = V_{Rd,c}^0 \cdot f_B \cdot f_\beta \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size	Non-cracked concrete					Cracked concrete				
	M6x40	M8x40	M10x50	M10x60	M12x60	M6x40	M8x40	M10x50	M10x60	M12x60
$V_{Rd,c}^0$ [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.

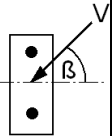
### Influencing factors

#### 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 $\beta$	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 <sup>a)</sup> for concrete edge resistance:  $f_4$** 

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sup>a)</sup>**

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".

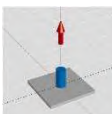
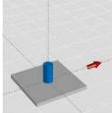
**Precalculated values**

Design resistance calculated according ETAG 001, Annex C and data given in ETA-02/0027, issue 2007-09-20. All data applies to concrete C 20/25 –  $f_{ck,cube} = 25$  N/mm<sup>2</sup>.

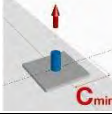
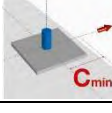
Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action  $\gamma = 1,4$ . The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

### Design resistance

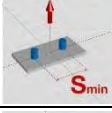

#### Single anchor, no edge effects

Anchor size		Non-cracked concrete					Cracked concrete					
		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	
	<b>Tensile <math>N_{Rd}</math></b>											
	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
	<b>Shear <math>V_{Rd}</math>, without lever arm</b>											
	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


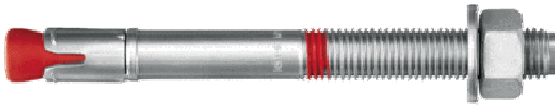
#### Single anchor, min. edge distance ( $c = c_{min}$ )

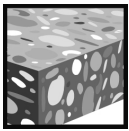
Anchor size		Non-cracked concrete					Cracked concrete					
		M6x 40	M8x 40	M10x 50	M10x 60	M12x 60	M6x 40	M8x 40	M10x 50	M10x 60	M12x 60	
Min. base material thickness $h_{min}$ [mm]		100	100	110	130	130	100	100	110	130	130	
Min. edge distance $c_{min}$ [mm]		40	40	50	60	60	40	40	50	60	60	
	<b>Tensile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

Anchor size		Non-cracked concrete					Cracked concrete					
		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	
	<b>Tensile <math>N_{Rd}</math></b>											
	HSC-I	[kN]	5,6	5,7	7,7	10,4	10,4	4,0	4,0	5,7	7,4	7,4
	HSC-IR	[kN]	5,6	5,7	7,7	10,4	10,4	4,0	4,0	5,7	7,4	7,4
	<b>Shear <math>V_{Rd}</math>, without lever arm</b>											
	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



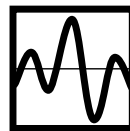
Tensile zone



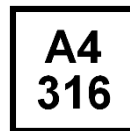
Fire resistance



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 <sup>a)</sup>	DIBt, Berlin	ETA-98/0001 / 2011-06-17
Shockproof fastenings in civil defence installations	Federal Office for Civil Protection, Bern	BZS D 08-602 / 2008-12-15
Fire test report	DIBt, Berlin	ETA-98/0001 / 2011-06-17
Fire test report ZTV-Tunnel	IBMB, Braunschweig	UB 3332/0881-2 / 2003-07-02
Assessment report (fire)	warringtonfire	WF 166402 / 2007-10-26

a) All data given in this section according ETA-98/0001, issue 2011-06-17.

### 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$

For details see Simplified design method

**Mean ultimate resistance**

Anchor size	Non-cracked concrete						Cracked concrete					
	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**

Anchor size	Non-cracked concrete						Cracked concrete					
	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**

Anchor size	Non-cracked concrete						Cracked concrete					
	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 [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 $V_{Rd}$												
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**

Anchor size	Non-cracked concrete						Cracked concrete					
	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  $\gamma = 1,4$ . 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

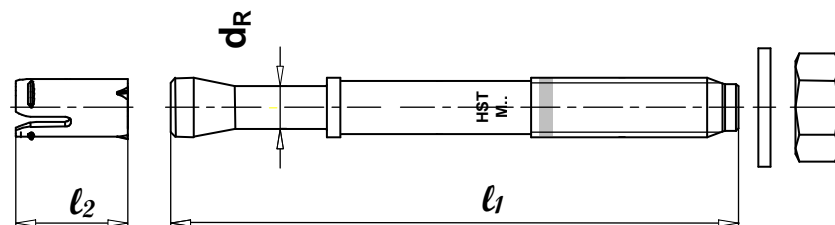
Anchor size		M8	M10	M12	M16	M20	M24
Nominal tensile strength $f_{uk}$	HST [N/mm <sup>2</sup> ]	800	800	800	720	700	530
	HST-R [N/mm <sup>2</sup> ]	720	700	700	650	650	650
	HST-HCR [N/mm <sup>2</sup> ]	800	800	800	800	-	-
Yield strength $f_{yk}$	HST [N/mm <sup>2</sup> ]	640	640	640	580	560	451
	HST-R [N/mm <sup>2</sup> ]	575	560	560	500	450	450
	HST-HCR [N/mm <sup>2</sup> ]	640	640	640	640	-	-
Stressed cross-section $A_s$	[mm <sup>2</sup> ]	36,6	58,0	84,3	157	245	353
Moment of resistance $W$	[mm <sup>3</sup> ]	31,2	62,3	109,2	277,5	540,9	935,5
Char. bending resistance $M_{Rk,s}^0$	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 $\mu$ m
	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	$l_{1,min}$ [mm]	75	90	115	140	170	200
Maximum length of the anchor	$l_{1,max}$ [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



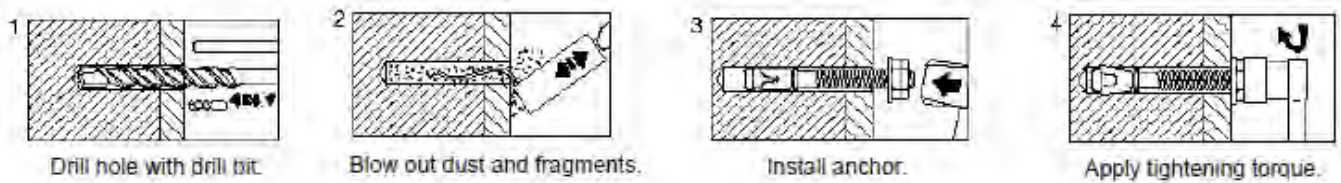
## Setting

### Installation equipment

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



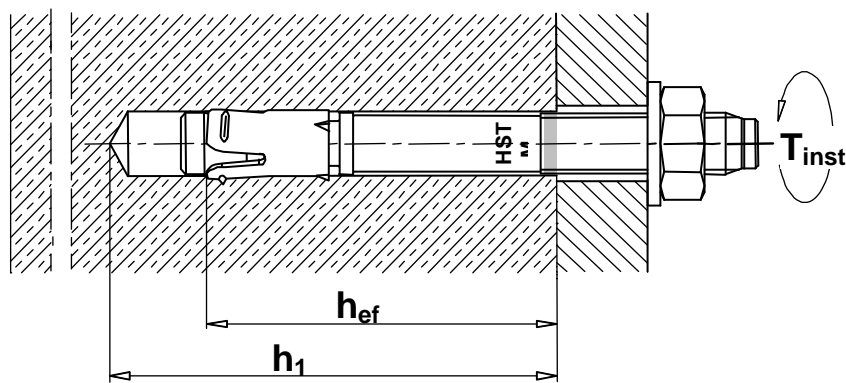
### Setting instruction



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 $h_{ef}$

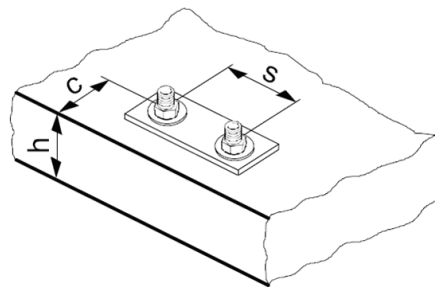


### Setting details HST, HST-R, HST-HCR

		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 $c \geq$ [mm]	50	80	85	110	225	255
	HST-R	$s_{min}$ [mm]	60	55	60	70	100	125
		for $c \geq$ [mm]	60	70	80	110	195	205
	HST-HCR	$s_{min}$ [mm]	60	55	60	70	-	-
		for $c \geq$ [mm]	50	70	80	110	-	-
Minimum spacing in cracked concrete	HST	$s_{min}$ [mm]	40	55	60	70	100	125
		for $c \geq$ [mm]	50	70	75	100	160	180
	HST-R	$s_{min}$ [mm]	40	55	60	70	100	125
		for $c \geq$ [mm]	50	65	75	100	130	130
	HST-HCR	$s_{min}$ [mm]	40	55	60	70	-	-
		for $c \geq$ [mm]	50	70	75	100	-	-
Minimum edge distance in non-cracked concrete	HST	$c_{min}$ [mm]	50	55	55	85	140	170
		for $s \geq$ [mm]	60	115	145	150	270	295
	HST-R	$c_{min}$ [mm]	60	50	55	70	140	150
		for $s \geq$ [mm]	60	115	145	160	210	235
	HST-HCR	$c_{min}$ [mm]	60	55	55	70	-	-
		for $s \geq$ [mm]	60	115	145	160	-	-
Minimum edge distance in cracked concrete	HST	$c_{min}$ [mm]	45	55	55	70	100	125
		for $s \geq$ [mm]	50	90	120	150	225	240
	HST-R HST-HCR	$c_{min}$ [mm]	45	50	55	60	100	125
		for $s \geq$ [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 2011-06-17.

- 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)

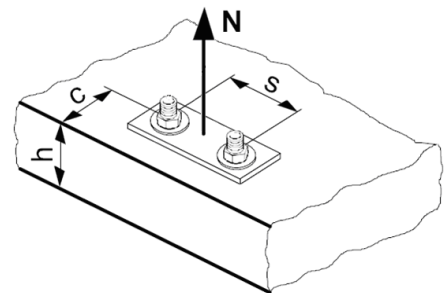
The values are valid for one anchor.

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



### 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 $N_{Rd,p} = N_{Rd,p}^0 \cdot f_B$

Anchor size		Non-cracked concrete						Cracked concrete					
		M8	M10	M12	M16	M20	M24	M8	M10	M12	M16	M20	M24
$N_{Rd,p}^0$	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 $N_{Rd,c} = N_{Rd,c}^0 \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$

#### Design splitting resistance <sup>a)</sup> $N_{Rd,sp} = N_{Rd,c}^0 \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$

Anchor size		Non-cracked concrete						Cracked concrete					
		M8	M10	M12	M16	M20	M24	M8	M10	M12	M16	M20	M24
$N_{Rd,c}^0$	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)

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

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

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

### Influence of reinforcement

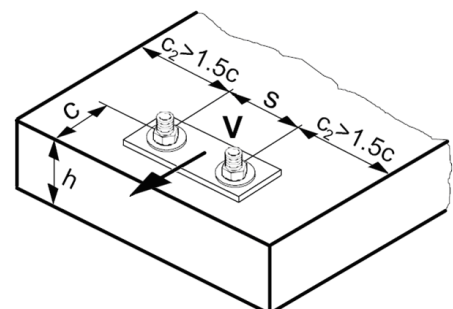
Anchor size	M8	M10	M12	M16	M20	M24
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,74 a)	0,8 a)	0,85 a)	0,91 a)	1	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



### 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 $V_{Rd,cp} = k \cdot N_{Rd,c}$ <sup>a)</sup>

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

Anchor size	Non-cracked concrete						Cracked concrete					
	M8	M10	M12	M16	M20	M24	M8	M10	M12	M16	M20	M24
$V_{Rd,c}^0$ [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.

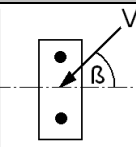
### Influencing factors

#### 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
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ <sup>a)</sup>	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 $\beta$	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 <sup>a)</sup> for concrete edge resistance:  $f_4$** 

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sup>a)</sup>**

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".

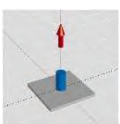
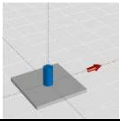
**Precalculated values**

Design resistance calculated according ETAG 001, Annex C and data given in ETA-98/0001, issue 2011-06-17. All data applies to concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ .


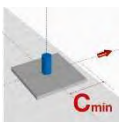
Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action  $\gamma = 1,4$ . The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

### Design resistance

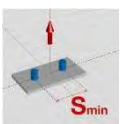
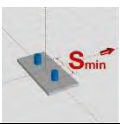
#### Single anchor, no edge effects

Anchor size			Non-cracked concrete						Cracked concrete					
			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
	<b>Tensile <math>N_{Rd}</math></b>													
	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	-	-
	<b>Shear <math>V_{Rd}</math>, without lever arm</b>													
	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 ( $c = c_{min}$ )

Anchor size			Non-cracked concrete						Cracked concrete					
			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	-	-
	<b>Tensile <math>N_{Rd}</math></b>													
	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	-	-
	<b>Shear <math>V_{Rd}</math>, without lever arm</b>													
	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	-	-

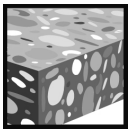
#### Double anchor, no edge effects, min. spacing ( $s = s_{min}$ ), (load values are valid for one anchor)

Anchor size			Non-cracked concrete						Cracked concrete					
			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
	<b>Tensile <math>N_{Rd}</math></b>													
	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	-	-
	<b>Shear <math>V_{Rd}</math>, without lever arm</b>													
	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	-	-



## HSA Stud anchor

	Anchor version	Benefits
	HSA Carbon steel with DIN 125 washe	<ul style="list-style-type: none"> <li>- small edge distance and spacing</li> <li>- three different embedment depth for each anchor size</li> <li>- approved for diamond drilled holes</li> <li>- simple and quick machine setting with torque bar for torque control</li> </ul>
	HSA-R Stainless steel A4 HSA-R2 Stainless steel A2 with DIN 125 washer	
	HSA-BW Carbon steel with DIN 9021 washer	



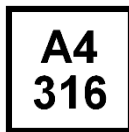
Concrete



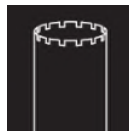
Small edge distance and spacing



Fire resistance



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 <sup>a)</sup>	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

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Steel failure
- Minimum base material thickness
- Non-cracked Concrete C 20/25,  $f_{ck,cube} = 25 \text{ N/mm}^2$

For details see Simplified design method



**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  $\gamma = 1,4$ . The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

## Materials

### Mechanical properties

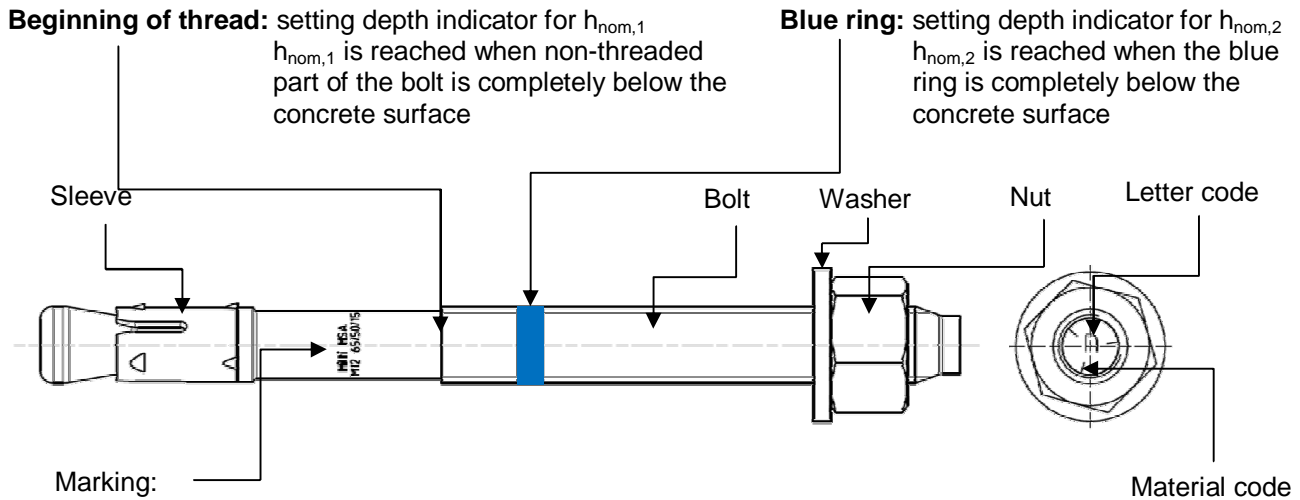
Anchor size			M6	M8	M10	M12	M16	M20
Nominal tensile strength $f_{uk,thread}$	HSA HSA-BW	[N/mm <sup>2</sup> ]	650	580	650	700	650	700
	HSA-R2 HSA-R	[N/mm <sup>2</sup> ]	650	560	650	580	600	625
Yield strength $f_{yk,thread}$	HSA HSA-BW	[N/mm <sup>2</sup> ]	520	464	520	560	520	560
	HSA-R2 HSA-R	[N/mm <sup>2</sup> ]	520	448	520	464	480	500
Stressed cross-section $A_{s,thread}$	HSA HSA-BW HSA-R2 HSA-R	[mm <sup>2</sup> ]	20,1	36,6	58,0	84,3	157,0	245,0
Moment of resistance W	HSA HSA-BW HSA-R2 HSA-R	[mm <sup>3</sup> ]	12,7	31,2	62,3	109,2	277,5	540,9
Char. bending resistance $M_{Rk,s}^0$	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
<b>HSA</b> <b>HSA-BW</b>  Carbon Steel	Bolt	Carbon-steel	Galvanized ( $\geq 5 \mu\text{m}$ )
	Sleeve	Carbon-steel	
	Washer	HSA :carbon steel, according Table 4 HSA-BW: carbon steel, according Table 4	
	Hexagon nut	Steel, strength class 8, EN 20898-2	
<b>HSA-R2</b>  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
<b>HSA-R</b>  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

## Anchor dimensions and coding

### Product marking and identification of anchor



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 \ $t_{fix}$	$t_{fix,1}/t_{fix,2}/t_{fix,3}$	$t_{fix,1}/t_{fix,2}/t_{fix,3}$	$t_{fix,1}/t_{fix,2}/t_{fix,3}$	$t_{fix,1}/t_{fix,2}/t_{fix,3}$	$t_{fix,1}/t_{fix,2}/t_{fix,3}$	$t_{fix,1}/t_{fix,2}/t_{fix,3}$
<b>z</b>	5/-/-	5/-/-	5/-/-	5/ -/-	5/-/-	5/-/-
<b>y</b>	10/-/-	10/-/-	10/-/-	10/-/-	10/-/-	<b>10/-/-</b>
<b>x</b>	15/5/-	15/5/-	15/5/-	15/-/-	15/-/-	15/-/-
<b>w</b>	<b>20/10/-</b>	<b>20/10/-</b>	<b>20/10/-</b>	<b>20/5/-</b>	<b>20/5/-</b>	20/-/-
<b>v</b>	25/15/-	25/15/-	25/15	25/10/-	25/10/-	25/-/-
<b>u</b>	30/20/-	30/20/-	30/20/-	30/15/-	30/15/-	30/5/-
<b>t</b>	35/25/5	<b>35/25/-</b>	<b>35/25/-</b>	<b>35/20/-</b>	35/20/-	35/10/-
<b>s</b>	<b>40/30/10</b>	40/30/-	40/30/-	40/25/-	<b>40/25/-</b>	40/15/-
<b>r</b>	45/35/15	45/35/5	45/35/5	45/30/-	45/30/-	45/20/5
<b>q</b>	50/40/20	50/40/10	<b>50/40/10</b>	50/35/-	50/35/-	50/25/10
<b>p</b>	<b>55/45/25</b>	<b>55/45/15</b>	55/45/15	55/40/5	55/40/-	<b>55/30/15</b>
<b>o</b>	60/50/30	60/50/20	60/50/20	60/45/10	60/45/5	60/35/20
<b>n</b>	65/55/35	65/55/25	65/55/25	<b>65/50/15</b>	65/50/10	65/40/25
<b>m</b>	70/60/40	70/60/30	<b>70/60/30</b>	70/55/20	70/55/15	70/45/30
<b>l</b>	75/65/45	75/65/35	75/65/35	75/60/25	75/60/20	75/50/35
<b>k</b>	80/70/50	<b>80/70/40</b>	80/70/40	80/65/30	80/65/25	80/55/40
<b>j</b>	85/75/55	85/75/45	85/75/45	85/70/35	<b>85/70/30</b>	85/60/45
<b>i</b>	90/80/60	90/80/50	<b>90/80/50</b>	90/75/40	90/75/35	90/65/50
<b>h</b>	95/85/65	95/85/55	95/85/55	<b>95/80/45</b>	95/80/40	95/70/55
<b>g</b>	100/90/70	100/90/60	100/90/60	100/85/50	100/85/45	100/75/60
<b>f</b>	105/95/75	105/95/65	<b>105/95/65</b>	105/90/55	105/90/50	105/80/65
<b>e</b>	110/100/80	110/100/70	110/100/70	110/95/60	110/95/55	110/85/70
<b>d</b>	115/105/85	115/105/75	115/105/75	115/100/65	115/100/60	115/90/75
<b>c</b>	120/110/90	120/110/80	120/110/80	<b>125/110/75</b>	120/105/65	120/95/80
<b>b</b>	125/115/95	125/115/85	125/115/85	135/120/85	125/110/70	125/100/85
<b>a</b>	130/120/100	130/120/90	130/120/90	<b>145/130/95</b>	<b>135/120/80</b>	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

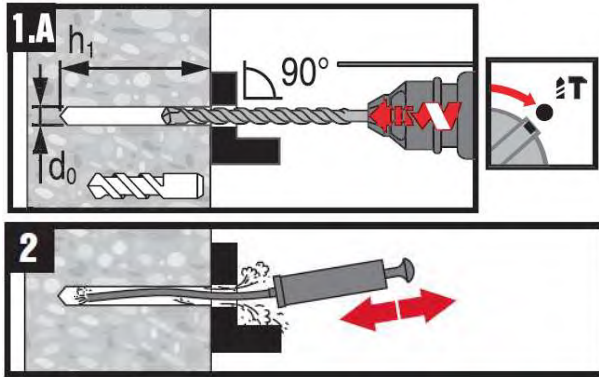
### Installation equipment

Anchor size	M6	M8	M10	M12	M16	M20
Rotary hammer	TE2 – TE16					TE40 – TE70
Other tools	hammer, torque wrench, blow out pump					

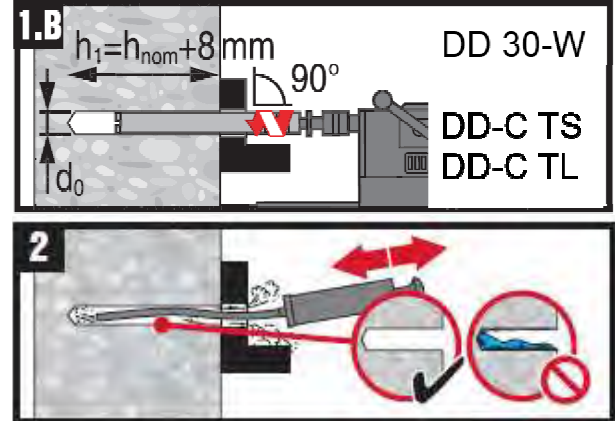
## Setting instruction

### Drill and clean borehole

Standard drilling method  
M6 – M20: Hammer drilling (HD)

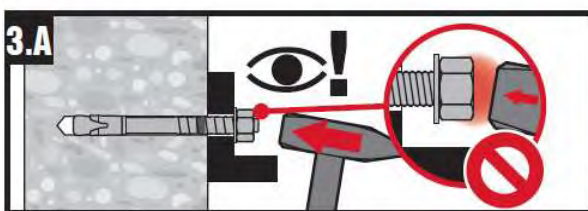


Alternative drilling method  
M12 – M20: Diamond drilling (DD)

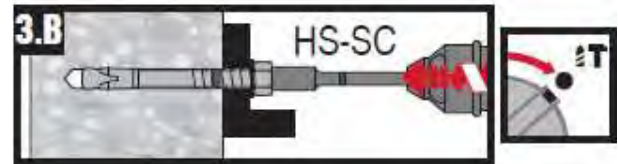


### Install anchor with hammer or machine setting tool

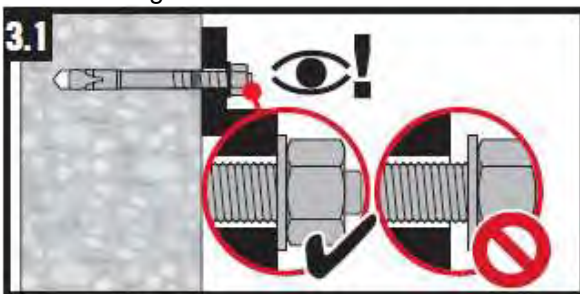
Standard setting method  
M6 – M20: Hammer setting



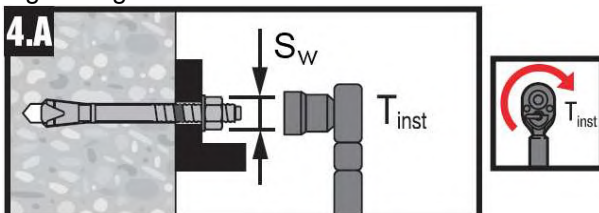
Alternative setting method  
M8 – M16: Machine setting



Check setting



Tightening the anchor



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

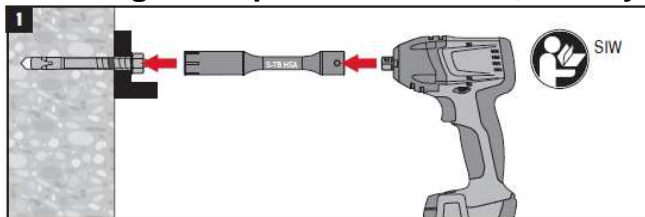
Type	HSA, HSA-BW, HSA-R2, HSA-R																	
Anchor Size	M6			M8			M10			M12			M16			M20		
Setting position	①	②	③	①	②	③	①	②	③	①	②	③	①	②	③	①	②	③
Nominal anchorage depth $h_{nom}$ [mm]	37	47	67	39	49	79	50	60	90	64	79	114	77	92	132	90	115	130
Standard installation torque $T_{inst}$ [Nm]	-			15			25			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	-			1			1			3			- <sup>1)</sup>			-		
	HSA, HSA-BW			HSA-R2, HSA-R														
Setting time $t_{set}$ [sec.]	-			-			-			4			-			-		

<sup>1)</sup> The impact screw driver operates with a fixed speed.

### Setting instruction for HSA, HSA-BW, HSA-R2 and HSA-R M8 – M16

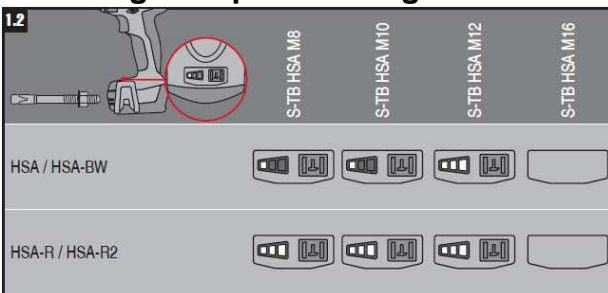
Tightening the anchor - alternatively with impact screw driver and special socket

#### Selecting the impact screw driver, battery and special socket



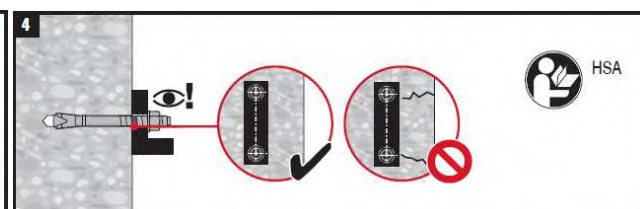
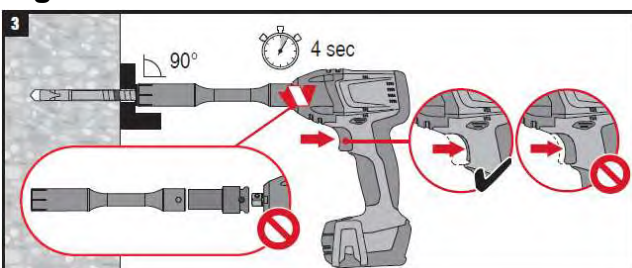
			S-TB HSA M8	S-TB HSA M10	S-TB HSA M12	S-TB HSA M16
SIW 14-A	14V	1.6Ah / 3.3Ah	✓	✓	✓	-
SIW 22-A	22V	1.6Ah / 2.6Ah / 3.3Ah	✓	✓	✓	-
SIW 22T-A	22V	2.6Ah / 3.3Ah	-	-	-	✓

#### Selecting the speed setting and state of charge of the battery



	$\leq 5^\circ$	$5^\circ \dots 10^\circ$	$\geq 10^\circ$
HSA / HSA-BW	-	-	-
HSA-R / HSA-R2	-	-	✓
HSA / HSA-BW	-	-	✓
HSA-R / HSA-R2	-	✓	✓

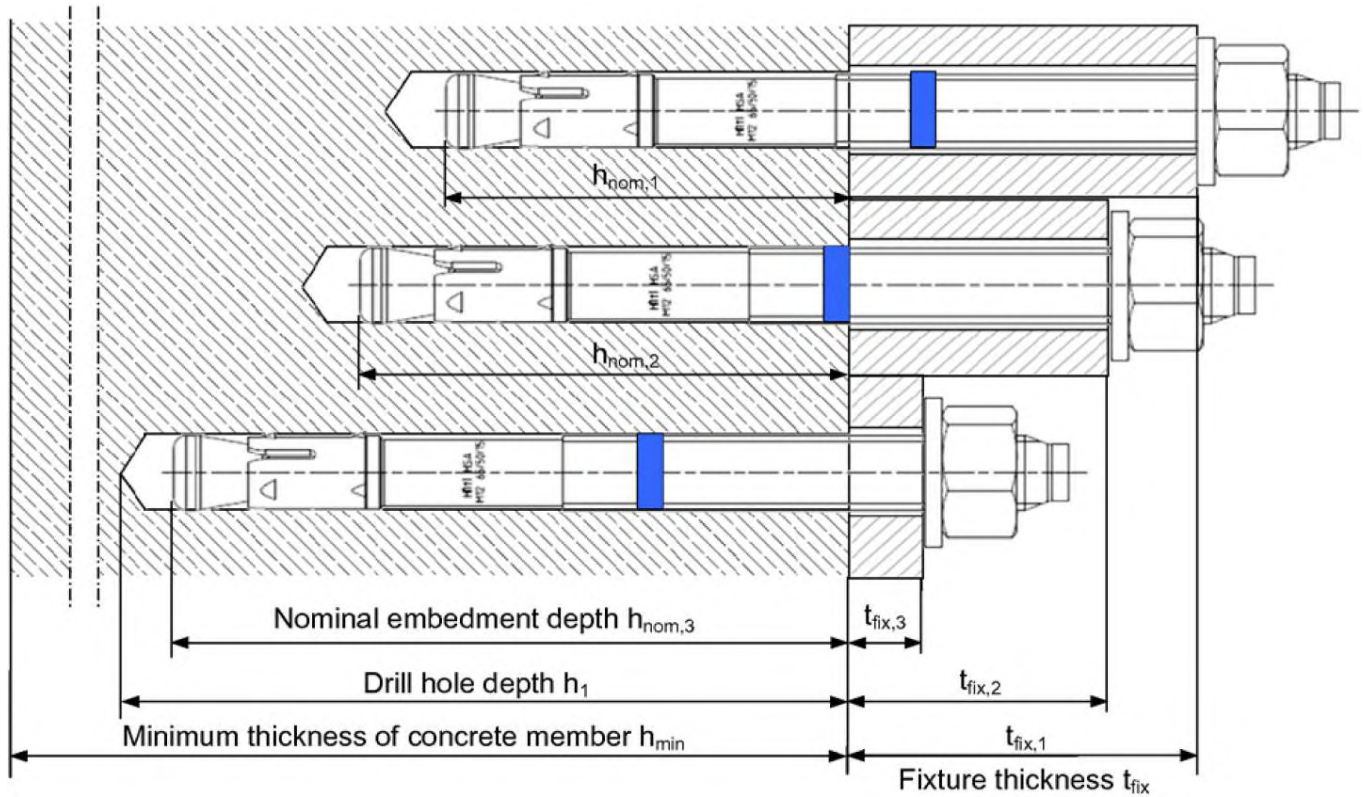
#### Tighten the anchor and check the installation



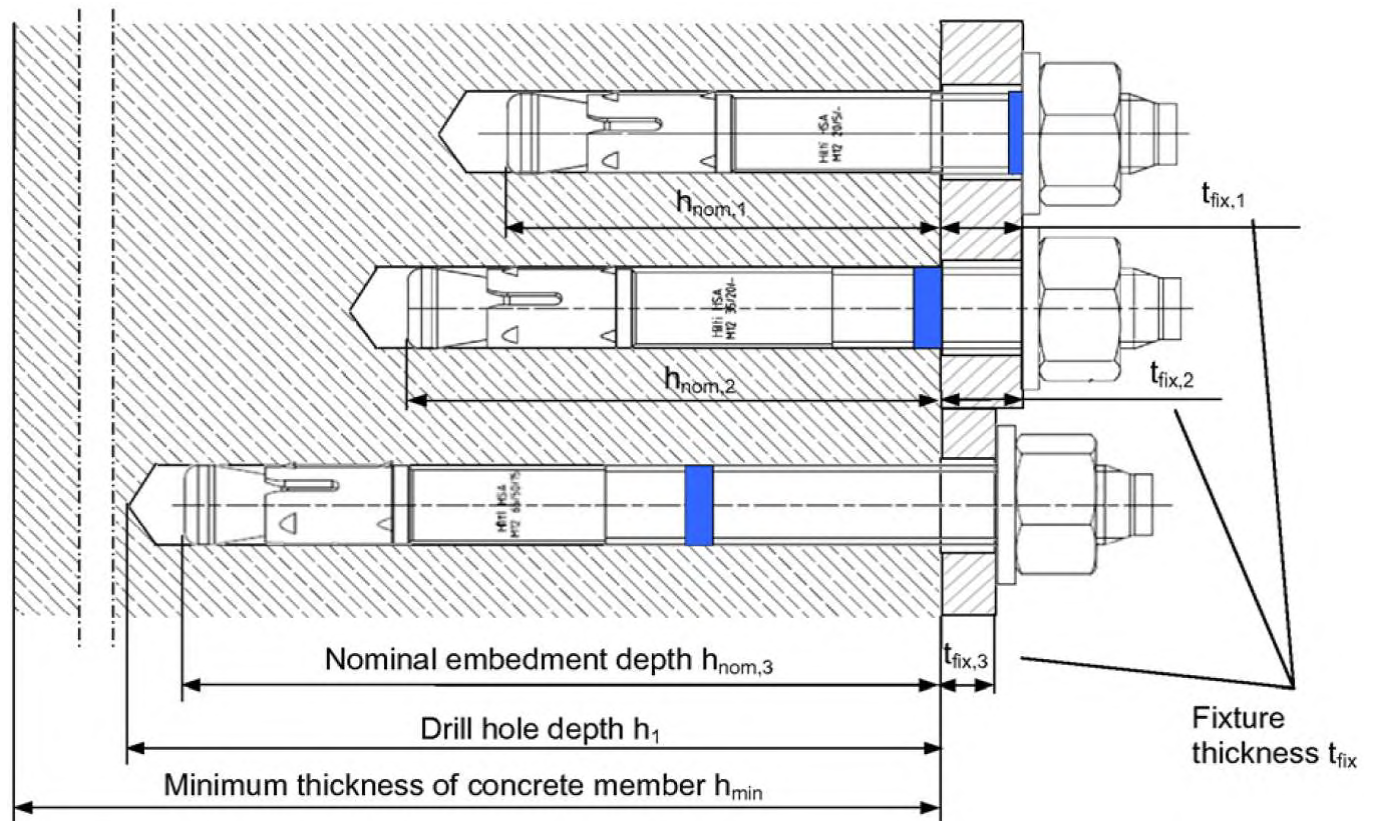
For detailed information on installation see instruction for use given with the package of the product.

### 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**

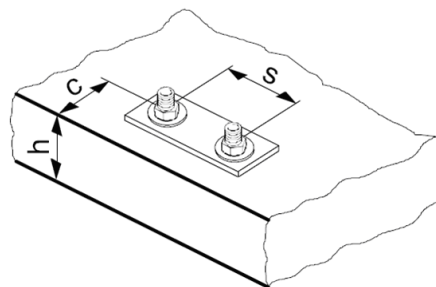
Anchor size		M6			M8			M10		
Nominal anchorage depth	$h_{nom}$ [mm]	37	47	67	39	49	79	50	60	90
Minimum base material thickness	$h_{min}$ [mm]	100	100	120	100	100	120	100	120	160
Minimum spacing	$s_{min}$ [mm]	35	35	35	35	35	35	50	50	50
Minimum edge distance	$c_{min}$ [mm]	35	35	35	40	35	35	50	40	40
Nominal 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)

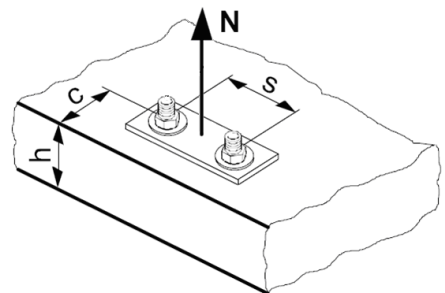
The values are valid for one anchor.

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



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

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)**

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

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 <sup>a)</sup>

$s/s_{cr,N}$	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
$f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp}) \leq 1$										

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	$\geq 1,84$
$f_{h,sp} = [h/(h_{min})]^{2/3}$	1	1,07	1,13	1,19	1,25	1,31	1,37	1,42	1,48	1,5

### Influence of reinforcement <sup>a)</sup>

Anchor size	M6			M8			M10		
Effective anchorage depth $h_{ef}$ [mm]	30	40	60	30	40	70	40	50	80
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,65	0,7	0,8	0,65	0,7	0,85	0,7	0,75	0,9

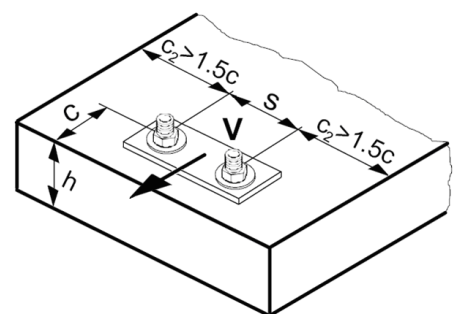
Anchor size	M12			M16			M20		
Effective anchorage depth $h_{ef}$ [mm]	50	65	100	65	80	120	75	100	115
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,75	0,83	1	0,83	0,9	1	0,88	1	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



## Basic design shear resistance

### Design steel resistance $V_{Rd,s}$

Anchor size		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  $V_{Rd,cp} = k \cdot N_{Rd,c}$ <sup>a)</sup>**

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  $V_{Rd,c}^0 = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$** 

Anchor size	M6			M8			M10		
Effective anchorage depth $h_{ef}$ [mm]	30	40	60	30	40	70	40	50	80
$V_{Rd,c}^0$ [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
$V_{Rd,c}^0$ [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 $\beta$	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 <sup>a)</sup> for concrete edge resistance: $f_4$

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sup>a)</sup>

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".

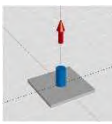
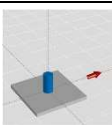
## Precalculated values

Design resistance calculated according ETAG 001, Annex C and Hilti technical data.  
All data applies to concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ .

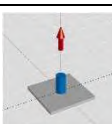
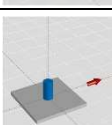
Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action  $\gamma = 1,4$ . The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

## Design resistance

### Single anchor, no edge effects


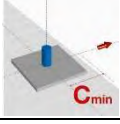
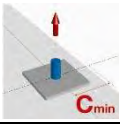
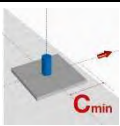
Anchor size		M6			M8			M10			
Effective anchorage depth	$h_{ef}$ [mm]	30	40	60	30	40	70	40	50	80	
Min. base material thickness $h_{min}$ [mm]		100	100	120	100	100	120	100	120	160	
	<b>Tensile <math>N_{Rd}</math></b>										
	HSA, HSA-BW	[kN]	4,0	5,0	6,0	5,5	8,5	10,7	8,5	11,9	16,7
	HSA-R2, HSA-R	[kN]	4,0	5,0	6,0	5,5	8,5	10,7	8,5	11,9	16,7
	<b>Shear <math>V_{Rd}</math>, without lever arm</b>										
	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

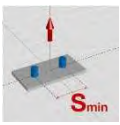
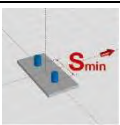
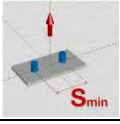
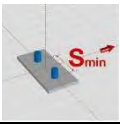
Anchor size		M12			M16			M20			
Effective anchorage depth	$h_{ef}$ [mm]	50	65	100	65	80	120	75	100	115	
Min. base material thickness $h_{min}$ [mm]		100	140	180	140	160	180	160	220	220	
	<b>Tensile <math>N_{Rd}</math></b>										
	HSA, HSA-BW	[kN]	11,9	17,6	23,3	17,6	24,1	33,3	21,9	33,7	41,5
	HSA-R2, HSA-R	[kN]	11,9	17,6	23,3	17,6	24,1	33,3	21,9	33,7	41,5
	<b>Shear <math>V_{Rd}</math>, without lever arm</b>										
	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	
	<b>Tensile <math>N_{Rd}</math></b>										
	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
	<b>Shear <math>V_{Rd}</math>, without lever arm</b>										
	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	
	<b>Tensile <math>N_{Rd}</math></b>										
	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
	<b>Shear <math>V_{Rd}</math>, without lever arm</b>										
	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

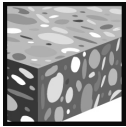
Double anchor, no edge effects, min. spacing ( $s = s_{min}$ ),  
(load values are valid for one anchor)

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	
	<b>Tensile <math>N_{Rd}</math></b>										
	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
	<b>Shear <math>V_{Rd}</math>, without lever arm</b>										
	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	
	<b>Tensile <math>N_{Rd}</math></b>										
	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
	<b>Shear <math>V_{Rd}</math>, without lever arm</b>										
	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



## HSV Stud anchor

	Anchor versions	Benefits
	<b>HSV</b> Carbon steel with DIN 125 washer	- torque-controlled mechanical expansion allows immediate load application - setting mark
	<b>HSV-BW</b> Carbon steel with DIN 9021 washer and DIN 127b spring washer	- 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.



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,  $f_{ck,cube} = 25 \text{ N/mm}^2$

### 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  $\gamma = 1,4$ . The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

## Materials

### Mechanical properties of HSV

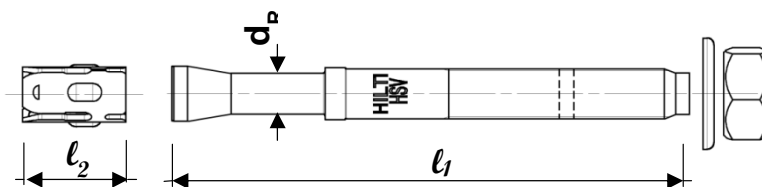
Anchor size		M8	M10	M12	M16
Nominal tensile strength $f_{uk}$ [N/mm <sup>2</sup> ]		580	660	660	660
Yield strength $f_{yk}$ [N/mm <sup>2</sup> ]		464	528	528	528
Stressed cross-section, thread $A_s$ [mm <sup>2</sup> ]		36,6	58,0	84,3	157
Stressed cross-section, neck $A_{s,neck}$ [mm <sup>2</sup> ]		26,9	39,6	63,6	105,7
Moment of resistance $W$ [mm <sup>3</sup> ]		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 $\mu$ m

### 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

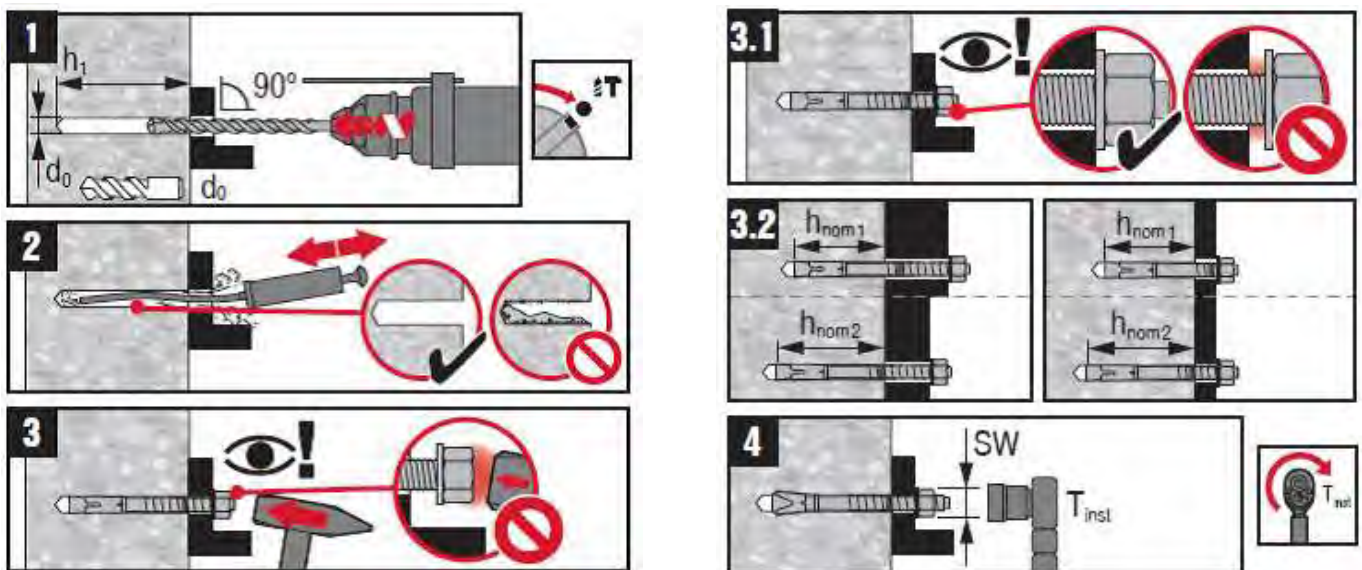


### Setting

#### Installation equipment

Anchor size	M8	M10	M12	M16
Rotary hammer	TE1 – TE30			
Other tools	blow out pump, hammer, torque wrench			

#### Setting instruction

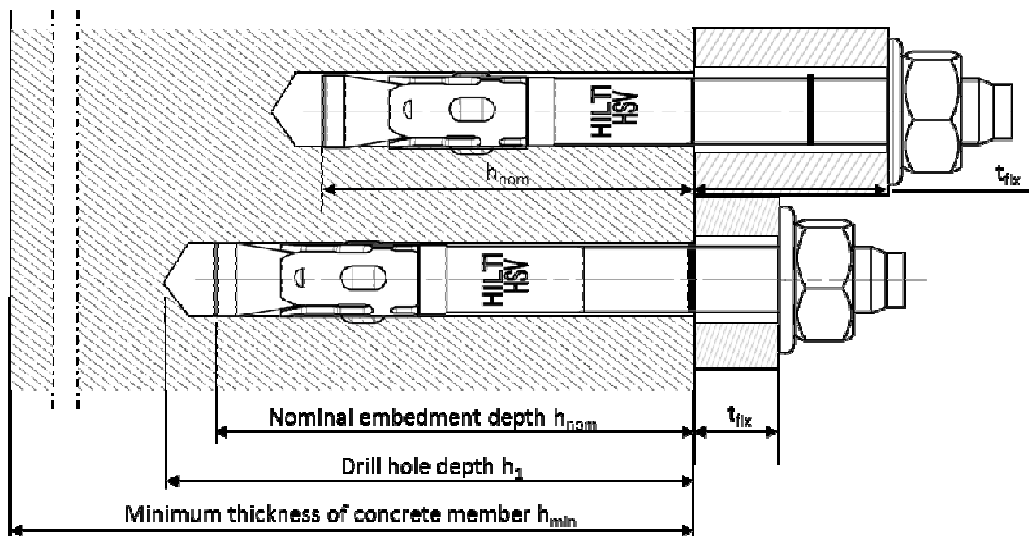


For detailed information on installation see instruction for use given with the package of the product.

### Setting details

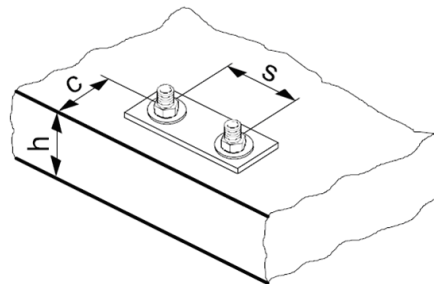
Anchor size		M8		M10		M12		M16	
Effective anchorage depth	$h_{ef}$ [mm]	30	40	40	50	50	65	65	80
Nominal embedment depth	$h_{nom}$ [mm]	39	49	51	61	62	77	81	96
Nominal Diameter of drill bit	$d_0$ [mm]	8		10		12		16	
Cutting diameter of drill bit	$d_{cut} \leq$ [mm]	8,45		10,45		12,5		16,5	
Depth of drill 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 <sup>a)</sup>	$t_{fix,min}$ [mm]	5	0	5	0	5	0	5	0
Maximum thickness of fixture <sup>a)</sup>	$t_{fix,max}$ [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** <sup>a)</sup>

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



a) 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 same 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)

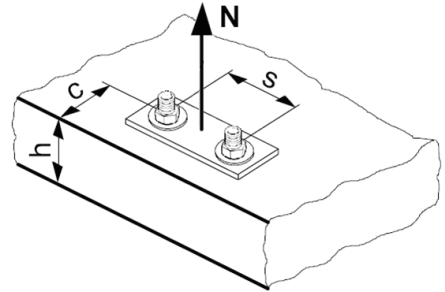
The values are valid for one anchor.



### Tension loading

The design tensile resistance is the lower value of

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



### 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  $N_{Rd,p} = N_{Rd,p}^0 \cdot f_B$

Anchor size	M8		M10		M12		M16	
Effective anchorage depth $h_{ef}$ [mm]	30	40	40	50	50	65	65	80
$N_{Rd,p}^0$ [kN]	6,7	6,7	8,0	9,3	9,7	13,3	16,6	20,8

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

Design splitting resistance <sup>a)</sup>  $N_{Rd,sp} = N_{Rd,c}^0 \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$

Anchor size	M8		M10		M12		M16	
Effective anchorage depth $h_{ef}$ [mm]	30	40	40	50	50	65	65	80
$N_{Rd,c}^0$ [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							
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ <sup>a)</sup>	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 <sup>a)</sup>**

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

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 <sup>a)</sup>**

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

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

**Influence of reinforcement**

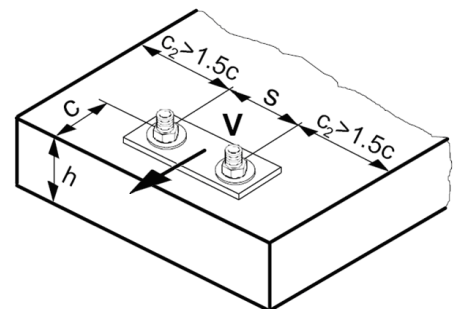
Anchor size	M8		M10		M12		M16	
Effective anchorage depth $h_{ef}$ [mm]	30	40	40	50	50	65	65	80
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,65 <sup>a)</sup>	0,7 <sup>a)</sup>	0,7 <sup>a)</sup>	0,75 <sup>a)</sup>	0,75 <sup>a)</sup>	0,825 <sup>a)</sup>	0,825 <sup>a)</sup>	0,9 <sup>a)</sup>

b) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



### 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 $V_{Rd,c}^a = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size	M8		M10		M12		M16	
Effective anchorage depth $h_{ef}$ [mm]	30	40	40	50	50	65	65	80
$V_{Rd,c}^0$ [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.

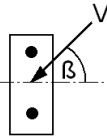
### Influencing factors

#### 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 $\beta$	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 <sup>a)</sup> for concrete edge resistance:  $f_4$**

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sup>a)</sup>**

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




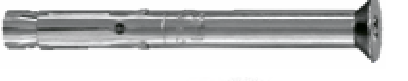



a) The edge distance shall not be smaller than the minimum edge distance  $c_{min}$ .

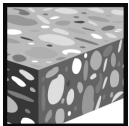
**Combined tension and shear loading**

For combined tension and shear loading see section "Anchor Design".

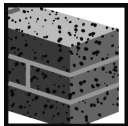


## HLC Sleeve anchor

	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, eyebolt closed	
	HLC-EO	Loop-hanger head, eyebolt 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 166402 / 2007-10-26 & suppl. WF 172920 for HLC-EC

### 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$

**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  $\gamma = 1,4$ . The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

**Materials**
**Material quality**

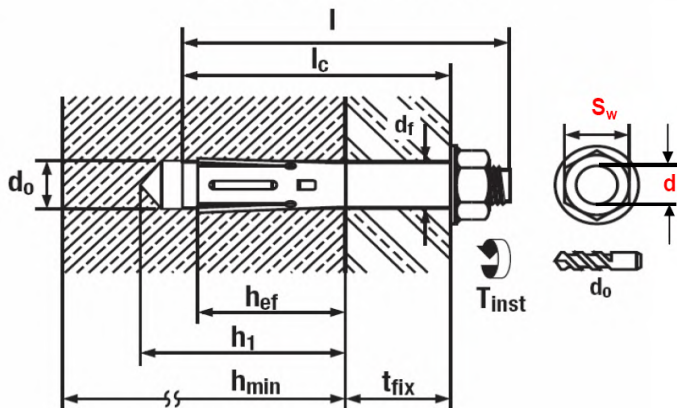
Part	Material	
Anchor	HLC HLC-EC HLC-EO	Carbon steel minimum tensile strength 500 MPa galvanised to min. 5 $\mu$ m
	HLC-H HLC-L HLC-SK HLC-T	Steel Bolt Strength 8.8, galvanised to min. 5 $\mu$ m

## Anchor dimensions

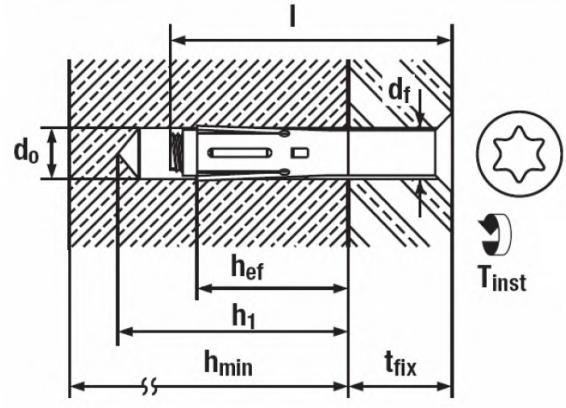
Anchor version	Thread size	$h_{ef}$ [mm]	d [mm]	l [mm]	$l_c$ [mm]	$t_{fix}$ [mm]
HLC, HLC-H, HLC- EC/EO carbon steel anchors	6,5 x 25/5	16	M5	30	25	5
	6,5 x 40/20			45	40	20
	6,5 x 60/40			65	60	40
	8 x 40/10	26	M6	46	40	10
	8 x 55/25			61	55	25
	8 x 70/40			76	70	40
	8 x 85/55			91	85	55
	10 x 40/5	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

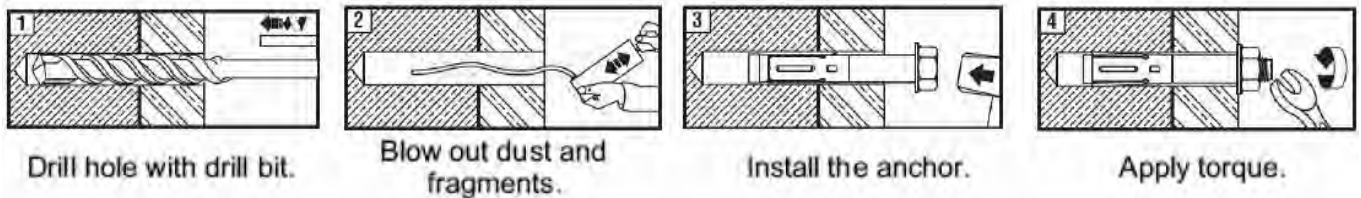


### Setting

#### 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



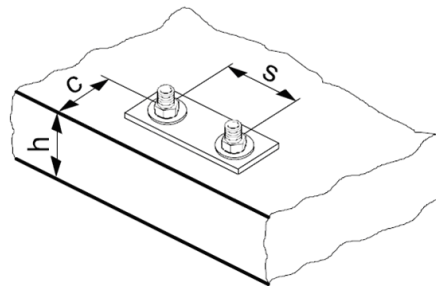
For detailed information on installation see instruction for use given with the package of the product.

#### Setting details HLC

Thread size	d	[mm]	M5	M6	M8	M10	M12	M16
			6,5	8	10	12	16	20
Nominal diameter of drill bit	$d_o$	[mm]	6,5 (1/4")	8	10	12	16	20
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	6,4	8,45	10,45	12,5	16,5	20,55
Depth of drill hole	$h_1 \geq$	[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	$d_f \leq$	[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 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<sup>a)</sup>**

Base material			Anchor size		Hilti				
					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 $f_b^{b)} \geq 12 \text{ N/mm}^2$	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 $f_b^{b)} \geq 12 \text{ N/mm}^2$	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	

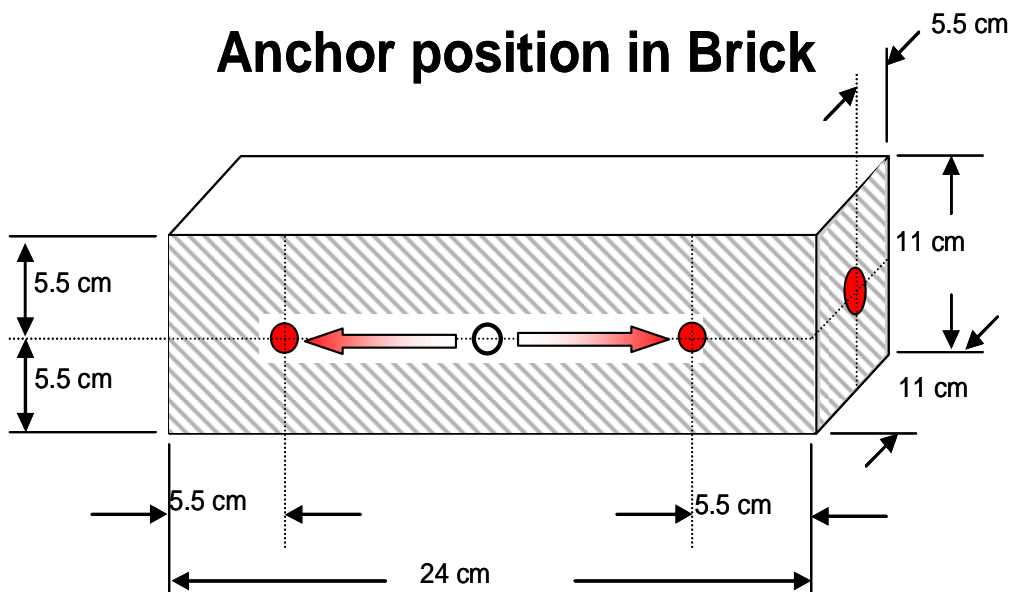
a) Recommended load values for German base materials are based on national regulations.

b)  $f_b$  = brick strength

c) Values only valid for Mz (DIN 105) with brick strength  $\geq 19 \text{ N/mm}^2$ , density  $2,0 \text{ kg/dm}^3$ , minimum brick size NF (24,0cm x 11,5cm x 11,5cm)

d) Values only valid for KS (DIN 106) with brick strength  $\geq 29 \text{ N/mm}^2$ , density  $2,0 \text{ kg/dm}^3$ , 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

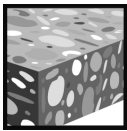
- The technical data for the HLC sleeve anchors are reference loads for MZ 12 and KS 12. Due to the large variation of natural stone solid bricks, on site anchor testing is recommended to validate technical data.
- The HLC anchor was installed and tested in center of solid bricks as shown. The HLC anchor 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  $\geq 300$  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  $\geq 2 \cdot c_{min}$

#### Limits

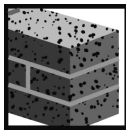
- Applied load to individual bricks may not exceed 1,0 kN without compression or 1,4 kN with compression
- All data is for multiple use for non structural applications
- Plaster, graveling, lining or levelling courses are regarded as non-bearing and may not be taken into account for the calculation of embedment depth.

## HAM Hard sleeve anchor

Anchor version	Benefits
 <p>HAM with steel strength 8.8 screw</p>	<ul style="list-style-type: none"> <li>- secure fastenings in various base materials</li> <li>- cone attached to sleeve to ensure pre-setting</li> <li>- wings to prevent spinning in the borehole</li> <li>- plastic cap in cone to prevent dust entrance</li> <li>- blue-chromate zinc coating</li> <li>- 8.8 steel strength of screw</li> </ul>
 <p>HAM</p>	



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,  $f_{ck,cube} = 25 \text{ N/mm}^2$

### Recommended Loads in uncracked concrete C20/25

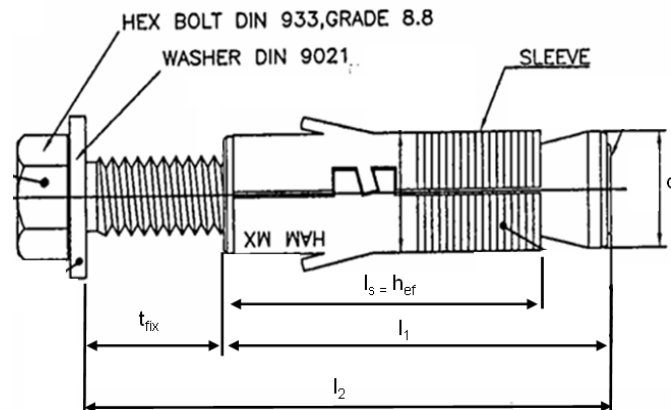
Thread Diameter	d	[mm]	M6x50	M8x60	M10x80	M12x90
Tension	$N_{rec}$	[kN]	4,0	4,8	5,8	8,7
Shear	$V_{rec}$	[kN]	4,6	8,4	13,3	19,3

### 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			

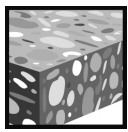
For detailed information on installation see instruction for use given with the package of the product.

#### 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

## HUS-HR Screw anchor, stainless steel

	Anchor version	Benefits
	HUS-HR Stainless steel Concrete Screw	<ul style="list-style-type: none"> <li>- Quick and easy setting</li> <li>- Low expansion forces in base materials</li> <li>- Through fastening</li> <li>- Removable</li> <li>- Forged-on washer and hexagon head with no protruding thread</li> </ul>



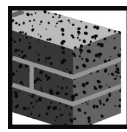
Concrete



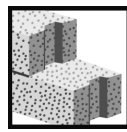
Tensile zone



Small edge distance and spacing



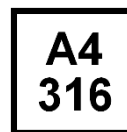
Solid brick



Autoclaved aerated concrete



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 <sup>a)</sup>	DIBt, Berlin	ETA-08/0307 / 2011-01-21
Fire test report	DIBt, Berlin	ETA-08/0307 / 2011-01-21
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 2011-01-21.

### 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$

For details see Simplified design method

**Mean ultimate resistance**

		Non-cracked concrete				Cracked concrete			
Anchor size	HUS-HR	6	8	10	14	6	8	10	14
Extra reduced embedment (Hilti Tech Data)									
$h_{nom}$	[mm]	30	50	60	-	30	50	60	-
Tensile $N_{Ru,m}$	[kN]	- <sup>a)</sup>	12,0	16,0	-	- <sup>a)</sup>	6,7	10,0	-
Shear $V_{Ru,m}$	[kN]	- <sup>a)</sup>	31,5	41,9	-	- <sup>a)</sup>	22,5	30,0	-
Reduced embedment									
$h_{nom}$	[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									
$h_{nom}$	[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	HUS-HR	6	8	10	14	6	8	10	14
Extra reduced embedment (Hilti Tech Data)									
$h_{nom}$	[mm]	30	50	60	-	30	50	60	-
Tensile $N_{Rk}$	[kN]	- <sup>a)</sup>	9,0	12,0	-	- <sup>a)</sup>	5,0	7,5	-
Shear $V_{Rk}$	[kN]	- <sup>a)</sup>	23,6	31,4	-	- <sup>a)</sup>	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	HUS-HR	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]	- <sup>a)</sup>	5,0	6,7	-	- <sup>a)</sup>	2,8	4,2	-
Shear $V_{Rd}$	[kN]	- <sup>a)</sup>	15,7	21,0	-	- <sup>a)</sup>	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	HUS-HR	6	8	10	14	6	8	10	14
Extra reduced embedment (Hilti Tech Data)									
$h_{nom}$	[mm]	30	50	60	-	30	50	60	-
Tensile $N_{rec}$ <sup>a)</sup>	[kN]	- <sup>b)</sup>	3,6	4,8	-	- <sup>b)</sup>	2,0	3,0	-
Shear $V_{rec}$ <sup>a)</sup>	[kN]	- <sup>b)</sup>	11,2	15,0	-	- <sup>b)</sup>	8,0	10,7	-
Reduced embedment (ETA-08/0307)									
$h_{nom}$	[mm]	-	60	70	70	-	60	70	70
Tensile $N_{rec}$ <sup>a)</sup>	[kN]	-	4,8	6,3	7,5	-	2,4	3,6	4,8
Shear $V_{rec}$ <sup>a)</sup>	[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 $N_{rec}$ <sup>a)</sup>	[kN]	3,1	6,3	9,9	16,0	1,7	4,8	6,3	9,9
Shear $V_{rec}$ <sup>a)</sup>	[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  $\gamma = 1,4$ . 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.






### Basic loading data for single anchor in solid masonry units

**All data in this section applies to**

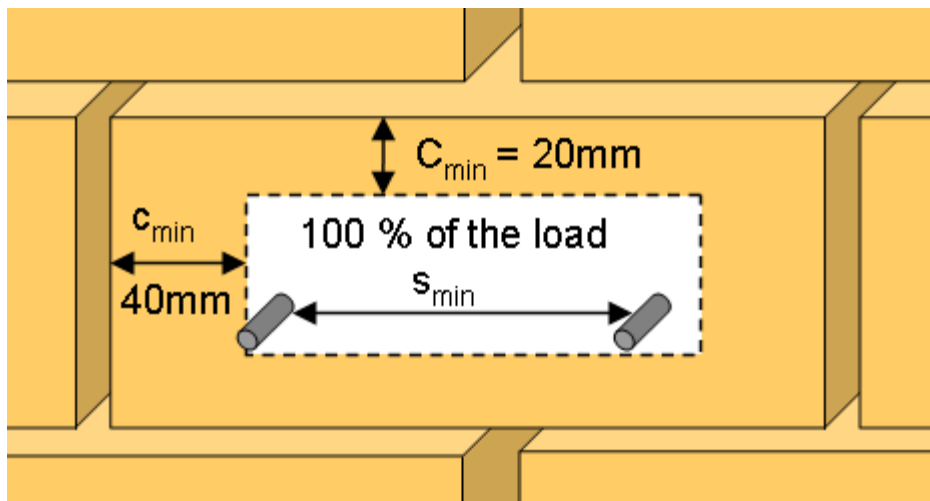
- Load values valid for holes drilled with TE rotary hammers in hammering mod
- Correct anchor setting (see instruction for use, setting details)
- The core / material ratio may not exceed 15% of a bed joint area.
- The brim area around holes must be at least 70mm
- Edge distances, spacing and other influences, see below

### Recommended loads

Base material		Anchor size		Hilti		
				HUS-HR 6	HUS-HR 8	HUS-HR 10
Germany, Austria, Switzerland		$h_{nom}$	[mm]	<b>55</b>	<b>60</b>	<b>70</b>
Solid clay brick Mz12/2,0 	DIN 105/ EN 771-1 $f_b^{a)} \geq 12 \text{ N/mm}^2$	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 $f_b^{a)} \geq 12 \text{ N/mm}^2$	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 $f_b^{a)} \geq 6 \text{ N/mm}^2$	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  $\geq 200$  mm
- Distance to free edge free edge to solid masonry (autoclaved aerated gas concrete) units  $\geq 170$  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  $\geq 2 \cdot c_{min}$

#### 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.

## Materials

### Mechanical properties

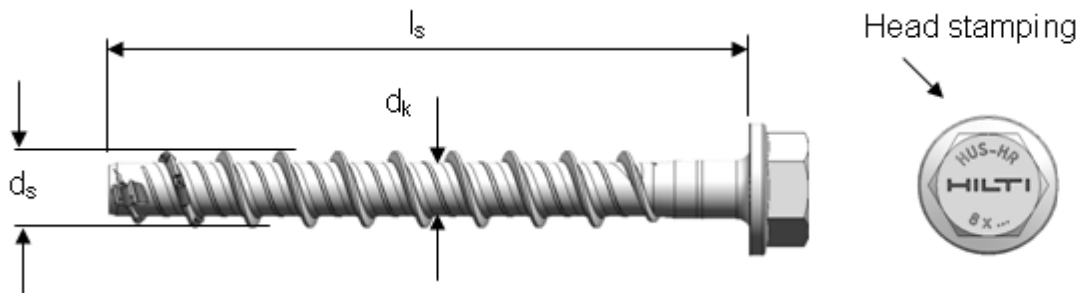
Anchor size	HUS-HR 6	HUS-HR 8	HUS-HR 10	HUS-HR 14
Nominal tensile strength $f_{uk}$ [N/mm <sup>2</sup> ]	1040	870	950	820
Stressed cross-section $A_s$ [mm <sup>2</sup> ]	23	39	55	125
Moment of resistance $W$ [mm <sup>3</sup> ]	15,5	34,4	58,2	196,4
Design bending resistance $M_{Rd,s}$ [Nm]	12,9	23,9	44,2	128,8

Part	Material
Stainless steel hexagonal head concrete screw	Stainless steel (grade A4)

### Anchor dimensions

#### Dimensions

Anchor version	$l_s$ [mm]	$d_s$ [mm]	$d_k$ [mm]
HUS-HR 6	35 ... 70	7,5	5,4
HUS-HR 8	55 ... 105	10,1	7,1
HUS-HR 10	65 ... 130	12,3	8,4
HUS-HR 14	80 ... 135	16,5	12,6

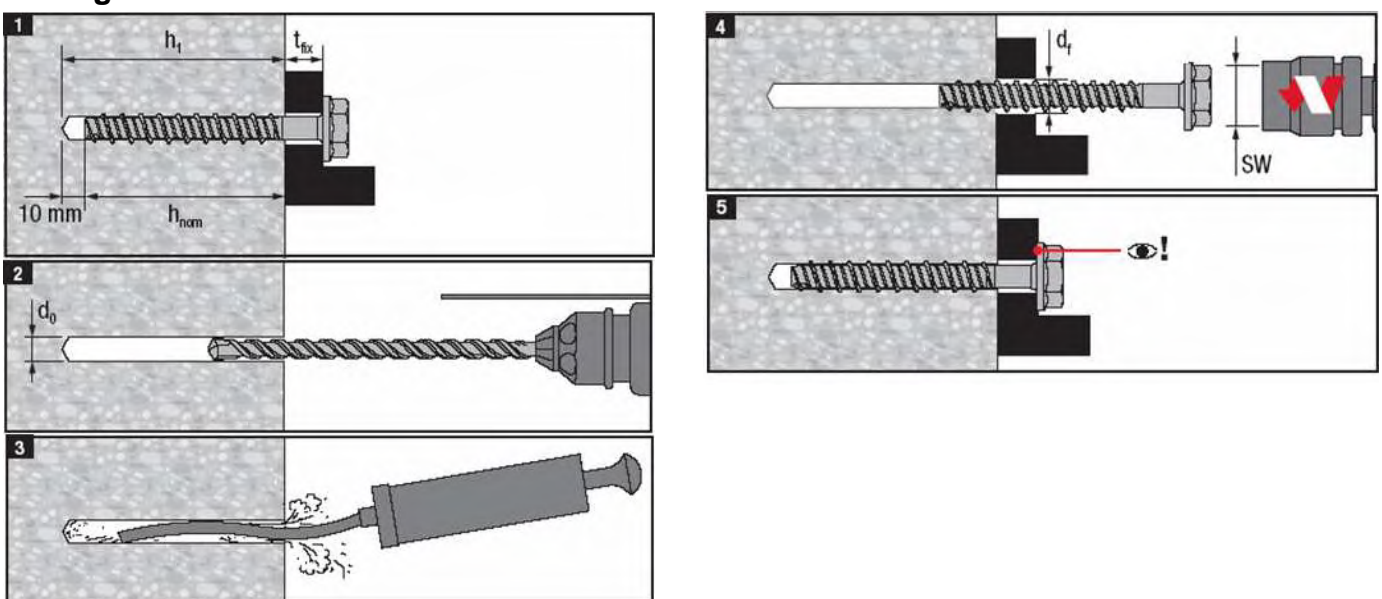


### Setting

#### Recommended installation equipment

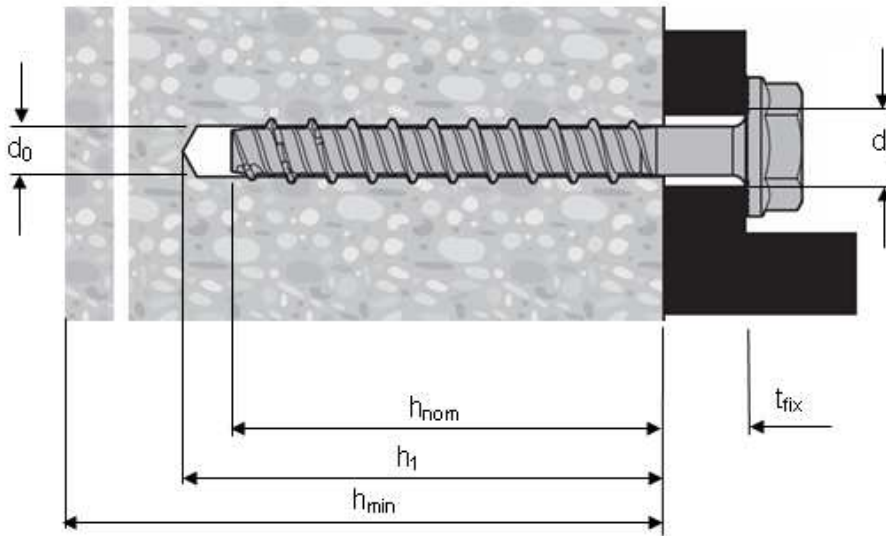
Anchor size	HUS-HR 6	HUS-HR 8	HUS-HR 10	HUS-HR 14
Rotary hammer	Hilti TE 6	Hilti TE 6	Hilti TE 16	Hilti -TE 16
drill bit	TE-C3X 6/17	TE-C3X 8/17	TE-C3X 10/22	TE-C3X 14/22
Socket wrench insert	S-NSD 13 ½ (L)	S-NSD 13 ½ (L)	S-NSD 15 ½ (L)	S-NSD 21 ½
Impact screw driver	Hilti SIW 144 or 121 Hilti TKI 2500	Hilti SI 100		

### 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  $h_{ef}$



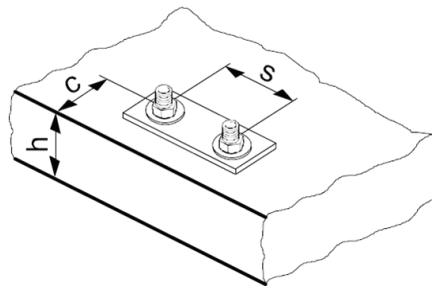
Setting details

Anchor version	HUS-HR	6		8			10			14		
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 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. fastening thickness	$t_{fix}$ [mm]	$l_s - h_{nom}$										
Max. installation torque	Concrete	$T_{inst}$ [Nm]	20	- a)	35	- a)	- a)	45	45	45	65	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.

### Base material thickness, anchor spacing and edge distance

Anchor size			HUS-HR 6		HUS-HR 8			HUS-HR 10			HUS-HR 14	
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]	40	40	45	45	50	50	50	50	50	60
Minimum edge distance	$c_{min}$	[mm]	40	40	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 safe 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)

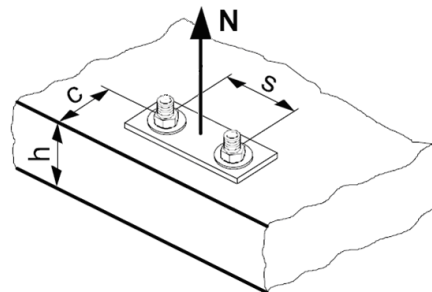
The values are valid for one anchor (single point fastening), multiple use applications are not part of this design method.

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



## Basic design tensile resistance

### Design steel resistance $N_{Rd,s}$

Anchor size		HUS-HR 6	HUS-HR 8	HUS-HR 10	HUS-HR 14
$N_{Rd,s}$	[kN]	17,0	24,3	37,6	73,0

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

Anchor size	Non-cracked concrete				Cracked concrete				
	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  $N_{Rd,c} = N_{Rd,c}^0 \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$

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

Anchor size	Non-cracked concrete				Cracked concrete			
	6	8	10	14	6	8	10	14
Extra reduced embedment (Hilti Tech Data)								
$h_{nom}$ [mm]	30	50	60	-	30	50	60	-
$N_{Rd,c}^0$ [kN]	-	6,6	8,7	-	-	4,7	6,2	-
Reduced embedment								
$h_{nom}$ [mm]	-	60	70	70	-	60	70	70
$N_{Rd,c}^0$ [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
$N_{Rd,c}^0$ [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)

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

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

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

### Influence of reinforcement

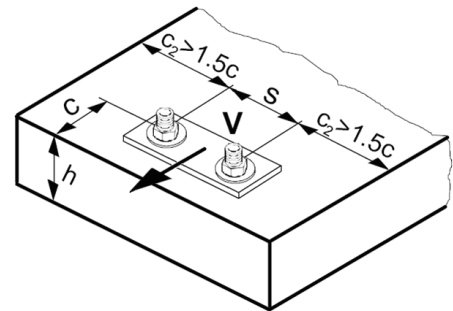
Anchor size	HUS-HR 6			HUS-HR 8			HUS-HR 10			HUS-HR 14	
$h_{nom}$ [mm]	30	55	50	60	80	60	70	90	70	110	
$h_{ef}$ [mm]	23	45	38	47	64	46	54	71	52	86	
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,62	0,73	0,69	0,74	0,82	0,73	0,77	0,86	0,76	0,93	

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



### Basic design shear resistance

#### Design steel resistance $V_{Rd,s}$

Anchor size			HUS-HR 6		HUS-HR 8		HUS-HR 10		HUS-HR 14	
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 $V_{Rd,cp} = k \cdot N_{Rd,c}$ <sup>a)</sup>

Anchor size			HUS-HR 6		HUS-HR 8		HUS-HR 10		HUS-HR 14	
$h_{nom}$ [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  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_\beta \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

		Non-cracked concrete				Cracked concrete			
Anchor size	HUS-HR	6	8	10	14	6	8	10	14
Extra reduced embedment (Hilti Tech Data)									
$h_{nom}$	[mm]	30	50	60	-	30	50	60	-
$V_{Rd,c}^0$	[kN]	-	5,9	8,6	-	-	4,2	6,1	-
Reduced embedment									
$h_{nom}$	[mm]	-	60	70	70	-	60	70	70
$V_{Rd,c}^0$	[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
$V_{Rd,c}^0$	[kN]	3,6	5,9	8,6	15,1	2,6	4,2	6,1	10,7

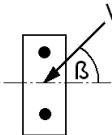
### Influencing factors

#### 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 $\beta$	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 <sup>a)</sup> for concrete edge resistance:  $f_4$

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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-HR 6		HUS-HR 8			HUS-HR 10			HUS-HR 14	
$h_{nom}$ [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 <sup>a)</sup>

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".


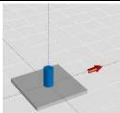

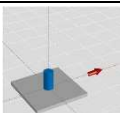

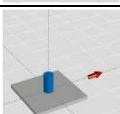
**Precalculated values**

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/mm<sup>2</sup>. Hilti technical data for the extra reduced embedment depth is not part of the approval.

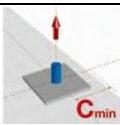
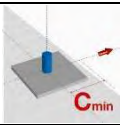
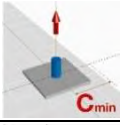
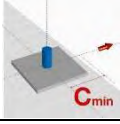
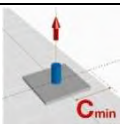
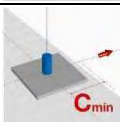
Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action  $\gamma = 1,4$ . The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

### Design resistance

Single anchor, no edge effects ( $c \geq c_{cr}$ ), shear without lever arm

Anchor size HUS-HR			Non-cracked concrete				Cracked concrete			
			6	8	10	14	6	8	10	14
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


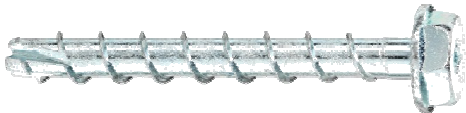



Single anchor, min. edge distance ( $c = c_{min}$ ), shear without lever arm

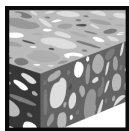
		Non-cracked concrete				Cracked concrete				
Anchor size	HUS-HR	6	8	10	14	6	8	10	14	
Extra reduced embedment (Hilti Tech Data)										
$h_{nom}$	[mm]	30	50	60	-	30	50	60	-	
Min. base material thickness $h_{min}$ [mm]		80	100	120	-	80	100	120	-	
Min. edge distance $c_{min}$ [mm]		40	45	50	-	40	45	50	-	
	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)

Anchor size HUS-HR		Non-cracked concrete				Cracked concrete				
		6	8	10	14	6	8	10	14	
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

## HUS Screw anchor, carbon steel

	Anchor version	Benefits
	HUS-A 6 Carbon steel Concrete Screw with hex head	<ul style="list-style-type: none"> <li>- Quick and easy setting</li> <li>- Low expansion forces in base materials</li> <li>- Through fastening</li> <li>- Removable</li> <li>- Forged-on washer and hexagon head with no protruding thread</li> </ul>
	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	



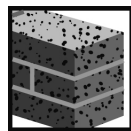
Concrete



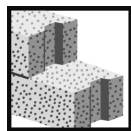
Tensile zone



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 <sup>a)</sup> with fire assessment according TR020	DIBt, Berlin	ETA-08/0307/ 2011-01-21
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

- Correct setting (see setting instruction)
- No edge distance and spacing influence
- Steel failure
- Minimum base material thickness
- Concrete C 20/25,  $f_{ck,cube} = 25 \text{ N/mm}^2$

The following technical data are based on:

ETA: Data according ETA-08/0307 issue 2011-01-21

Hilti: Additional Hilti technical data

For details see simplified design method

**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  $\gamma = 1,4$ . 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 $f_{ck,cube} \geq 15 \text{ N/mm}^2$ :

All data in this section applies to the following conditions:

### Concrete:

- Strength class C 20/25,  $f_{ck,cube} \geq 15 \text{ N/mm}^2$

### Installation:

- For hand installation  $T_{inst,rec} = 40 \text{ Nm}$

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:

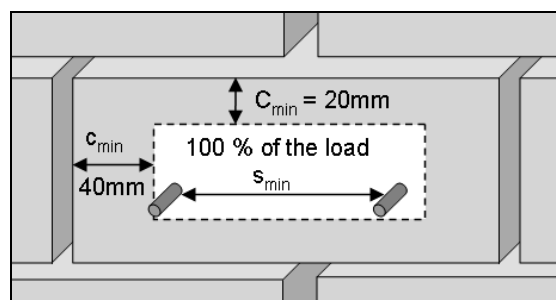
- Holes in Mz and KS drilled with TE rotary hammers drilled with hammering mode
- Holes in PPW drilled with TE rotary hammers drilled without hammering mode

### 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  $c_{min,free} \geq 200 \text{ mm}$
- Distance to free edge free edge to solid masonry (autoclaved aerated gas concrete) units  $c_{min,free} \geq 170 \text{ mm}$
- 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  $s_{min} = 80 \text{ mm}$





### Recommended loads

		Hilti		
		6	8	10
Base material	Anchor size			
	Type HUS-	A, H, I, P	H	H
	$h_{nom}$ [mm]	55	60	70
	Compressive strength class [N/mm <sup>2</sup> ]	$F_{rec}^{a)}$ [kN] Tensile and Shear		
 <p><b>Solid clay brick</b> <b>Mz 2,0-2DF</b> DIN V 105-100 / EN 771-1 LxWxH [mm]: 240x115x113 <math>h_{min}</math> [mm]: 115</p>	$\geq 8$	0,6	0,8	1,0
	$\geq 10$	0,7	0,9	1,2
	$\geq 12$	0,8	1,0	1,3
	$\geq 16$	0,9	1,2	1,5
	$\geq 20$	0,9	1,3	1,7
 <p><b>Solid sand-lime brick</b> <b>KS 2,0-2DF</b> DIN V 106-100 / EN 771-2 LxWxH [mm]: 240x115x113 <math>h_{min}</math> [mm]: 115</p>	$\geq 8$	0,8	1,0	1,1
	$\geq 10$	0,9	1,1	1,2
	$\geq 12$	1,0	1,2	1,3
	$\geq 16$	1,1	1,3	1,5
	$\geq 20$	1,2	1,5	1,7
 <p><b>Aerated concrete</b> <b>PPW -0,65</b> DIN 4165/ EN 771-4 LxWxH [mm]: 499x240x249 <math>h_{min}</math> [mm]: 240</p>	$\geq 6$	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:

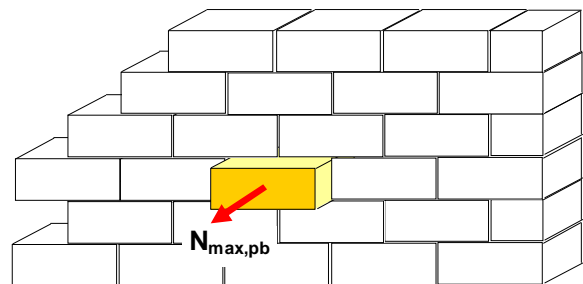
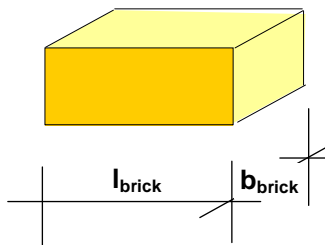
**Clay bricks:**

$N_{max,pb}$ [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**

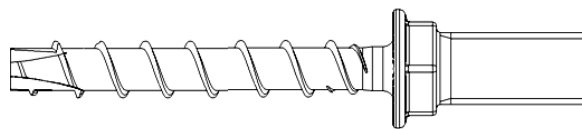
Anchor size		6	8	10	14
Type	HUS-	A, H, I, P	H	H	H
Nominal tensile strength $f_{uk}$	[N/mm <sup>2</sup> ]	930	950	1000	770
Yield strength $f_{yk}$	[N/mm <sup>2</sup> ]	750	855	900	700
Stressed cross-section $A_s$	[mm <sup>2</sup> ]	26,9	39,0	55,4	143,1
Moment of resistance $W$	[mm <sup>3</sup> ]	19,6	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	Carbon Steel, galvanized ( $\geq 5 \mu\text{m}$ )
	HUS-H 6	
	HUS-I 6	
	HUS-P 6	
	HUS-H 8	
	HUS-H 10	
	HUS-H 14	

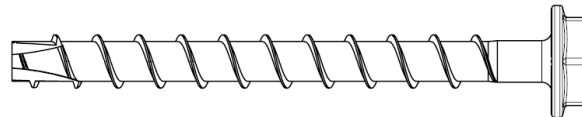
### Head configuration

**HUS-A 6**  
External thread  
M8 or M10

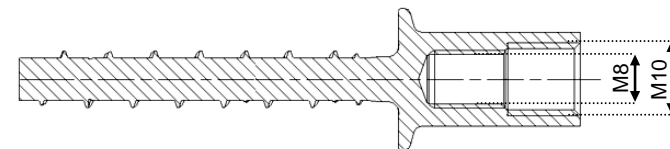
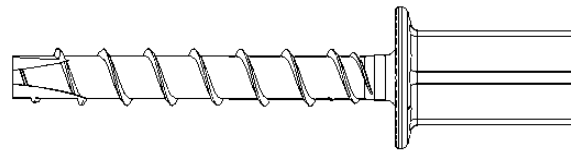


Circle mark with  $d = 2,5 \text{ mm}$  for  $h_{\text{nom}} = 55 \text{ mm}$

**HUS-H 6**  
Hex head

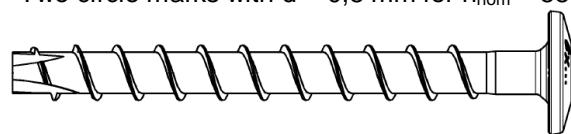


**HUS-I 6**  
Internal threads  
M8 and M10



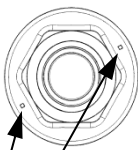
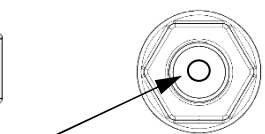
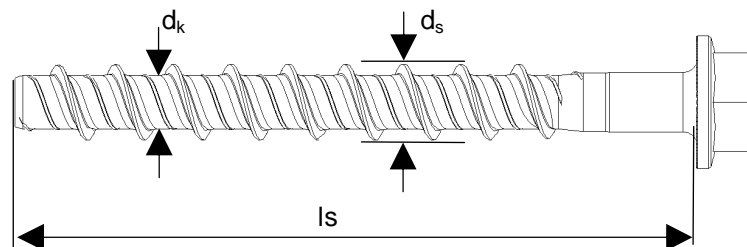
Two circle marks with  $d = 0,8 \text{ mm}$  for  $h_{\text{nom}} = 55 \text{ mm}$

**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	$d_{cut} \leq$	[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	$h_1 \geq$	[mm]	$h_{nom}+10$ mm				$h_{nom}+10$ mm			$h_{nom}+10$ mm			$h_{nom}+10$ mm		
Depth of drill hole in ceiling position	$h_1 \geq$	[mm]	$h_{nom}+3$ mm				$h_{nom}+10$ mm			$h_{nom}+10$ mm			$h_{nom}+10$ 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) <sup>a)</sup>		
Impact screw driver for machine setting			SIW/SID 121,144 TKI 2500				SIW 22T-A SI 100						SIW 22T-A SI 100 <sup>b)</sup>		

<sup>a)</sup> For concrete < 28 days old and  $f_{ck,cube} \geq 15$  N/mm<sup>2</sup>

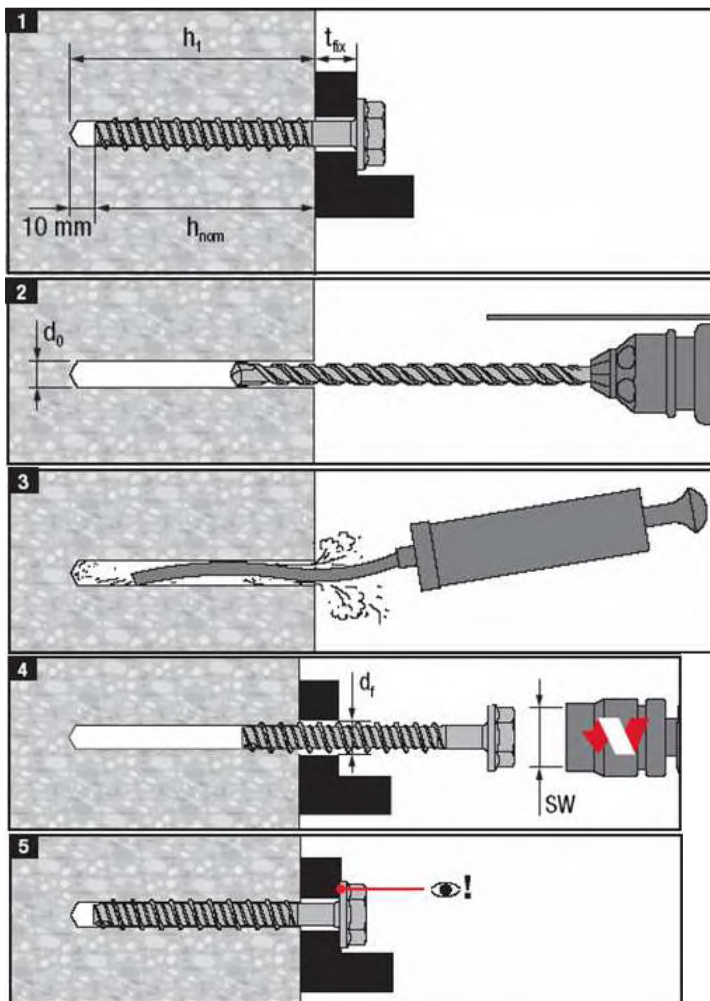
<sup>b)</sup> For concrete < 28 days old and  $f_{ck,cube} \geq 15$  N/mm<sup>2</sup> only hand setting is recommended

### 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	$h_1 \geq$ [mm]	$h_{nom} + 10$ mm						
Thickness of fixture	$t_{fix}$ [mm]	$l_s - h_{nom}$						
Max. installation torque for hand setting <sup>a)</sup>								
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	

<sup>a)</sup> Only hand setting is recommended

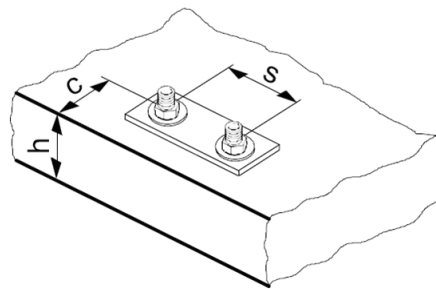
### Setting instruction



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	$s_{min}$	35	55			65			80		
	Minimum edge distance	$c_{min}$	35	55			65			60		
cracked concrete	Minimum spacing	$s_{min}$	35	55	40	40	65	50	50	-	80	-
	Minimum edge distance	$c_{min}$	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 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)

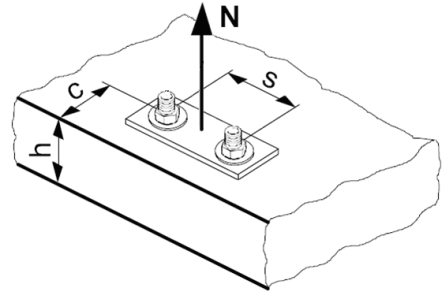
The values are valid for one anchor.

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:  $N_{Rd,p} = N_{Rd,p}^0 \cdot f_B$
- Concrete cone resistance:  $N_{Rd,c} = N_{Rd,c}^0 \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
- Concrete splitting resistance (only non-cracked concrete):  
 For HUS-A, H, I, P  $N_{Rd,sp} = N_{Rd,p}^0 \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$   
 For all the other HUS  $N_{Rd,sp} = N_{Rd,c}^0 \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$



### 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 2011-01-21 Hilti: Additional Hilti technical data

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

	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 $N_{Rd,p}^0$ [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 $N_{Rd,p}^0$ [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 2011-01-21 Hilti: Additional Hilti technical data

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

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

#### b) $N_{Rd,sp} = N_{Rd,p}^0 \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re,N}$

	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 $N_{Rd,c}^0$ [kN]	7,6	9,0	13,0	11,1	13,2	6,0	8,2	11,9	18,4	28,7
Cracked concrete										
Tensile $N_{Rd,c}^0$ [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 2011-01-21 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
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ <sup>a)</sup>	6	55	1	1,10	1,22	1,34	1,41	1,48	1,55
	8	50...75							
	10	85							
	14	70...110							
$f_B = (f_{ck,cube}/25N/mm^2)^{0,4}$ <sup>a)</sup>	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 <sup>a)</sup>

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

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 <sup>a)</sup>

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

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	$\geq 3,68$
$f_{h,sp} = [h/(2 \cdot h_{ef})]^{2/3}$	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
$f_{re,N}^{a)} = 0,5 + h_{ef}/200mm \leq 1$		0,71	0,68	0,73	0,8	0,72	0,76	0,83	0,7	0,84	0,95

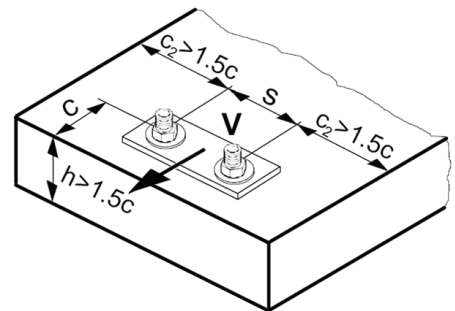
a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  mm, then a factor  $f_{re,N} = 1$  may be applied.



### Shear loading

The design shear resistance is the lower value of

- Steel resistance:  $V_{Rd,s}$
- Concrete pryout resistance:  $V_{Rd,cp} = V_{Rd,cp}^0 \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4$



### 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  $V_{Rd,cp} = V_{Rd,cp}^0 \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{re,N}$

		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											
$V_{Rd,cp}^0$	[kN]	13,7	21,7	31,2	26,7	36,9	14,5	19,6	23,8	36,9	57,4
Cracked concrete											
$V_{Rd,cp}^0$	[kN]	9,8	15,5	22,3	19,0	26,3	10,4	14,0	-	26,3	-

Design concrete edge resistance  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_4$

		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											
$V_{Rd,c}^0$	[kN]	2,1	2,7	4,1	3,7	5,3	1,7	2,6	3,6	5,9	9,7
Cracked concrete											
$V_{Rd,c}^0$	[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
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ <sup>a)</sup>	6	55	1	1,10	1,22	1,34	1,41	1,48	1,55
	8	50...75							
	10	85							
	14	70...110							
$f_B = (f_{ck,cube}/25N/mm^2)^{0,4}$ <sup>a)</sup>	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 <sup>a)</sup>

$c/c_{cr,N}$	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 <sup>a)</sup>

$s/s_{cr,N}$	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  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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 $\beta$		0° - 55°	60°	65°	70°	75°	80°	85°	90° - 180°
$f_\beta$		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	$\geq 1,5$
$f_h = \{h/(1,5 \cdot c)\}^{2/3} \leq 1$	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 <sup>a)</sup> for concrete edge resistance:  $f_4$** 

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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".


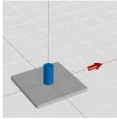
### Precalculated values

Design resistance calculated according ETAG 001, Annex C and data given in ETA-08/0307 issue 2011-01-21.  
All data applies to concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ .

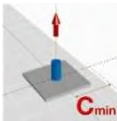
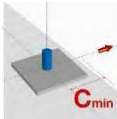
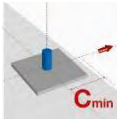
Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action  $\gamma = 1,4$ . The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

## Design resistance

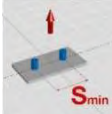
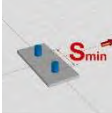
### Single anchor, no edge effects

		ETA-08/0307					Hilti				
<b>Anchor size</b>		<b>6</b>	<b>8</b>	<b>8</b>	<b>10</b>	<b>10</b>	<b>8</b>	<b>10</b>	<b>14</b>	<b>14</b>	<b>14</b>
<b><math>h_{nom}</math></b>	<b>[mm]</b>	<b>55</b>	<b>60</b>	<b>75</b>	<b>70</b>	<b>85</b>	<b>50</b>	<b>60</b>	<b>70</b>	<b>90</b>	<b>110</b>
Base material thickness $h_{min}$	[mm]	100	110	120	130	130	100	110	130	170	210
	<b>Tensile <math>N_{Rd}</math> [kN]</b>										
	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	-
	<b>Shear <math>V_{Rd}</math>, without lever arm [kN]</b>										
	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	-


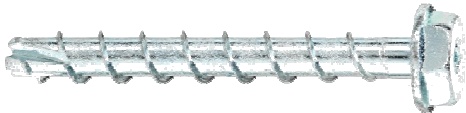



### Single anchor, min. edge distance ( $c = c_{min}$ )

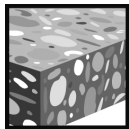
		ETA-08/0307					Hilti				
<b>Anchor size</b>		<b>6</b>	<b>8</b>	<b>8</b>	<b>10</b>	<b>10</b>	<b>8</b>	<b>10</b>	<b>14</b>	<b>14</b>	<b>14</b>
<b><math>h_{nom}</math></b>	<b>[mm]</b>	<b>55</b>	<b>60</b>	<b>75</b>	<b>70</b>	<b>85</b>	<b>50</b>	<b>60</b>	<b>70</b>	<b>90</b>	<b>110</b>
Base material thickness $h_{min}$	[mm]	100	110	120	130	130	100	110	130	170	210
	<b>Tensile <math>N_{Rd}</math> [kN]</b>										
	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	-
	<b>Shear <math>V_{Rd}</math>, without lever arm [kN]</b>										
	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				
<b>Anchor size</b>		<b>6</b>	<b>8</b>	<b>8</b>	<b>10</b>	<b>10</b>	<b>8</b>	<b>10</b>	<b>14</b>	<b>14</b>	<b>14</b>
<b><math>h_{nom}</math></b>	<b>[mm]</b>	<b>55</b>	<b>60</b>	<b>75</b>	<b>70</b>	<b>85</b>	<b>50</b>	<b>60</b>	<b>70</b>	<b>90</b>	<b>110</b>
Base material thickness $h_{min} =$	[mm]	100	110	120	130	130	100	110	130	170	210
	<b>Tensile <math>N_{Rd}</math> [kN]</b>										
	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	-
	<b>Shear <math>V_{Rd}</math>, without lever arm [kN]</b>										
	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

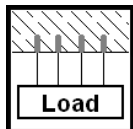
	Anchor version	Benefits
	HUS-A 6 Carbon steel Concrete Screw with hex head	- Quick and easy setting - Low expansion forces in base materials - Through fastening
	HUS-H 6 Carbon steel Concrete Screw with hex head	- Removable - Forged-on washer and hexagon head with no protruding thread
	HUS-I 6 Carbon 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



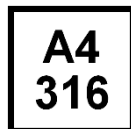
Redundant  
fastening



Small edge  
distance  
and spacing



Fire  
resistance



Corrosion  
Resistance



European  
Technical  
Approval



CE  
conformity

### Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval <sup>a)</sup>	DIBt, Berlin	ETA-10/0005 / 2011-08-23
Fire test report	DIBt, Berlin	ETA-10/0005 / 2011-08-23

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 2011-08-23

### Basic loading data

All data in this section applies to

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Concrete C 20/25,  $f_{ck,cube} = 25 \text{ N/mm}^2$

For details see Simplified design method

The following technical data are based on:

ETA: Data according ETA-05/0005 issue 2011-08-23

Hilti: Additional Hilti technical data

### Characteristic resistance

			Hilti tech. data	Data according ETA-10/0005, issue 2011-08-23	
Anchor version			HUS-HR 6		HUS-A, -H, -I, -P 6
Nominal embedment depth	$h_{nom}$	[mm]	30	35	35
All load directions	$35 \leq c < 80$ mm	$F_{Rk}^0$	2,0	3,0	2,0
	$c \geq 80$ mm	$F_{Rk}^0$		5,0	3,0

### Design resistance

			Hilti tech. data	Data according ETA-10/0005, issue 2011-08-23	
Anchor version			HUS-HR 6		HUS-A, -H, -I, -P 6
Nominal embedment depth	$h_{nom}$	[mm]	30	35	35
All load directions	$35 \leq c < 80$ mm	$F_{Rd}^0$	1,0	1,4	1,3
	$c \geq 80$ mm	$F_{Rd}^0$		2,4	2,0

### Recommended loads

			Hilti tech. data	Data according ETA-10/0005, issue 2011-08-23	
Anchor version			HUS-HR 6		HUS-A, -H, -I, -P 6
Nominal embedment depth	$h_{nom}$	[mm]	30	35	35
All load directions <sup>a)</sup>	$35 \leq c < 80$ mm	$F_{Rec}^0$	0,7	1,0	0,9
	$c \geq 80$ mm	$F_{Rec}^0$		1,7	1,4

a) With 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.

### 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 <sup>a)</sup>
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

Anchor version			HUS-HR 6	HUS-A, -H, -I, -P 6
Nominal tensile strength	$f_{uk}$	[N/mm <sup>2</sup> ]	1040	930
Stressed cross-section	$A_s$	[mm <sup>2</sup> ]	23	26,9
Moment of resistance	$W$	[mm <sup>3</sup> ]	15,5	19,7
Design bending resistance	$M_{Rd,s}$	[Nm]	12,9	14,6

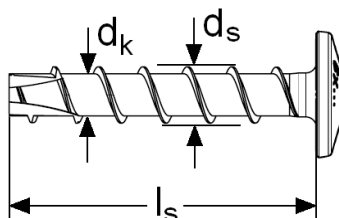
### Material quality

Anchor version			HUS-HR 6	HUS-A, -H, -I, -P 6
Material			Stainless steel (grade A4)	Steel, Galvanised $\geq 5 \mu\text{m}$

## 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

<b>HUS-A 6</b>	External thread M8 or M10		
		Square mark with $d = 2 \text{ mm}$ edge length for $h_{\text{nom}} = 35 \text{ mm}$	
<b>HUS-H 6</b>	Hex head and Torx T30		
<b>HUS-I 6</b>	Internal threads M8 and M10		
		One circle mark with $d = 0.8 \text{ mm}$ for $h_{\text{nom}} = 35 \text{ mm}$	
<b>HUS-P 6</b>	Pan head with		
<b>HUS-HR 6</b>	Hexagon head SW = 13 mm		

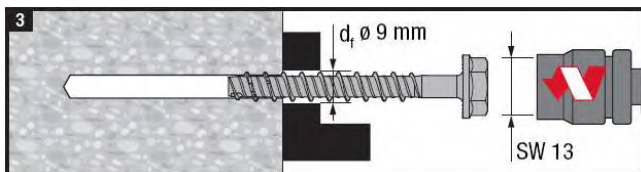
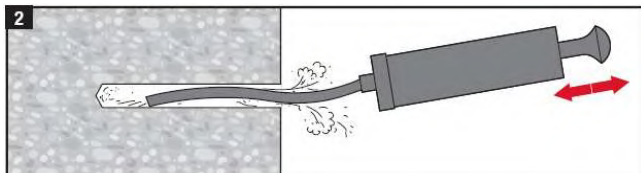
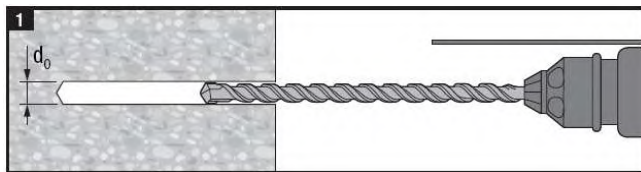
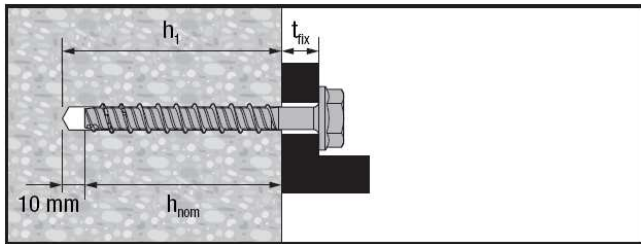
### Setting

#### 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				

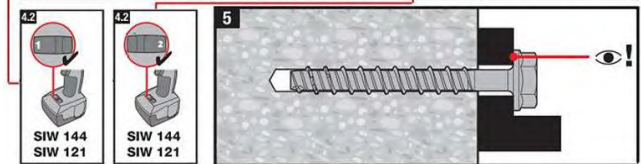
Setting instruction

HUS-HR 6

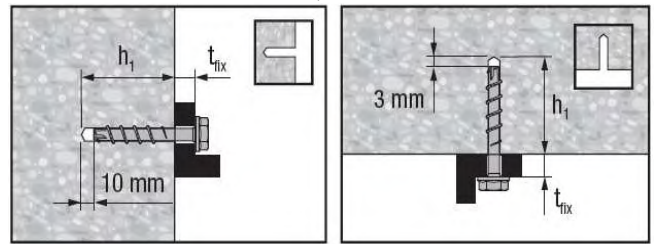


3.1

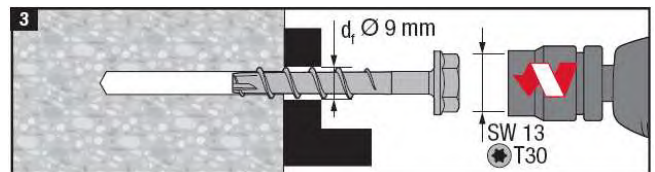
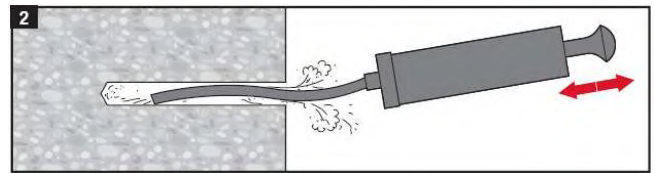
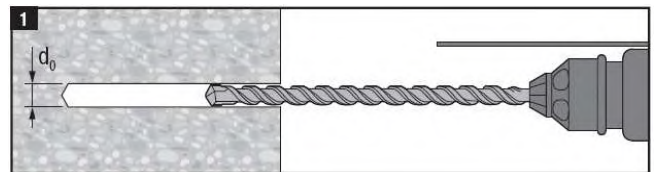
$h_{nom}$	30 mm	35 mm	55 mm	55 mm	55 mm
	✓	✓	✓	✗	✗
	✓	✓	✓	✗	✗
	✗	✗	✗	✗	✗
	✗	✗	✗	✗	✗
	✓	✓	✓	✗	✗
	✗	✗	✗	12 Nm	6 Nm



HUS-P 6, HUS-I 6

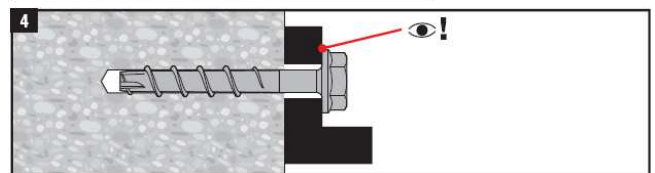


reduced drilling depth  
for overhead installation



3.1

	✓
	✓
	✓
	18 Nm

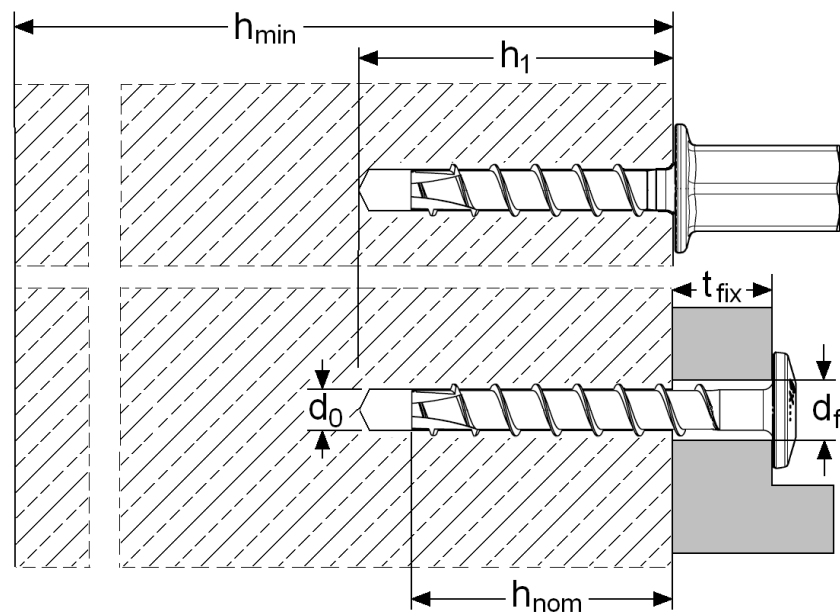


For detailed information on installation see instruction for use given with the package of the product.

### 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]	- <sup>a)</sup>		18			

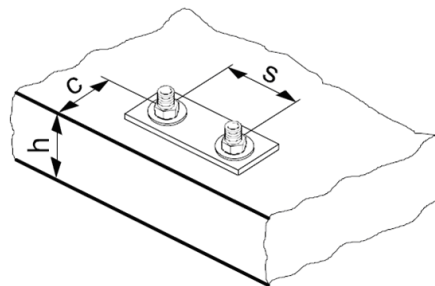
a) Hilti recommends machine setting only



### 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) <sup>1)</sup>	35 (80) <sup>1)</sup>
Critical spacing	$s_{cr}$	[mm]	3 $h_{ef}$		
Critical edge distance	$c_{cr}$	[mm]	1,5 $h_{ef}$		

<sup>1)</sup> 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 2011-08-23.

- 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. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the same 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  $F_{Rd} = F_{Rd}^0 \cdot f_B \cdot f_1 \cdot f_2 \cdot f_3 \cdot f_{re}$

### Basic design resistance

		Hilti tech. data	Data according ETA-10/0005, issue 2011-08-23	
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	$35 \leq c < 80$ mm	1,0	1,4	1,3
	$c \geq 80$ mm		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
$f_1 = 0,7 + 0,3 \cdot c/c_{cr} \leq 1$	0,73	0,76	0,79	0,82	0,85	0,88	0,91	0,94	0,97	1
$f_2 = 0,5 \cdot (1 + c/c_{cr}) \leq 1$	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. 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
$f_3 = 0,5 \cdot (1 + s/s_{cr}) \leq 1$	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.

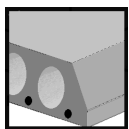
#### Influence of reinforcement

$h_{nom}$ [mm]	Dense reinforcement		Standard reinforcement a)	
	30	35	30	35
$f_{re} = 0,5 + h_{ef}/200mm \leq 1$	0,62	0,63	1	

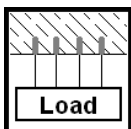
a) If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  mm, then a factor  $f_{re,N} = 1$  may be applied.

## 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	<ul style="list-style-type: none"> <li>- Quick and easy setting</li> <li>- Low expansion forces in base materials</li> <li>- Through fastening</li> <li>- Removable</li> <li>- Forged-on washer and hexagon head with no protruding thread</li> </ul>
	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

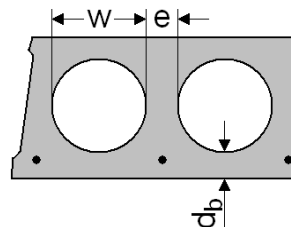
Description	Authority / Laboratory	No. / date of issue
European technical approval <sup>a)</sup>	DIBt, Berlin	ETA-10/0005 / 2011-05-12

a) All data given in this section according ETA-10/0005 issue 2011-05-12

### 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  $w/e \leq 4,2$
- 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 <sup>a)</sup>	$F_{rec}$	[kN]	0,5	1,0	1,4

a) With 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.

## 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 <sup>a)</sup>
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-A, -H, -I, -P 6
Nominal tensile strength $f_{uk}$	[N/mm <sup>2</sup> ]	930
Stressed cross-section $A_s$	[mm <sup>2</sup> ]	26,9
Moment of resistance $W$	[mm <sup>3</sup> ]	19,7
Design bending resistance $M_{Rd,s}$	[Nm]	14,6

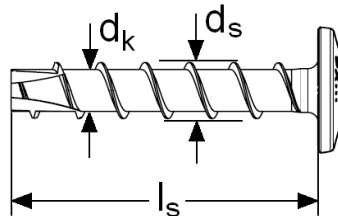
### Material quality

Anchor version		HUS-A, -H, -I, -P 6
Material		Carbon steel, galvanised to min. 5 $\mu$ m



## 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

<b>HUS-A 6</b>	External thread M8 or M10		
Square mark with $d = 2$ mm edge length for $h_{nom} = 35$ mm			
<b>HUS-H 6</b>	Hex head and Torx T30		
<b>HUS-I 6</b>	Internal threads M8 and M10		
One circle mark with $d = 0,8$ mm for $h_{nom} = 35$ mm			
<b>HUS-P 6</b>	Pan head with		

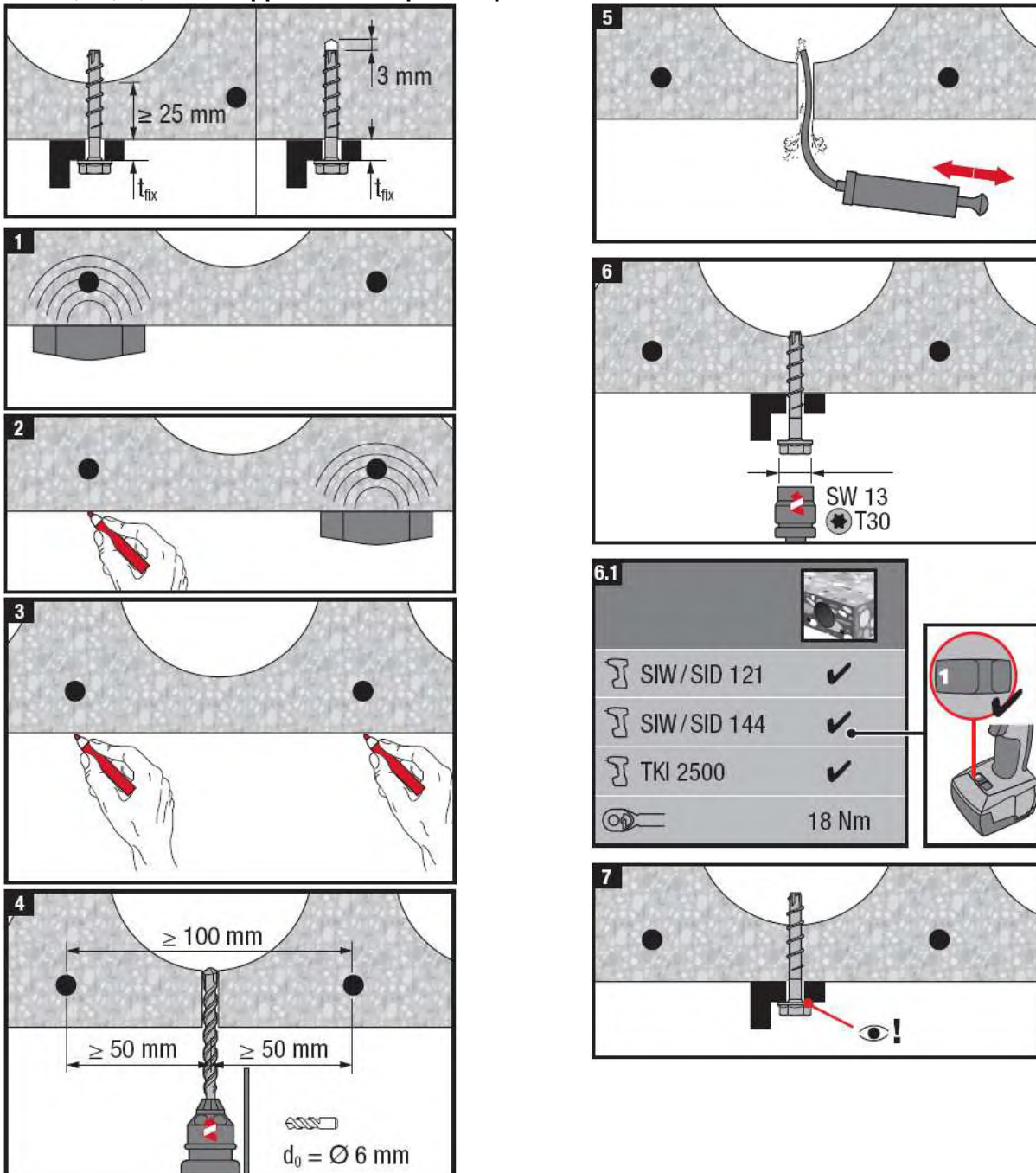
## Setting

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

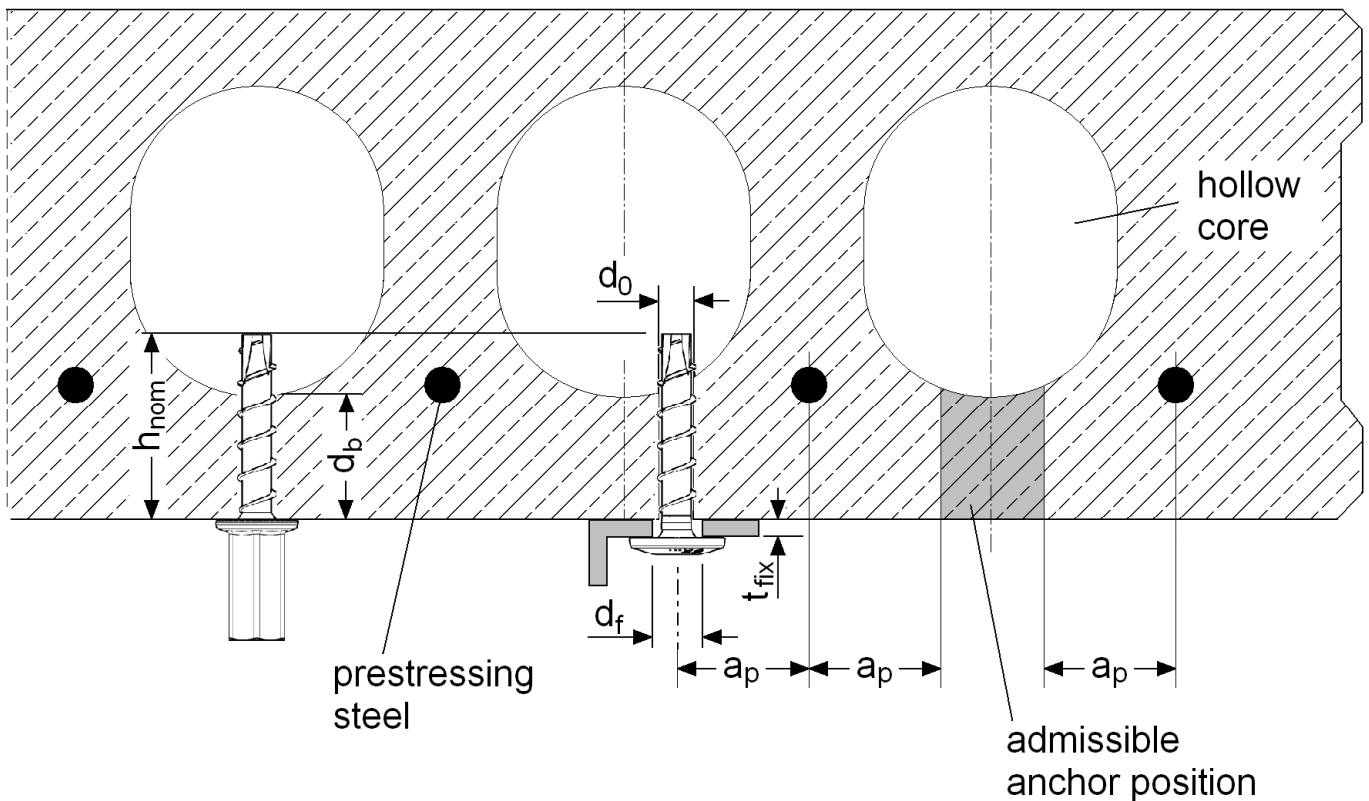


For detailed information on installation see instruction for use given with the package of the product.

### Setting details

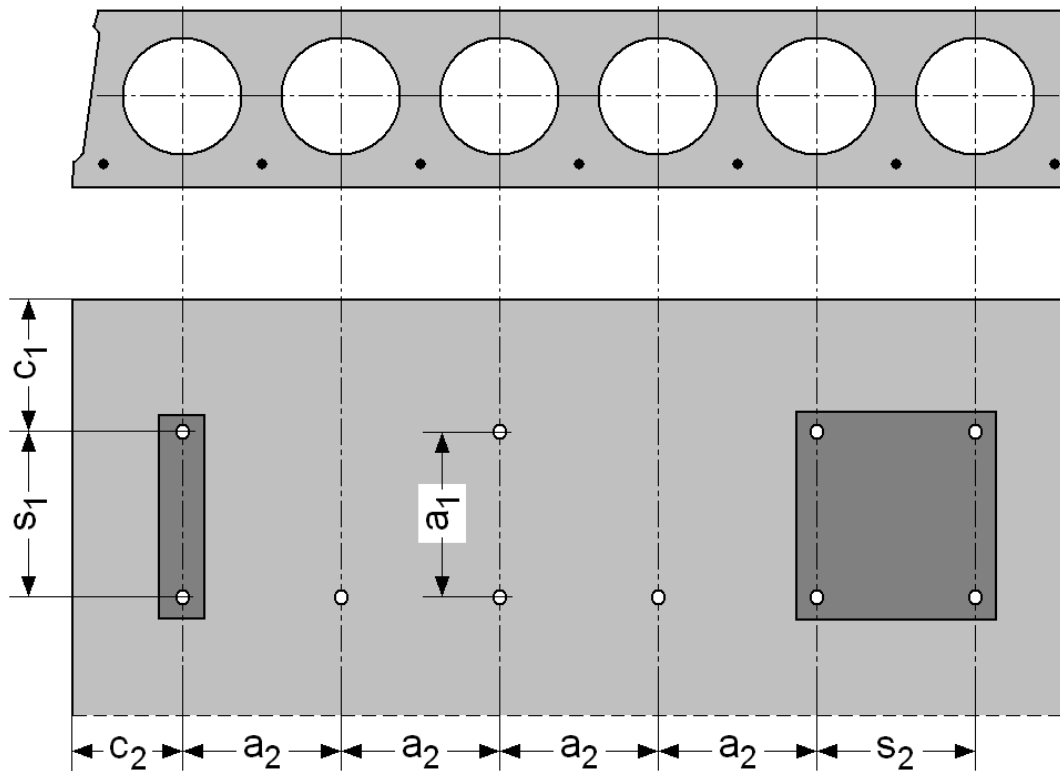
Anchor version		HUS-A, -H, -P 6					HUS-A, -I 6
Nominal embedment depth	$h_{nom}$ [mm]	35					
Bottom flange thickness	$d_b \geq$ [mm]	25					
Nominal diameter of drill bit	$d_o$ [mm]	6					
Cutting diameter of drill bit	$d_{cut} \leq$ [mm]	6,4					
Nominal depth of drill hole <sup>a)</sup>	$h_1 \geq$ [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





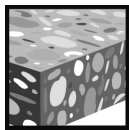
## Anchor spacing and edge distance

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

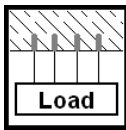


## HUS 6 / HUS-S 6 Screw anchor

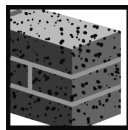
	Anchor version	Benefits
	HUS 6	Carbon steel
	HUS-S 6	Concrete Screw
		<ul style="list-style-type: none"> <li>- Quick and easy setting</li> <li>- Low expansion forces in base materials</li> <li>- Through fastening</li> <li>- Removable</li> </ul>



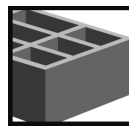
Concrete



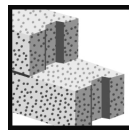
Redundant fastening



Solid brick



Hollow brick



Autoclaved aerated concrete



Fire resistance



Small edge distance and spacing

### Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Fire test report	IBMB, Braunschweig DIBt, Berlin	UB 3574/5146 / 2006-05-20 Z-21.1-1710 / 2009-05-20
Assessment report (fire)	warringtonfire	WF 166402 / 2007-10-26

### 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$

#### 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  $12 \text{ N/mm}^2$ , bulk density  $1,8 \text{ N/mm}^2$ , format  $\geq 240/175/113 \text{ mm}$  (length/width/height)
  - KS 12 → solid lime block, compressive strength  $12 \text{ N/mm}^2$ , bulk density  $2,0 \text{ N/mm}^2$ , format  $\geq 240/175/113 \text{ mm}$  (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  $6 \text{ N/mm}^2$ , bulk density  $0,6 \text{ N/mm}^2$
  - PB2 → block, compressive strength  $2 \text{ N/mm}^2$ , bulk density  $0,2 \text{ N/mm}^2$

- 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 <sup>b)</sup>	KS sand Lime Block <sup>b)</sup>	Hz 0.8/12 Hollow Brick <sup>b)</sup>	Aerated concrete							
	Non- cracked	Cracked <sup>a)</sup>				PB2 / PB4 <sup>c)</sup>		PB6					
Anchor size	HUS 6	HUS 6	HUS 6	HUS 6	HUS 6	HUS 6		HUS 6					
$h_{nom}$ [mm]	34		44		64		64		64				
Edge distance $c \geq$ [mm]	60	30	100	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  $\gamma = 1,4$ . 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/mm <sup>2</sup> ]	1000
Yield strength $f_{yk}$ [N/mm <sup>2</sup> ]	900
Stressed cross-section $A_s$ [mm <sup>2</sup> ]	5,2
Moment of resistance $W$ [mm <sup>3</sup> ]	13,8
Design bending resistance $M_{Rd,s}$ [Nm]	11

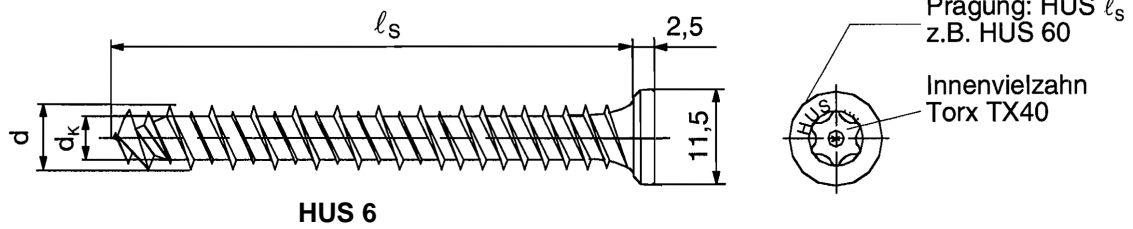
### Material quality

Part	Material
Screw anchor	Carbon Steel, galvanised to min. 5 $\mu$ m

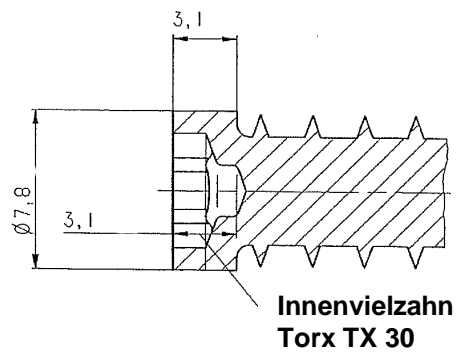
## Anchor dimensions

### 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



### Head configuration HUS-S



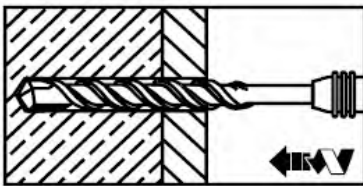
### Setting

#### Recommended installation equipment

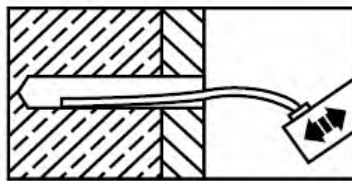
Anchor size	HUS 6		HUS-S 6
Rotary hammer	TE 6 / TE 7		
Drill bit	TE-C3X 6/17		
Recommended Setting Tool	SID/SIW 121, SID/SIW 144, TKI 2500		
Accessories	S-B TXI 40 bit		S-B TXI 30 bit

#### Setting instruction

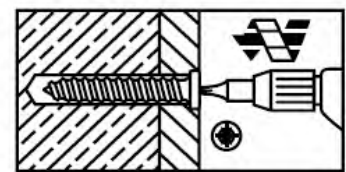
##### HUS:



Drill hole with drill bit.

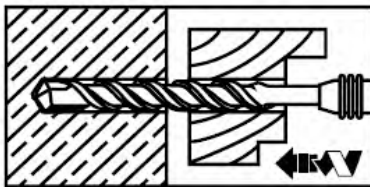


Blow out dust and fragments.

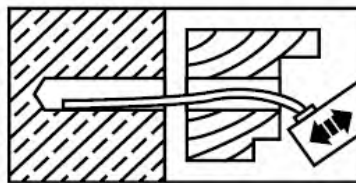


Install anchor with an electric screwdriver.

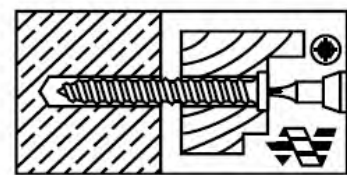
##### HUS-S:



Drill hole with drill bit.



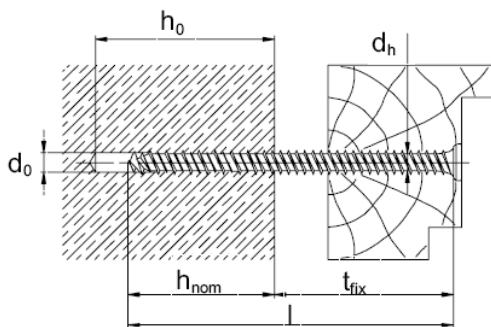
Blow out dust and fragments.



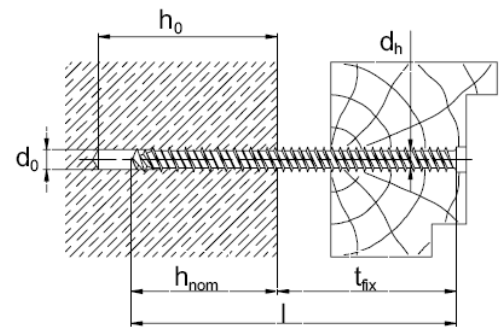
Install anchor with an electric screwdriver.

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



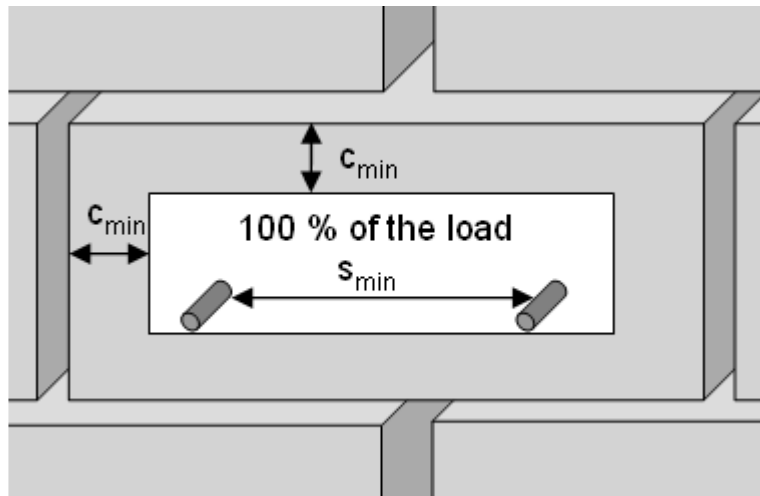
### Setting details

		[mm]	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 <sup>b)</sup>	64 <sup>a)</sup>	- <sup>b)</sup>	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






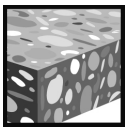
- Distance to free edge free edge to solid masonry (Mz and KS) units  $\geq 200$  mm
- Distance to free edge free edge to solid masonry (HLz and autoclaved aerated gas concrete) units  $\geq 170$  mm
- The minimum distance to horizontal and vertical mortar joint ( $c_{min}$ ) is stated in the recommended 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  $\geq 2 \cdot c_{min}$





## HKD Push-in anchor, Single anchor application

	Anchor version	Benefits
	HKD Carbon steel with lip	<ul style="list-style-type: none"> <li>- simple and well proven</li> <li>- approved, tested and confirmed by everyday jobsite experience</li> <li>- reliable setting thanks to simple visual check</li> <li>- versatile</li> <li>- for medium-duty fastening with bolts or threaded rods</li> <li>- available in various materials and sizes for maximized coverage of possible applications</li> </ul>
	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



Hilti anchor  
design  
software



PROFIS  
Anchor  
design  
software

### Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval <sup>a)</sup>	DIBt, Berlin	ETA-02/0032 / 2010-04-22

a) Anchors with anchorage depth  $h_{ef} = 25\text{mm}$  are not covered by ETA

### 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,  $f_{ck,cube} = 25\text{ N/mm}^2$
- screw or rod with steel strength 5.8 (carbon steel) and/or A4-70 (stainless steel)

For details see Simplified design method

**Mean Ultimate Resistance**

Anchor size	Hilti technical data											
	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**

Anchor size	Hilti technical data				according ETA-02/0032, issue 2010-04-22							
	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**

Anchor size	Hilti technical data				according ETA-02/0032, issue 2010-04-22							
	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

Anchor size	Hilti technical data				according ETA-02/0032, issue 2010-04-22							
	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  $\gamma = 1,4$ . 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/mm <sup>2</sup> ]		570	570	570	570	640	590
	HKD-S HKD-E [N/mm <sup>2</sup> ]		560	560	510	510	-	460
	HKD-SR HKD-ER [N/mm <sup>2</sup> ]		540	540	540	540	-	540
Yield strength $f_{yk}$	HKD [N/mm <sup>2</sup> ]		460	460	460	480	510	470
	HKD-S HKD-E [N/mm <sup>2</sup> ]		440	440	410	410	-	375
	HKD-SR HKD-ER [N/mm <sup>2</sup> ]		355	355	355	355	-	355
Stressed cross-section $A_s$	HKD [mm <sup>2</sup> ]		20,7	26,7	32,7	60,1	105	167
	HKD-S (R) HKD-E (R) [mm <sup>2</sup> ]		20,9	26,1	28,8	58,7	-	163
Moment of resistance $W$	HKD [mm <sup>3</sup> ]		32,3	54,6	82,9	184	431	850
	HKD-S (R) HKD-E (R) [mm <sup>3</sup> ]		50	79	110	264	602	1191
Char. bending resistance for rod or bolt $M_{Rk,s}^0$	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

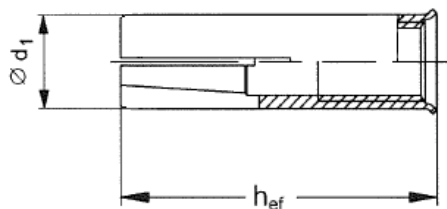
Part		Material
Anchor Body	HKD	Steel Fe/Zn5 galvanised to min. 5 µm
	HKD-S HKD-E	Steel Fe/Zn5 galvanised to min. 5 µm
	HKD-SR HKD-ER	Stainless steel, 1.4401, 1.4404, 1.4571
Tapered expansion plug	HKD	Steel material
	HKD-S HKD-E	Steel material
	HKD-SR HKD-ER	Stainless steel, 1.4401, 1.4404, 1.4571

### Anchor dimensions

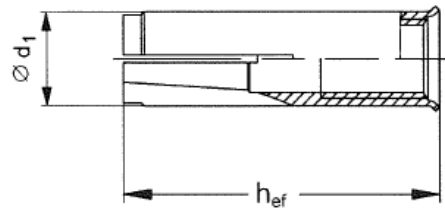
Anchor size Anchor version			M6x25	M8x25	M10x25	M12x25	M6x30	M8x30	M8x40	M10x30	M10x40	M12x50	M16x65	M20x80
Effective anchorage depth	$h_{ef}$	[mm]	25	25	25	25	30	30	40	30	40	50	60	80
Anchor diameter	$d_1$	[mm]	7,9	9,95	11,9	14,9	8	9,95	9,95	11,8	11,95	14,9	19,75	24,75
Plug diameter	$d_2$	[mm]	5,1	6,35	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

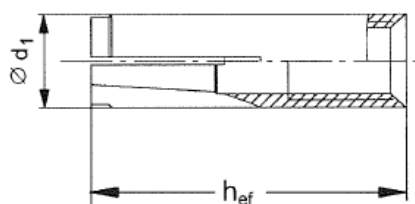
HKD



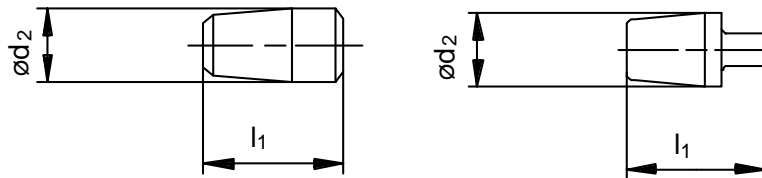
HKD-S and HKD-SR



HKD-E and HKD ER



## Expansions plugs

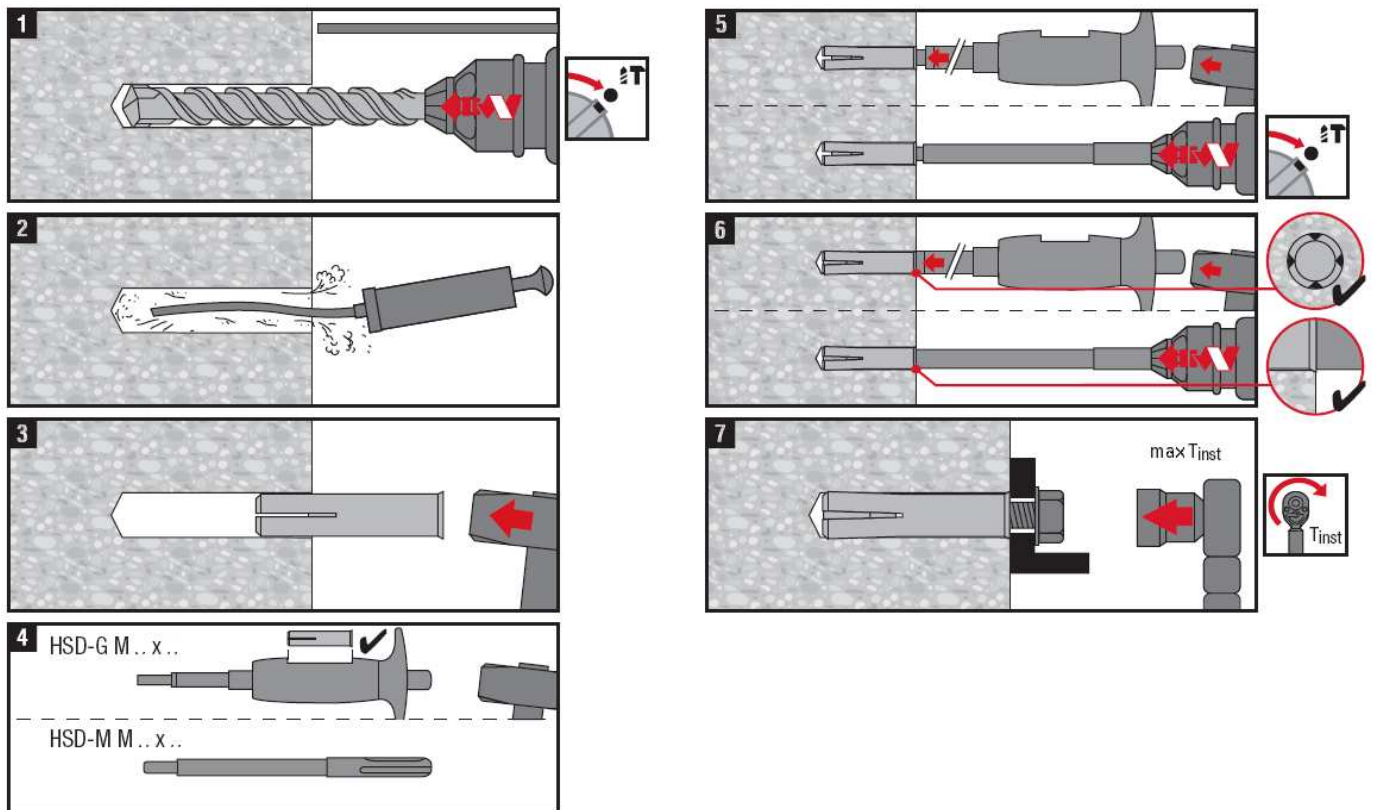


## Setting

### 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												
Other tools	hammer, torque wrench, blow out pump											

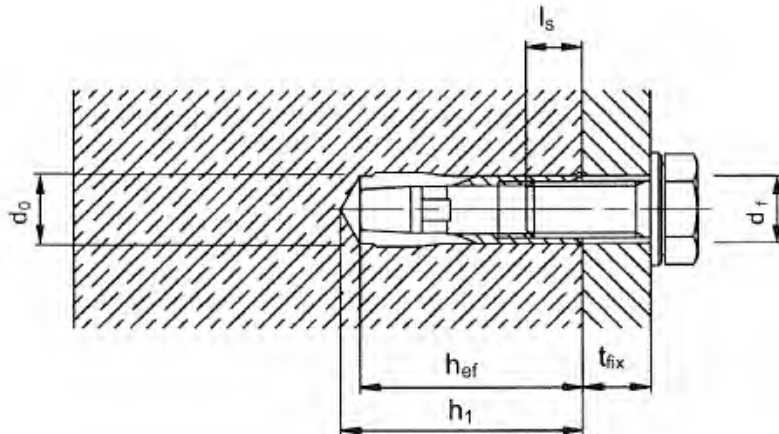
### Setting instruction



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  $h_{ef}$

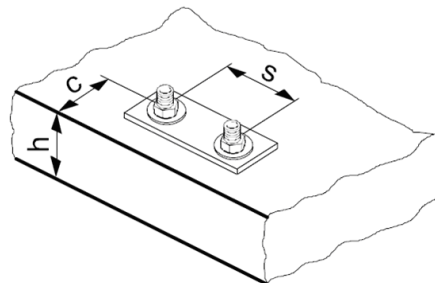


### Setting details

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 $c \geq$	[mm]	140	105	140	175	230	280
Minimum edge distance HKD	$c_{min}$	[mm]	100	80	140	175	230	280
	for $s \geq$	[mm]	150	120	80	125	130	160
Critical spacing and edge distance for concrete cone failure	$s_{cr,N}$	[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	$s_{cr,sp}$	200	210	280	350	455	560
		$c_{cr,sp}$	100	105	140	175	227	280
	HKD-S (R) HKD-E (R)	$s_{cr,sp}$	176	210	280	350	455	560
		$c_{cr,sp}$	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 2010-04-22 .

- 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 same 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)

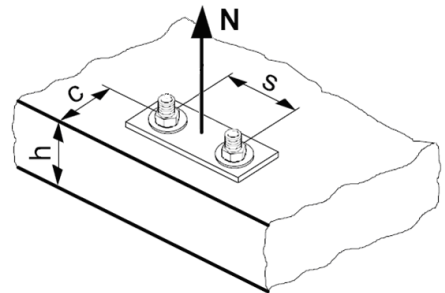
The values are valid for one anchor.

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



### 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

Anchor size			Hilti technical data				according ETA-02/0032, issue 2010-04-22							
			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  $N_{Rd,p} = N_{Rd,p}^0 \cdot f_B$**

Anchor size			Non-cracked concrete											
			Hilti technical data				according ETA-02/0032, issue 2010-04-22							
			M6x25	M8x25	M10x25	M12x25	M6x30	M8x30	M8x40	M10x30	M10x40	M12x50	M16x65	M20x80
$N_{Rd,p}^0$	HKD	[kN]	-	-	-	-	-	-	6,0	-	-	-	-	-
	HKD-S, HKD-E	[kN]	-	-	-	-	-	-	5,0	-	-	-	-	-
	HKD-SR, HKD-ER	[kN]	-	-	-	-	-	-	-	-	-	-	-	-

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

**Design splitting resistance<sup>a)</sup>  $N_{Rd,sp} = N_{Rd,c}^0 \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,sp} \cdot f_{re}$**

Anchor size			Non-cracked concrete											
			Hilti technical data				according ETA-02/0032, issue 2010-04-22							
			M6x25	M8x25	M10x25	M12x25	M6x30	M8x30	M8x40	M10x30	M10x40	M12x50	M16x65	M20x80
$N_{Rd,c}^0$	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<sup>a)</sup>**

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

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 <sup>a)</sup>

$s/s_{cr,N}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$s/s_{cr,sp}$										
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N}) \leq 1$										
$f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp}) \leq 1$	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	$\geq 3,68$
$f_{h,sp} = [h/(2 \cdot h_{ef})]^{2/3}$	1	1,07	1,13	1,19	1,25	1,31	1,37	1,42	1,48	1,5

### Influence of reinforcement

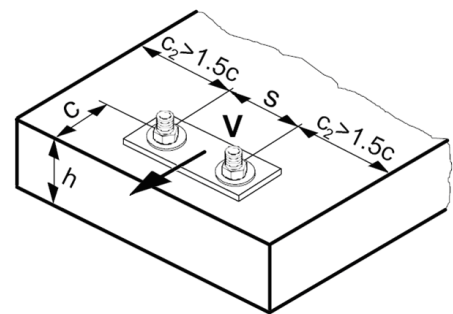
Anchor size	M6x25	M8x25	M10x25	M12x25	M6x30	M8x30	M8x40	M10x30	M10x40	M12x50	M16x65	M20x80
$f_{re,N} = 0,5 + h_{ef}/200\text{mm} \leq 1$	0,63 <sup>a)</sup>	0,63 <sup>a)</sup>	0,63 <sup>a)</sup>	0,63 <sup>a)</sup>	0,65 <sup>a)</sup>	0,65 <sup>a)</sup>	0,7 <sup>a)</sup>	0,65 <sup>a)</sup>	0,7 <sup>a)</sup>	0,75 <sup>a)</sup>	0,83 <sup>a)</sup>	0,9 <sup>a)</sup>

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{fB} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



## 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

Anchor size			Hilti technical data				according ETA-02/0032, issue 2010-04-22							
			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  $V_{Rd,cp} = k \cdot N_{Rd,c}$ <sup>a)</sup>**

Anchor size	Hilti technical data				according ETA-02/0032, issue 2010-04-22							
	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<sup>a)</sup>  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$**

Anchor size	M6x25	M8x25	M10x25	M12x25	M6x30	M8x30	M8x40	M10x30	M10x40	M12x50	M16x65	M20x80
$V_{Rd,c}^0$ [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
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ <sup>a)</sup>	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 $\beta$	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 <sup>a)</sup> for concrete edge resistance:  $f_4$** 

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sup>a)</sup>**

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".

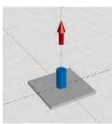
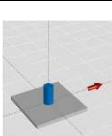
**Precalculated values**

Design resistance calculated according ETAG 001, Annex C and data given in ETA-02/0032, issue 2010-04-22. All data applies to concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  and steel strength 5.8 and/or A4-70.


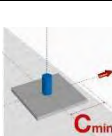
Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action  $\gamma = 1,4$ . The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

## Design resistance

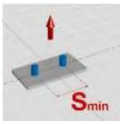
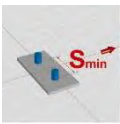
### Single anchor, no edge effects

		Non-cracked concrete												
		Hilti technical data				according ETA-02/0032, issue 2010-04-22								
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	
	<b>Tensile <math>N_{Rd}</math></b>													
	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
	<b>Shear <math>V_{Rd}</math>, without lever arm</b>													
	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 ( $c = c_{min}$ )

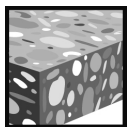
		Non-cracked concrete												
		Hilti technical data				according ETA-02/0032, issue 2010-04-22								
Anchor size		M6x25	M8x25	M10x25	M12x25	M6x30	M8x30	M8x40	M10x30	M10x40	M12x50	M16x65	M20x80	
Min. base material thickness $h_{min}$	[mm]	100	100	100	100	100	100	100	100	100	100	130	160	
Min. edge distance $c_{min}$	[mm]	100	100	100	100	105	105	140	105	140	175	230	280	
	<b>Tensile <math>N_{Rd}</math></b>													
	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
	<b>Shear <math>V_{Rd}</math>, without lever arm</b>													
	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 2010-04-22								
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	
	<b>Tensile <math>N_{Rd}</math></b>													
	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
	<b>Shear <math>V_{Rd}</math>, without lever arm</b>													
	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

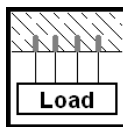
	Anchor version	Benefits
	HKD Carbon steel with lip	<ul style="list-style-type: none"> <li>- simple and well proven</li> <li>- approved, tested and confirmed by everyday jobsite experience</li> <li>- reliable setting thanks to simple visual check</li> <li>- versatile</li> <li>- for medium-duty fastening with bolts or threaded rods</li> <li>- available in various materials and sizes for maximized coverage of possible applications</li> </ul>
	HKD-S(R) Carbon steel, stainless steel with lip	
	HKD-E(R) Carbon steel, stainless steel without lip	



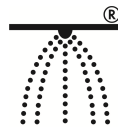
Concrete



Tensile zone <sup>a)</sup>



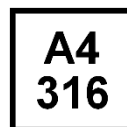
Redundant fastening



Sprinkler approved



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 <sup>a)</sup>	DIBt, Berlin	ETA-06/0047 / 2011-03-14
Fire test report	DIBt, Berlin	ETA-06/0047 / 2011-03-14
Assessment report (fire)	warringtonfire	WF 166402 / 2007-10-26

a) All data given in this section for HKD-S(R) and HKD-E(R), according ETA-06/0047, issue 2011-03-14 . The anchor is to be used only for redundant fastening for non-structural applications.

### Basic loading data for all load directions according design method 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  $f_{ck,cube} = 25 \text{ N/mm}^2$  to C50/60,  $f_{ck,cube} = 60 \text{ N/mm}^2$
- 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 <sup>a)</sup>, 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  $\gamma = 1,4$ . 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 <sup>a)</sup>
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/mm <sup>2</sup> ]	570	570	570	570	640
	HKD-S HKD-E	[N/mm <sup>2</sup> ]	560	560	510	510	-
	HKD-SR HKD-ER	[N/mm <sup>2</sup> ]	540	540	540	540	-
Yield strength $f_{yk}$	HKD	[N/mm <sup>2</sup> ]	460	460	460	480	510
	HKD-S HKD-E	[N/mm <sup>2</sup> ]	440	440	410	410	-
	HKD-SR HKD-ER	[N/mm <sup>2</sup> ]	355	355	355	355	-
Stressed cross-section $A_s$	HKD	[mm <sup>2</sup> ]	20,7	26,7	32,7	60,1	105
	HKD-S (R) HKD-E (R)	[mm <sup>2</sup> ]	20,9	26,1	28,8	58,7	-
Moment of resistance $W$	HKD	[mm <sup>3</sup> ]	32,3	54,6	82,9	184	431
	HKD-S (R) HKD-E (R)	[mm <sup>3</sup> ]	50	79	110	264	-
Char. bending resistance for rod or bolt $M_{Rk,s}^0$	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

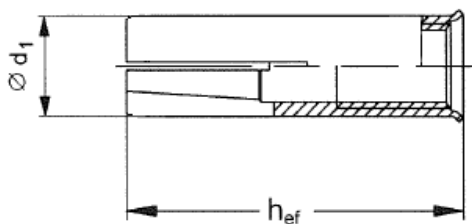
Part	Material	
Anchor Body	HKD	Steel Fe/Zn5 galvanised to min. 5 µm
	HKD-S HKD-E	Steel Fe/Zn5 galvanised to min. 5 µm
	HKD-SR HKD-ER	Stainless steel, 1.4401, 1.4404, 1.4571
Tapered expansion plug	HKD	Steel material
	HKD-S HKD-E	Steel material
	HKD-SR HKD-ER	Stainless steel, 1.4401, 1.4404, 1.4571

### Anchor dimensions

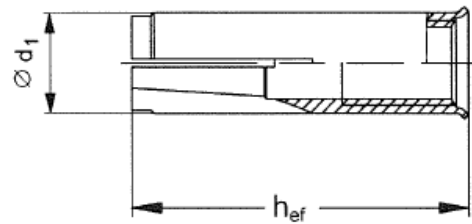
Anchor size Anchor version			M6x25	M6x30	M8x25	M8x30	M8x40	M10x25	M10x30	M10x40	M12x25	M12x50	M16x65
Effective anchorage depth	$h_{ef}$	[mm]	25	30	25	30	40	25	30	40	25	50	65
Anchor diameter	$d_1$	[mm]	7,9	8	9,95	9,95	9,95	11,9	11,8	11,95	14,9	14,9	19,75
Plug diameter	$d_2$	[mm]	5,1	5	6,35	6,5	6,35	8,1	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

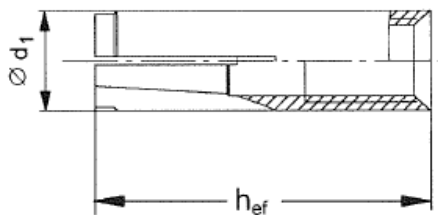
HKD



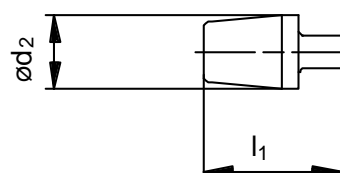
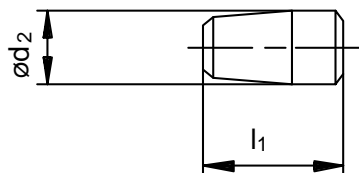
HKD-S and HKD-SR



HKD-E and HKD ER



### Expansions plugs

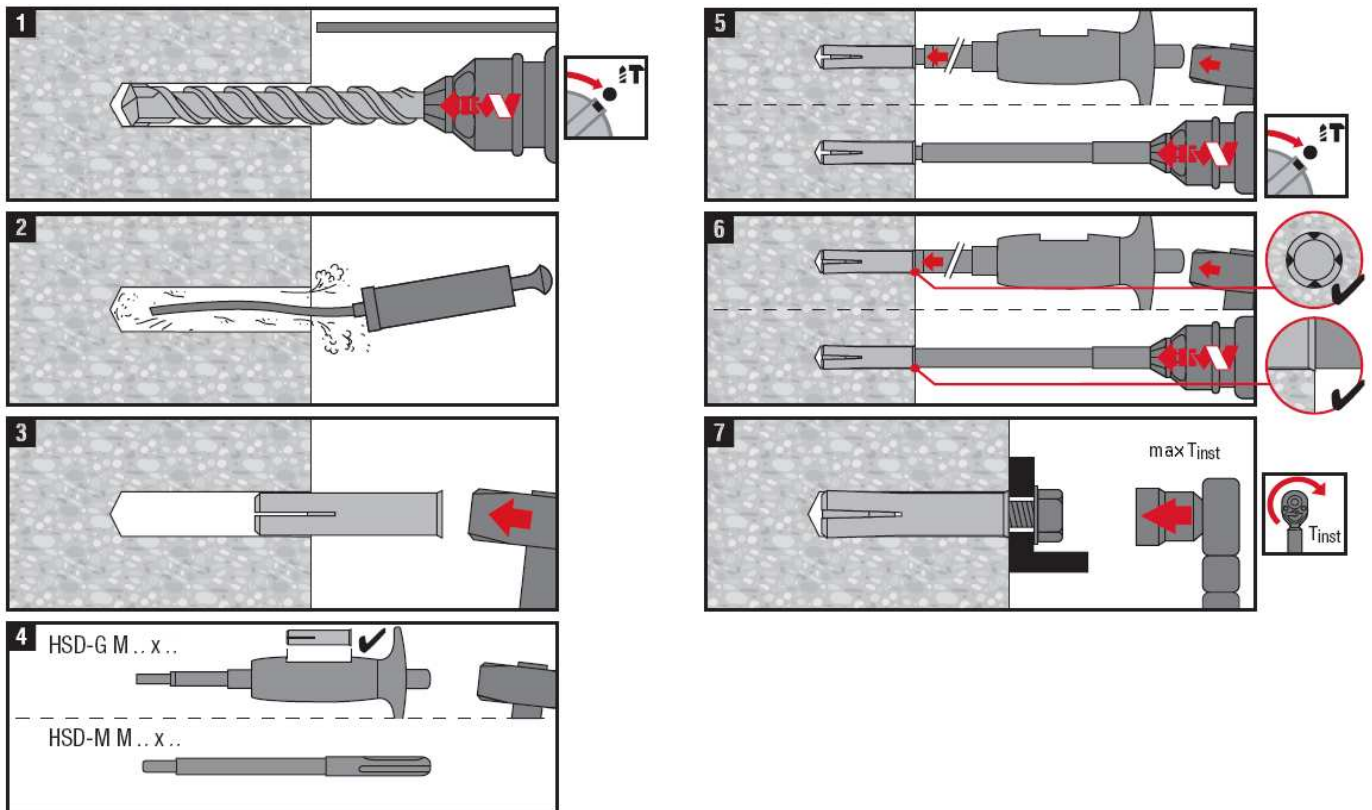


## Setting

### Installation equipment

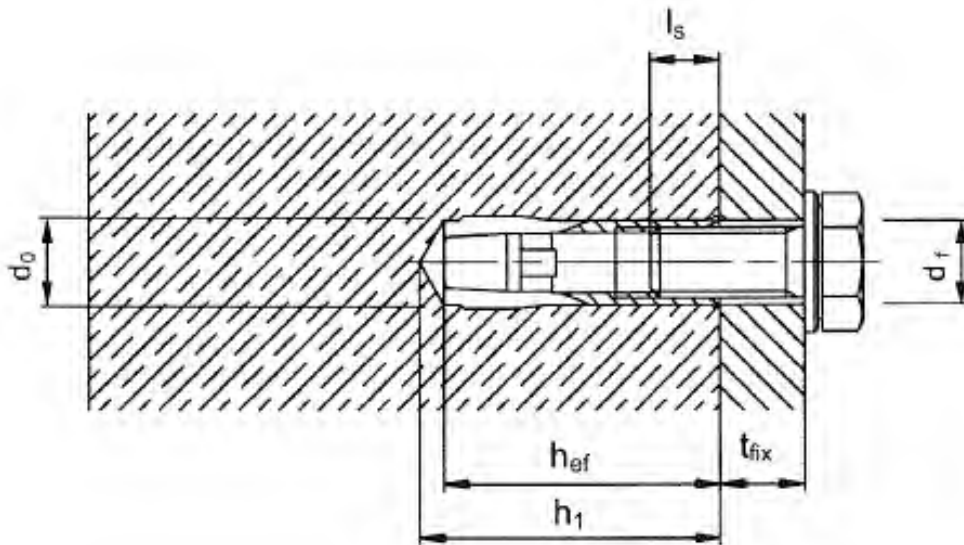
Anchor size		M6x25	M6x30	M8x25	M8x30	M8x40	M10x25	M10x30	M10x40	M12x25	M12x50	M16x65
Rotary hammer		TE 2 – TE 16									TE 16 – 50	
Machine setting tool	HSD-M	6x25/30	8x25/30	8x40	10x25/30	10x40	12x25	12x50	16x65			
Hand Setting tool	HSD-G											
Other tools		hammer, torque wrench, blow out pump										

### 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	$d_0$	[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**

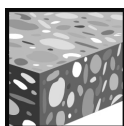
Anchor size		M6x25 M8x25 M10x25 M12x25	M6x30 M8x30 M10x30	M8x40 M10x40	M12x50	M16x65
Minimum base material thickness	$h_{min}$ [mm]	80	80	80	-	-
Minimum spacing and Minimum edge distance	$s_{min}$ [mm]	200	200	200	-	-
	$c_{min}$ [mm]	150	150	150	-	-
Minimum base material thickness	$h_{min}$ [mm]	100	100	100	100	130
Minimum spacing and minimum edge distance	$s_{min}$ [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 $c \geq$ [mm]	140	105	140	175	230
Minimum edge distance HKD	$c_{min}$ [mm]	100	80	140	175	230
	for $s \geq$ [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	<ul style="list-style-type: none"> <li>- simple and well proven</li> <li>- approved, tested and confirmed by everyday jobsite experience</li> <li>- reliable setting thanks to simple visual check</li> <li>- versatile</li> <li>- for medium-duty fastening with bolts or threaded rods</li> <li>- available in various materials and sizes for maximized coverage of possible applications</li> </ul>



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,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- 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 <sup>a)</sup>

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  $\gamma = 1,4$ . 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/mm <sup>2</sup> ]	570	570	570	570	570	640
Yield strength $f_{yk}$ [N/mm <sup>2</sup> ]	460	460	460	460	460	510
Stressed cross-section $A_s$ [mm <sup>2</sup> ]	20,7	26,7	32,7	32,7	60,1	105
Moment of resistance $W$ [mm <sup>3</sup> ]	32,3	54,6	82,9	82,9	184	431
Char. bending resistance for rod or bolt $M_{Rk,s}^0$ with 5.8 Steel Strength [Nm]	7,6	18,7	37,4	37,4	65,5	167

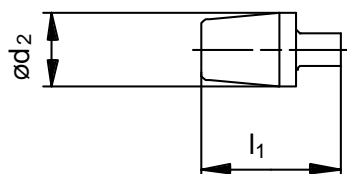
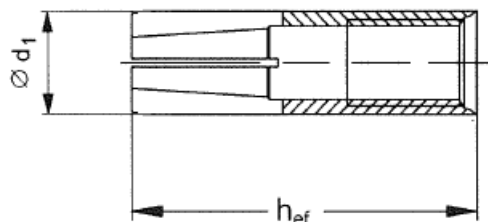
### Material quality

Part	Material
Anchor Body	Steel Fe/Zn5 galvanised to min. 5 $\mu$ m
expansion plug	Steel material

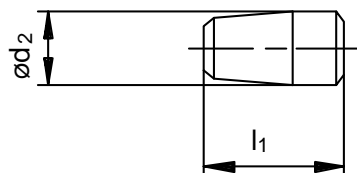
### Anchor dimensions

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

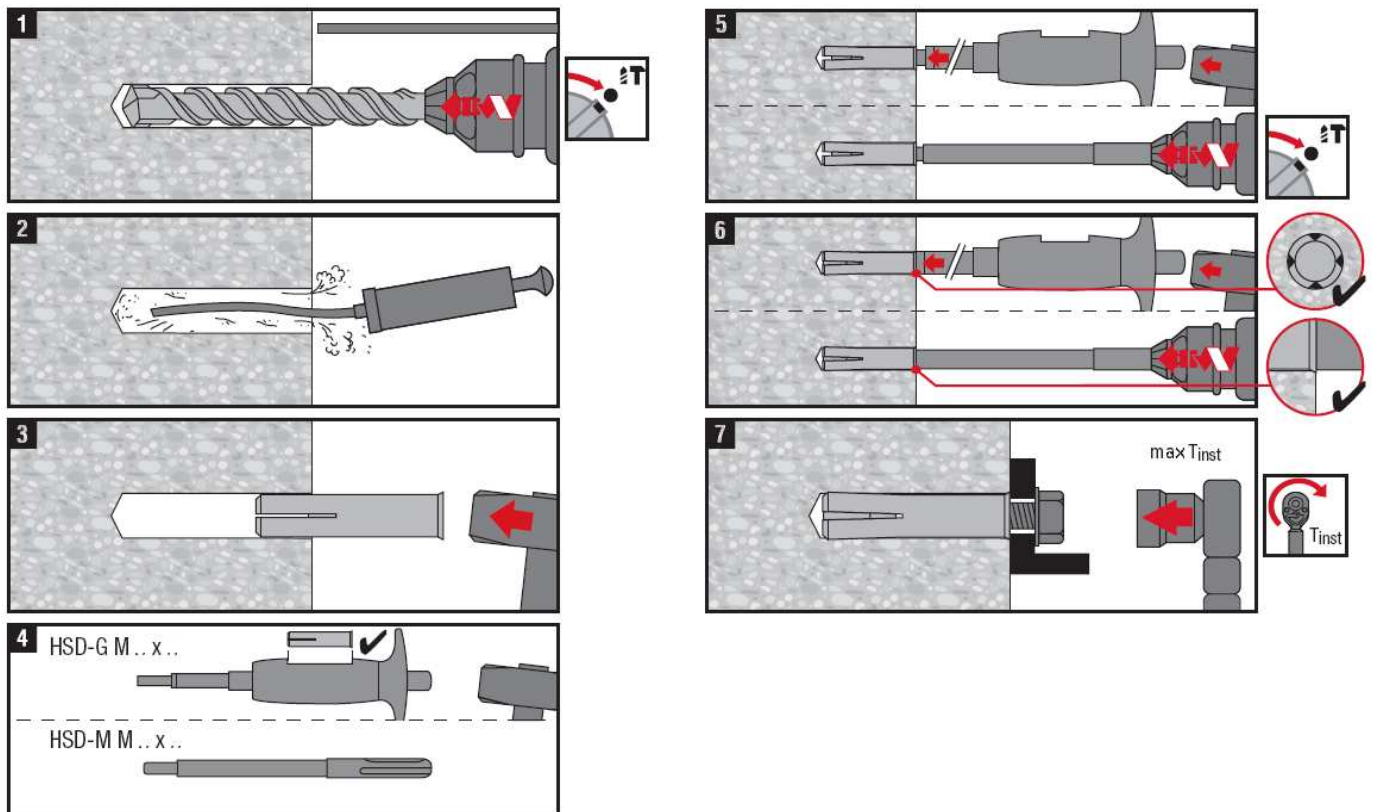


## Setting

### Installation equipment

Anchor size		M6x25	M8x30	M10x30	M10x40	M12x50	M16x65
Rotary hammer		TE 2 – TE 16				TE 16 – TE 50	
Machine setting tool	HSD-M	6x25/30	8x25/30	10x25/30	10x40	12x50	16x65
Hand Setting tool	HSD-G						
Other tools		hammer, torque wrench, blow out pump					

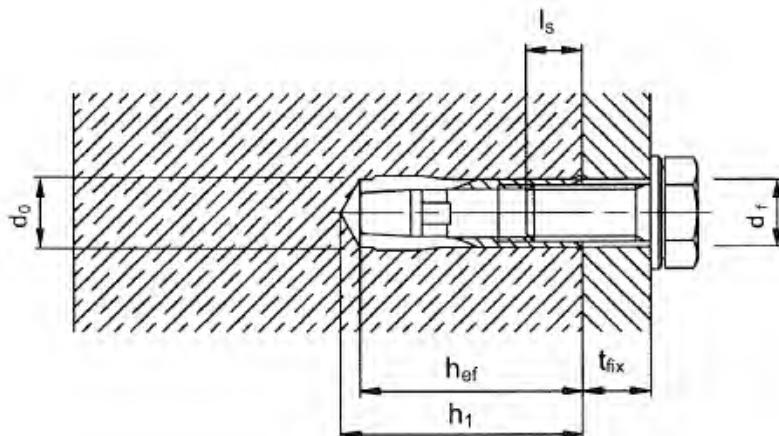
### Setting instruction



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

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 $h_{ef}$

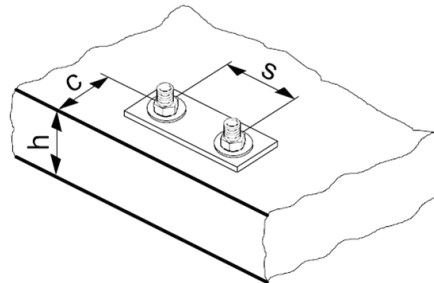


### Setting details

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

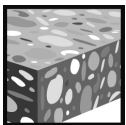
### Base material thickness, anchor spacing and edge distances

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

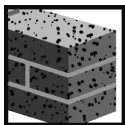


## HUD-1 Universal anchor

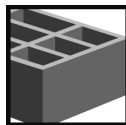
	Anchor version	Benefits
	<p>HUD-1</p>	<ul style="list-style-type: none"> <li>- fast setting</li> <li>- flexibility of screw length</li> <li>- an anchor for every base material</li> </ul>



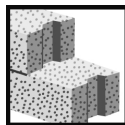
Concrete



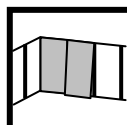
Solid brick



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	Screw type <sup>d)</sup>	5x25		6x30		8x40		10x50		12x60	14x70
		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 <sub>Rk</sub> [kN]	1,5	0,5	2,75	1,75	4,25	2,5	7	-	10	15
	V <sub>Rk</sub> [kN]	2	-	4,5	-	6,25	-	11	-	15	28
Solid clay brick Mz 20	N <sub>Rk</sub> [kN]	0,85	0,3	1,75	0,75	3	1,75	4	-	5	5 <sup>a)</sup>
	V <sub>Rk</sub> [kN]	1,2	-	1,5	-	2,2	-	-	-	-	-
Solid sand-lime brick KS 12	N <sub>Rk</sub> [kN]	1,25	0,75	2,5	1,5	4,25	2	5	-	7,5	7,5 <sup>a)</sup>
	V <sub>Rk</sub> [kN]	1,25	-	2,8	-	3,7	-	6,6	-	-	-
Hollow clay brick HlzB 12	N <sub>Rk</sub> [kN]	0,4	0,25	0,5	0,4	1	0,6	1,25	-	1,4	1,6
	V <sub>Rk</sub> [kN]	1,15	-	1,75	-	-	-	-	-	-	-
Hollow clay brick HlzB 12 – 15mm plastered	N <sub>Rk</sub> [kN]	0,4	0,25	0,75	0,5	1,25	0,75	1,5	-	1,75	2
	V <sub>Rk</sub> [kN]	1,15	-	1,75	-	-	-	-	-	-	-
Autoclaved aerated concrete AAC 2	N <sub>Rk</sub> [kN]	0,3	0,2	0,5	0,3	0,75	0,5	1	-	1,25	1,5
	V <sub>Rk</sub> [kN]	0,2	-	0,25	-	0,4	-	-	-	-	-
Autoclaved aerated concrete AAC 4	N <sub>Rk</sub> [kN]	0,5	0,3	0,75	0,5	1,5	1	2	-	2,5	3
	V <sub>Rk</sub> [kN]	0,65	-	0,9	-	1,5	-	-	-	-	-
Gypsum board Thickness 12,5mm	N <sub>Rk</sub> [kN]	0,2	0,3	0,25	0,4	0,3	0,5	-	0,75 <sup>b)</sup>	-	-
	V <sub>Rk</sub> [kN]	0,45	-	0,7	-	-	-	-	-	-	-
Gypsum board Thickness 2x12,5mm	N <sub>Rk</sub> [kN]	0,3	0,3	0,4	0,4	0,5	0,5	0,75 <sup>b)</sup>	1 <sup>b)</sup>	1,5 <sup>c)</sup>	-
	V <sub>Rk</sub> [kN]	0,45	-	0,7	-	-	-	-	-	-	-
Fibre reinforced gypsum board Thickness 12,5mm	N <sub>Rk</sub> [kN]	0,45	-	0,6	-	0,9	-	-	-	-	-
	V <sub>Rk</sub> [kN]	0,72	-	0,96	-	1,44	-	-	-	-	-
Fibre reinforced gypsum board Thickness 2x12,5mm	N <sub>Rk</sub> [kN]	0,45	-	1,2	-	1,8	-	2,1	-	-	-
	V <sub>Rk</sub> [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	Screw type <sup>d)</sup>	5x25		6x30		8x40		10x50		12x60	14x70
		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 <sub>Rd</sub> [kN]	0,42	0,14	0,77	0,49	1,19	0,70	1,96		2,80	4,20
	V <sub>Rd</sub> [kN]	0,56		1,26		1,75		3,08		4,20	7,84
Solid clay brick Mz 20	N <sub>Rd</sub> [kN]	0,24	0,08	0,49	0,21	0,84	0,49	1,12		1,40	1,40 <sup>c)</sup>
	V <sub>Rd</sub> [kN]	0,34		0,42		0,62					
Solid sand-lime brick KS 12	N <sub>Rd</sub> [kN]	0,35	0,21	0,70	0,42	1,19	0,56	1,40		2,10	2,10 <sup>c)</sup>
	V <sub>Rd</sub> [kN]	0,35		0,78		1,04		1,85			
Hollow clay brick HlzB 12	N <sub>Rd</sub> [kN]	0,11	0,07	0,14	0,11	0,28	0,17	0,35		0,39	0,45
	V <sub>Rd</sub> [kN]	0,32		0,49							
Hollow clay brick HlzB 12 – 15mm plastered	N <sub>Rd</sub> [kN]	0,11	0,07	0,21	0,14	0,35	0,21	0,42		0,49	0,56
	V <sub>Rd</sub> [kN]	0,32		0,49							
Autoclaved aerated concrete AAC 2	N <sub>Rd</sub> [kN]	0,08	0,06	0,14	0,08	0,21	0,14	0,28		0,35	0,42
	V <sub>Rd</sub> [kN]	0,06		0,07		0,11					
Autoclaved aerated concrete AAC 4	N <sub>Rd</sub> [kN]	0,14	0,08	0,21	0,14	0,42	0,28	0,56		0,70	0,84
	V <sub>Rd</sub> [kN]	0,18		0,25		0,42					
Gypsum board Thickness 12,5mm	N <sub>Rd</sub> [kN]	0,06	0,08	0,07	0,11	0,08	0,14		0,21 <sup>a)</sup>		
	V <sub>Rd</sub> [kN]	0,13		0,20							
Gypsum board Thickness 2x12,5mm	N <sub>Rd</sub> [kN]	0,08	0,08	0,11	0,11	0,14	0,14	0,21 <sup>a)</sup>	0,28 <sup>a)</sup>	0,42 <sup>b)</sup>	
	V <sub>Rd</sub> [kN]	0,13		0,20							
Fibre reinforced gypsum board Thickness 12,5mm	N <sub>Rd</sub> [kN]	0,13		0,17		0,25					
	V <sub>Rd</sub> [kN]	0,20		0,27		0,40					
Fibre reinforced gypsum board Thickness 2x12,5mm	N <sub>Rd</sub> [kN]	0,13		0,34		0,50		0,59			
	V <sub>Rd</sub> [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 <sup>e)</sup>

Anchor size	Screw type <sup>d)</sup>	5x25		6x30		8x40		10x50		12x60	14x70
		W	C	W	C	W	C	W	C	W	W
Concrete ≥ C16/20	N <sub>rec</sub> [kN]	0,3	0,1	0,55	0,35	0,85	0,5	1,4		2	3
	V <sub>rec</sub> [kN]	0,4		0,9		1,25		2,2		3	5,6
Solid clay brick Mz 20	N <sub>rec</sub> [kN]	0,17	0,06	0,35	0,15	0,6	0,35	0,8		1	1
	V <sub>rec</sub> [kN]	0,24		0,3		0,44					
Solid sand-lime brick KS 12	N <sub>rec</sub> [kN]	0,25	0,15	0,5	0,3	0,85	0,4	1		1,5	1,5
	V <sub>rec</sub> [kN]	0,25		0,56		0,74		1,32			
Hollow clay brick HlzB 12	N <sub>rec</sub> [kN]	0,08	0,05	0,1	0,08	0,2	0,12	0,25		0,28	0,32
	V <sub>rec</sub> [kN]	0,23		0,35							
Hollow clay brick HlzB 12 – 15mm plastered	N <sub>rec</sub> [kN]	0,08	0,05	0,15	0,1	0,25	0,15	0,3		0,35	0,4
	V <sub>rec</sub> [kN]	0,23		0,35							
Autoclaved aerated concrete AAC 2	N <sub>rec</sub> [kN]	0,06	0,04	0,1	0,06	0,15	0,1	0,2		0,25	0,3
	V <sub>rec</sub> [kN]	0,04		0,05		0,08					
Autoclaved aerated concrete AAC 4	N <sub>rec</sub> [kN]	0,1	0,06	0,15	0,1	0,3	0,2	0,4		0,5	0,6
	V <sub>rec</sub> [kN]	0,13		0,18		0,3					
Gypsum board Thickness 12,5mm	N <sub>rec</sub> [kN]	0,04	0,06	0,05	0,08	0,06	0,1		0,15		
	V <sub>rec</sub> [kN]	0,09		0,14							
Gypsum board Thickness 2x12,5mm	N <sub>rec</sub> [kN]	0,06	0,06	0,08	0,08	0,1	0,1	0,15	0,2	0,3	
	V <sub>rec</sub> [kN]	0,09		0,14							
Fibre reinforced gypsum board Thickness 12,5mm	N <sub>rec</sub> [kN]	0,09		0,12		0,18					
	V <sub>rec</sub> [kN]	0,14		0,19		0,29					
Fibre reinforced gypsum board Thickness 2x12,5mm	N <sub>rec</sub> [kN]	0,09		0,24		0,36		0,42			
	V <sub>rec</sub> [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  $\gamma = 5$  to the characteristic loads and a partial safety factor of  $\gamma = 1,4$  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

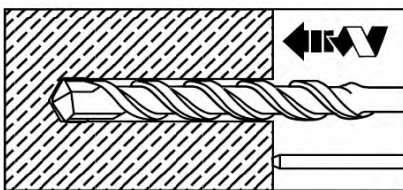
Part	Material
Plastic sleeve	Polyamide 6

### Setting

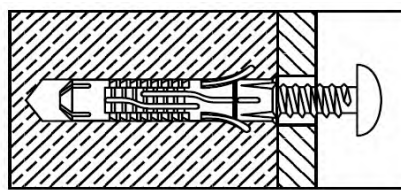
#### Installation equipment

Anchor size	5x25	6x30	8x40	10x50	12x60	14x70
Rotary hammer	TE 2 – TE 16					
Other tools	Screwdriver					

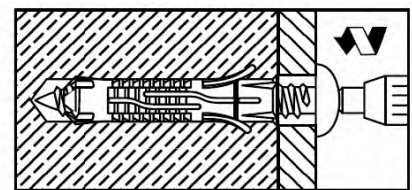
#### Setting instruction



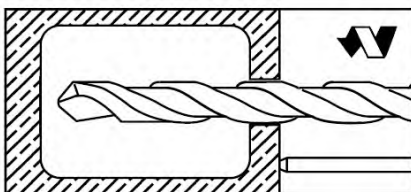
Drill hole with drill bit.



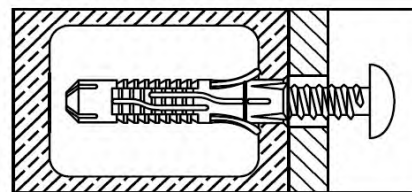
Install anchor.



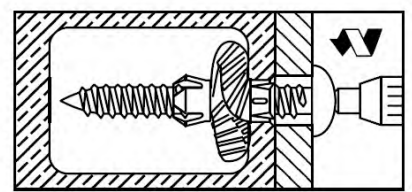
Drive screw into anchor.



Drill hole with drill bit.



Install anchor.



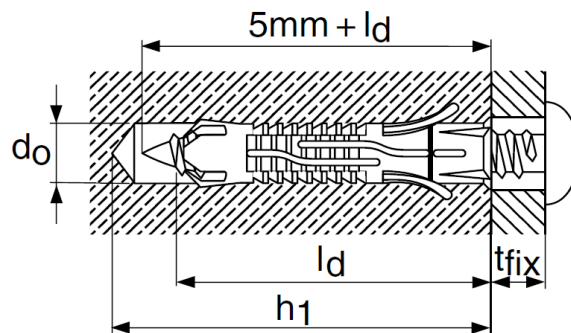
Drive screw into anchor.

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 $h_{ef}$





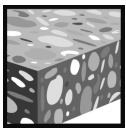
### Setting details HUD-1

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 <sup>a)</sup>	$d$ [mm]	3,5 - 4	4,5 - 5	5 - 6	7 - 8	8 - 10	10 - 12

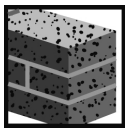
- a) The basic loading data are depending on the woodscrew diameters, if other types or different screws are used the load capacity may decrease. Highlighted diameters refer to basic loading data table, except footnotes <sup>a),b),c)</sup> of basic loading data tables.

## HUD-L Universal anchor

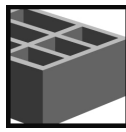
	Anchor version	Benefits
	HUD-L 6 HUD-L 8	<ul style="list-style-type: none"> <li>- universal plastic anchor for weak base materials and renovation</li> <li>- for many base materials</li> <li>- daily application</li> <li>- excellent setting behaviour</li> </ul>
	HUD-L 10	



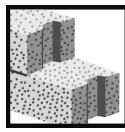
Concrete



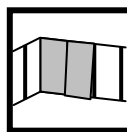
Solid brick



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 <sup>o)</sup>	Woodscrew 4,5x80 DIN 96	Woodscrew 5x90 DIN 96	Woodscrew 8mm DIN 571
Concrete ≥ C16/20	F <sub>Rk</sub> [kN]	1,15	1,4	9,0
Solid clay brick Mz 12	F <sub>Rk</sub> [kN]	0,85	1,0	-
Solid clay brick Mz 20	F <sub>Rk</sub> [kN]	-	-	7,0
Solid sand-lime brick KS 12	F <sub>Rk</sub> [kN]	0,85	1,0	2
Hollow clay brick Hlz 12 <sup>a)</sup>	F <sub>Rk</sub> [kN]	0,5	0,75	1,5
Hollow sand-lime brick KSL 12	F <sub>Rk</sub> [kN]	0,7	0,8	-
Autoclaved aerated concrete AAC 2 <sup>a)</sup>	F <sub>Rk</sub> [kN]	0,25	0,55	2,0
Gypsum board Thickness 2x12,5mm <sup>a)</sup>	F <sub>Rk</sub> [kN]	0,3	0,7	0,6 <sup>b)</sup>

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 <sup>c)</sup>	Woodscrew 4,5x80 DIN 96	Woodscrew 5x90 DIN 96	Woodscrew 8mm DIN 571
Concrete ≥ C16/20	F <sub>Rd</sub> [kN]	0,32	0,39	2,52
Solid clay brick Mz 12	F <sub>Rd</sub> [kN]	0,24	0,28	-
Solid clay brick Mz 20	F <sub>Rd</sub> [kN]	-	-	1,96
Solid sand-lime brick KS 12	F <sub>Rd</sub> [kN]	0,24	0,28	0,56
Hollow clay brick Hz 12 <sup>a)</sup>	F <sub>Rd</sub> [kN]	0,14	0,21	0,42
Hollow sand-lime brick KSL 12	F <sub>Rd</sub> [kN]	0,20	0,22	-
Autoclaved aerated concrete AAC 2 <sup>a)</sup>	F <sub>Rd</sub> [kN]	0,07	0,15	0,56
Gypsum board Thickness 2x12,5mm <sup>a)</sup>	F <sub>Rd</sub> [kN]	0,08	0,20	0,17 <sup>b)</sup>

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 <sup>d)</sup>**

Anchor size		HUD-L 6x50	HUD-L 8x60	HUD-L 10x70
	Screw type <sup>c)</sup>	Woodscrew 4,5x80 DIN 96	Woodscrew 5x90 DIN 96	Woodscrew 8mm DIN 571
Concrete ≥ C16/20	F <sub>rec</sub> [kN]	0,23	0,28	1,8
Solid clay brick Mz 12	F <sub>rec</sub> [kN]	0,17	0,2	-
Solid clay brick Mz 20	F <sub>rec</sub> [kN]	-	-	1,4
Solid sand-lime brick KS 12	F <sub>rec</sub> [kN]	0,17	0,2	0,4
Hollow clay brick Hz 12 <sup>a)</sup>	F <sub>rec</sub> [kN]	0,1	0,15	0,3
Hollow sand-lime brick KSL 12	F <sub>rec</sub> [kN]	0,14	0,16	-
Autoclaved aerated concrete AAC 2 <sup>a)</sup>	F <sub>rec</sub> [kN]	0,05	0,11	0,4
Gypsum board Thickness 2x12,5mm <sup>a)</sup>	F <sub>rec</sub> [kN]	0,06	0,14	0,12 <sup>b)</sup>

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

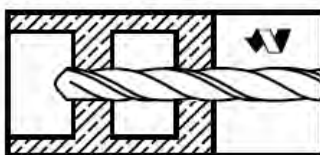
Part	Material
Plastic sleeve	Polyamide 6

### Setting

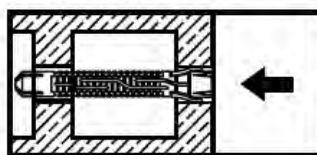
#### Installation equipment

Anchor size	HUD-L 6x50	HUD-L 8x60	HUD-L 10x70
Rotary hammer	TE 2 – TE 16		
Other tools	Screwdriver		

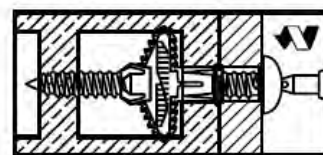
#### Setting instruction



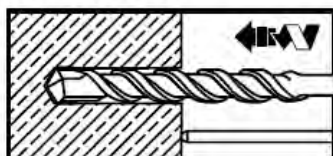
Drill hole with drill bit.



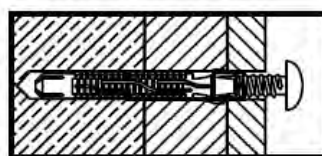
Install anchor.



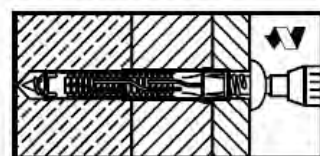
Put part being fastened in place and drive screw into anchor.



Drill hole with drill bit.



Put part being fastened in place and install anchor.

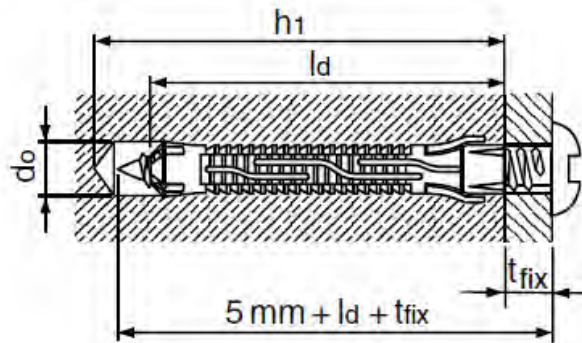


Drive screw into anchor.

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 $h_{ef}$




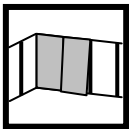
### Setting details HUD-L

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 <sup>a)</sup>	$d$ [mm]	<b>4,5 - 5</b>	<b>5 - 6</b>	<b>7 - 8</b>

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	<ul style="list-style-type: none"> <li>- plastic undercut anchor</li> <li>- simple setting</li> <li>- esp. for drywall applications</li> </ul>



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 <sup>a)</sup>						
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 $\geq$ C16/20	C	$F_{Rk}$	[kN]	1,25	2	2,5

a) See setting details

## Design resistance

Anchor size	Anchoring principle <sup>a)</sup>			HLD 2	HLD 3	HLD 4
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 $\geq$ C16/20	C	$F_{Rd}$	[kN]	0,35	0,56	0,70

a) See setting details

## Recommended loads <sup>b)</sup>

Anchor size	Anchoring principle <sup>a)</sup>			HLD 2	HLD 3	HLD 4
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 $\geq$ C16/20	C	$F_{rec}$	[kN]	0,25	0,4	0,5

a) See setting details

b) 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 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

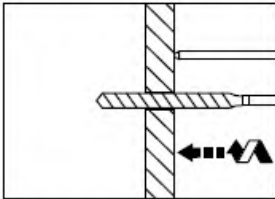
Part	Material
Sleeve	Polyamide PA 6

## Setting

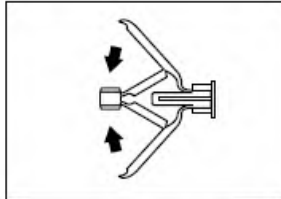
### Installation equipment

Anchor size		
Rotary hammer		TE 2 – TE 16
Other tools		Screwdriver

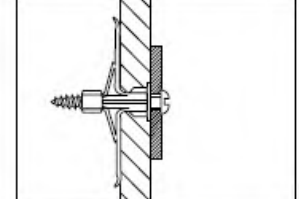
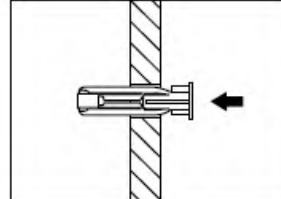
### Setting instruction



Drill hole with drill bit.



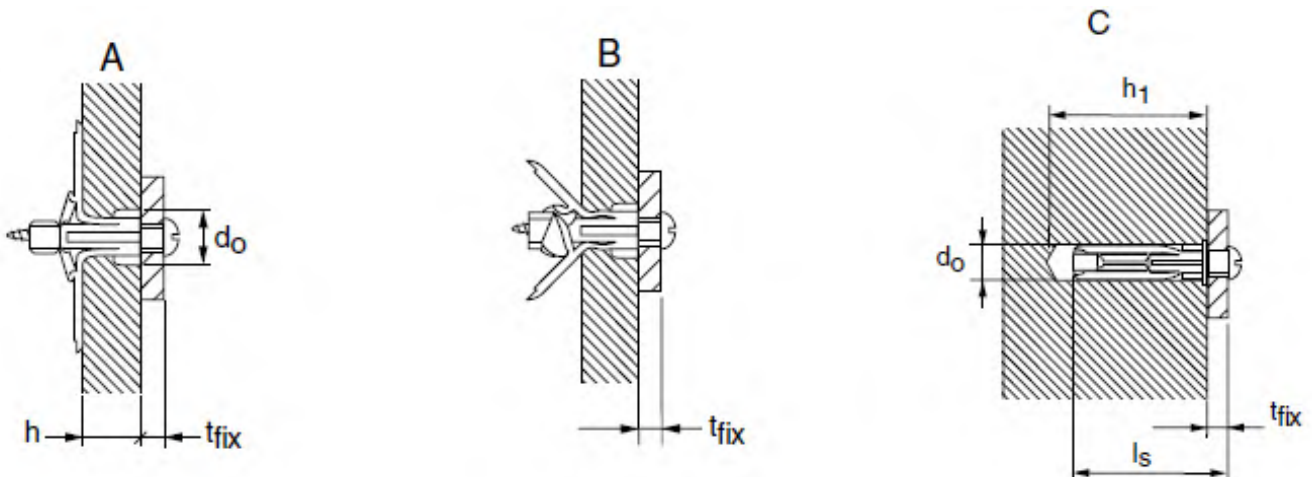
Install the HLD anchor.



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

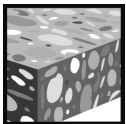
Anchor version			HLD 2	HLD 3	HLD 4
Nominal diameter of drill bit	$d_o$	[mm]	10		
Depth of drill hole	(only anchoring principle C)	$h_1 \geq$	50	56	66
Screw length	(anchoring principle A/B)	$l_s$	$33 + t_{fix}$	$40 + t_{fix}$	$49 + t_{fix}$
	(anchoring principle C)	$l_s$	$40 + t_{fix}$	$46 + t_{fix}$	$56 + t_{fix}$
Screw diameter	(anchoring principle A/B)	$d_s$	4 – 5		
	(anchoring principle C)	$d_s$	5 – 6		
Wall / panel thickness	(anchoring principle A)	$h$	4 – 12	15 – 19	24 – 28
	(anchoring principle B)	$h$	12 – 16	19 – 25	28 – 32
	(anchoring principle C)	$h \geq$	35	42	50
Installation temperature		[°C]	-10 to +40		



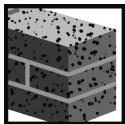


## HRD-U 10 / - S 10 / -U 14 Frame anchor

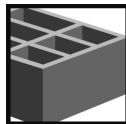
	Anchor version	Benefits
	HRD-U 10 Carbon steel Stainless steel	- universal frame anchor for façade, steelwork, and mechanical installation - base material versatility - excellent setting behaviour
	HRD-S 10 Carbon steel Stainless steel	
	HRD-U 14 Carbon steel Stainless steel	



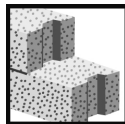
Concrete



Solid brick



Hollow brick



Autoclaved  
aerated  
concrete



Fire  
resistance

### Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Allgemeine bauaufsichtliche Zulassung (national German approval) <sup>a)</sup>	DIBt, Berlin	Z-21.2-599 / 2009-09-16
Fire test report	IBMB, Braunschweig	UB 3613/3891-1 Nau / 2001-11-23 UB 3613/3891-2 Nau / 2001-11-26

a) All data given in this section for HRD-U 10 / S 10 / U 14 according Z-21.2-599 01, issue 2009-09-16.

### 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

- The data that are highlighted in light grey are not part of the approvals

## 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 panels		$F_{rec}$ [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/mm <sup>2</sup> ]	600		
	Stainless steel [N/mm <sup>2</sup> ]	580		500
Yield strength $f_{yk}$	Carbon steel [N/mm <sup>2</sup> ]	480		
	Stainless steel [N/mm <sup>2</sup> ]	450		400
Stressed cross-section $A_s$	[mm <sup>2</sup> ]	31,2		56,8
Moment of resistance $W$	[mm <sup>3</sup> ]	24,6		60,4
Char. bending resistance $M_{Rk,s}^0$	Carbon steel [Nm]	17,7		43,5
	Stainless steel [Nm]	17,1		36,2

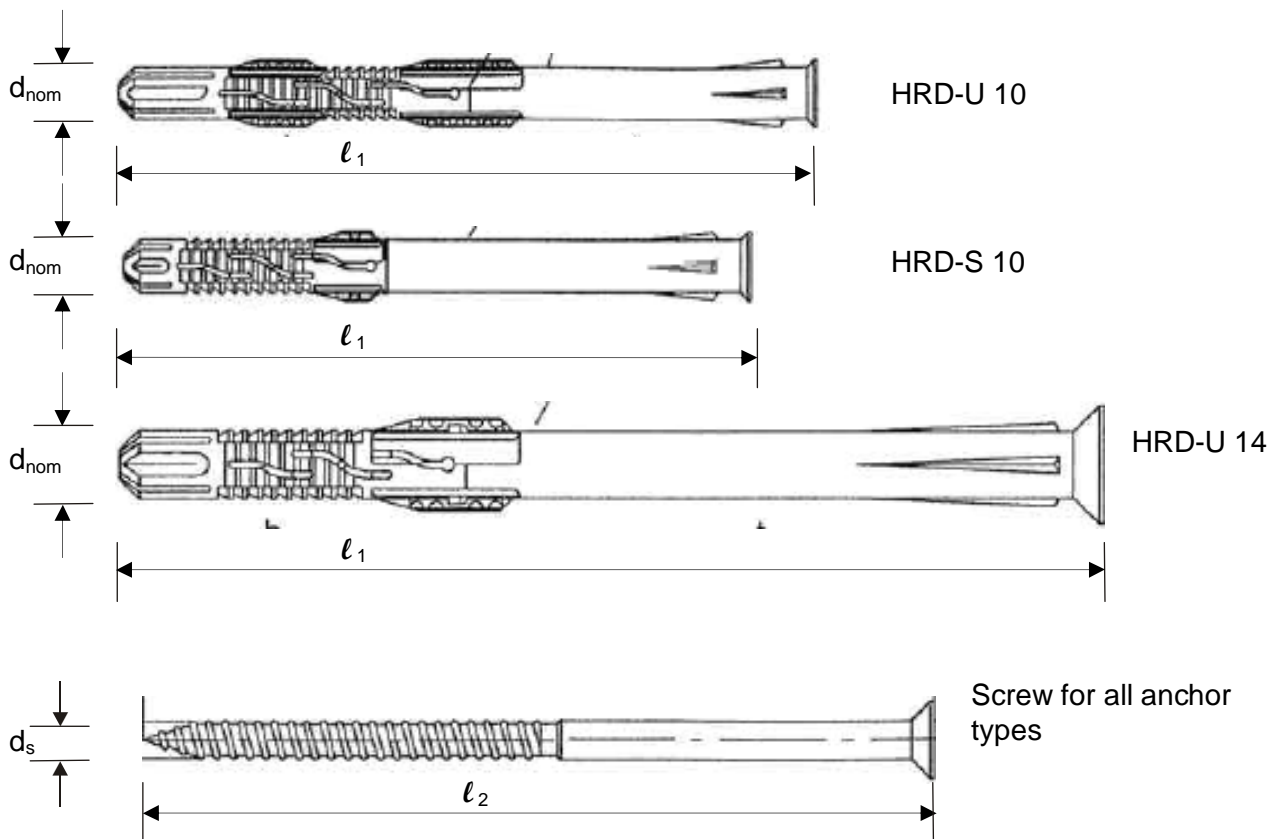
The recommended bending moment shall be calculated by dividing the characteristic bending moment by 1,4 and 1,25

### 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	$l_{1,min}$ [mm]	80	60	80	110
Maximum length of the sleeve	$l_{1,max}$ [mm]	230	180	350	330
Diameter of the screw	$d_s$ [mm]	7	7	10	10
Minimum length of the screw	$l_{2,min}$ [mm]	85	65	85	115
Maximum length of the screw	$l_{2,max}$ [mm]	235	285	355	335

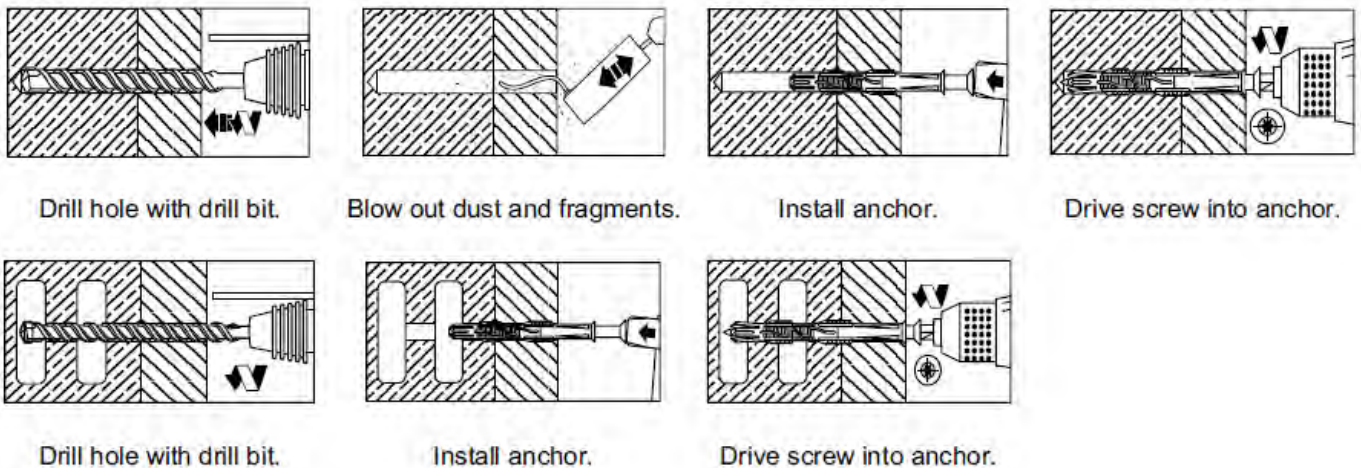


### Setting

#### Installation equipment

Anchor size	U 10	S 10	U 14
Rotary hammer	TE2 ... TE16		TE16... TE40
Other tools	hammer, screw driver		

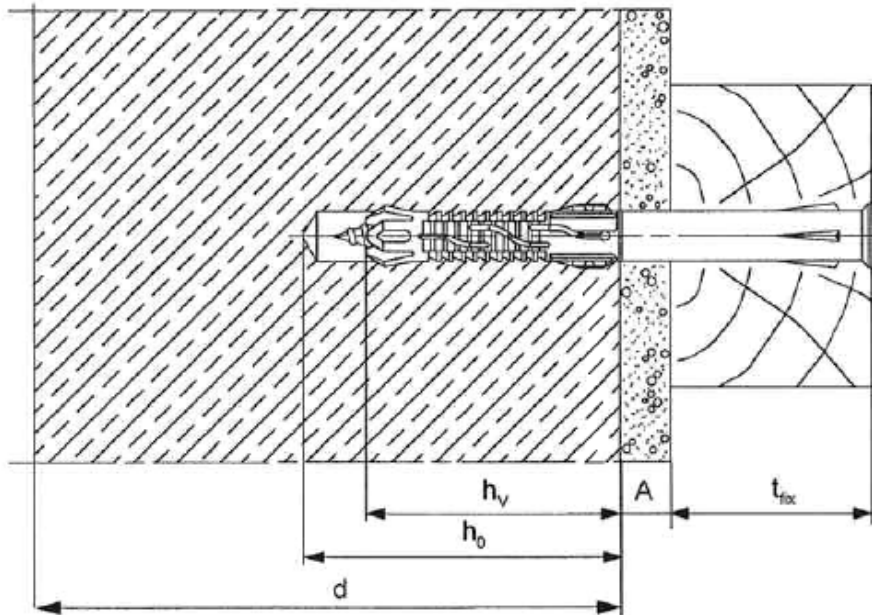
#### Setting instruction



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  $h_{nom}$**

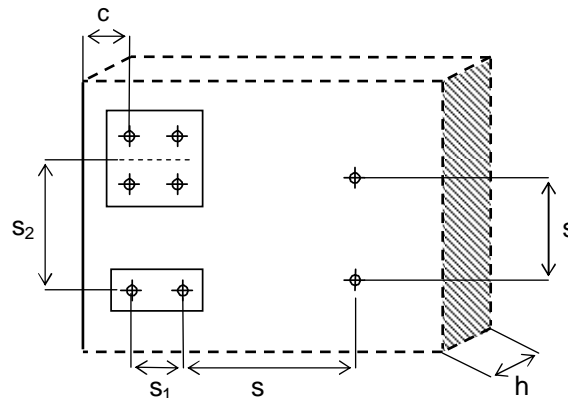


**Setting details HRD-U 10 / S 10 / U 14**

		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		

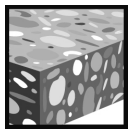
### Base material thickness, anchor spacing and edge distance

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
Solid masonry		$s_{min}$	[mm]	100	100	250
Hollow masonry		$s_{min}$	[mm]	250	250	250
AAC		$s_{min}$	[mm]	100 <sup>a)</sup>	-	-
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

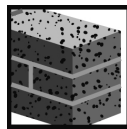
	Anchor version	Benefits
	HRD-C 8x HRD CR 8x	Innovative screw design for better hold Suitable on practically all base materials
	HRD-C 10x... HRD-CR 10x... HRD-CR2 10x...	Flexible embedment depth (approved at 50mm and 70mm)
	HRD-H 10x... HRD-HR 10x... HRD-HR2 10x... HRD-HF 10x...	Suitable for fastening thicknesses up to 260mm
	HRD-K 10x... HRD-KR 10x... HRD-KR2 10x...	Available in 4 different materials for optimum suitability in all corrosive environments
	HRD-P 10x... HRD-PR 10x... HRD-PR2 10x...	Pre-assembled for optimum handling and fastening quality



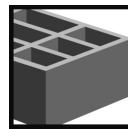
Concrete



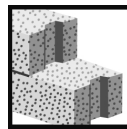
Tensile zone <sup>a)</sup>



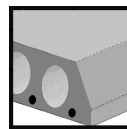
Solid brick



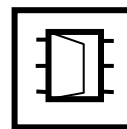
Hollow brick



Autoclaved aerated concrete



Prestressed hollow core slabs



Window frame



Fire resistance



European Technical Approval



CE conformity

<sup>a)</sup> Redundant fastening only

### Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval <sup>a)</sup>	DIBt, Berlin	ETA-07/0219 / 2011-10-19
Allgemeine bauaufsichtliche Zulassung <sup>c)</sup> (national German approval)	DIBt, Berlin	Z-21.2-1952 / 2011-10-31
Fire test report	MFPA, Leipzig	GS 3.2/10-157-1/ 2010-09-02
Window frame report <sup>b)</sup>	Ift, Rosenheim	Ift report 105 33035 / 2007-07-09

<sup>a)</sup> All data given in this section according ETA-07/0219, issue 2011-02-01. The anchor is to be used only for redundant fastening for non-structural applications.

<sup>b)</sup> only available for HRD 8

<sup>c)</sup> 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 <sup>b)</sup>	10,6 / 10,1 <sup>b)</sup> / 11,1 <sup>c)</sup>		-	
Concrete C 16/20 –C 50/60	$N_{Rk}$ [kN]		3,0	4,5	8,5	-	
	$V_{Rk}$ [kN]		6,9 / 6,6 <sup>b)</sup>	10,6 / 10,1 <sup>b)</sup> / 11,1 <sup>c)</sup>		-	
Solid clay brick Mz 2,0 DIN V 105-100 / EN 771-1	$f_b \geq 20 \text{ N/mm}^2$	$F_{Rk}$ [kN]	1,5	3,0 4,5 <sup>d)</sup>	f)	-	
	$f_b \geq 10 \text{ N/mm}^2$	$F_{Rk}$ [kN]	1,2	2,0 3,0 <sup>d)</sup>	f)	-	
Solid sand-lime brick KS 2,0 DIN V 106 / EN 771-2	$f_b \geq 20 \text{ N/mm}^2$	$F_{Rk}$ [kN]	2,5	3,0 4,5 <sup>d)</sup>	f)	-	
	$f_b \geq 10 \text{ N/mm}^2$	$F_{Rk}$ [kN]	2,0	2,0 3,0 <sup>d)</sup>	f)	-	
Lightweight solid block Vbl 0,9 DIN V 18151-100 / EN 771-3	$f_b \geq 20 \text{ N/mm}^2$	$F_{Rk}$ [kN]	-	3,5 6,0 <sup>d)</sup>	f)	-	
	$f_b \geq 10 \text{ N/mm}^2$	$F_{Rk}$ [kN]	-	2,5 4,5 <sup>d)</sup>	f)	-	
	$f_b \geq 6 \text{ N/mm}^2$	$F_{Rk}$ [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 A <sup>e)</sup>	brick $f_b \geq 12 \text{ N/mm}^2$	$F_{Rk}$ [kN]	0,50	-	-	-	
Vertically perforated clay brick Hlz 1,2-2DF F <sup>e)</sup>	brick $f_b \geq 8 \text{ N/mm}^2$	$F_{Rk}$ [kN]	-	1,5	-	-	
	brick $f_b \geq 10 \text{ N/mm}^2$	$F_{Rk}$ [kN]	-	2,0	-	-	
	brick $f_b \geq 12 \text{ N/mm}^2$	$F_{Rk}$ [kN]	-	2,0	-	-	
Vertically perforated clay brick Hlz 1,0-2DF G <sup>e)</sup>	brick $f_b \geq 8 \text{ N/mm}^2$	$F_{Rk}$ [kN]	-	0,4	0,75	-	
	brick $f_b \geq 10 \text{ N/mm}^2$	$F_{Rk}$ [kN]	-	0,5	0,9	-	
	brick $f_b \geq 12 \text{ N/mm}^2$	$F_{Rk}$ [kN]	-	0,6	0,9	-	
	brick $f_b \geq 20 \text{ N/mm}^2$	$F_{Rk}$ [kN]	-	0,9	1,5	-	
Vertically perforated clay brick VHlz 1,6-2DF brick H <sup>e)</sup>	brick $f_b \geq 28 \text{ N/mm}^2$	$F_{Rk}$ [kN]	-	2,0	2,5	-	
	brick $f_b \geq 50 \text{ N/mm}^2$	$F_{Rk}$ [kN]	-	3,0	3,5	-	
Vertically perforated clay brick Poroton T8 M <sup>e)</sup>	brick $f_b \geq 6 \text{ N/mm}^2$	$F_{Rk}$ [kN]	-	0,75	1,5	-	
Vertically perforated clay brick Hlz 1,0-9DF L <sup>e)</sup>	brick $f_b \geq 8 \text{ N/mm}^2$	$F_{Rk}$ [kN]	-	1,2	1,5	-	
	brick $f_b \geq 10 \text{ N/mm}^2$	$F_{Rk}$ [kN]	-	1,5	1,5	-	
	brick $f_b \geq 12 \text{ N/mm}^2$	$F_{Rk}$ [kN]	-	1,5	2,0	-	
	brick $f_b \geq 16 \text{ N/mm}^2$	$F_{Rk}$ [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 <b>O<sup>e)</sup></b>	brick	$f_b \geq 12 \text{ N/mm}^2$	$F_{Rk}$	[kN]	0,75	-	-	-
Vertically perforated sand-lime brick KSL 1,6-2DF	brick <b>P<sup>e)</sup></b>	$f_b \geq 8 \text{ N/mm}^2$	$F_{Rk}$	[kN]	-	1,5	-	-
		$f_b \geq 10 \text{ N/mm}^2$	$F_{Rk}$	[kN]	-	1,5	-	-
		$f_b \geq 12 \text{ N/mm}^2$	$F_{Rk}$	[kN]	-	2,0	-	-
Vertically perforated sand-lime brick KSL 1,4-3DF	brick <b>Q<sup>e)</sup></b>	$f_b \geq 8 \text{ N/mm}^2$	$F_{Rk}$	[kN]	-	-	2,0	-
		$f_b \geq 10 \text{ N/mm}^2$	$F_{Rk}$	[kN]	-	-	2,5	-
		$f_b \geq 12 \text{ N/mm}^2$	$F_{Rk}$	[kN]	-	-	3,0	-
Vertically perforated sand-lime brick KSL R 1,6-16DF	brick <b>R<sup>e)</sup></b>	$f_b \geq 8 \text{ N/mm}^2$	$F_{Rk}$	[kN]	-	0,9	1,2	-
		$f_b \geq 10 \text{ N/mm}^2$	$F_{Rk}$	[kN]	-	1,2	1,5	-
		$f_b \geq 12 \text{ N/mm}^2$	$F_{Rk}$	[kN]	-	1,5	2,0	-
		$f_b \geq 16 \text{ N/mm}^2$	$F_{Rk}$	[kN]	-	2,0	2,5	-
Lightweight hollow brick Hbl 2/0,8 <b>S<sup>e)</sup></b>	brick	$f_b \geq 2 \text{ N/mm}^2$	$F_{Rk}$	[kN]	0,30	-	-	-
Lightweight concrete hollow block Hbl 1,2-12DF	brick <b>T<sup>e)</sup></b>	$f_b \geq 2 \text{ N/mm}^2$	$F_{Rk}$	[kN]	-	0,5	0,75	-
		$f_b \geq 6 \text{ N/mm}^2$	$F_{Rk}$	[kN]	-	1,2	2,0	-
Ital. Hollow brick Mattone <b>E<sup>e)</sup></b>	brick	$f_b \geq 22 \text{ N/mm}^2$	$F_{Rk}$	[kN]	1,5	-	-	-
Ital. Hollow brick Poroton P700	brick <b>N<sup>e)</sup></b>	$f_b \geq 15 \text{ N/mm}^2$	$F_{Rk}$	[kN]	-	-	0,6	-
Ital. Hollow brick Doppio Uni <b>C+I<sup>e)</sup></b>	brick	$f_b \geq 25 \text{ N/mm}^2$	$F_{Rk}$	[kN]	0,9 (C)	-	1,5 (I)	-
Span. Hollow brick Rojo hidrofugano <b>D<sup>e)</sup></b>	brick	$f_b \geq 40 \text{ N/mm}^2$	$F_{Rk}$	[kN]	0,60	-	-	-
Span. Hollow brick Ladrillo perforado <b>J<sup>e)</sup></b>	brick	$f_b \geq 26 \text{ N/mm}^2$	$F_{Rk}$	[kN]	-	1,5	2,0	-
Span. Hollow brick Clinker mediterraneo	brick <b>K<sup>e)</sup></b>	$f_b \geq 75 \text{ N/mm}^2$	$F_{Rk}$	[kN]	-	-	1,5	-
French Hollow brick Brique Creuse	brick <b>B<sup>e)</sup></b>	$f_b \geq 6 \text{ N/mm}^2$	$F_{Rk}$	[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
		AAC 6	$F_{Rk}$	[kN]	-	-	3,5 <sup>d)</sup>	4,5 <sup>d)</sup>

### 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 <sup>b)</sup>	8,5 / 8,1 <sup>b)</sup> / 8,5 <sup>c)</sup>		-
Concrete C 16/20 –C 50/60	$N_{Rd}$ [kN]		1,7	2,5	4,7	-
	$V_{Rd}$ [kN]		5,5 / 5,2 <sup>b)</sup>	8,5 / 8,1 <sup>b)</sup> / 8,5 <sup>c)</sup>		-
Solid clay brick Mz 2,0 DIN V 105-100 / EN 771-1	$f_b \geq 20 \text{ N/mm}^2$	$F_{Rd}$ [kN]	0,6	1,2 1,8 <sup>d)</sup>	f)	-
	$f_b \geq 10 \text{ N/mm}^2$	$F_{Rd}$ [kN]	0,48	0,8 1,2 <sup>d)</sup>	f)	-
Solid sand-lime brick KS 2,0 DIN V 106 / EN 771-2	$f_b \geq 20 \text{ N/mm}^2$	$F_{Rd}$ [kN]	1,0	1,2 1,8 <sup>d)</sup>	f)	-
	$f_b \geq 10 \text{ N/mm}^2$	$F_{Rd}$ [kN]	0,8	0,8 1,2 <sup>d)</sup>	f)	-
Lightweight solid block Vbl 0,9 DIN V 18151-100 / EN 771-3	$f_b \geq 20 \text{ N/mm}^2$	$F_{Rd}$ [kN]	-	1,4 2,4 <sup>d)</sup>	f)	-
	$f_b \geq 10 \text{ N/mm}^2$	$F_{Rd}$ [kN]	-	1,0 1,8 <sup>d)</sup>	f)	-
	$f_b \geq 6 \text{ N/mm}^2$	$F_{Rd}$ [kN]	0,2	-	-	-
Ital. solid brick Tufo	$f_b \geq n/a$	$F_{Rd}$ [kN]	0,56	-	-	-
Hollow clay brick Hlz B 12/1,2 brick <b>A</b> <sup>e)</sup>	$f_b \geq 12 \text{ N/mm}^2$	$F_{Rd}$ [kN]	0,2	-	-	-
Vertically perforated clay brick Hlz 1,2-2DF brick <b>F</b> <sup>e)</sup>	$f_b \geq 8 \text{ N/mm}^2$	$F_{Rd}$ [kN]	-	0,6	-	-
	$f_b \geq 10 \text{ N/mm}^2$	$F_{Rd}$ [kN]	-	0,8	-	-
	$f_b \geq 12 \text{ N/mm}^2$	$F_{Rd}$ [kN]	-	0,8	-	-
Vertically perforated clay brick Hlz 1,0-2DF brick <b>G</b> <sup>e)</sup>	$f_b \geq 8 \text{ N/mm}^2$	$F_{Rd}$ [kN]	-	0,16	0,3	-
	$f_b \geq 10 \text{ N/mm}^2$	$F_{Rd}$ [kN]	-	0,2	0,36	-
	$f_b \geq 12 \text{ N/mm}^2$	$F_{Rd}$ [kN]	-	0,24	0,36	-
	$f_b \geq 20 \text{ N/mm}^2$	$F_{Rd}$ [kN]	-	0,36	0,6	-
Vertically perforated clay brick VHlz 1,6-2DF brick <b>H</b> <sup>e)</sup>	$f_b \geq 28 \text{ N/mm}^2$	$F_{Rd}$ [kN]	-	0,8	1,0	-
	$f_b \geq 50 \text{ N/mm}^2$	$F_{Rd}$ [kN]	-	1,2	1,4	-
Vertically perforated clay brick Poroton T8 brick <b>M</b> <sup>e)</sup>	$f_b \geq 6 \text{ N/mm}^2$	$F_{Rd}$ [kN]	-	0,3	0,6	-
Vertically perforated clay brick Hlz 1,0-9DF brick <b>L</b> <sup>e)</sup>	$f_b \geq 8 \text{ N/mm}^2$	$F_{Rd}$ [kN]	-	0,48	0,6	-
	$f_b \geq 10 \text{ N/mm}^2$	$F_{Rd}$ [kN]	-	0,6	0,6	-
	$f_b \geq 12 \text{ N/mm}^2$	$F_{Rd}$ [kN]	-	0,6	0,8	-
	$f_b \geq 16 \text{ N/mm}^2$	$F_{Rd}$ [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 <b>O<sup>e)</sup></b>	brick	$f_b \geq 12 \text{ N/mm}^2$	$F_{Rd}$	[kN]	0,3	-	-	-
Vertically perforated sand-lime brick KSL 1,6-2DF	brick <b>P<sup>e)</sup></b>	$f_b \geq 8 \text{ N/mm}^2$	$F_{Rd}$	[kN]	-	0,6	-	-
		$f_b \geq 10 \text{ N/mm}^2$	$F_{Rd}$	[kN]	-	0,6	-	-
		$f_b \geq 12 \text{ N/mm}^2$	$F_{Rd}$	[kN]	-	0,8	-	-
Vertically perforated sand-lime brick KSL 1,4-3DF	brick <b>Q<sup>e)</sup></b>	$f_b \geq 8 \text{ N/mm}^2$	$F_{Rd}$	[kN]	-	-	0,8	-
		$f_b \geq 10 \text{ N/mm}^2$	$F_{Rd}$	[kN]	-	-	1,0	-
		$f_b \geq 12 \text{ N/mm}^2$	$F_{Rd}$	[kN]	-	-	1,2	-
Vertically perforated sand-lime brick KSL R 1,6-16DF	brick <b>R<sup>e)</sup></b>	$f_b \geq 8 \text{ N/mm}^2$	$F_{Rd}$	[kN]	-	0,36	0,48	-
		$f_b \geq 10 \text{ N/mm}^2$	$F_{Rd}$	[kN]	-	0,48	0,6	-
		$f_b \geq 12 \text{ N/mm}^2$	$F_{Rd}$	[kN]	-	0,6	0,8	-
		$f_b \geq 16 \text{ N/mm}^2$	$F_{Rd}$	[kN]	-	0,8	1,0	-
Lightweight hollow brick Hbl 2/0,8	brick <b>S<sup>e)</sup></b>	$f_b \geq 2 \text{ N/mm}^2$	$F_{Rd}$	[kN]	0,12	-	-	-
Lightweight concrete hollow block Hbl 1,2-12DF	brick <b>T<sup>e)</sup></b>	$f_b \geq 2 \text{ N/mm}^2$	$F_{Rd}$	[kN]	-	0,2	0,3	-
		$f_b \geq 6 \text{ N/mm}^2$	$F_{Rd}$	[kN]	-	0,48	0,8	-
Ital. Hollow brick Mattone	brick <b>E<sup>e)</sup></b>	$f_b \geq 22 \text{ N/mm}^2$	$F_{Rk}$	[kN]	0,6	-	-	-
Ital. Hollow brick Poroton P700	brick <b>N<sup>e)</sup></b>	$f_b \geq 15 \text{ N/mm}^2$	$F_{Rd}$	[kN]	-	-	0,24	-
Ital. Hollow brick Doppio Uni	brick <b>C+I<sup>e)</sup></b>		$F_{Rd}$	[kN]	0,36 (C)	-	0,6 (I)	-
Span. Hollow brick Rojo hidrofugano	brick <b>D<sup>e)</sup></b>	$f_b \geq 40 \text{ N/mm}^2$	$F_{Rd}$	[kN]	0,24	-	-	-
Span. Hollow brick Ladrillo perforado	brick <b>J<sup>e)</sup></b>	$f_b \geq 26 \text{ N/mm}^2$	$F_{Rd}$	[kN]	-	0,6	0,8	-
Span. Hollow brick Clinker mediterraneo	brick <b>K<sup>e)</sup></b>	$f_b \geq 75 \text{ N/mm}^2$	$F_{Rd}$	[kN]	-	-	0,6	-
French Hollow brick Brique Creuse	brick <b>B<sup>e)</sup></b>	$f_b \geq 6 \text{ N/mm}^2$	$F_{Rd}$	[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 <sup>d)</sup>	2,25 <sup>d)</sup>

Recommended loads <sup>a)</sup>

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 <sup>b)</sup>	6,1 / 5,8 <sup>b)</sup> / 6,1 <sup>c)</sup>		-	
Concrete C 16/20 –C 50/60	$N_{rec}$ [kN]		1,2	1,8	3,4	-	
	$V_{rec}$ [kN]		3,9 / 3,7 <sup>b)</sup>	6,1 / 5,8 <sup>b)</sup> / 6,1 <sup>c)</sup>		-	
Solid clay brick Mz 2,0 DIN V 105-100 / EN 771-1	$f_b \geq 20 \text{ N/mm}^2$	$F_{rec}$ [kN]	0,42	0,85 1,28 <sup>d)</sup>	f)	-	
	$f_b \geq 10 \text{ N/mm}^2$	$F_{rec}$ [kN]		0,57 0,85 <sup>d)</sup>			
Solid sand-lime brick KS 2,0 DIN V 106 / EN 771-2	$f_b \geq 20 \text{ N/mm}^2$	$F_{rec}$ [kN]	0,7	0,85 1,28 <sup>d)</sup>	f)	-	
	$f_b \geq 10 \text{ N/mm}^2$	$F_{rec}$ [kN]		0,57 0,85 <sup>d)</sup>			
Lightweight solid block Vbl 0,9 DIN V 18151-100 / EN 771-3	$f_b \geq 20 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	1,0 1,71 <sup>d)</sup>	f)	-	
	$f_b \geq 10 \text{ N/mm}^2$	$F_{rec}$ [kN]		0,71 1,28 <sup>d)</sup>			
	$f_b \geq 6 \text{ N/mm}^2$	$F_{rec}$ [kN]	0,14	-	-	-	
Ital. solid brick Tufo	$f_b \geq n/a$	$F_{rec}$ [kN]	0,4	-	-	-	
Hollow clay brick Hz B 12/1,2 <b>A</b> <sup>e)</sup>	brick $f_b \geq 12 \text{ N/mm}^2$	$F_{rec}$ [kN]	0,14	-	-	-	
Vertically perforated clay brick Hz 1,2-2DF <b>F</b> <sup>e)</sup>	brick $f_b \geq 8 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	0,42	-	-	
	$f_b \geq 10 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	0,57	-	-	
	$f_b \geq 12 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	0,57	-	-	
Vertically perforated clay brick Hz 1,0-2DF <b>G</b> <sup>e)</sup>	brick $f_b \geq 8 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	0,11	0,21	-	
	$f_b \geq 10 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	0,14	0,25	-	
	$f_b \geq 12 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	0,17	0,25	-	
	$f_b \geq 20 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	0,25	0,42	-	
Vertically perforated clay brick VHz 1,6-2DF brick <b>H</b> <sup>e)</sup>	$f_b \geq 28 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	0,57	0,71	-	
	$f_b \geq 50 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	0,85	1,0	-	
Vertically perforated clay brick Poroton T8 <b>M</b> <sup>e)</sup>	brick $f_b \geq 6 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	0,21	0,42	-	
Vertically perforated clay brick Hz 1,0-9DF <b>L</b> <sup>e)</sup>	brick $f_b \geq 8 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	0,34	0,42	-	
	$f_b \geq 10 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	0,42	0,42	-	
	$f_b \geq 12 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	0,42	0,57	-	
	$f_b \geq 16 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	0,57	0,85	-	

**Recommended loads <sup>a)</sup>**

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 <b>O</b> <sup>e)</sup>	$f_b \geq 12 \text{ N/mm}^2$	$F_{rec}$ [kN]	0,21	-	-	-
	$f_b \geq 8 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	0,42	-	-
Vertically perforated sand-lime brick KSL 1,6-2DF brick <b>P</b> <sup>e)</sup>	$f_b \geq 10 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	0,42	-	-
	$f_b \geq 12 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	0,57	-	-
	$f_b \geq 8 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	-	0,57	-
Vertically perforated sand-lime brick KSL 1,4-3DF brick <b>Q</b> <sup>e)</sup>	$f_b \geq 10 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	-	0,71	-
	$f_b \geq 12 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	-	0,85	-
	$f_b \geq 8 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	0,25	0,34	-
Vertically perforated sand-lime brick KSL R 1,6-16DF brick <b>R</b> <sup>e)</sup>	$f_b \geq 10 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	0,34	0,42	-
	$f_b \geq 12 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	0,42	0,57	-
	$f_b \geq 16 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	0,57	0,71	-
Lightweight hollow brick Hbl 2/0,8 brick <b>S</b> <sup>e)</sup>	$f_b \geq 2 \text{ N/mm}^2$	$F_{rec}$ [kN]	0,09	-	-	-
Lightweight concrete hollow block Hbl 1,2-12DF brick <b>T</b> <sup>e)</sup>	$f_b \geq 2 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	0,14	0,21	-
	$f_b \geq 6 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	0,34	0,57	-
Ital. Hollow brick Mattone brick <b>E</b> <sup>e)</sup>	$f_b \geq 22 \text{ N/mm}^2$	$F_{rec}$ [kN]	0,43	-	-	-
Ital. Hollow brick Poroton P700 brick <b>N</b> <sup>e)</sup>	$f_b \geq 15 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	-	0,17	-
Ital. Hollow brick Doppio Uni brick <b>C+I</b> <sup>e)</sup>	$f_b \geq 25 \text{ N/mm}^2$	$F_{rec}$ [kN]	0,25 (C)	-	0,42 (I)	-
Span. Hollow brick Rojo hidrofugano brick <b>D</b> <sup>e)</sup>	$f_b \geq 40 \text{ N/mm}^2$	$F_{rec}$ [kN]	0,17	-	-	-
Span. Hollow brick Ladrillo perforado brick <b>J</b> <sup>e)</sup>	$f_b \geq 26 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	0,42	0,57	-
Span. Hollow brick Clinker mediterraneo brick <b>K</b> <sup>e)</sup>	$f_b \geq 75 \text{ N/mm}^2$	$F_{rec}$ [kN]	-	-	0,42	-
French Hollow brick Brique Creuse brick <b>B</b> <sup>e)</sup>	$f_b \geq 6 \text{ N/mm}^2$	$F_{rec}$ [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 <sup>d)</sup>	1,6 <sup>d)</sup>

- a) With 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.
- b) Values for hot-dip galvanized carbon steel
- c) Values for stainless steel
- d) Valid for edge distance  $c \geq 150mm$ , 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.

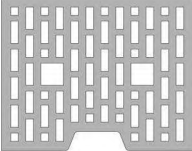
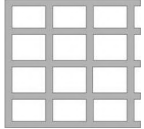


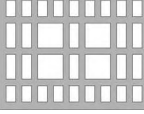
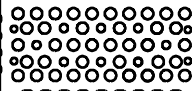
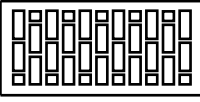
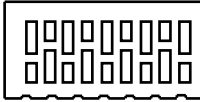
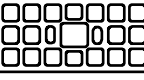
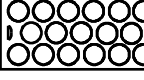
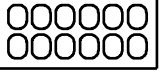
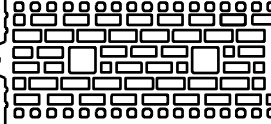
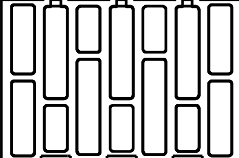
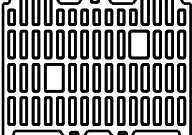
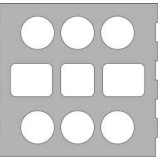
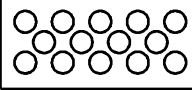
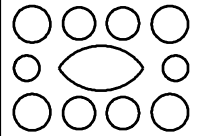
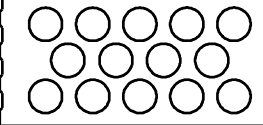

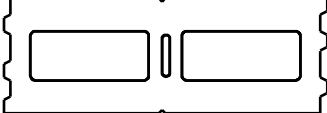
**Characteristic resistance for pull-out failure (plastic sleeve) for use in concrete**

Anchor type		HRD 8	HRD 10	
<b>Pull-out failure in <u>standard concrete slabs</u></b>				
Embedment depth	$h_{nom} \geq$ [mm]	50	50	70
Characteristic resistance	$\geq$ 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	$\gamma_{Mc}^{a)}$	1,8		
<b>Pull-out failure in <u>thin skins (weather resistant skins of external wall panels)</u></b>				
Embedment depth	$h_{nom} \geq$ [mm]	-	50	-
Characteristic resistance	$h = 40\text{mm}$ $\geq$ C16/20 $N_{Rk,p}$ [kN]	-	3,5	-
	to 100mm C12/15 $N_{Rk,p}$ [kN]	-	2,5	-
Partial safety factor	$\gamma_{Mc}^{a)}$	1,8		
<b>Pull-out failure in <u>precast prestressed hollow core slabs</u></b>				
Embedment depth	$h_{nom} \geq$ [mm]	-	50	-
Characteristic resistance	$d_b \geq 25\text{mm}$ $\geq$ C35/45 $N_{Rk,p}$ [kN]	-	0,6	-
	$d_b \geq 30\text{mm}$ $\geq$ C35/45 $N_{Rk,p}$ [kN]	-	1,5	-
	$d_b \geq 35\text{mm}$ $\geq$ C35/45 $N_{Rk,p}$ [kN]	-	2,5	-
	$d_b \geq 40\text{mm}$ $\geq$ C35/45 $N_{Rk,p}$ [kN]	-	3,5	-
Partial safety factor	$\gamma_{Mc}^{a)}$	1,8		

a) In absence of other national regulations



### Specification of hollow base material brick types

Specification	Picture / drilling method	Specification	Picture / drilling method
<b>Hollow clay bricks according EN 771-1</b>			
brick <b>A</b> Hlz B 12/1,2 LxWxH [mm]: 300x240x248 hmin [mm]: 240	 Rotary drilling	brick <b>B</b> Brique Creuse LxWxH [mm]: 210x198x... hmin [mm]: 210	 Rotary drilling
brick <b>C</b> Doppio Uni LxWxH [mm]: 230x120x100 hmin [mm]: 120	 Rotary drilling	brick <b>D</b> Rojo hidrofugano LxWxH [mm]: 240x115x50 hmin [mm]: 115	 Rotary drilling
brick <b>E</b> Mattone LxWxH [mm]: 240x180x100 hmin [mm]: 180	 Rotary drilling	brick <b>F</b> Hlz 1,2-2DF LxWxH [mm]: 240x115x113 hmin [mm]: 115	 Hammer drilling
brick <b>G</b> Hlz 1,0-2DF LxWxH [mm]: 240x115x113 hmin [mm]: 110	 Hammer drilling	brick <b>H</b> VHlz 1,6-2DF LxWxH [mm]: 240x115x113 hmin [mm]: 115	 Hammer drilling
brick <b>I</b> Doppio Uni LxWxH [mm]: 250x120x190 hmin [mm]: 120	 Rotary drilling	brick <b>J</b> Ladrillo perforado LxWxH [mm]: 240x110x100 hmin [mm]: 110	 Rotary drilling
brick <b>K</b> Clinker mediterraneo LxWxH [mm]: 240x113x50 hmin [mm]: 113	 Hammer drilling	brick <b>L</b> Hlz 1,0-9DF LxWxH [mm]: 372x175x238 hmin [mm]: 175	 Rotary drilling
brick <b>M</b> Poroton T8 LxWxH [mm]: 248x365x249 hmin [mm]: 365	 Rotary drilling	brick <b>N</b> Poroton P700 LxWxH [mm]: 225x300x190 hmin [mm]: 300	 Rotary drilling
<b>Hollow sand-lime bricks according EN 771-2</b>			
brick <b>O</b> KSL 12/1,4 LxWxH [mm]: 240x248x248 hmin [mm]: 240	 Hammer drilling	brick <b>P</b> KS L 1,6-2DF LxWxH [mm]: 240x115x113 hmin [mm]: 115	 Hammer drilling
brick <b>Q</b> KS L 1,4-3DF LxWxH [mm]: 240x175x113 hmin [mm]: 175	 Hammer drilling	brick <b>R</b> KS L R 1,6-16DF LxWxH [mm]: 480x240x248 hmin [mm]: 240	 Rotary drilling
<b>Lightweight concrete hollow block according EN 771-3</b>			
brick <b>S</b> Hbl 2/0,8 LxWxH [mm]: 497x240x248 hmin [mm]: 240	 Hammer drilling	brick <b>T</b> 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 <sup>a)</sup>
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/mm <sup>2</sup> ]	600	580	600	600	630
Yield strength $f_{yk}$	[N/mm <sup>2</sup> ]	480	450	480	480	480
Stressed cross-section $A_s$	[mm <sup>2</sup> ]	22,9	22,9	35,3	33,7	35,3
Moment of resistance $W$	[mm <sup>3</sup> ]	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

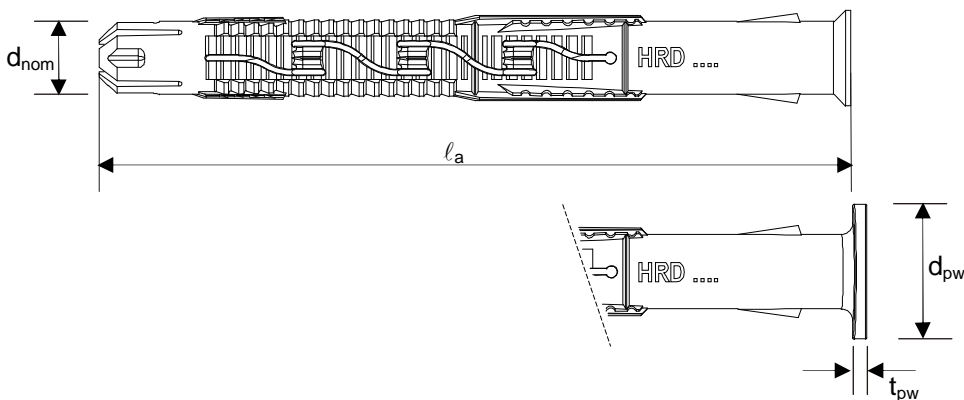
### Material quality

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

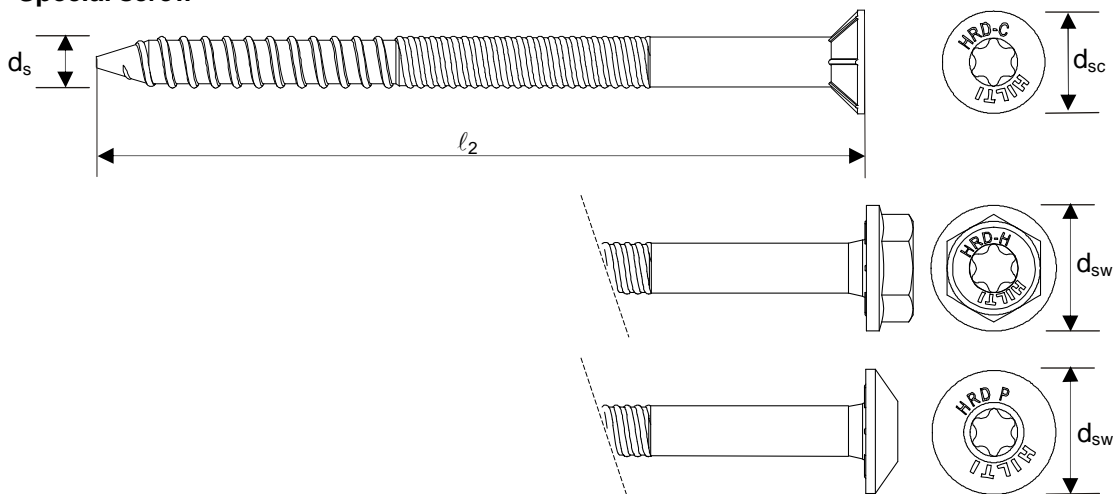
### Anchor dimensions

Anchor size		HRD 8	HRD 10
Minimum thickness of fixture	$t_{\text{fix,min}}$ [mm]	0	0
Maximum thickness of fixture	$t_{\text{fix,max}}$ [mm]	90	260
Diameter of the sleeve	$d_{\text{nom}}$ [mm]	8	10
Minimum length of the sleeve	$l_{1,\text{min}}$ [mm]	60	60
Maximum length of the sleeve	$l_{1,\text{max}}$ [mm]	140	310
Diameter of plastic washer	$d_{\text{pw}}$ [mm]	-	17,5
Thickness of plastic washer	$t_{\text{pw}}$ [mm]	-	2
Diameter of the screw	$d_{\text{s}}$ [mm]	6	7
Minimum length of the screw	$l_{2,\text{min}}$ [mm]	65	65
Maximum length of the screw	$l_{2,\text{max}}$ [mm]	145	315
Head diameter of countersunk screw	$d_{\text{sc}}$ [mm]	11	14
Head diameter of hexhead screw	$d_{\text{sw}}$ [mm]	-	17,5

#### Anchor sleeve



#### Special screw

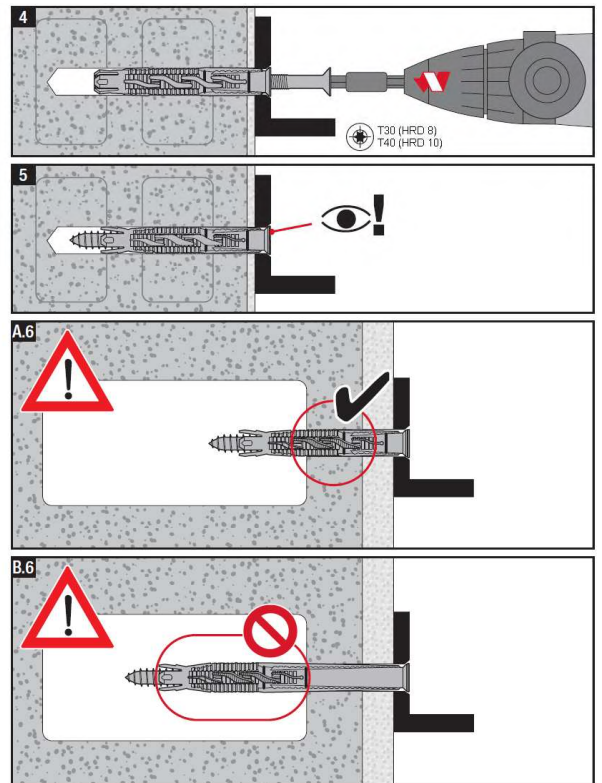
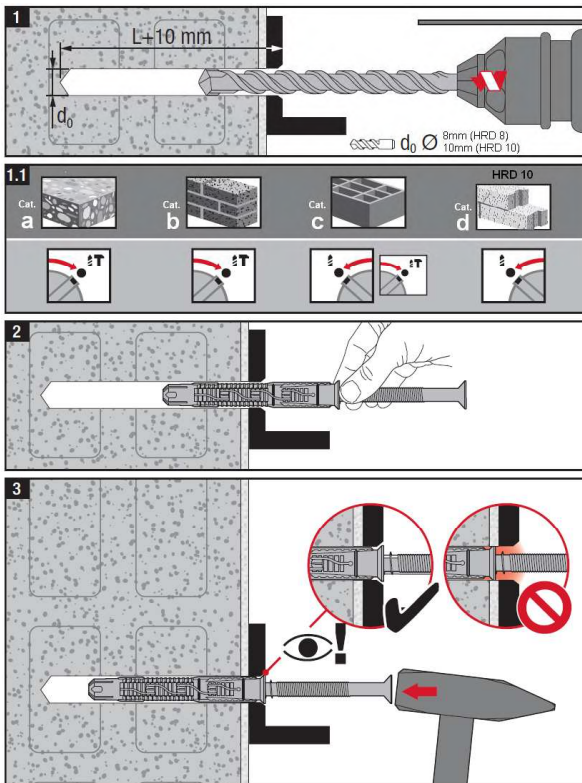


## Setting

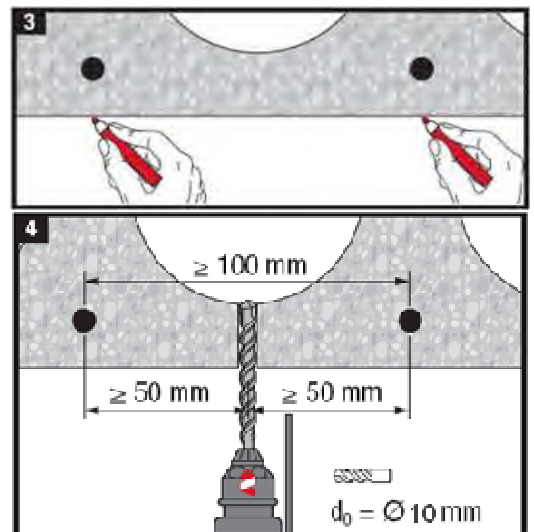
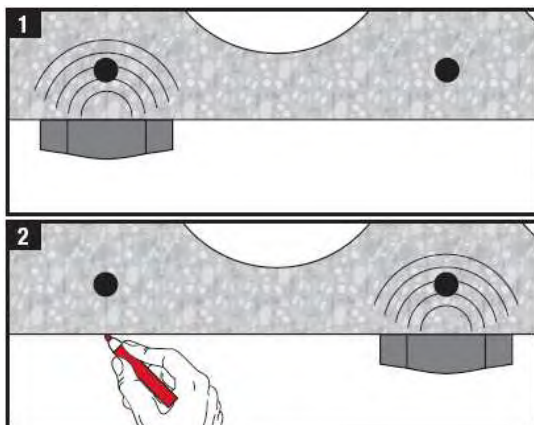
### Installation equipment

Anchor size	
Rotary hammer	TE2 ... TE16
Other tools	hammer, screw driver

### Setting instruction

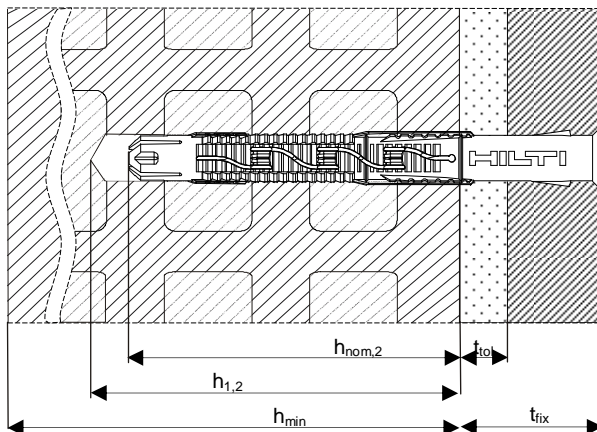
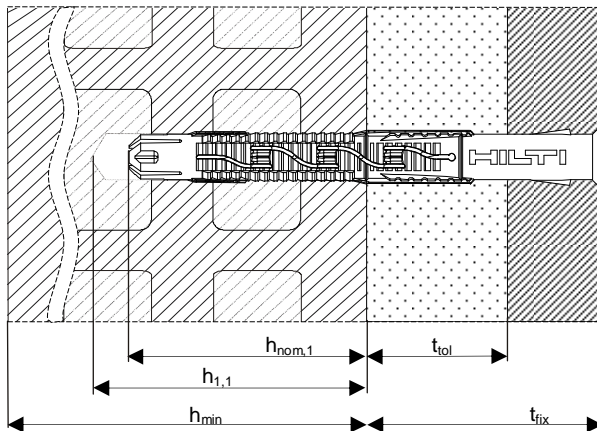


**Additional preparation in case of application in precast prestressed hollow core slabs**  
After drilling follow the main instruction above



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  $h_{nom,3} = 90\text{mm}$  analogue

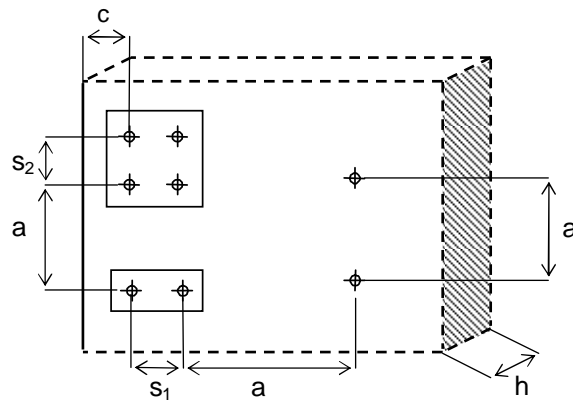
### Setting details HRD

			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 <sup>a)</sup>
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 <sup>a)</sup>
Diameter of clearance hole in the fixture	Countersunk screw	$d_f \leq$	[mm]	8,5
	Hexhead screw	$d_f \leq$	[mm]	-
Installation temperature		[°C]	-10 - +40	

<sup>a)</sup> for use in AAC

### Setting parameters

Anchor size				HRD 8		HRD 10	
				$h_{nom} = 50\text{mm}$		$h_{nom} = 50\text{mm}$	$h_{nom} = 70\text{mm}$
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 $\geq$ C16/20	$s_{min}$	[mm]	100	50		
		for $c \geq$	[mm]	50	100 <sup>c)</sup>		
	Concrete C12/15	$s_{min}$	[mm]	140	70		
		for $c \geq$	[mm]	70	140 <sup>c)</sup>		
	Masonry and AAC	$a_{min}$	[mm]	250	250		
Masonry and AAC	$s_{min1}$	[mm]	200 (120 <sup>d)</sup> )	100			
	$s_{min2}$	[mm]	400 (240 <sup>d)</sup> )	100			
Minimum edge distance	Concrete $\geq$ C16/20	$c_{min}$	[mm]	50	50		
		for $s \geq$	[mm]	100	150 <sup>c)</sup>		
	Concrete C12/15	$c_{min}$	[mm]	70	70		
		for $s \geq$	[mm]	140	210 <sup>c)</sup>		
Masonry and AAC	$c_{min}$	[mm]	100 (60 <sup>d)</sup> )	100			
Critical spacing in concrete <sup>a)</sup>	Concrete $\geq$ C16/20	$s_{cr,N}$	[mm]	62	80	125	
	Concrete C12/15	$s_{cr,N}$	[mm]	68	90	135	
Critical edge distance in concrete <sup>b)</sup>	Concrete $\geq$ C16/20	$c_{cr,N}$	[mm]	100	100		
	Concrete C12/15	$c_{cr,N}$	[mm]	140	140		

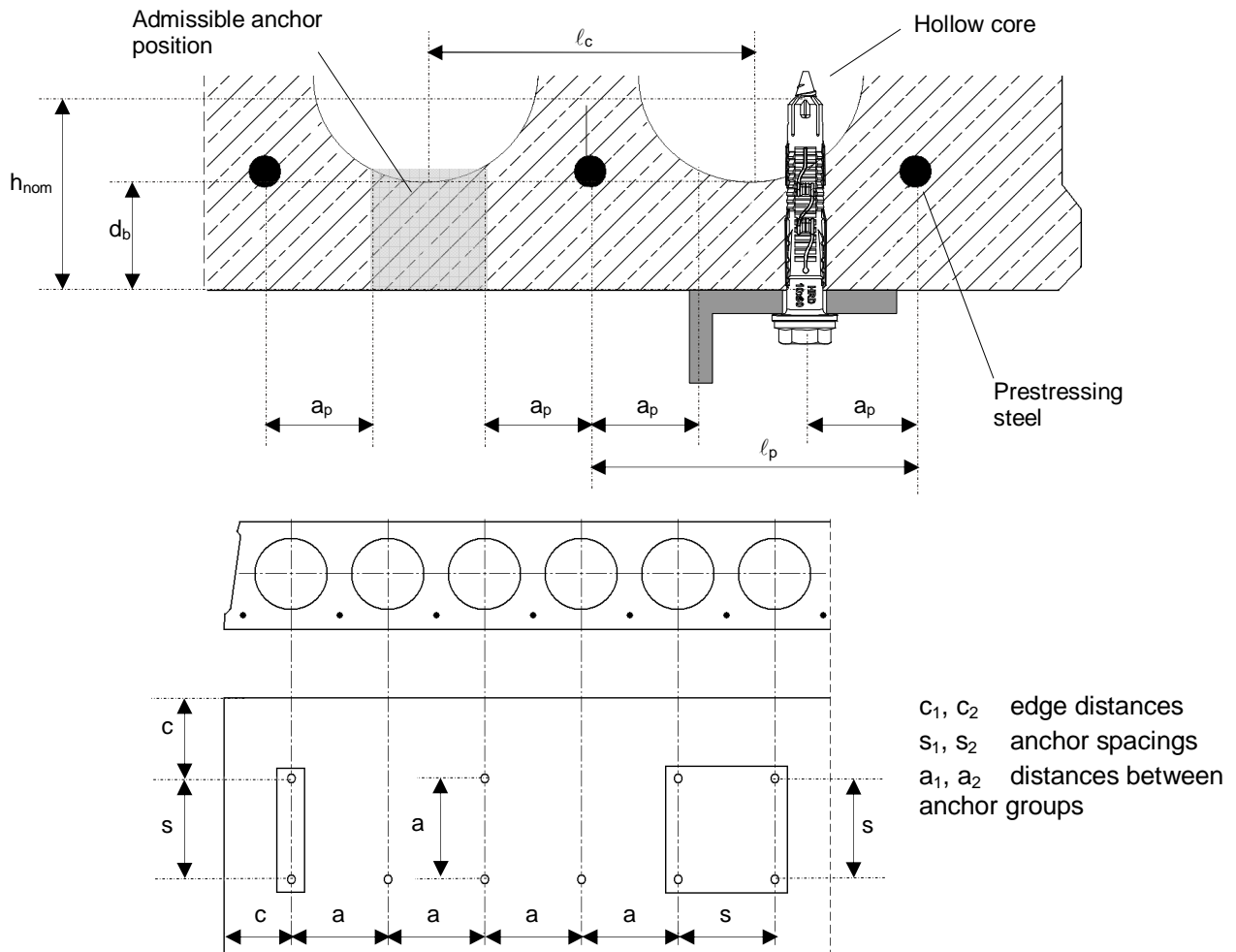


- a) For spacing larger than the critical spacing each anchor in a group can be considered in design.
- b) For edge distance smaller than critical edge distance the design loads have to be reduced.
- c) Linear interpolation allowed
- d) only for brick "Doppio Uni" and "Mattone"

### 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 plastic anchor embedment depth in the base material	$h_{nom} \geq$ [mm]	-	50
Bottom flange thickness	$d_b \geq$ [mm]	-	25
Core distance	$l_c \geq$ [mm]	-	100
Prestressing steel distance	$l_p \geq$ [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





## Design method

Design method according ETAG 020, Annex C. Design resistance according data given in ETA-07/0219, issue 2011-02-01.

- Valid for a group of two anchors
- Influence of edge distance

The design method is based on the following simplifications:

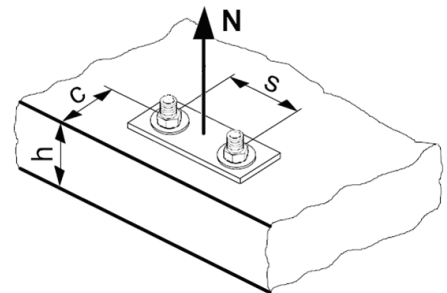
- Minimum base material thickness  $h_{min}$
- All data for concrete C16/20 – C50/60
- No different loads are acting on individual anchors (no eccentricity)
- Shear without lever arm

The values are valid for a single anchor or a anchor group with spacing  $< s_{cr,N}$  (for anchor groups with spacing  $\geq s_{cr,N}$  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:  $N_{Rd,s}$
- Concrete pull-out resistance:  $N_{Rd,p}$
- Concrete cone resistance:  $N_{Rd,c} = N_{Rd,p} \cdot (c/c_{cr,N})$



## Basic design tensile resistance

### Design steel resistance $N_{Rd,s}$

Anchor size		HRD 8	HRD 10	
		$h_{nom} = 50mm$	$h_{nom} = 50mm$	$h_{nom} \geq 70mm$
$N_{Rd,s}$	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 $N_{Rd,c} = N_{Rd,p} \cdot (c/c_{cr,N})$

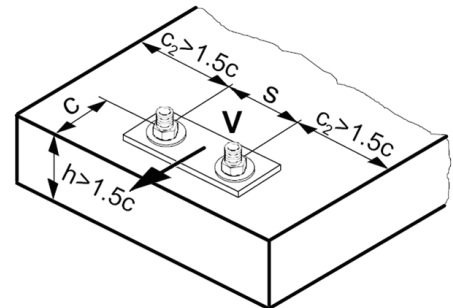
Anchor size		HRD 8	HRD 10	
		$h_{nom} = 50mm$	$h_{nom} = 50mm$	$h_{nom} \geq 70mm$
$N_{Rd,p}$	Carbon steel [kN]	1,7	2,5	4,7
	Stainless steel [kN]	1,7	2,5	4,7



### Shear loading in concrete

The design shear resistance is the lower value of

- Steel resistance:  $V_{Rd,s}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_c$



### Basic design shear resistance

#### Design steel resistance $V_{Rd,s}$

Anchor size	HRD 8		HRD 10	
	$h_{nom} = 50mm$	$h_{nom} = 50mm$	$h_{nom} \geq 70mm$	$h_{nom} \geq 70mm$
$V_{Rd,s}$	Carbon steel [kN]	5,5	8,5	8,5
	Stainless steel [kN]	5,2	8,5	8,5

#### Design concrete edge resistance<sup>a)</sup> $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_c$

Anchor type	HRD 8		HRD 10	
	$h_{nom} = 50mm$	$h_{nom} = 50mm$	$h_{nom} \geq 70mm$	$h_{nom} \geq 70mm$
$V_{Rd,c}^0$ [kN]	5,1	5,5	5,8	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<sup>a)</sup>

h [mm]	c [mm]	50	60	70	80	90	100	120	140	160	180	200	220
		$f_c =$	0,35	0,46	0,57	0,65	0,73	0,82	0,98	1,14	1,31	1,47	1,63
h = 100 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 = 120 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 = 150 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
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  $c_{min}$ .

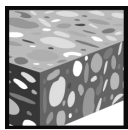
The base material thickness shall not be smaller than the minimum base material thickness  $h_{min}$ .

### Combined TENSION and SHEAR loading in masonry

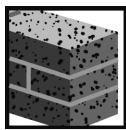
The design resistance in masonry and AAC  $F_{Rd}$  (see basic loading data) shall be used in each load direction for single anchors and anchor groups.

## HPS-1 Impact anchor

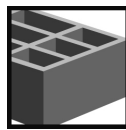
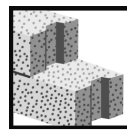
	Anchor version	Benefits
	HPS-1	<ul style="list-style-type: none"> <li>- impact anchor for light frames, battens and profiles on solid base materials</li> <li>- impact and temperature resistant</li> <li>- high quality plastic</li> </ul>



Concrete



Solid brick

Perforated  
brickAutoclaved  
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 <sup>a)</sup>

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
Thermalite 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
Thermalite 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  $\gamma = 5$  to the characteristic loads and a partial safety factor of  $\gamma = 1,4$  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

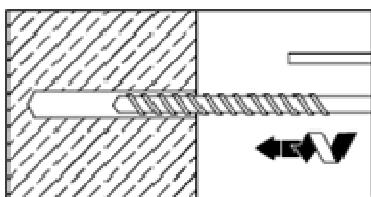
Part	Material
Plastic sleeve	Polyamide 6.6
Screw	Carbon steel, galvanised to 5 µm or Stainless steel, grade A2 or Stainless steel, grade A2, copper-plated

### Setting

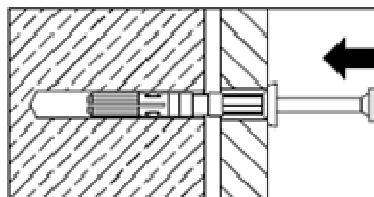
#### Installation equipment

Anchor size	HPS-1 4	HPS-1 5	HPS-1 6	HPS-1 8
Rotary hammer	TE2 – TE16			
Other tools	Screwdriver			

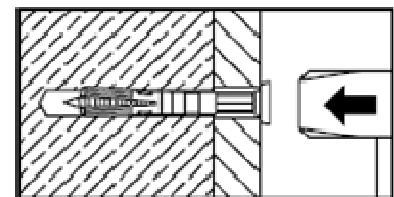
#### Setting instruction



Drill hole with drill bit

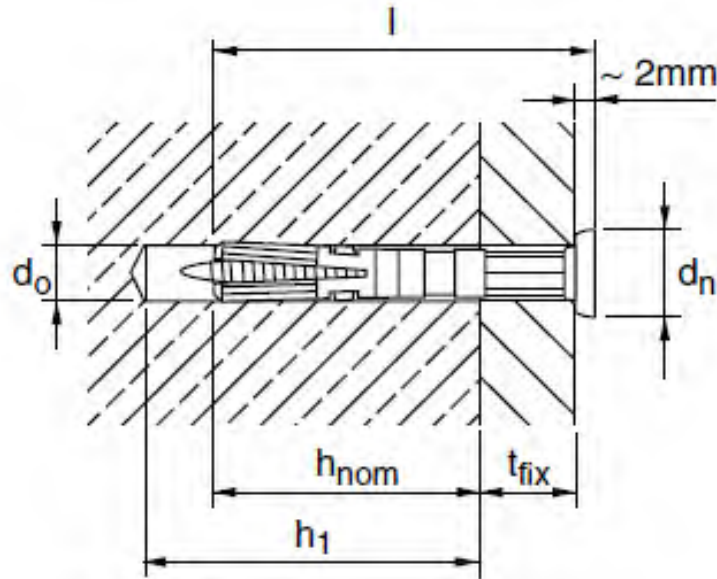


Install anchor.



Hammer in anchor.

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

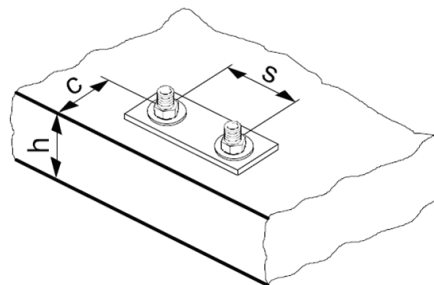


Setting details HPS-1

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

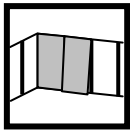
Anchor size			HPS-1 4/	HPS-1 5/	HPS-1 6/	HPS-1 8/
Spacing	$s$	[mm]	20	25	30	35
Edge distance	$c$	[mm]	20	25	30	35





## HHD-S Cavity anchor

	Anchor version	Benefits
	HHD-S	<ul style="list-style-type: none"> <li>- metal undercut anchor with metric screw, esp. for drywall</li> <li>- metal to metal fastening</li> <li>- reliable undercut</li> </ul>



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 <sup>a)</sup>

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  $\gamma = 3$  to the characteristic loads and a partial safety factor of  $\gamma = 1,4$  to the design values.

### Materials

#### Material quality

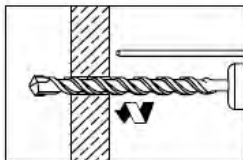
Part	Material
Sleeve	Carbon steel, galvanised
Screw	Carbon steel, galvanised

### Setting

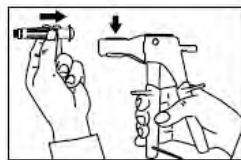
#### Installation equipment

Anchor size	
Rotary hammer	TE2... TE16
Other tools	Screwdriver, HHD-SZ2 expansion tool

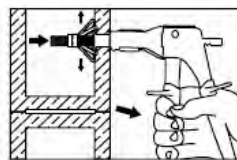
#### Setting instruction



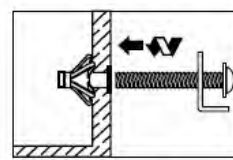
Drill hole with drill bit.



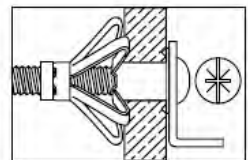
Put anchor into setting tool.



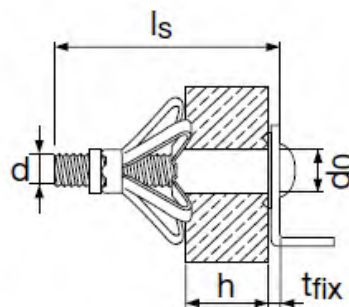
Install anchor with setting tool.



Remove screw from anchor and screw in gain with part being fastened attached.



#### Setting details:



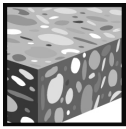
#### Setting details HHD-S

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"	<ul style="list-style-type: none"> <li>- re-usable (up to 5 times with 30% load reduction)</li> <li>- high load capacity</li> <li>- big washer: <math>\varnothing</math> 34 mm</li> <li>- for temporary external applications</li> <li>- removable</li> </ul>



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

### Recommended loads <sup>a)</sup>

		Concrete C 20/25		Young concrete $f_{ck,cube} \geq 14 \text{ N/mm}^2$	
Anchor version	HCA	5/8" x 3 1/2"	5/8" x 5"	5/8" x 3 1/2"	5/8" x 5"
Tensile $N_{rec}$	[kN]	6,9	13,7	5,2	10,2
Shear $V_{rec}$	[kN]	19,4	38,4	14,5	28,7

a) With overall global safety factor  $\gamma \geq 3$  to the characteristic loads and  $\gamma \geq 4$  to the mean ultimate loads.

## Materials

### Material quality

Material
Carbon steel, galvanised

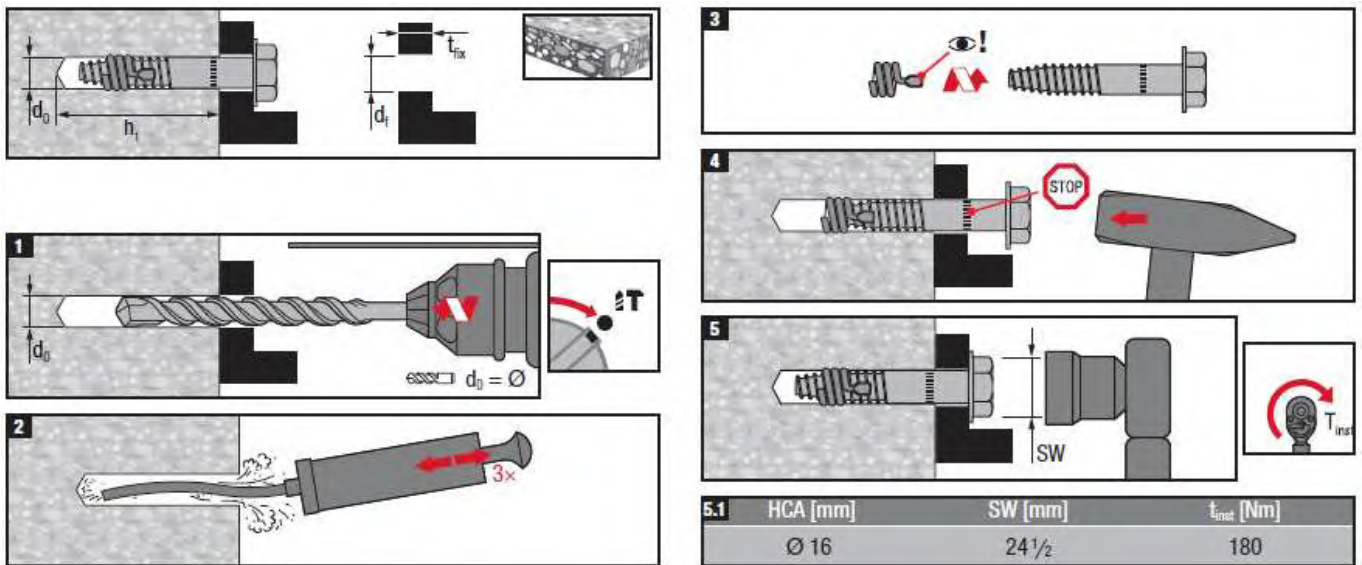
## Setting

### Installation equipment

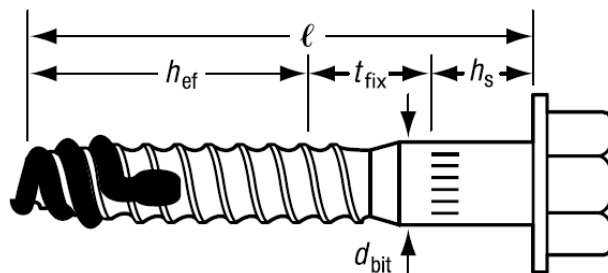
Rotary hammer	TE2... TE30
Other tools	hammer, torque wrench, blow out pump



### Setting instruction




### Setting details:

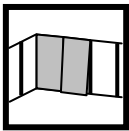


### Setting details HCA

Anchor version			HCA 5/8" x 3 1/2"	HCA 5/8" x 5"
Nominal diameter of drill bit	$d_o$	[mm]	16	
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	16,5	
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	18	
Anchor length	$l$	[mm]	90	130
Marking for correct installation	$h_s$	[mm]	19	
Thickness of fixture	$t_{fix}$	[mm]	0 ... 11	0 ... 13
Depth of drill hole	$h_1 \geq$	[mm]	$95 \text{ mm} - t_{fix}$	$135 \text{ mm} - t_{fix}$
Effective anchorage depth	$h_{ef}$	[mm]	60	98
Torque moment	$T_{inst}$	[Nm]	180	
Width across	SW	[mm]	24,5	
Minimum base material thickness	$h_{min}$	[mm]	$2 h_{ef}$	
Minimum spacing	$s_{min}$	[mm]	$3 h_{ef}$	
Minimum edge distance for single anchor	$c_{min}^{(1)}$	[mm]	$5 h_{ef}$	
Minimum edge distance for group of two anchors	$c_{min}^{(2)}$	[mm]	$10 h_{ef}$	

## HSP / HFP Drywall plug

	Anchor version	Benefits
	HSP	<ul style="list-style-type: none"> <li>- for light fastenings on drywall panel</li> <li>- self-cutting</li> <li>- quick setting</li> </ul>
	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 <sup>a)</sup>	$N_{rec}$ [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

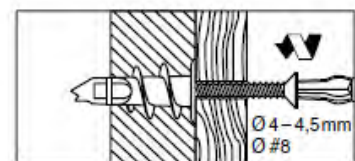
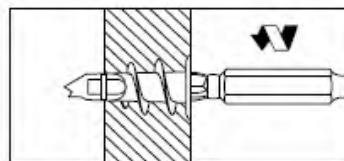
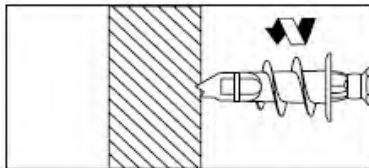
### Setting

#### Installation equipment

Anchor size	
Rotary hammer	-
Other tools	Screwdriver with D-B PH2 HSP/HFP duo-bit

#### Setting instruction

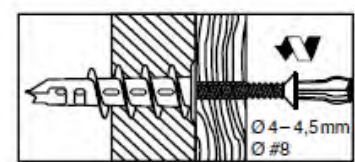
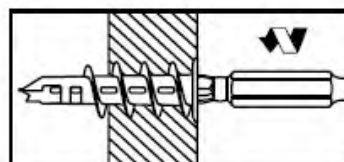
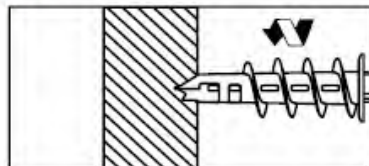
##### HFP:



Drive in the plug.

Fasten part and drive in screw.

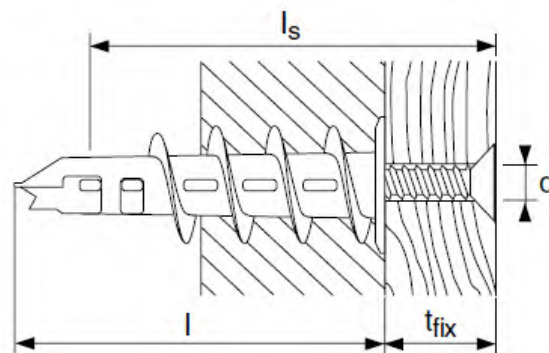
##### HSP:



Drive in the plug.

Fasten part and drive in screw.



#### Setting details:

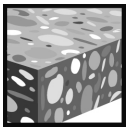


#### Setting details HSP / HFP

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

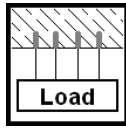
	Anchor version	Benefits
	HA 8 R1	- 8mm anchor for concrete ceilings - hand-setting - follow-up expansion
	HA 8 H1	



Concrete



Tensile zone <sup>a)</sup>



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 166402 / 2007-10-26

### 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
- Only for redundant fastening
- Values are only valid for tensile loading
- Concrete  $\geq$  C 20/25 ( $f_{ck,cube} = 25 \text{ N/mm}^2$ ),  $\leq$  C50/60 ( $f_{ck,cube} = 60 \text{ N/mm}^2$ )

### Recommended loads

	Non-cracked concrete	Cracked concrete (redundant fastening)
<b>Anchor size</b>		
Tensile $N_{rec}$ [kN]	0,8	0,8

### Materials

#### Material quality

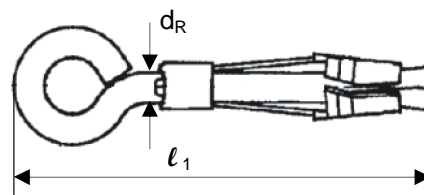
Part	Material
Expansion sleeve	Carbon steel, galvanised to min. 5 µm
Bolt	Carbon steel, galvanised to min. 5 µm

#### Mechanical properties of HA 8

Anchor size	HA 8 expansion sleeve	HA 8 bolt
Nominal tensile strength $f_{uk}$ [N/mm <sup>2</sup> ]	370	460
Yield strength $f_{yk}$ [N/mm <sup>2</sup> ]	270	220

### Anchor dimensions

Anchor size			
Bolt diameter	$d_R$	[mm]	5
Length of the anchor	$l_1$	[mm]	66

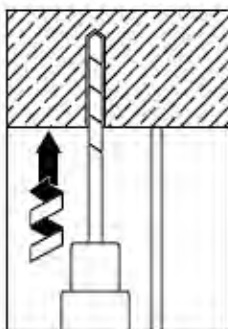


### Setting

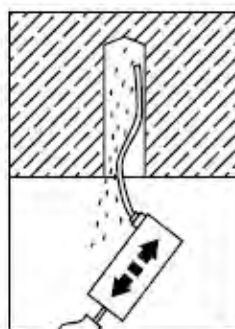
#### Installation equipment

Anchor size	
Rotary hammer	TE2 ... TE16
Other tools	hammer, blow out pump

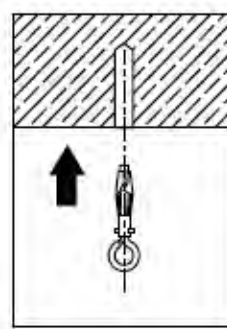
#### Setting instruction



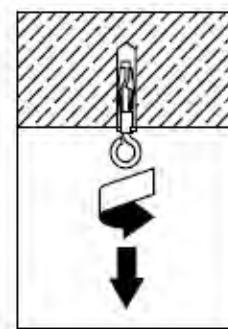
Drill hole with drill bit.



Blow out dust and fragments.

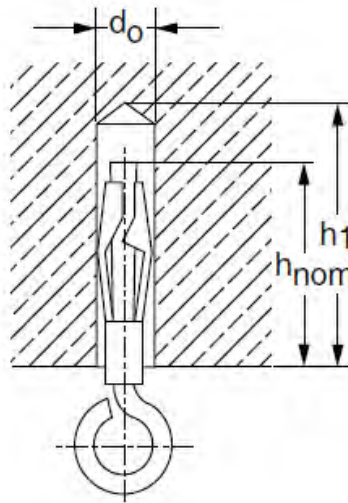


Install anchor.



Pull to expand the anchor.

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

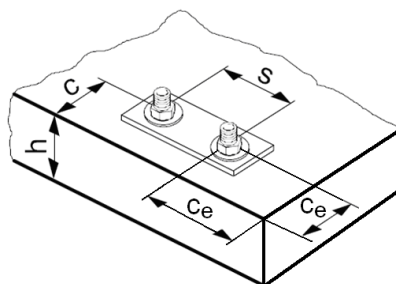


**Setting details HA 8**

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**

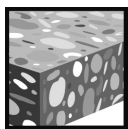
Anchor size			
Minimum base material thickness	$h_{min}$	[mm]	100
Minimum spacing	$s$	[mm]	200
Minimum edge distance	$c$	[mm]	100
Minimum edge distance at the corner	$c_e$	[mm]	150



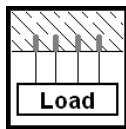


## DBZ Wedge anchor

	Anchor version	Benefits
	DBZ Carbon steel	<ul style="list-style-type: none"> <li>- well proven</li> <li>- simple installation</li> <li>- small drill bit diameter</li> <li>- reliable setting thanks to simple visual check</li> <li>- for fixing in cracked concrete, redundant fastening only, e.g. suspended ceilings</li> </ul>



Concrete

Tensile zone<sup>a)</sup>

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 <sup>a)</sup>	DIBt	ETA-06/0179, 2011-09-14
Fire test report	DIBt	ETA-06/0179, 2011-09-14
Assessment report (fire)	warringtonfire	WF 166402 / 2007-10-26

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  $f_{ck,cube} = 25 \text{ N/mm}^2$  to C50/60,  $f_{ck,cube} = 60 \text{ N/mm}^2$
- 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 <sup>a)</sup>, 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  $\gamma = 1,4$ . 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 <sup>a)</sup>
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.

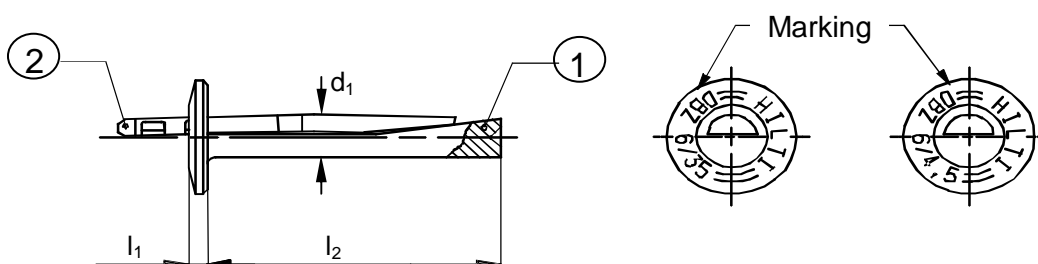
## Materials

### Mechanical properties of DBZ

Anchor size		DBZ 6/4,5	DBZ 6/35
Nominal tensile strength	$f_{uk}$ [N/mm <sup>2</sup> ]	390	390
Yield strength	$f_{yk}$ [N/mm <sup>2</sup> ]	310	310
Stressed cross-section	$A_s$ [mm <sup>2</sup> ]	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 $\geq 5\mu\text{m}$
2 ... Expansion pin	Cold-formed steel; galvanized $\geq 5\mu\text{m}$



## Anchor dimensions

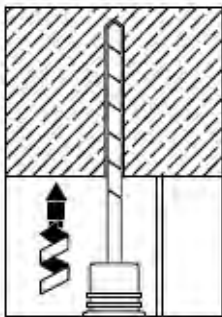
Anchor size		DBZ 6/4,5	DBZ 6/35
Height anchor head	$l_1$ [mm]	2,5	2,5
Max. distance	$d_1$ [mm]	6,4	6,4
Length of anchor shaft	$l_2$ [mm]	37,5	68

## Setting

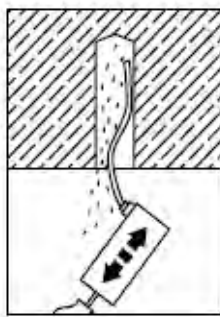
### Recommended installation equipment

Anchor size	DBZ 6/4,5	DBZ 6/35
Rotary hammer	TE 2 – TE 7	
Other tools	hammer, blow out pump	

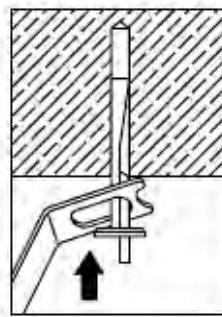
### Setting instruction



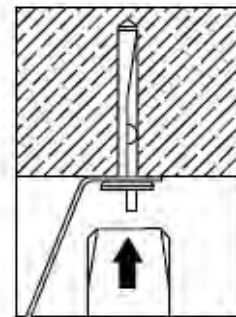
Drill hole with drill bit.



Blow out dust and fragments.

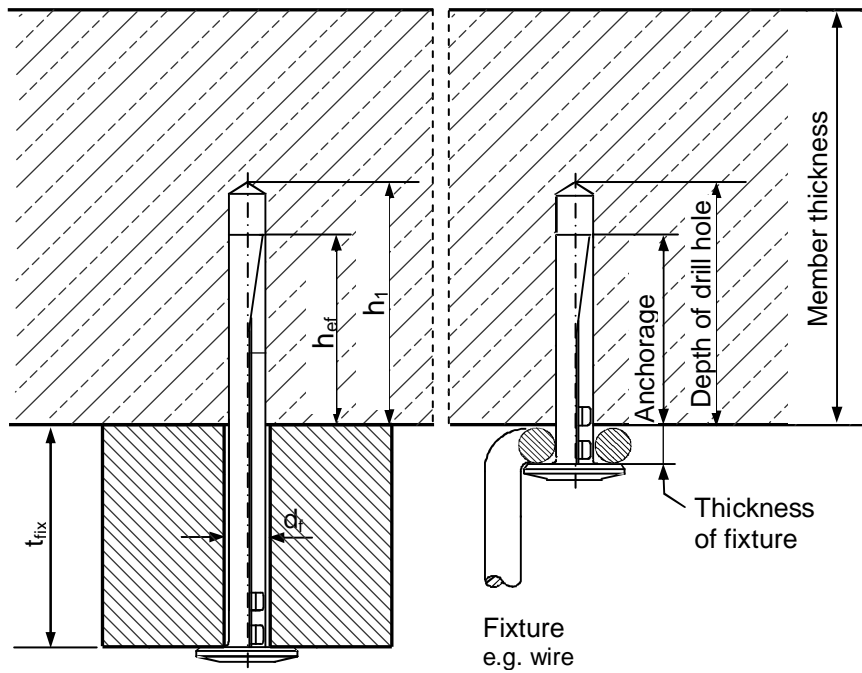


Install anchor with suspended item.



Hammer in anchor.

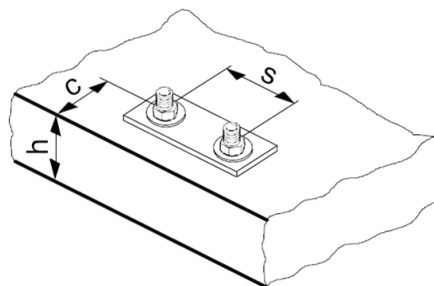
### Setting details



Anchor size		DBZ 6/4,5	DBZ 6/35	
Thickness of fixture	$t_{fix}$ [mm]	$\leq 4,5$	$20 \leq t_{fix} \leq 35$	$5 \leq t_{fix} < 20$
Depth of drill hole	$h_1 \geq$ [mm]	40	55	70
Nominal diameter of drill bit	$d_0$ [mm]	6	6	
Cutting diameter of drill bit	$d_{cut} \leq$ [mm]	6,4	6,4	
Clearance hole diameter	$d_f \leq$ [mm]	7	7	


### Base material thickness, anchor spacing and edge distance <sup>a)</sup>

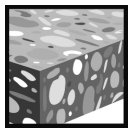
Anchor size		DBZ 6/4,5	DBZ 6/35	
Thickness of fixture	$t_{fix}$ [mm]	$\leq 4,5$	$20 \leq t_{fix} \leq 35$	$5 \leq t_{fix} < 20$
Minimum member thickness	$h_{min} \geq$ [mm]	80	80	100
Effective anchorage depth	$h_{ef}$ [mm]	32	32	
Critical spacing	$s_{cr}$ [mm]	200	200	
Critical edge distance	$c_{cr}$ [mm]	150	150	



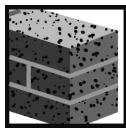
a) The critical spacing (critical edge distance) shall be kept. Smaller spacing (edge distance) than critical spacing (critical edge distance) are not covered by the design method.

## HT Metal frame anchor

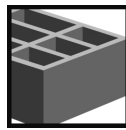
	Anchor version	Benefits
	HT	<ul style="list-style-type: none"> <li>- fastening door and window frames</li> <li>- no risk of distortion or forces of constraint</li> <li>- expansion cone can not be lost</li> </ul>



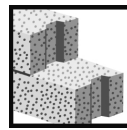
Concrete



Solid brick



Hollow brick

Autoclaved  
aerated  
concreteFire  
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 166402 / 2007-10-26

### 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 material as specified in the table
- Non-cracked concrete:  $f_{cc} \geq 20 \text{ N/mm}^2$
- Minimum base material thickness

#### Characteristic resistance

		HT 8	HT10
Concrete, $f_{cc} = 30 \text{ N/mm}^2$	$N_{Rk}$ [kN]	4,2	5,0
	$V_{Rk}$ [kN]	6,6	7,0
Aerated Concrete PP2 <sup>a)</sup>	$N_{Rk}$ [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, $f_{cc} = 30 \text{ N/mm}^2$	$N_{rec}$ [kN]	1,4	1,7
	$V_{rec}$ [kN]	0,5	0,5
Aerated Concrete PP2 <sup>a)</sup>	$N_{rec}$ [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

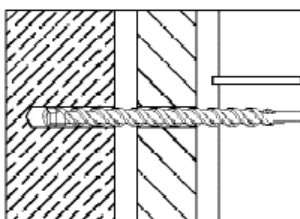
Part	Material
Bolt	steel strength 4.8, zinc plated to 5 $\mu\text{m}$
Sleeve	steel 02 DIN 17162, sendzimir zinc plated to 20 $\mu\text{m}$

### Setting

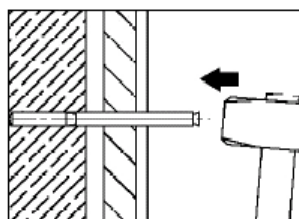
#### installation equipment

Anchor size	
Rotary hammer	TE1 – TE16
Other tools	hammer, screwdriver

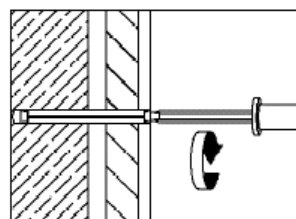
#### Setting instruction



Drill hole with drill bit.



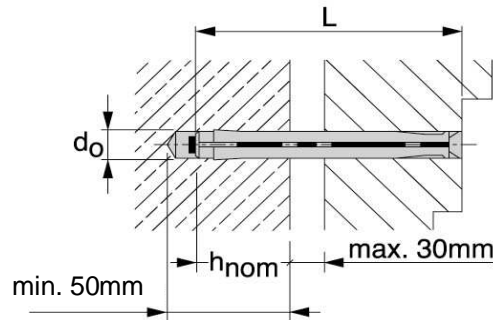
Install anchor.



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

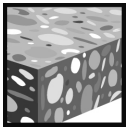
a) First value: solid base material, second value: hollow base material

		HT 10	10x132	10x152	10x182	10x202
Nominal diameter of drill bit	$d_0$	[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

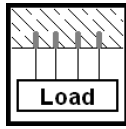
	Anchor version	Benefits
	HK -Carbon steel -Stainless steel -High corrosion resistant steel	- well proven - small drill bit diameter - for fixing in cracked concrete, redundant fastening only, e.g. suspended ceilings
	HK I -Carbon steel -Stainless steel -High corrosion resistant steel	



Concrete



Tensile zone <sup>a)</sup>



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 <sup>a)</sup>	DIBt	ETA-04/0043, 2010-06-30
Fire test report	DIBt	ETA-04/0043, 2010-06-30
Assessment report (fire)	warringtonfire	WF 166402 / 2007-10-26

a) All data given in this section for HK Ceiling anchor according ETA-04/0043, issue 2010-06-30. 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$  to C50/60,  $f_{ck,cube} = 60 \text{ N/mm}^2$
- 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)

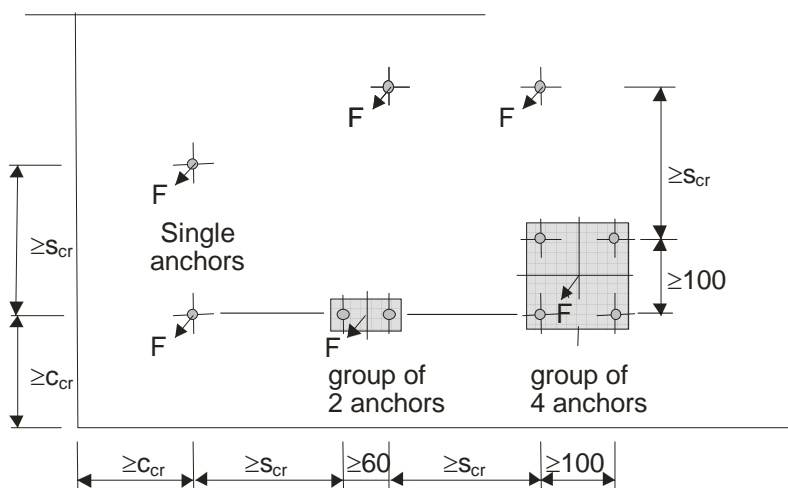
### Recommended loads <sup>a)</sup>, all load directions

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  $\gamma = 1,4$ . 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 <sup>a)</sup>
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 <sup>a)</sup>	$M^0_{Rk,s}$ [Nm]	3,6	7,7	18

a) Partial material safety factor  $\gamma_{Ms} = 1,25$ .

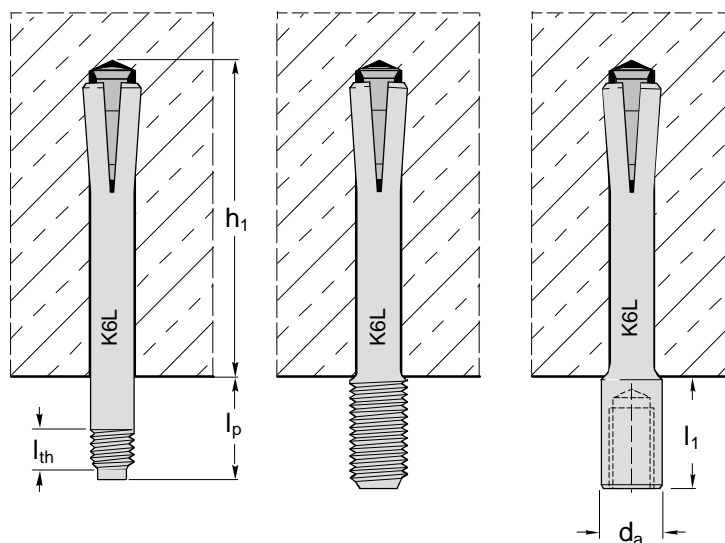
Anchor size (stainless steel, HCR)		HK6 -R /-HCR	HK6L -R /-HCR	HK8 -R /-HCR
Char. bending resistance <sup>a)</sup>	$M^0_{Rk,s}$ [Nm]	4,0	8,4	20,6

a) Partial material safety factor  $\gamma_{Ms} = 1,5$ .

### Material quality of HK

Part	Marking	Material
Anchor HK6 Anchor HK6L Anchor HK8	K6 K6L K8	galvanised steel $\geq 5 \mu\text{m}$
Anchor HK6 -R Anchor HK6L -R Anchor HK8 -R	K6E K6LE K8E	stainless steel, 1.4401 or 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 <sub>fix</sub>	M8/t <sub>fix</sub>	M6/4	M6/t <sub>fix</sub>	M8/t <sub>fix</sub>	I M6	I M8
Thread size	external M6	external M8	external M6	external M6	external M8	internal M6	internal M8
Length of thread l <sub>th</sub> [mm]	5 ... 50		≥ 5	≥ 5	≥ 5	12	12
Length of projection l <sub>p</sub> [mm]	t <sub>fix</sub> + 7		11	≤ 300	≤ 300	-	-
Diameter of sleeve d <sub>a</sub> [mm]	-		-	-	-	8	10
Length of sleeve l <sub>1</sub> [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 <sub>a</sub> [mm]	10	12	14	12
Length of sleeve l <sub>1</sub> [mm]	15	20	20	25

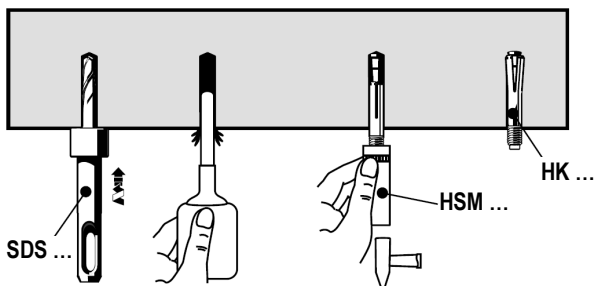
## Setting

### Recommended installation equipment

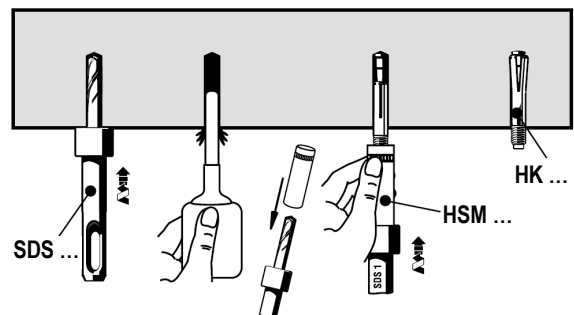
Anchor size	HK6	HKL	HK8
Rotary hammer	TE 2 – TE 16		
Stop drill bit	SDS 2		SDS 3
Setting tool	HSM ... / HSM I ...		HSM 8 ... / HSM 8 I ...
Other tools	blow out pump		

## Setting instruction

### Setting of HK

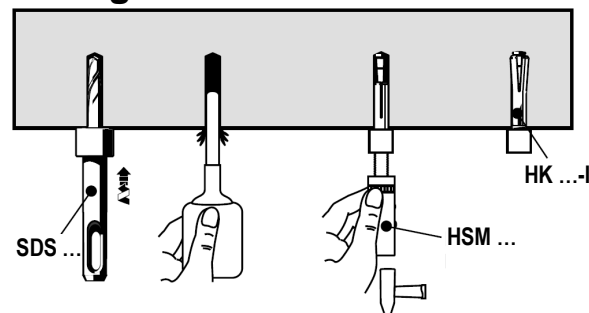


a) with hand setting tool

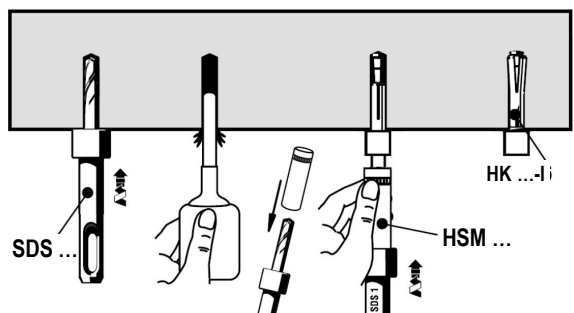


b) with machine setting tool

### Setting of HK-I

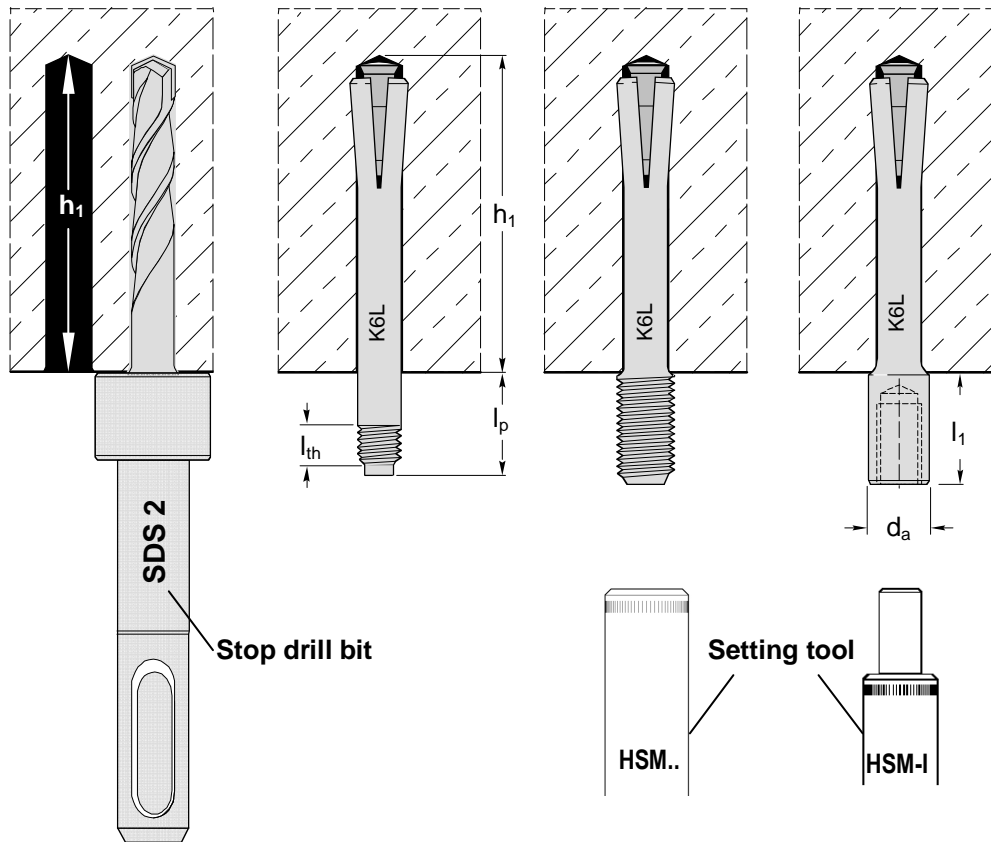


a) with hand setting tool



b) with machine setting tool

Setting details



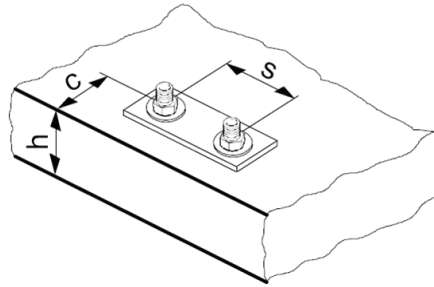
Anchor size	HK6		HKL					
	M6/t <sub>fix</sub>	M8/t <sub>fix</sub>	M6/4	M6/t <sub>fix</sub>	M8/t <sub>fix</sub>	I M6	I M8	
Stop drill bit <sup>a)</sup>	SDS 1		SDS 2					
Depth of drill hole <sup>b)</sup>	h <sub>1</sub> [mm]	32	42					
Nominal diameter of drill bit	d <sub>0</sub> [mm]	6	6					
Setting tool	HSM 6 / t <sub>fix</sub>	HSM 8 / t <sub>fix</sub>	HSM 6 / 4	HSM 6 / t <sub>fix</sub>	HSM 8 / t <sub>fix</sub>	HSM I M6	HSM I M8	
Clearance hole	d <sub>f</sub> ≤ [mm]	7	9	7	7	9	9	12
Max. torque moment	T <sub>max</sub> [Nm]	5		5				

Anchor size	HK8				
	I M8	I M10	I M12	I M8/M10	
Stop drill bit <sup>a)</sup>	SDS 3				
Depth of drill hole <sup>b)</sup>	h <sub>1</sub> [mm]	43			
Nominal diameter of drill bit	d <sub>0</sub> [mm]	8			
Setting tool	HSM 8 I M8	HSM 8 I M10	HSM 8 I M12	HSM 8 I M8	
Clearance hole	d <sub>f</sub> ≤ [mm]	12	14	16	14
Max. torque moment	T <sub>max</sub> [Nm]	10			

- a) In case of through setting 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 <sup>a)</sup>

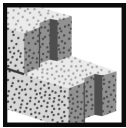
Anchor size		HK6	HKL	HK8
Minimum member thickness	$h_{\min} \geq$ [mm]	80		
Effective anchorage depth	$h_{\text{ef}}$ [mm]	26	36	36
Critical spacing	$s_{\text{cr}}$ [mm]	200		
Critical edge distance	$c_{\text{cr}}$ [mm]	150		



- 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	<ul style="list-style-type: none"> <li>- anchor for autoclaved aerated concrete</li> <li>- maximum use of base material capacity</li> <li>- setting without drilling</li> </ul>



Autoclaved  
aerated  
concrete



Sprinkler  
approved



Fire  
resistance

### Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Allgemeine bauaufsichtliche Zulassung (national approval in Germany) <sup>a)</sup>	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 166402 / 2007-10-26
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

Anchor size			Non-cracked AAC <sup>a)</sup>			Cracked AAC		
			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 $100\text{mm} \leq s \leq 200\text{mm}$								
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 $s \geq 200\text{mm}$								
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 ( $\leq 250\text{mm} \times 500\text{mm} \times \text{thickness}$ ) 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/mm <sup>2</sup> ]	800	500	500
	Stainless steel [N/mm <sup>2</sup> ]	750	565	565
Yield strength $f_{yk}$	Carbon steel [N/mm <sup>2</sup> ]	-	-	-
	Stainless steel [N/mm <sup>2</sup> ]	-	-	-
Stressed cross-section $A_s$	[mm <sup>2</sup> ]	20,1	36,6	58
Moment of resistance $W$	[mm <sup>3</sup> ]	12,7	31,2	62,3
Char. bending resistance $M_{Rk,s}^0$	Carbon steel [Nm]	12	19	37
	Stainless steel [Nm]	11	21	42

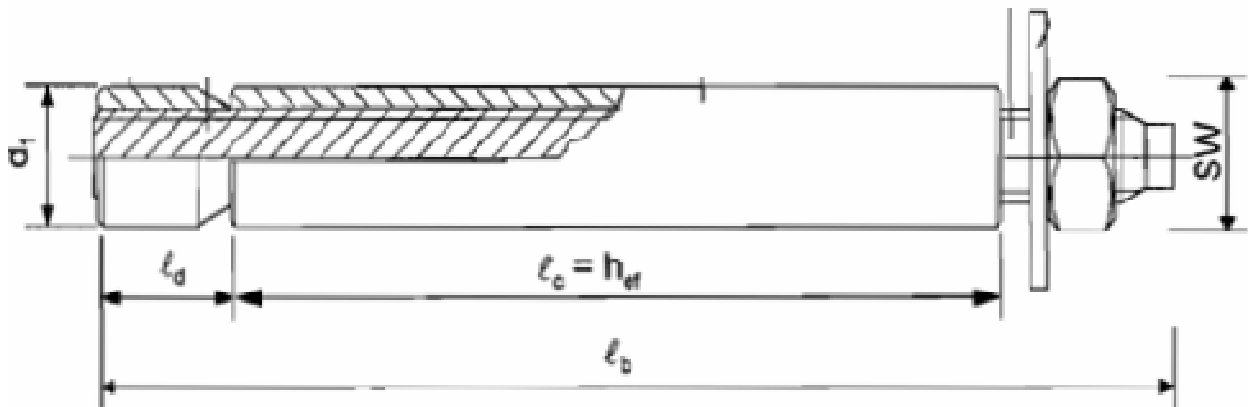
The recommended bending moment shall be calculated by dividing the characteristic bending moment by 1,4 and 1,25

### 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	$t_{\text{fix,min}}$ [mm]	0	0	0
Maximum thickness of fixture*	$t_{\text{fix,max}}$ [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		



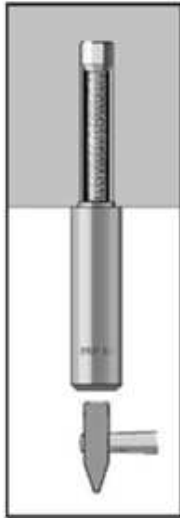
### Setting

#### 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



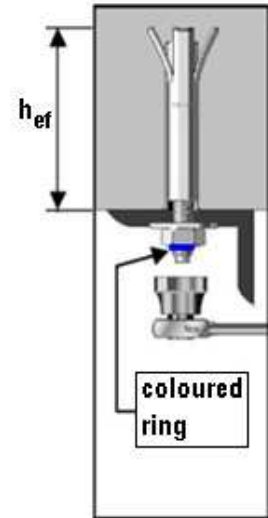
Insert the cone bolt by hammering it in, until setting tool touches surface.



Insert the expansion sleeve over the threaded rod.

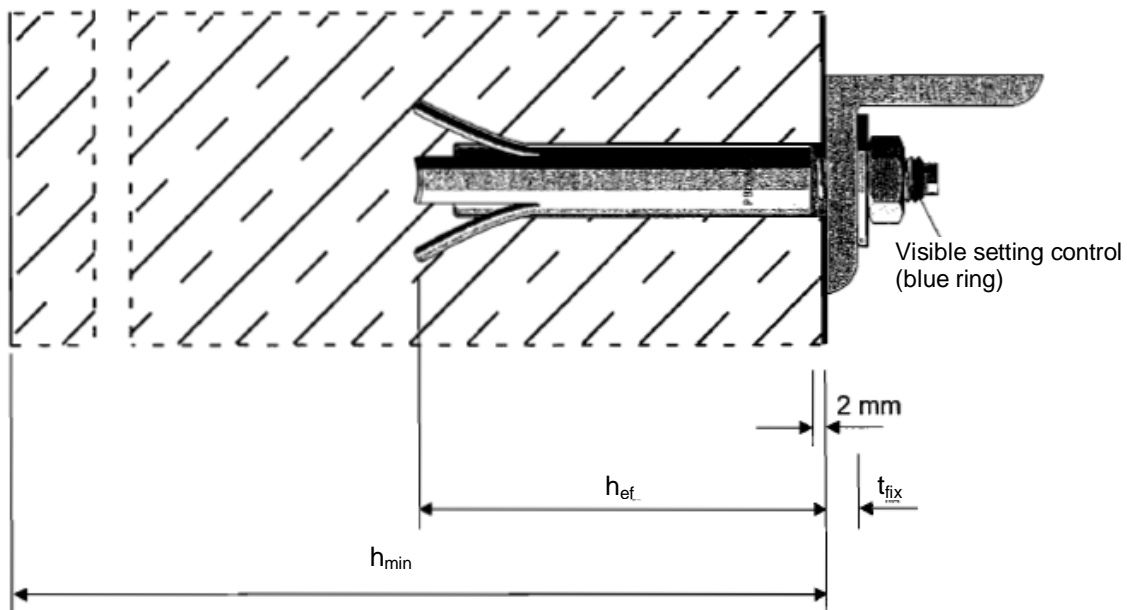


Bash in the sleeve by hammering or with the machine setting tool.



Tighten the nut until the blue ring becomes visible.

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

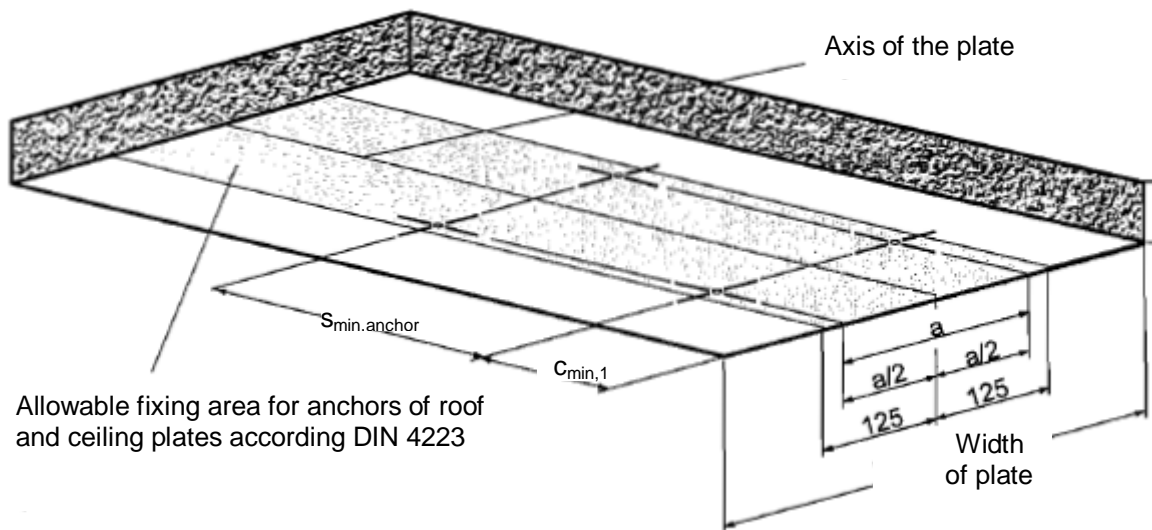
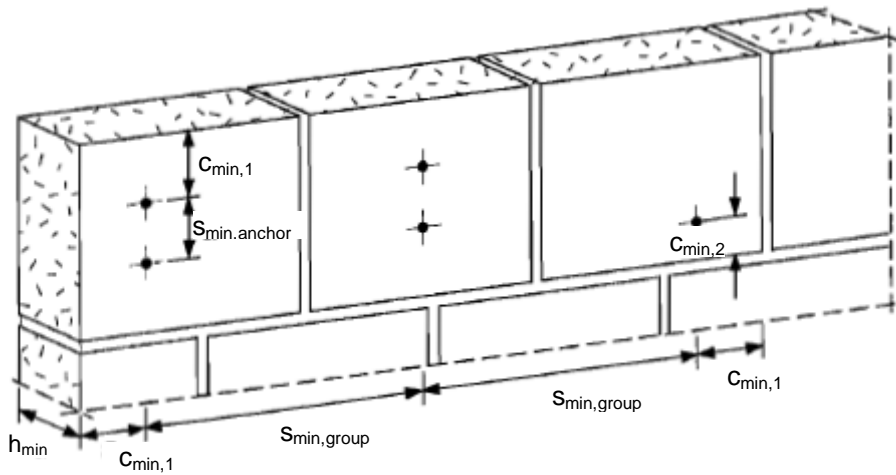


### Setting details HPD

			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	$S_{min,anchor}$	100 / 200		
	Of anchor groups	$S_{min,group}$	600		
Minimum edge distance	to member edge and to vertical joints	$C_{min,1}$	150	150	150
	to horizontal joints	$C_{min,2}$	50	50	50

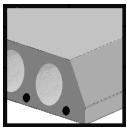


Allowable fixing area for anchors of roof and ceiling plates according DIN 4223



# HKH Hollow deck anchor

	Anchor version	Benefits
	HKH	<ul style="list-style-type: none"> <li>- anchor for suspended ceilings &amp; overhead support applications</li> <li>- channel installation</li> <li>- optical setting control</li> </ul>



Prestressed hollow core slabs



Sprinkler approved



Fire resistance



Corrosion resistance

## Approvals / certificates

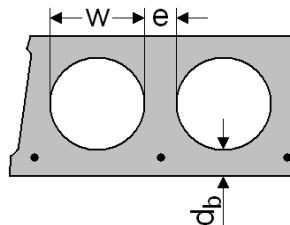
Description	Authority / Laboratory	No. / date of issue
Allgemeine bauaufsichtliche Zulassung (national approval in Germany for single point fastening) <sup>a)</sup>	DIBt, Berlin	Z-21.1-1722 / 2011-10-31
Fire test report	IBMB, Braunschweig	UB 3606 / 8892 / 2002-07-22
Assessment report (fire)	warringtonfire	WF 166402 / 2007-10-26
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  $f_{cc} \geq 50 \text{ N/mm}^2$
- 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]	$\geq 25$			$\geq 30$			$\geq 40$		
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 $s \geq 100$ mm and $\leq 200$ mm									
Tensile, $F_{rec}$ spacing $s \geq 100$ mm [kN]	0,9	0,9	1,2	1,2	1,2	1,6	2,5	2,5	4,0
Tensile, $F_{rec}$ spacing, $s \geq 200$ 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 $s \geq 100$ mm and $\leq 200$ mm									
Tensile, $F_{rec}$ spacing, $s \geq 100/100$ mm [kN]	1,2	1,2	1,6	1,6	1,6	2,1	3,5	3,5	5,3
Tensile, $F_{rec}$ spacing, $s \geq 100/200$ mm [kN]	1,5	1,5	2,0	2,0	2,0	2,6	4,4	4,4	6,6
Tensile, $F_{rec}$ spacing, $s \geq 200/200$ 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  $\geq C 45/55$
- Hollow decks where  $b_H \leq 4,2 \cdot b_{st}$

### Materials

#### Mechanical properties of HKH

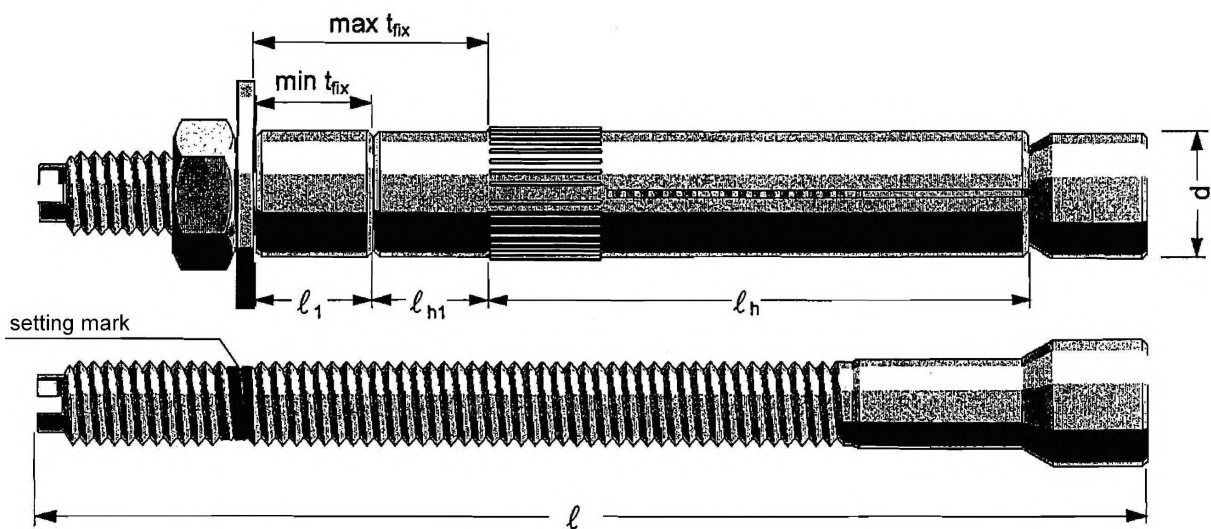
Anchor size		M6	M8	M10
Nominal tensile strength $f_{uk}$	Carbon steel [N/mm <sup>2</sup> ]	800	500	500
	Stainless steel [N/mm <sup>2</sup> ]	700	700	700
admissible bending resistance	Carbon steel [Nm]	7,0	10,7	21,4
	Stainless steel [Nm]	4,9	12,1	24,1

#### Material quality

Part	Material	
All parts	HKH (Carbon steel)	galvanised to min. 5 $\mu$ m
	HKH (stainless steel)	Stainless steel A4

### Anchor dimensions

Anchor size		M6	M8	M10
$t_{fix}$	[mm]	$\leq 10$	$\leq 10$	$\leq 10$
$l_1$	[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		

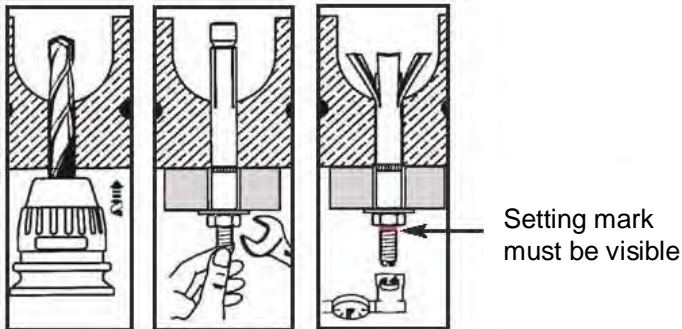


### Setting

#### 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

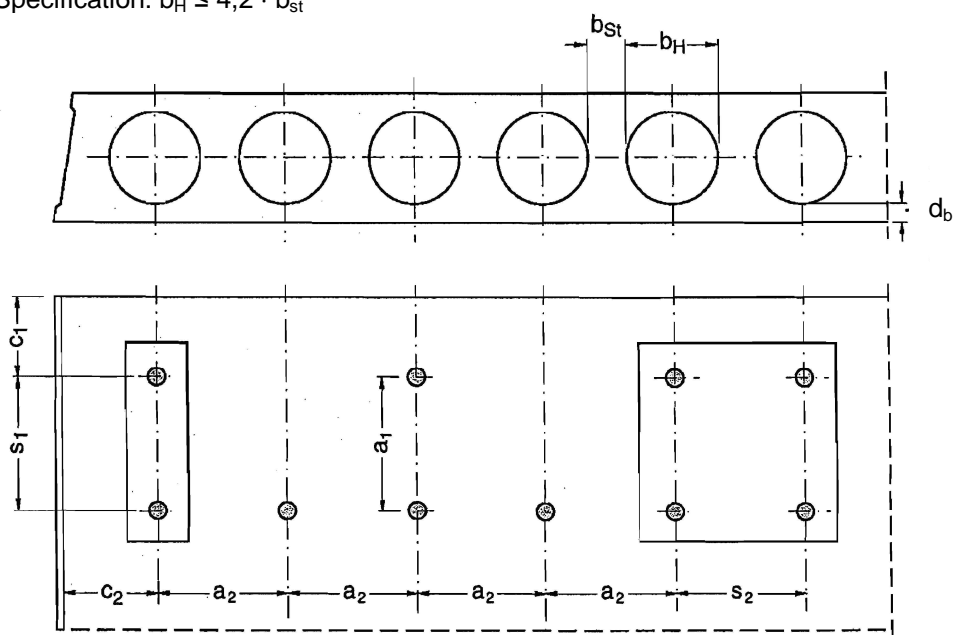
Anchor size		M6	M8	M10
Diameter of clearance hole in the fixture	$d_f \leq$ [mm]	12	14	16
Embedment depth for HKH	$h_s$ [mm]	55 to 65		
Thickness of fixture	$t_{fix}$ [mm]	$\leq 10$		
Torque moment	$T_{inst}$ [Nm]	5	10	20
Width across	SW [mm]	10	13	17

### Base material thickness, anchor spacing and edge distance

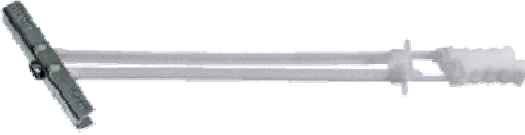
Anchor size		M6	M8	M10
Edge distance <sup>a)</sup>	$c \geq$ [mm]	150		
	$c_{min} \geq$ [mm]	100		
Spacing between outer anchors of neighbouring fixation	$a \geq$ [mm]	300		

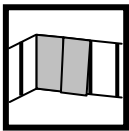
a) For edge distance < 150 mm the recommended load has to be reduced with  $F = 0,75 \cdot F_{rec}$

Specification:  $b_H \leq 4,2 \cdot b_{st}$



## HTB Hollow wall metal anchor

	Anchor version	Benefits
	HTB	<ul style="list-style-type: none"> <li>- Ingenious and strong for hollow base materials</li> <li>- Convincing simplicity when setting</li> <li>- Technical superiority with up to 92mm fixing thickness</li> <li>- Load carried by strong metal channel and screw</li> </ul>



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 $\geq 30,0$ 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 $\geq 30,0$ 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 <sup>a)</sup>**

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 $\geq 30,0$ 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  $\gamma = 3$  to the characteristic loads and a partial safety factor of  $\gamma = 1,4$  to the design values

## Materials

### Material quality

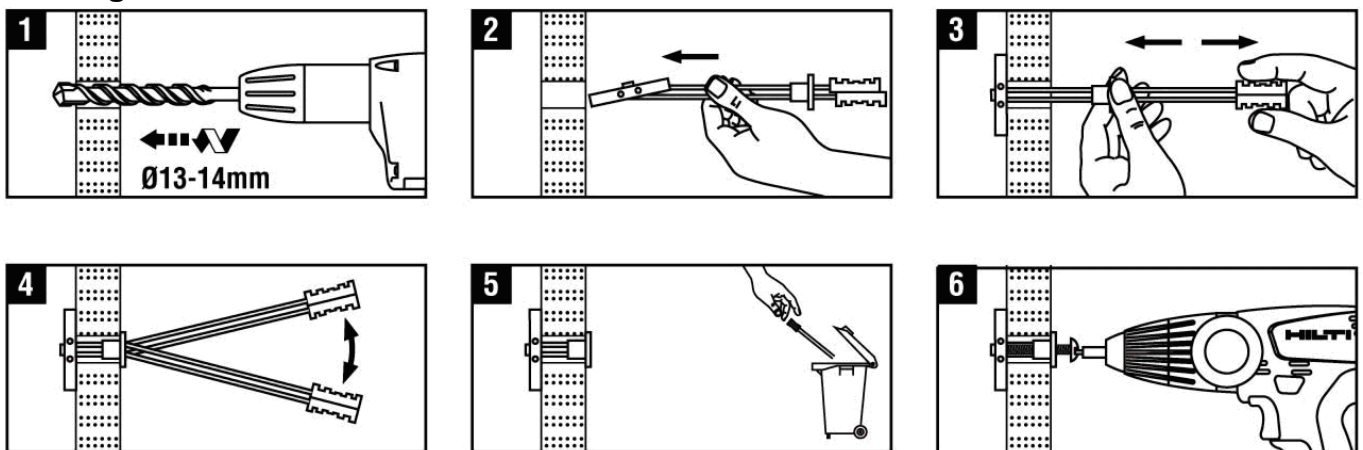
Part	Material
Metal channel	Carbon steel galvanized to 5 microns
Cap washer	Polypropylene copolymer
Legs	High impact polystyrene
Screw	Carbon steel galvanized to 3 microns

## Setting

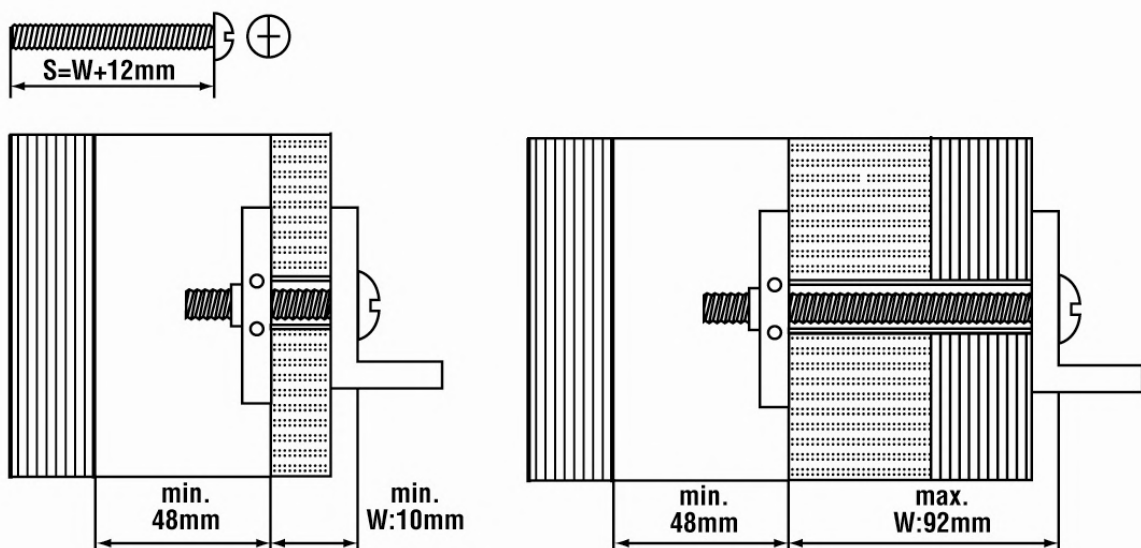
### Installation equipment

Anchor size	M5 / M6
Rotary hammer	TE2 ... TE16
Other tools	Screwdriver

### Setting instruction




### Setting details:

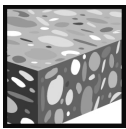


**Setting details HTB**

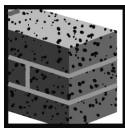
Anchor version			M5	M6
Nominal diameter of drill bit	$d_o$	[mm]	13 - 14	
Thickness of wall and fixture	min	$h + t_{fix}$ [mm]	10	
	max	$h + t_{fix}$ [mm]	92	
Minimum space of cavity	$l$	[mm]	48	
Screw length	$l$	[mm]	$12 + h + t_{fix}$	
Screw size	$d$		M5	M6
Tightening torque	$T_{inst}$	[Nm]	3	5

## IDP Insulation fastener

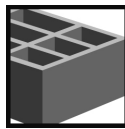
Anchor version	Benefits
 <p>IDP</p>	<ul style="list-style-type: none"> <li>- for insulating up to 15 cm</li> <li>- simple setting</li> </ul>



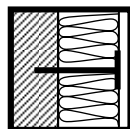
Concrete



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 <sup>a)</sup>

		IDP
Concrete $\geq$ 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 <sup>b)</sup>
Hollow sand-lime brick KSL 12 – 1,4 – 3DF	$N_{rec}$ [kN]	0,04

a) With overall global safety factor  $\gamma = 5$  to the characteristic loads and a partial safety factor of  $\gamma = 1,4$  to the design values.

b) Drilling without hammering

### Recommended number of IDP not regarding wind suction

			Number of fasteners per m <sup>2</sup>
Expanded polystyrene (EPS) Polyurethane (PU)	density ≤ 40 kg/m <sup>3</sup>	thickness ≤ 150 mm	4
Mineral wool	density ≤ 150 kg/m <sup>3</sup>	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

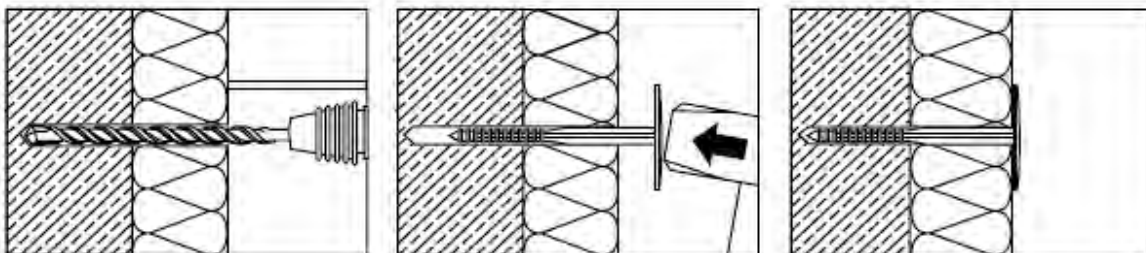
Part	Material
Plastic sleeve	Polypropylene

### Setting

#### installation equipment

Anchor size	IDP
Rotary hammer	TE2 ... TE16
Other tools	Hammer

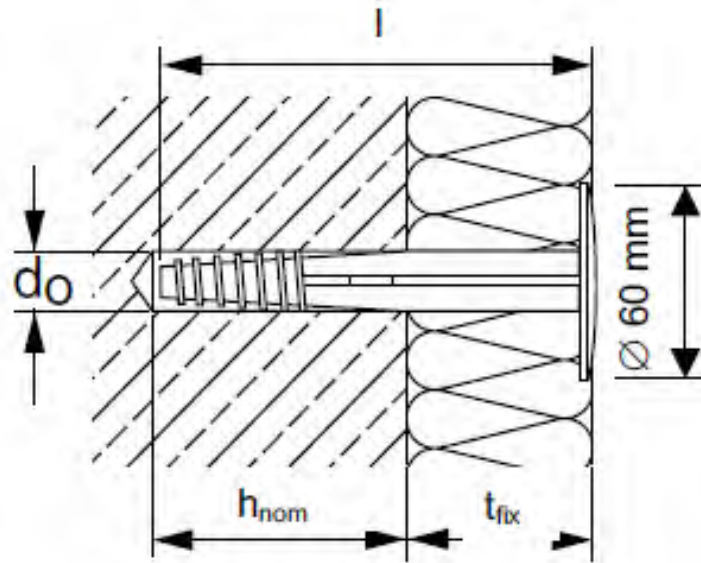
#### Setting instruction



Drill hole with drill bit.

Tap in fastener with a hammer.

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



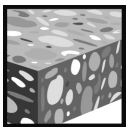
### Setting details IDP

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]	$l - t_{fix} + 10 \text{ mm} \geq 40 \text{ mm}$						
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						

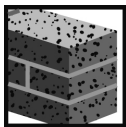


## IZ Insulation fastener

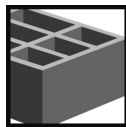
	Anchor version	Benefits
	IZ	<ul style="list-style-type: none"> <li>- Insulation fastener esp. for plastered surfaces</li> <li>- 30mm setting depth</li> <li>- perfect flush setting</li> </ul>



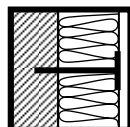
Concrete



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 $\geq$ 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 <sup>a)</sup>
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 $\geq$ 40 mm	0,15	5
Mineral wool, type HD thickness $\geq$ 40 mm	0,15	5
Mineral wool, type WV thickness $\geq$ 40 mm	0,15	4
Mineral wool, type lamella, with slip-on-plate HDT 140 thickness $\geq$ 40 mm	0,167	4



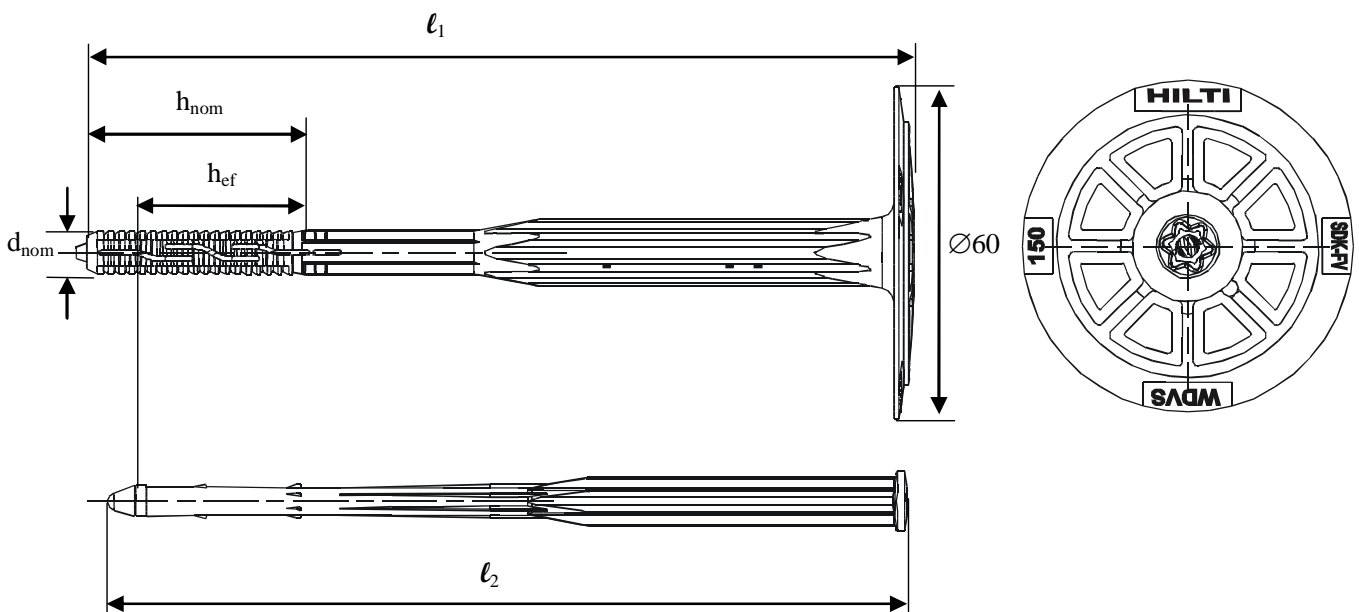
### Materials

#### Material quality

Part	Material
Anchor sleeve	Polypropylene
Expansion pin	Polyamide, fibre reinforced $\geq 50\%$ ,

### 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	$l_{1,min}$	[mm]	70
Maximum length of the sleeve	$l_{1,max}$	[mm]	210
Minimum length of the screw	$l_{2,min}$	[mm]	65
Maximum length of the screw	$l_{2,max}$	[mm]	205

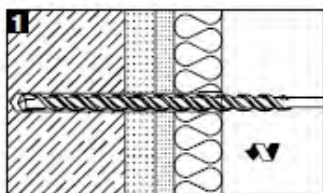


### Setting

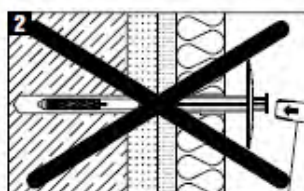
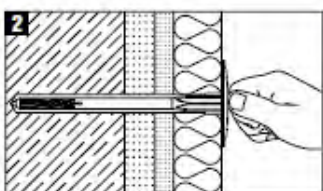
#### installation equipment

Anchor size	IDP
Rotary hammer	TE2 – TE16
Other tools	Hammer, stepped-drill TE-C 8/12-370 is necessary when $t_{tol} > 30mm$

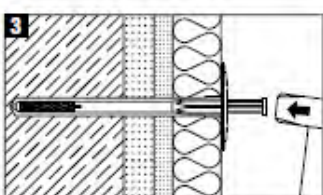
Setting instruction



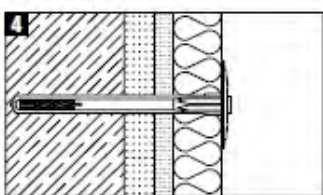
Drill hole with drill bit.



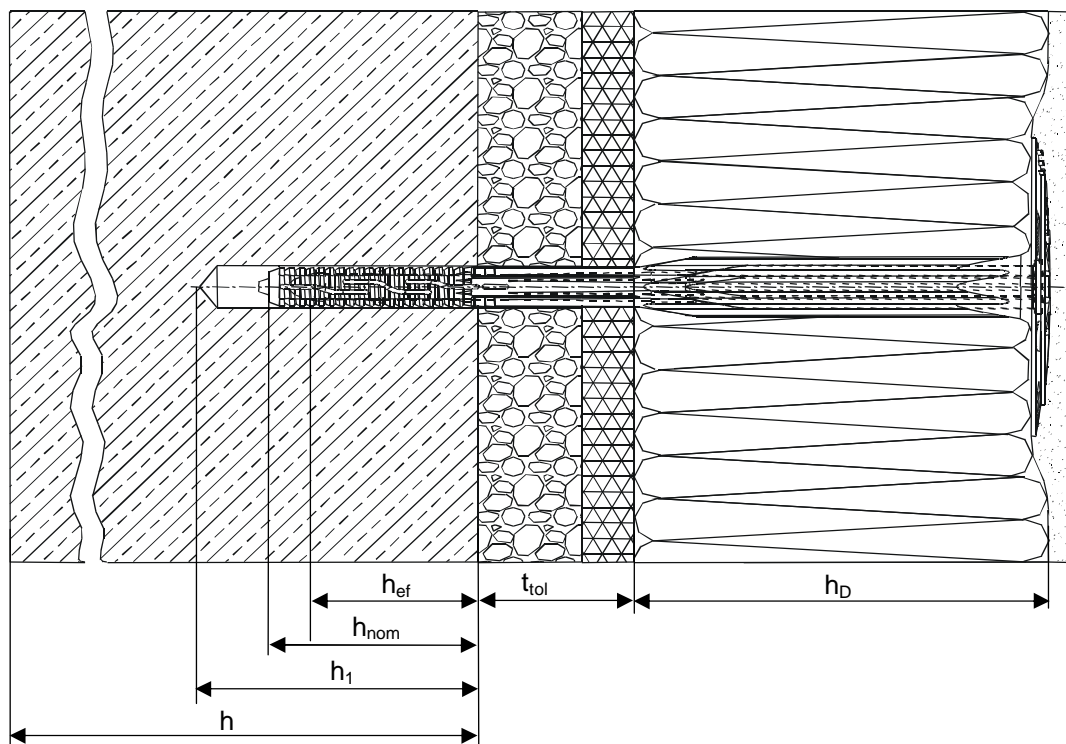
Tap in fastener body only.



Hammer in expansion pin.



Setting details:

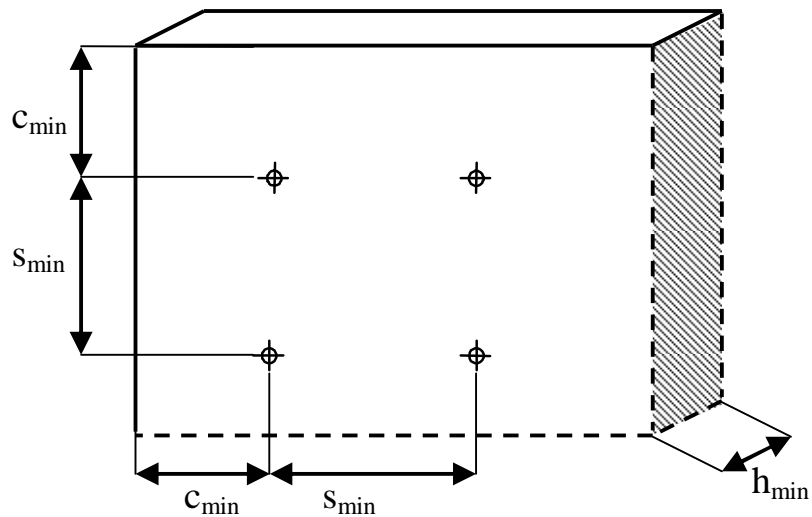


### Setting details IZ


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

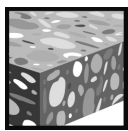
### Setting parameters

Anchor size		
Minimum base material thickness	$h_{min}$ [mm]	100
Spacing	$s_{min}$ [mm]	100
Edge distance	$c_{min}$ [mm]	100

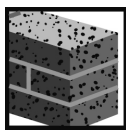


## IDMS / IDMR Insulation fastener

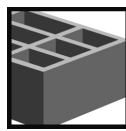
	Anchor version	Benefits
	IDMS Carbon steel  IDMR Stainless steel	<ul style="list-style-type: none"> <li>- for insulating material up to 15 cm thick</li> <li>- a non-flammable metal fastener</li> <li>- IDMS-T / IDMR-T insulation plate for non self-supporting insulation material</li> </ul>



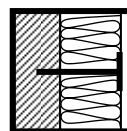
Concrete



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 $\geq$ 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 <sup>a)</sup>
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 m <sup>2</sup>
Expanded polystyrene (EPS) Polyurethane (PU)	density ≤ 40 kg/m <sup>3</sup>	thickness ≤ 150 mm	4
Mineral wool	density ≤ 150 kg/m <sup>3</sup>	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

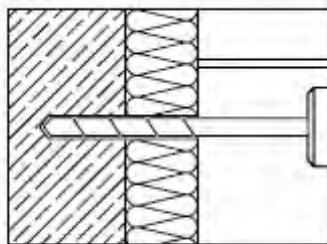
Part	Material
IDMS	Carbon steel, galvanised to 16 µm
IDMR	Stainless steel, grade 1.4301

### Setting

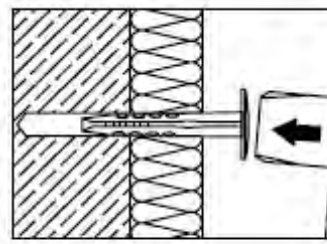
#### installation equipment

	IDMS / IDMR
Rotary hammer	TE2 – TE16
Other tools	Hammer

#### Setting instruction

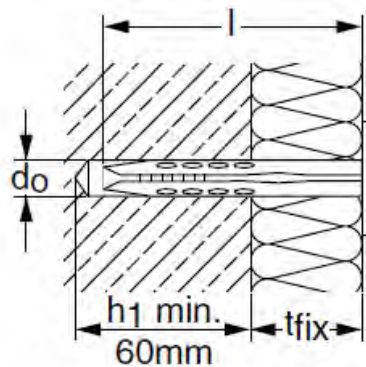


Drill hole with drill bit.



Install the fastener.

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

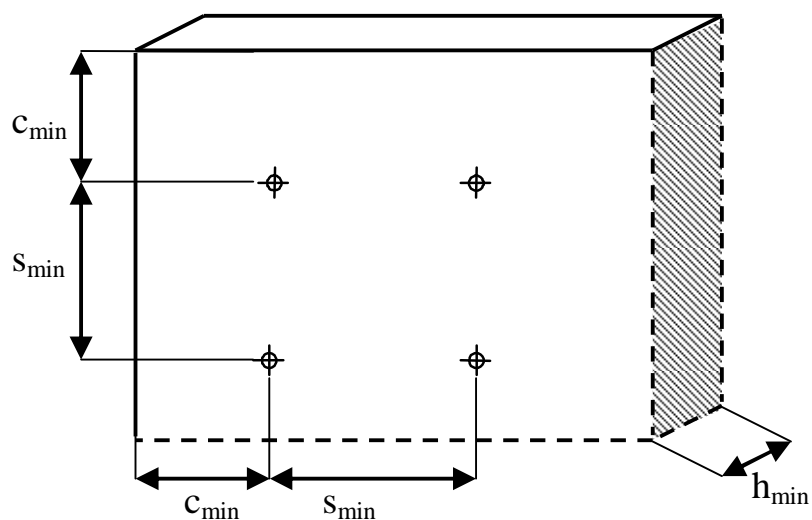


Setting details IDMS / IDMR

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]	$l - t_{fix} + 10 \text{ mm} \geq 60 \text{ mm}$				
Effective anchorage depth	$h_{nom}$ [mm]	$l - t_{fix} \geq 50$ 30 – 50		full load capacity 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









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## Adhesive anchoring systems

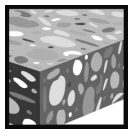
Foil capsule systems

Injection mortar systems



# HVZ Adhesive anchor

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



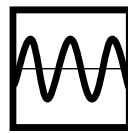
Fire resistance



Corrosion resistance



High corrosion resistance



Fatigue



Shock



European Technical Approval



CE conformity



## Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval <sup>a)</sup>	DIBt, Berlin	ETA-03/0032 / 2008-09-29
Approval for shockproof fastenings in civil defence installations	Federal Office for Civil Protection, Bern	BZS D 09-602 / 2009-10-28
Fatigue loading	DIBt, Berlin	Z-21.3-1692 / 2012-03-07
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 166402 / 2007-10-26

a) All data given in this section according ETA-03/0032, issue 2008-09-29.

## 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- 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 <sup>a)</sup>: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HVZ**

Data according ETA-03/0032, issue 2008-09-29						
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HVZ**

Data according ETA-03/0032, issue 2008-09-29						
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HVZ**

Data according ETA-03/0032, issue 2008-09-29						
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 <sup>a)</sup>: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HVZ**

Data according ETA-03/0032, issue 2008-09-29						
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  $\gamma = 1,4$ . 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 2008-09-29				
Anchor size			M10x75	M12x95	M16x105	M16x125	M20x170
Nominal tensile strength $f_{uk}$	HAS-(R) (HCR)TZ	[N/mm <sup>2</sup> ]	800				
Yield strength $f_{yk}$	HAS-(R) (HCR)TZ	[N/mm <sup>2</sup> ]	640				
Stressed cross-section $A_s$	tension	[mm <sup>2</sup> ]	44,2	63,6	113	113	227
	shear	[mm <sup>2</sup> ]	50,3	73,9	141	141	245
Moment of resistance $W$	HAS-(R) (HCR)TZ	[mm <sup>3</sup> ]	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

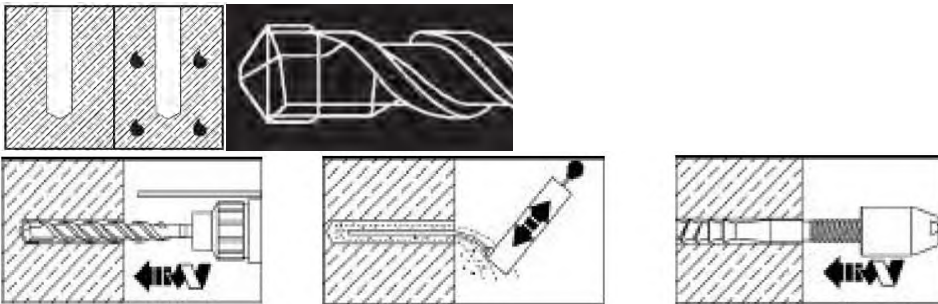
### Setting

#### installation equipment

Anchor size	M10x75	M12x95	M16x105	M16x125	M20x170
Rotary hammer	TE 2 – TE 16 / TE30/40				TE 50 – TE 70
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-04/0084, issue 2007-01-03	
Temperature of the base material	Curing time before anchor can be fully loaded $t_{cure}$
$\geq 20 \text{ }^{\circ}\text{C}$	20 min
10 $^{\circ}\text{C}$ to 20 $^{\circ}\text{C}$	30 min
0 $^{\circ}\text{C}$ to 10 $^{\circ}\text{C}$	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 2008-09-29				
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 <sup>c)</sup>	$T_{max}$	[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 safe 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 2007-01-03.

- 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)

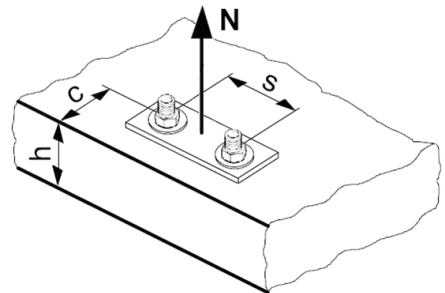
The values are valid for one anchor.

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



### Basic design tensile resistance

#### Design steel resistance $N_{Rd,s}$

		Data according ETA-03/0032, issue 2008-09-29				
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 $N_{Rd,p} = N_{Rd,p}^0 \cdot f_{B,p} \cdot f_{h,p}$

		Data according ETA-03/0032, issue 2008-09-29				
Anchor size		M10x75	M12x95	M16x105	M16x125	M20x170
Embedment depth $h_{ef}$ [mm]		75	95	105	125	170
Non cracked concrete						
$N_{Rd,p}^0$	Temperature range I [kN]	21,9	26,7	36,2	47,1	74,6
Cracked concrete						
$N_{Rd,p}^0$	Temperature range I [kN]	15,6	22,2	25,8	33,5	53,2

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

Design splitting resistance <sup>a)</sup>  $N_{Rd,sp} = N_{Rd,c}^0 \cdot f_B \cdot f_{h,N} \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{re,N}$

		Data according ETA-03/0032, issue 2008-09-29				
Anchor size		M10x75	M12x95	M16x105	M16x125	M20x170
$N_{Rd,c}^0$ Non cracked concrete [kN]		21,9	31,2	36,2	47,1	74,6
$N_{Rd,c}^0$ 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
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0.1}$ <sup>a)</sup>	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
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ <sup>a)</sup>	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 <sup>a)</sup>

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

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 <sup>a)</sup>

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

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

$f_{h,N} = (h_{ef}/h_{ef,typ})^{1,5}$
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### Influence of reinforcement

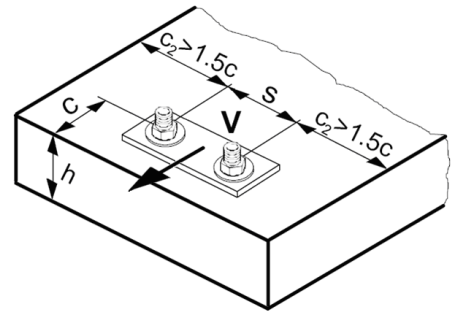
$h_{ef}$ [mm]	40	50	60	70	80	90	$\geq 100$
$f_{re,N} = 0,5 + h_{ef}/200\text{mm} \leq 1$	0,7 <sup>a)</sup>	0,75 <sup>a)</sup>	0,8 <sup>a)</sup>	0,85 <sup>a)</sup>	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_h \cdot f_4$



### Basic design shear resistance

#### Design steel resistance $V_{Rd,s}$

		Data according ETA-03/0032, issue 2008-09-29				
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 $V_{Rd,cp} = \text{lower value}^a)$ of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

$$k = 1 \text{ for } h_{ef} < 60 \text{ mm}$$

$$k = 2 \text{ for } h_{ef} \geq 60 \text{ mm}$$

- a)  $N_{Rd,p}$ : Design combined pull-out and concrete cone resistance  
 $N_{Rd,c}$ : Design concrete cone resistance

#### Design concrete edge resistance $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_h \cdot f_4$

Anchor size	Non-cracked concrete					Cracked concrete				
	M10x75	M12x95	M16x105	M16x125	M20x170	M10x75	M12x95	M16x105	M16x125	M20x170
$V_{Rd,c}^0$ [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
$f_B = (f_{ck,cube}/25\text{N/mm}^2)^{1/2}$ 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 $\beta$	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 <sup>a)</sup> for concrete edge resistance:  $f_4$**

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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  $c_{min}$ .

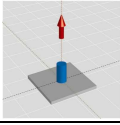
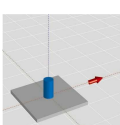
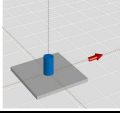
**Combined tension and shear loading**

For combined tension and shear loading see section "Anchor Design".

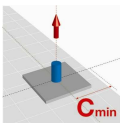

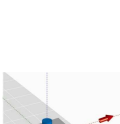
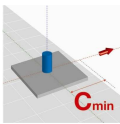


**Precalculated values**

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action  $\gamma = 1,4$ . 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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$

		Data according ETA-03/0032, issue 2008-09-29					
Anchor size		M10x75	M12x95	M16x105	M16x125	M20x170	
Embedment depth	$h_{ef} = [\text{mm}]$	75	95	105	125	170	
Base material thickness	$h_{min} = [\text{mm}]$	150	190	210	250	340	
<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>							
Non cracked concrete							
	HVZ						
	HVZ-R	[kN]	21,9	26,7	36,2	47,1	74,6
	HVZ-HCR						
Cracked concrete							
	HVZ						
	HVZ-R	[kN]	15,6	22,2	25,8	33,5	53,2
	HVZ-HCR						
<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>							
Non cracked and cracked concrete							
	HVZ	[kN]	14,4	21,6	40,8	40,8	70,4
	HVZ-R	[kN]	16,0	24,0	44,8	44,8	78,4
	HVZ-HCR						

Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$




		Data according ETA-03/0032, issue 2008-09-29					
Anchor size		M10x75	M12x95	M16x105	M16x125	M20x170	
Embedment depth	$h_{ef} = [\text{mm}]$	75	95	105	125	170	
Base material thickness	$h_{min} = [\text{mm}]$	150	190	210	250	340	
<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>							
Non cracked concrete							
	$c_{min}$	[mm]	50	70	85	85	80
	HVZ						
	HVZ-R	[kN]	13,2	15,7	21,8	26,2	38,9
	HVZ-HCR						
	Cracked concrete						
	$c_{min}$	[mm]	50	60	70	70	80
	HVZ						
	HVZ-R	[kN]	9,4	14,0	17,1	20,4	27,7
	HVZ-HCR						
<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>							
Non cracked concrete							
	$c_{min}$	[mm]	50	70	85	85	80
	HVZ						
	HVZ-R	[kN]	3,5	5,1	7,2	7,4	10,3
	HVZ-HCR						
	Cracked concrete						
	$c_{min}$	[mm]	50	60	70	70	80
	HVZ						
	HVZ-R	[kN]	2,5	4,6	6,9	7,1	7,4
	HVZ-HCR						

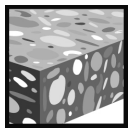
Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$   
 (load values are valid for single anchor)

		Data according ETA-03/0032, issue 2008-09-29					
Anchor size		M10x75	M12x95	M16x105	M16x125	M20x170	
Embedment depth	$h_{ef} = [\text{mm}]$	75	95	105	125	170	
Base material thickness	$h_{min} = [\text{mm}]$	150	190	210	250	340	
Spacing	$s = s_{min} = [\text{mm}]$	50	60	70	70	80	
<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>							
Non cracked concrete							
	HVZ						
	HVZ-R	[kN]	13,4	16,1	22,1	27,9	43,2
	HVZ-HCR						
Cracked concrete							
	HVZ						
	HVZ-R	[kN]	9,5	13,5	15,8	19,9	30,8
	HVZ-HCR						
<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>) , without lever arm</b>							
Non cracked concrete							
	HVZ	[kN]	14,4	21,6	40,8	40,8	70,4
	HVZ-R	[kN]	16,0	24,0	44,3	44,8	78,4
	HVZ-HCR						
Cracked concrete							
	HVZ	[kN]	14,4	21,6	31,6	39,8	61,5
	HVZ-R	[kN]	16,0	24,0	31,6	39,8	61,5
	HVZ-HCR						



## HVU with HAS/HAS-E rod adhesive anchor

Mortar system		Benefits
	Hilti HVU foil capsule	<ul style="list-style-type: none"> <li>- suitable for non-cracked concrete C 20/25 to C 50/60</li> <li>- high loading capacity</li> <li>- suitable for dry and water saturated concrete</li> <li>- large diameter applications</li> <li>- high corrosion resistant</li> </ul>
	HAS HAS-R HAS-HCR rod	
	HAS-E HAS-E R HAS-E HCR rod	



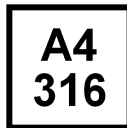
Concrete



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 <sup>a)</sup>	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 166402 / 2007-10-26

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
- One typical embedment depth, as specified in the table
- One anchor material, as specified in the tables
- Concrete C 20/25,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- Temperature range I  
(min. base material temperature  $-40^\circ\text{C}$ , max. long term/short term base material temperature:  $+24^\circ\text{C}/40^\circ\text{C}$ )
- Installation temperature range  $-5^\circ\text{C}$  to  $+40^\circ\text{C}$

**Embedment depth <sup>a)</sup> 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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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 $N_{R_u,m}$ HAS [kN]	17,9	27,3	39,9	75,6	117,6	168,0	249,3	297,4
Shear $V_{R_u,m}$ HAS [kN]	8,9	13,7	20,0	37,8	58,8	84,0	182,7	221,6

**Characteristic resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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 <sup>a)</sup>: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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  $\gamma = 1,4$ . 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/mm <sup>2</sup> ]	500	500	500	500	500	500	-	-
	HAS-(E)(F) 8.8	[N/mm <sup>2</sup> ]	800	800	800	800	800	800	800	800
	HAS-(E)R	[N/mm <sup>2</sup> ]	700	700	700	700	700	700	500	500
	HAS-(E)HCR	[N/mm <sup>2</sup> ]	800	800	800	800	800	700	-	-
Yield strength $f_{yk}$	HAS-(E)(F) 5.8	[N/mm <sup>2</sup> ]	400	400	400	400	400	400	-	-
	HAS-(E)(F) 8.8	[N/mm <sup>2</sup> ]	640	640	640	640	640	640	640	640
	HAS-(E)R	[N/mm <sup>2</sup> ]	450	450	450	450	450	450	210	210
	HAS-(E)HCR	[N/mm <sup>2</sup> ]	640	640	640	640	640	400	-	-
Stressed cross-section $A_s$	HAS	[mm <sup>2</sup> ]	32,8	52,3	76,2	144	225	324	427	519
Moment of resistance $W$	HAS	[mm <sup>3</sup> ]	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 $\geq 5 \mu\text{m}$ (F) hot dipped galvanized $\geq 45 \mu\text{m}$ ,
Threaded rod HAS-(E)F M8-M30	Strength class 8.8, $A_5 > 8\%$ ductile steel galvanized $\geq 5 \mu\text{m}$ , (F) hot dipped galvanized $\geq 45 \mu\text{m}$ ,
Threaded rod HAS-(E)R	Stainless steel grade A4, $A_5 > 8\%$ ductile strength class 70 for $\leq M24$ 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 $\leq M20$ : $R_m = 800 \text{ N/mm}^2$ , $R_{p0.2} = 640 \text{ N/mm}^2$ , $A_5 > 8\%$ ductile M24: $R_m = 700 \text{ N/mm}^2$ , $R_{p0.2} = 400 \text{ N/mm}^2$ , $A_5 > 8\%$ 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 $\geq 5 \mu\text{m}$ , hot dipped galvanized $\geq 45 \mu\text{m}$ ,
	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

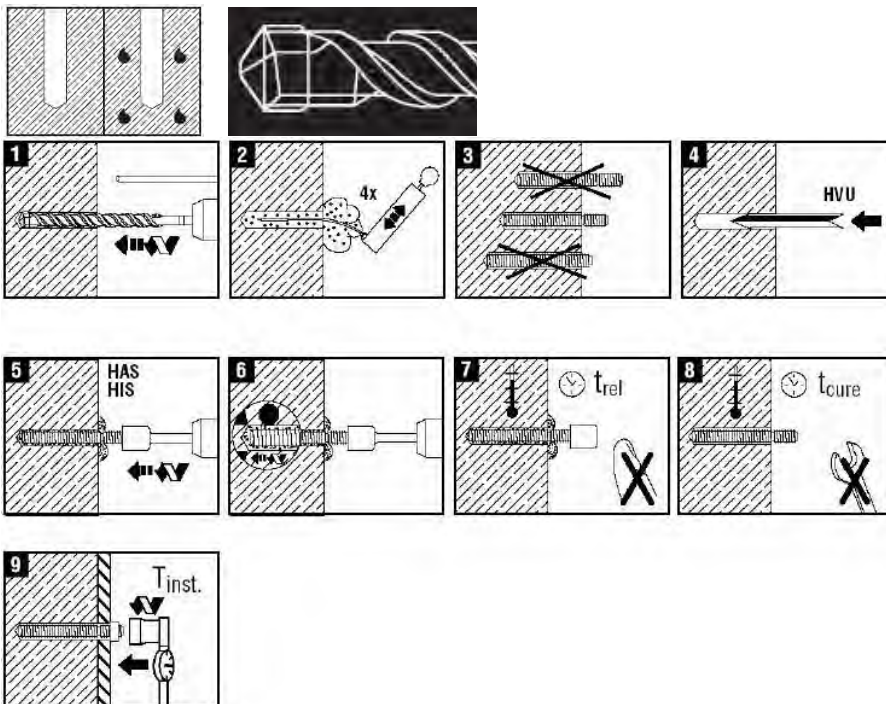
### Setting

#### installation equipment

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Rotary hammer	TE 2 – TE 16				TE 40 – TE 70			
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.

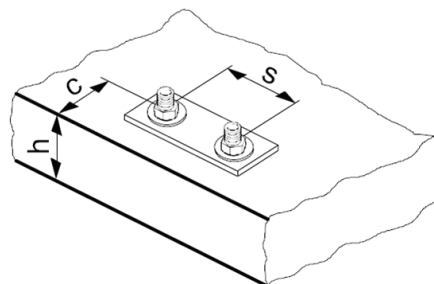
For technical data for anchors in diamond drilled holes please contact the Hilti Technical advisory service.

### 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 <sup>b)</sup>	$c_{cr,sp}$ [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 <sup>c)</sup>	$c_{cr,N}$	$1,5 h_{ef}$							
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 <sup>c)</sup>	$T_{max}$ [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)

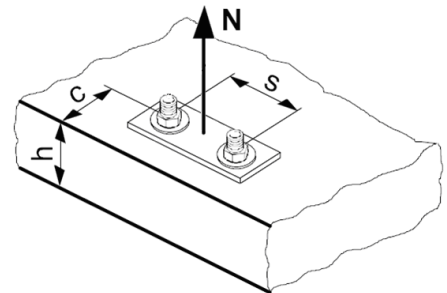
The values are valid for one anchor.

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



### 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 $N_{Rd,p} = N_{Rd,p}^0 \cdot f_{B,p} \cdot f_{h,p}$

		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
$N_{Rd,p}^0$	Temperature range I [kN]	16,7	23,3	33,3	40,0	76,7	93,3	133,3	166,7
$N_{Rd,p}^0$	Temperature range II [kN]	13,3	16,7	26,7	33,3	50,0	76,7	93,3	113,3
$N_{Rd,p}^0$	Temperature range III [kN]	6,0	8,0	10,7	16,7	26,7	40,0	50,0	50,0

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

Design splitting resistance <sup>a)</sup>  $N_{Rd,sp} = N_{Rd,c}^0 \cdot f_B \cdot f_{h,N} \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{re,N}$

		Data according ETA-05/0255, issue 2011-06-23							
Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
$N_{Rd,c}^0$	[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
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,14}$ <sup>a)</sup>	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

$f_{h,p} = 1$
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### 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
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ <sup>a)</sup>	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 <sup>a)</sup>

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

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 <sup>a)</sup>

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

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

$f_{h,N} = 1$
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### Influence of reinforcement

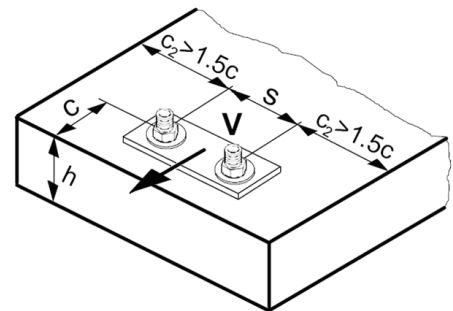
$h_{ef}$ [mm]	40	50	60	70	80	90	$\geq 100$
$f_{re,N} = 0,5 + h_{ef}/200\text{mm} \leq 1$	0,7 <sup>a)</sup>	0,75 <sup>a)</sup>	0,8 <sup>a)</sup>	0,85 <sup>a)</sup>	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_h \cdot f_4$



### 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 $V_{Rd,cp} = \text{lower value}^a)$ of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

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

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
$V_{Rd,c}^0$ [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
$f_B = (f_{ck,cube}/25\text{N/mm}^2)^{1/2}$ 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 $\beta$		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 <sup>a)</sup> for concrete edge resistance: $f_4$

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sup>a)</sup>

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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$**

		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
	<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>								
	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	-	-
	<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>								
	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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$**



		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
	<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>								
	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	-	-
	<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>								
	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	-	-

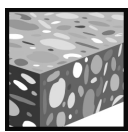
**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  (load values are valid for single anchor)**

		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
	<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>								
	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	-	-
	<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>								
	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 adhesive anchor

Mortar system		Benefits
 <p>Hilti HVU foil capsule</p>		<ul style="list-style-type: none"> <li>- suitable for non-cracked concrete C 20/25 to C 50/60</li> <li>- high loading capacity</li> <li>- suitable for dry and water saturated concrete</li> </ul>
 <p>HIS-(R)N sleeve</p>		



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 <sup>a)</sup>	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 166402 / 2007-10-26

a) All data given in this section according to 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- Temperate range I  
(min. base material temperature  $-40^\circ\text{C}$ , max. long term/short term base material temperature:  $+24^\circ\text{C}/40^\circ\text{C}$ )
- Installation temperature range  $-5^\circ\text{C}$  to  $+40^\circ\text{C}$

### 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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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 <sup>a)</sup>: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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  $\gamma = 1,4$ . 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/mm <sup>2</sup> ]	490	490	460	460	460
	Screw 8.8	[N/mm <sup>2</sup> ]	800	800	800	800	800
	HIS-RN	[N/mm <sup>2</sup> ]	700	700	700	700	700
	Screw A4-70	[N/mm <sup>2</sup> ]	700	700	700	700	700
Yield strength $f_{yk}$	HIS-N	[N/mm <sup>2</sup> ]	410	410	375	375	375
	Screw 8.8	[N/mm <sup>2</sup> ]	640	640	640	640	640
	HIS-RN	[N/mm <sup>2</sup> ]	350	350	350	350	350
	Screw A4-70	[N/mm <sup>2</sup> ]	450	450	450	450	450
Stressed cross-section $A_s$	HIS-(R)N	[mm <sup>2</sup> ]	51,5	108,0	169,1	256,1	237,6
	Screw	[mm <sup>2</sup> ]	36,6	58	84,3	157	245
Moment of resistance $W$	HIS-(R)N	[mm <sup>3</sup> ]	145	430	840	1595	1543
	Screw	[mm <sup>3</sup> ]	31,2	62,3	109	277	541

### Material quality

Part	Material
internally threaded sleeves <sup>a)</sup> HIS-N	C-steel 1.0718, steel galvanized $\geq 5\mu\text{m}$
internally threaded sleeves <sup>b)</sup> HIS-RN	stainless steel 1.4401 and 1.4571

a) related fastening screw: strength class 8.8, A5 > 8% Ductile steel galvanized  $\geq 5\mu\text{m}$

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

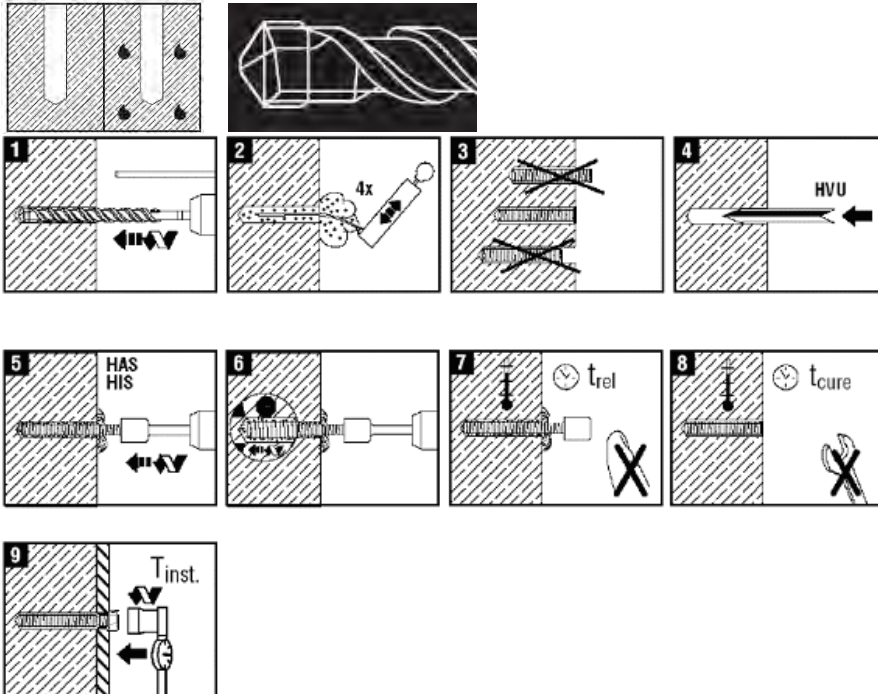
## Setting

### installation equipment

Anchor size	M8	M10	M12	M16	M20
Rotary hammer	TE2 – TE16		TE40 – TE70		
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.

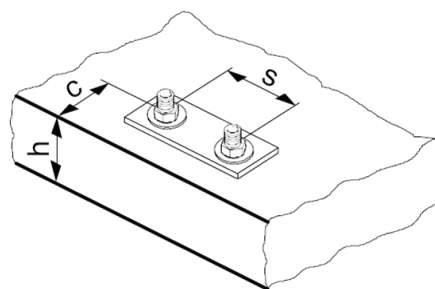
For technical data for anchors in diamond drilled holes please contact the Hilti Technical advisory service.

### 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 <sup>a)</sup>	$c_{cr,sp}$ [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	$c_{cr,N}$	$1,5 h_{ef}$				
Torque moment <sup>b)</sup>	$T_{max}$ [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 same 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)

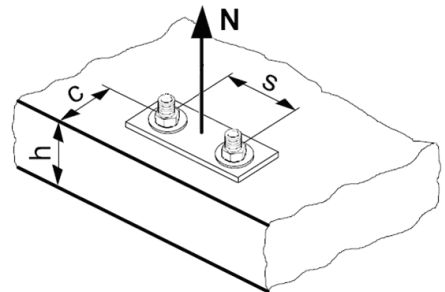
The values are valid for one anchor.

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



## 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  $N_{Rd,p} = N_{Rd,p}^0 \cdot f_{B,p} \cdot f_{h,p}$

		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
$N_{Rd,p}^0$	Temperature range I [kN]	16,7	26,7	40,0	63,3	93,3
$N_{Rd,p}^0$	Temperature range II [kN]	13,3	23,3	33,3	50,0	63,3
$N_{Rd,p}^0$	Temperature range III [kN]	6,0	10,7	13,3	26,7	33,3

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

Design splitting resistance <sup>a)</sup>  $N_{Rd,sp} = N_{Rd,c}^0 \cdot f_B \cdot f_{h,N} \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{re,N}$

		Data according ETA-05/0255, issue 2011-06-23				
Anchor size		M8	M10	M12	M16	M20
$N_{Rd,c}^0$	[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)

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

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)

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

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

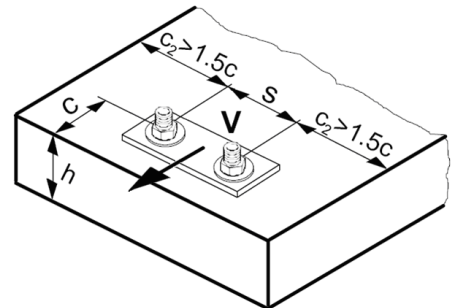
$h_{ef}$ [mm]	80	90	$\geq 100$
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_\beta \cdot f_h \cdot f_4$



### 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 $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_\beta \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		M8	M10	M12	M16	M20
$V_{Rd,c}^0$	[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 $\beta$	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 <sup>a)</sup> for concrete edge resistance: $f_4$

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sup>a)</sup>

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

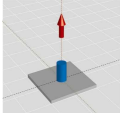
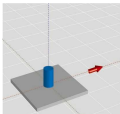
For combined tension and shear loading see section "Anchor Design".



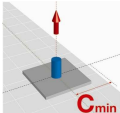
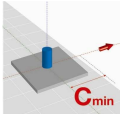
### Precalculated values

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.

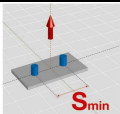
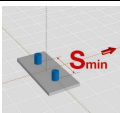
Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$

		Data according ETA-05/0255, issue 2011-06-23				
Anchor size		M8	M10	M12	M16	M20
Embedment depth	$h_{ef} = [\text{mm}]$	90	110	125	170	205
Base material thickness	$h_{min} = [\text{mm}]$	120	150	170	230	270
	<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>					
	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
	<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>					
	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


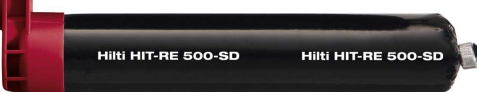


Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$

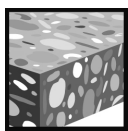
		Data according ETA-05/0255, issue 2011-06-23				
Anchor size		M8	M10	M12	M16	M20
Embedment depth	$h_{ef} = [\text{mm}]$	90	110	125	170	205
Base material thickness	$h_{min} = [\text{mm}]$	120	150	170	230	270
Edge distance	$c = c_{min} = [\text{mm}]$	40	45	60	80	125
	<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>					
	HIS-(R)N [kN]	8,9	13,4	21,0	33,5	49,2
	<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>					
	HIS-(R)N [kN]	4,2	5,5	8,5	13,8	25,3

Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$   
(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	$h_{ef} = [\text{mm}]$	90	110	125	170	205
Base material thickness	$h_{min} = [\text{mm}]$	120	150	170	230	270
Spacing	$s = s_{min} = [\text{mm}]$	40	45	60	80	125
	<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>					
	HIS-(R)N [kN]	11,0	16,9	24,4	38,8	56,2
	<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>					
	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 with HIT-V rod

Injection mortar system		Benefits
   	<p>Hilti HIT-RE 500-SD 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)</p> <p>Static mixer</p> <p>HIT-V rod</p>	<ul style="list-style-type: none"> <li>- suitable for non-cracked and cracked concrete C 20/25 to C 50/60</li> <li>- high loading capacity</li> <li>- suitable for dry and water saturated concrete</li> <li>- large diameter applications</li> <li>- high corrosion resistant</li> <li>- long working time at elevated temperatures</li> <li>- odourless epoxy</li> <li>- embedment depth range: from 40 ... 160 mm for M8 to 120 ... 600 mm for M30</li> </ul>



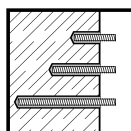
Concrete



Tensile zone



Small edge distance and spacing



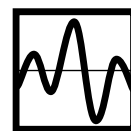
Variable embedment depth



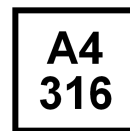
Fire resistance



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 <sup>a)</sup>	DIBt, Berlin	ETA-07/0260 / 2009-01-12
ES report incl. seismic	ICC evaluation service	ESR 2322 / 2012-02-01
Shockproof fastenings in civil defence installations	Federal Office for Civil 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 166402 / 2007-10-26 & suppl. WF 172920 / 2008-05-27

a) All data given in this section according ETA-07/0260, issue 2009-01-12.

### 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- Temperate range I  
(min. base material temperature  $-40^\circ\text{C}$ , max. long term/short term base material temperature:  $+24^\circ\text{C}/40^\circ\text{C}$ )
- Installation temperature range  $+5^\circ\text{C}$  to  $+40^\circ\text{C}$

### Embedment depth <sup>a)</sup> 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 – $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HIT-V 5.8

		Data according ETA-07/0260, issue 2009-01-12							
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 – $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HIT-V 5.8

		Data according ETA-07/0260, issue 2009-01-12							
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 – $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HIT-V 5.8

		Data according ETA-07/0260, issue 2009-01-12							
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 <sup>a)</sup>: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HIT-V 5.8**

			Data according ETA-07/0260, issue 2009-01-12							
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  $\gamma = 1,4$ . 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 2009-01-12							
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Nominal tensile strength $f_{uk}$	HIT-V 5.8	[N/mm <sup>2</sup> ]	500	500	500	500	500	500	500	500
	HIT-V 8.8	[N/mm <sup>2</sup> ]	800	800	800	800	800	800	800	800
	HIT-V-R	[N/mm <sup>2</sup> ]	700	700	700	700	700	700	500	500
	HIT-V-HCR	[N/mm <sup>2</sup> ]	800	800	800	800	800	700	700	700
Yield strength $f_{yk}$	HIT-V 5.8	[N/mm <sup>2</sup> ]	400	400	400	400	400	400	400	400
	HIT-V 8.8	[N/mm <sup>2</sup> ]	640	640	640	640	640	640	640	640
	HIT-V -R	[N/mm <sup>2</sup> ]	450	450	450	450	450	450	210	210
	HIT-V -HCR	[N/mm <sup>2</sup> ]	600	600	600	600	600	400	400	400
Stressed cross-section $A_s$	HIT-V	[mm <sup>2</sup> ]	36,6	58,0	84,3	157	245	353	459	561
Moment of resistance $W$	HIT-V	[mm <sup>3</sup> ]	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 <sub>5</sub> > 8% ductile steel galvanized ≥ 5 μm, (F) hot dipped galvanized ≥ 45 μm,
Threaded rod HIT-V(F) 8.8	Strength class 8.8, A <sub>5</sub> > 8% ductile steel galvanized ≥ 5 μm, (F) hot dipped galvanized ≥ 45 μm,
Threaded rod HIT-V-R	Stainless steel grade A4, A <sub>5</sub> > 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 <sub>m</sub> = 800 N/mm <sup>2</sup> , R <sub>p0.2</sub> = 640 N/mm <sup>2</sup> , A <sub>5</sub> > 8% ductile M24 to M30: R <sub>m</sub> = 700 N/mm <sup>2</sup> , R <sub>p0.2</sub> = 400 N/mm <sup>2</sup> , A <sub>5</sub> > 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							

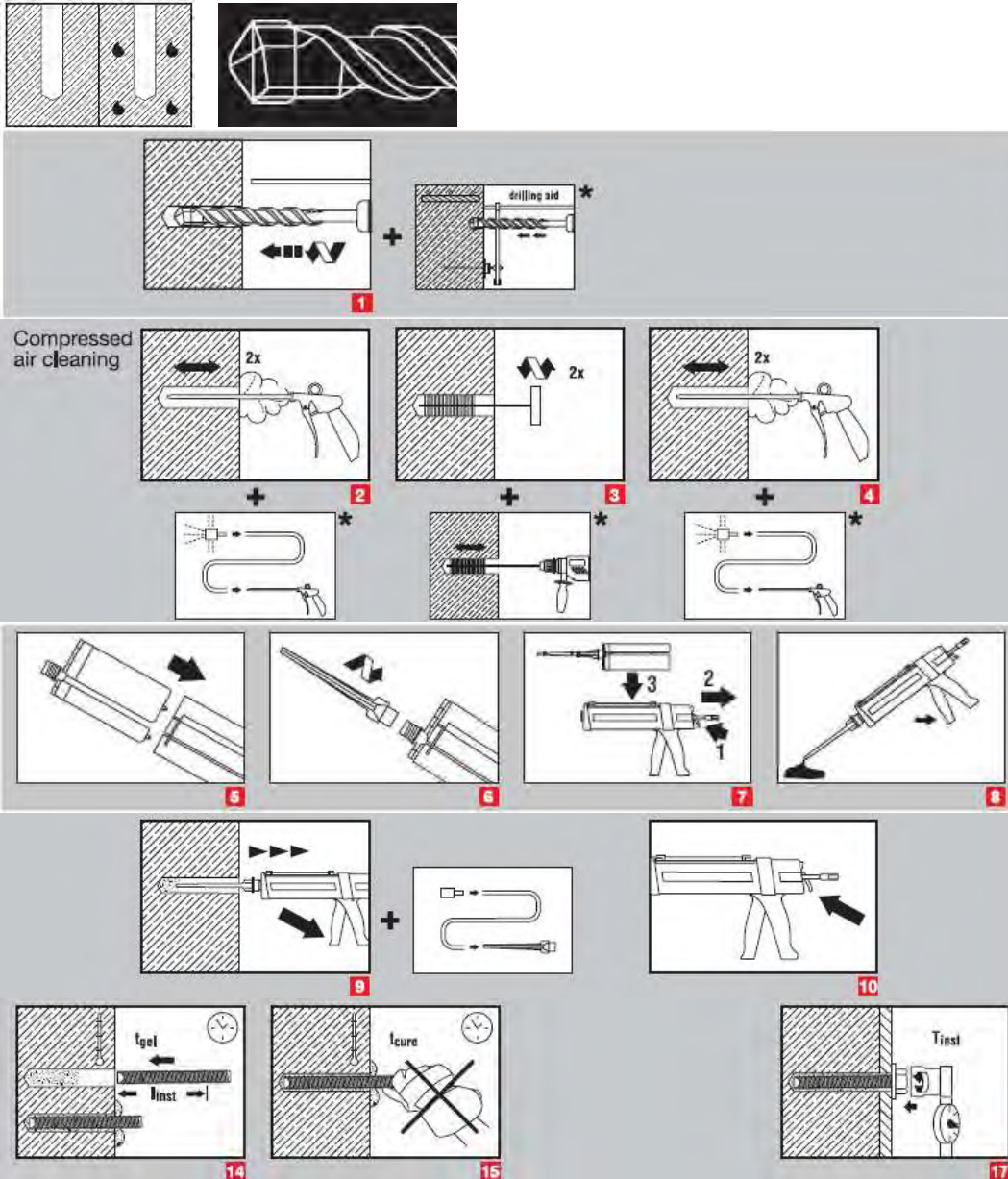
### Setting

#### 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

Dry and water-saturated concrete, hammer drilling



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

Data according ETA-07/0260, issue 2009-01-12

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 2009-01-12							
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 <sup>a)</sup>	$h_{ef,min}$	[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]	$h_{ef} + 30 \text{ mm}$ $\geq 100 \text{ mm}$			$h_{ef} + 2 d_0$				
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 <sup>b)</sup>	$c_{cr,sp}$	[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 <sup>c)</sup>	$c_{cr,N}$		$1,5 h_{ef}$							
Torque moment <sup>d)</sup>	$T_{max}$	[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 safe 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 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)

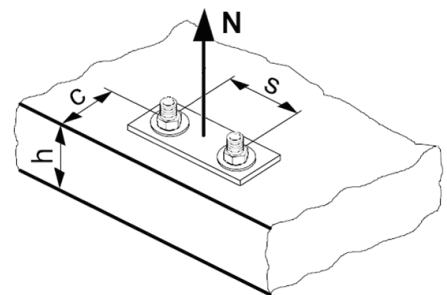
The values are valid for one anchor.

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



## Basic design tensile resistance

### Design steel resistance $N_{Rd,s}$

		Data according ETA-07/0260, issue 2009-01-12							
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

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

	Data according ETA-07/0260, issue 2009-01-12							
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								
$N_{Rd,p}^0$ Temperature range I [kN]	17,9	25,1	36,9	44,9	76,3	105,6	135,7	157,5
$N_{Rd,p}^0$ Temperature range II [kN]	14,5	20,4	29,9	35,9	61,0	82,9	106,6	133,3
$N_{Rd,p}^0$ Temperature range III [kN]	8,9	12,6	18,4	22,4	35,6	52,8	63,0	78,8
Cracked concrete								
$N_{Rd,p}^0$ Temperature range I [kN]	8,9	12,6	17,3	20,9	35,6	52,8	63,0	72,7
$N_{Rd,p}^0$ Temperature range II [kN]	7,3	9,4	13,8	18,0	28,0	41,5	48,5	60,6
$N_{Rd,p}^0$ Temperature range III [kN]	4,5	5,5	8,1	10,5	15,3	22,6	29,1	36,4

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

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

	Data according ETA-07/0260, issue 2009-01-12							
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
$N_{Rd,c}^0$ Non cracked concrete [kN]	20,1	24,0	32,4	33,6	53,3	73,2	89,4	106,7
$N_{Rd,c}^0$ 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 <sup>a)</sup>

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

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 <sup>a)</sup>

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

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

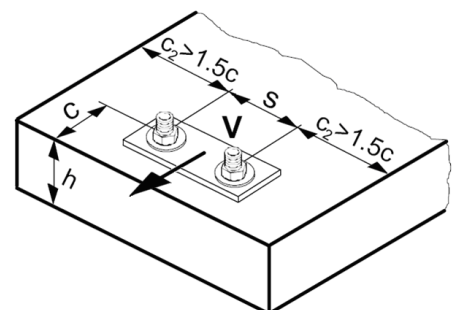
$h_{ef}$ [mm]	40	50	60	70	80	90	$\geq 100$
$f_{re,N} = 0,5 + h_{ef}/200\text{mm} \leq 1$	0,7 <sup>a)</sup>	0,75 <sup>a)</sup>	0,8 <sup>a)</sup>	0,85 <sup>a)</sup>	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



### Basic design shear resistance

#### Design steel resistance $V_{Rd,s}$

			Data according ETA-07/0260, issue 2009-01-12							
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<sup>a)</sup> 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 $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete									
$V_{Rd,c}^0$	[kN]	5,9	8,6	11,6	18,7	27,0	36,6	44,5	53,0
Cracked concrete									
$V_{Rd,c}^0$	[kN]	4,2	6,1	8,2	13,2	19,2	25,9	31,5	37,5

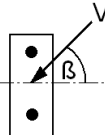
### Influencing factors

#### 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 $\beta$	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 <sup>a)</sup> for concrete edge resistance:  $f_4$   
 $f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sub>ef</sub> /d	4	4,5	5	6	7	8	9	10	11
f <sub>hef</sub> = 0,05 · (h <sub>ef</sub> / d) <sup>1,68</sup>	0,51	0,63	0,75	1,01	1,31	1,64	2,00	2,39	2,81
h <sub>ef</sub> /d	12	13	14	15	16	17	18	19	20
f <sub>hef</sub> = 0,05 · (h <sub>ef</sub> / d) <sup>1,68</sup>	3,25	3,72	4,21	4,73	5,27	5,84	6,42	7,04	7,67

### Influence of edge distance <sup>a)</sup>

c/d	4	6	8	10	15	20	30	40
f <sub>c</sub> = (d / c) <sup>0,19</sup>	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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I

		Data according ETA-07/0260, issue 2009-01-12								
Anchor size		M8	M10	M12	M16	M20	M24	M27	M30	
Embedment depth	$h_{ef,1} = [\text{mm}]$	48	60	72	96	120	144	162	180	
Base material thickness	$h_{min} = [\text{mm}]$	100	100	102	132	168	200	222	250	
<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>										
Non cracked concrete										
HIT-V 5.8										
HIT-V 8.8										
HIT-V-R		[kN]	9,3	13,0	17,1	22,6	31,6	41,6	49,6	58,1
HIT-V-HCR										
Cracked concrete										
HIT-V 5.8										
HIT-V 8.8										
HIT-V-R		[kN]	5,4	8,4	11,3	16,1	22,5	29,6	35,3	41,4
HIT-V-HCR										
<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>										
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I

		Data according ETA-07/0260, issue 2009-01-12								
Anchor size		M8	M10	M12	M16	M20	M24	M27	M30	
Embedment depth	$h_{ef,1} = [\text{mm}]$	48	60	72	96	120	144	162	180	
Base material thickness	$h_{min} = [\text{mm}]$	100	100	102	132	168	200	222	250	
Edge distance	$c = c_{min} = [\text{mm}]$	40	50	60	80	100	120	135	150	
<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>										
Non cracked concrete										
HIT-V 5.8										
HIT-V 8.8										
HIT-V-R		[kN]	6,3	8,5	9,9	12,9	18,2	23,8	28,2	33,2
HIT-V-HCR										
Cracked concrete										
HIT-V 5.8										
HIT-V 8.8										
HIT-V-R		[kN]	3,6	5,6	7,1	9,2	12,9	16,9	20,1	23,7
HIT-V-HCR										
<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>										
Non cracked concrete										
HIT-V 5.8										
HIT-V 8.8										
HIT-V-R		[kN]	3,4	4,9	6,7	10,8	15,7	21,4	26,0	31,1
HIT-V-HCR										
Cracked concrete										
HIT-V 5.8										
HIT-V 8.8										
HIT-V-R		[kN]	2,4	3,5	4,7	7,6	11,1	15,1	18,4	22,0
HIT-V-HCR										

Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I  
(load values are valid for single anchor)

		Data according ETA-07/0260, issue 2009-01-12								
Anchor size		M8	M10	M12	M16	M20	M24	M27	M30	
Embedment depth	$h_{ef,1} = [\text{mm}]$	48	60	72	96	120	144	162	180	
Base material thickness	$h_{min} = [\text{mm}]$	100	100	102	132	168	200	222	250	
Spacing	$s = s_{min} = [\text{mm}]$	40	50	60	80	100	120	135	150	
<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>										
Non cracked concrete										
HIT-V 5.8										
HIT-V 8.8										
HIT-V-R		[kN]	6,0	8,2	10,3	13,5	19,0	24,9	29,6	34,8
HIT-V-HCR										
Cracked concrete										
HIT-V 5.8										
HIT-V 8.8										
HIT-V-R		[kN]	3,6	5,5	7,4	9,6	13,5	17,8	21,1	24,8
HIT-V-HCR										
<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>										
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I

		Data according ETA-07/0260, issue 2009-01-12								
Anchor size		M8	M10	M12	M16	M20	M24	M27	M30	
Embedment depth	$h_{ef,typ} = [\text{mm}]$	80	90	110	125	170	210	240	270	
Base material thickness	$h_{min} = [\text{mm}]$	110	120	140	161	218	266	300	340	
<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>										
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		[kN]	8,9	12,6	17,3	20,9	35,6	52,2	63,0	72,7
HIT-V-R										
HIT-V-HCR										
<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>										
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I

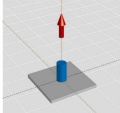
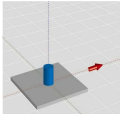
		Data according ETA-07/0260, issue 2009-01-12								
Anchor size		M8	M10	M12	M16	M20	M24	M27	M30	
Embedment depth	$h_{ef,typ} = [\text{mm}]$	80	90	110	125	170	210	240	270	
Base material thickness	$h_{min} = [\text{mm}]$	110	120	140	161	218	266	300	340	
Edge distance	$c = c_{min} = [\text{mm}]$	40	50	60	80	100	120	135	150	
<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>										
Non cracked concrete										
HIT-V 5.8										
HIT-V 8.8		[kN]	9,6	11,6	15,5	16,9	26,1	35,6	43,3	51,4
HIT-V-R										
HIT-V-HCR										
Cracked concrete										
HIT-V 5.8										
HIT-V 8.8		[kN]	4,8	7,0	9,5	12,1	18,6	25,4	30,8	36,7
HIT-V-R										
HIT-V-HCR										
<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>										
Non cracked concrete										
HIT-V 5.8										
HIT-V 8.8		[kN]	3,7	5,3	7,3	11,5	17,2	23,6	29,0	34,8
HIT-V-R										
HIT-V-HCR										
Cracked concrete										
HIT-V 5.8										
HIT-V 8.8		[kN]	2,6	3,8	5,2	8,1	12,2	16,7	20,5	24,7
HIT-V-R										
HIT-V-HCR										

Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I  
(load values are valid for single anchor)

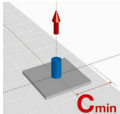
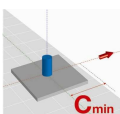
		Data according ETA-07/0260, issue 2009-01-12								
Anchor size		M8	M10	M12	M16	M20	M24	M27	M30	
Embedment depth	$h_{ef,typ} = [\text{mm}]$	80	90	110	125	170	210	240	270	
Base material thickness	$h_{min} = [\text{mm}]$	110	120	140	161	218	266	300	340	
Spacing	$s = s_{min} = [\text{mm}]$	40	50	60	80	100	120	135	150	
<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>										
Non cracked concrete										
HIT-V 5.8										
HIT-V 8.8		[kN]	10,9	13,5	18,1	19,2	30,1	41,2	50,3	59,9
HIT-V-R										
HIT-V-HCR										
Cracked concrete										
HIT-V 5.8										
HIT-V 8.8		[kN]	5,9	8,1	11,1	13,2	21,5	29,4	35,8	42,7
HIT-V-R										
HIT-V-HCR										
<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>										
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I**

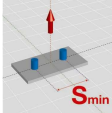
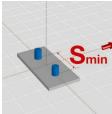
		Data according ETA-07/0260, issue 2009-01-12							
Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	$h_{ef,2} =$ [mm]	96	120	144	192	240	288	324	360
Base material thickness	$h_{min} =$ [mm]	126	150	174	228	288	344	384	430
<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>									
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
<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>									
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I**

		Data according ETA-07/0260, issue 2009-01-12							
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
<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>									
Non cracked concrete									
	HIT-V 5.8								
	HIT-V 8.8 [kN]	11,6	16,5	21,7	28,6	40,0	52,6	62,7	73,5
	HIT-V-R								
	HIT-V-HCR								
Cracked concrete									
	HIT-V 5.8								
	HIT-V 8.8 [kN]	5,8	9,0	12,2	17,5	27,4	37,5	44,7	52,4
	HIT-V-R								
	HIT-V-HCR								
<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>									
Non cracked concrete									
	HIT-V 5.8								
	HIT-V 8.8 [kN]	3,9	5,7	7,8	12,9	18,9	25,9	31,8	38,1
	HIT-V-R								
	HIT-V-HCR								
Cracked concrete									
	HIT-V 5.8								
	HIT-V 8.8 [kN]	2,8	4,0	5,5	9,1	13,4	18,4	22,5	27,0
	HIT-V-R								
	HIT-V-HCR								

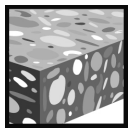


Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I  
(load values are valid for single anchor)

		Data according ETA-07/0260, issue 2009-01-12							
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
<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>									
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 [kN]	7,2	11,0	14,8	20,8	31,7	44,9	52,9	61,1
	HIT-V-R [kN]								
	HIT-V-HCR [kN]								
<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>									
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

## Hilti HIT-RE 500-SD with HIS-(R)N

Injection mortar system		Benefits
	Hilti HIT-RE 500-SD 330 ml foil pack	<ul style="list-style-type: none"> <li>- suitable for cracked and non-cracked concrete C 20/25 to C 50/60</li> <li>- high loading capacity</li> <li>- suitable for dry and water saturated concrete</li> <li>- long working time at elevated temperatures</li> <li>- odourless epoxy</li> </ul>
	(also available as 500 ml and 1400 ml foil pack)	
	Statik mixer	
	HIS-(R)N sleeve	



Concrete



Tensile zone



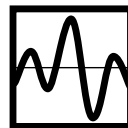
Small edge distance and spacing



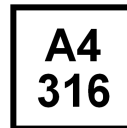
Fire resistance



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 <sup>a)</sup>	DIBt, Berlin	ETA-07/0260 / 2009-01-12
ES report incl. seismic	ICC evaluation service	ESR 2322 / 2012-02-01
Shockproof fastenings in civil defence installations	Federal Office for Civil 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 166402 / 2007-10-26 & suppl. WF 172920 / 2008-05-27

a) All data given in this section according ETA-07/0260, issue 2009-01-12.

### 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- Temperature range I  
(min. base material temperature  $-40^\circ\text{C}$ , max. long term/short term base material temperature:  $+24^\circ\text{C}/40^\circ\text{C}$ )
- Installation temperature range  $+5^\circ\text{C}$  to  $+40^\circ\text{C}$

### 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 – $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HIS-N

Data according ETA-07/0260, issue 2009-01-12							
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 – $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HIS-N

Data according ETA-07/0260, issue 2009-01-12							
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 – $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HIS-N

Data according ETA-07/0260, issue 2009-01-12							
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 <sup>a)</sup>: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HIS-N**

			Data according ETA-07/0260, issue 2009-01-12				
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  $\gamma = 1,4$ . 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 2009-01-12				
Anchor size			M8	M10	M12	M16	M20
Nominal tensile strength $f_{uk}$	HIS-N	[N/mm <sup>2</sup> ]	490	490	460	460	460
	Screw 8.8	[N/mm <sup>2</sup> ]	800	800	800	800	800
	HIS-RN	[N/mm <sup>2</sup> ]	700	700	700	700	700
	Screw A4-70	[N/mm <sup>2</sup> ]	700	700	700	700	700
Yield strength $f_{yk}$	HIS-N	[N/mm <sup>2</sup> ]	410	410	375	375	375
	Screw 8.8	[N/mm <sup>2</sup> ]	640	640	640	640	640
	HIS-RN	[N/mm <sup>2</sup> ]	350	350	350	350	350
	Screw A4-70	[N/mm <sup>2</sup> ]	450	450	450	450	450
Stressed cross-section $A_s$	HIS-(R)N	[mm <sup>2</sup> ]	51,5	108,0	169,1	256,1	237,6
	Screw	[mm <sup>2</sup> ]	36,6	58	84,3	157	245
Moment of resistance $W$	HIS-(R)N	[mm <sup>3</sup> ]	145	430	840	1595	1543
	Screw	[mm <sup>3</sup> ]	31,2	62,3	109	277	541

## Material quality

Part	Material
internally threaded sleeves <sup>a)</sup> HIS-N	C-steel 1.0718, steel galvanized $\geq 5\mu\text{m}$
internally threaded sleeves <sup>b)</sup> HIS-RN	stainless steel 1.4401 and 1.4571

a) related fastening screw: strength class 8.8, A5 > 8% Ductile  
steel galvanized  $\geq 5\mu\text{m}$

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

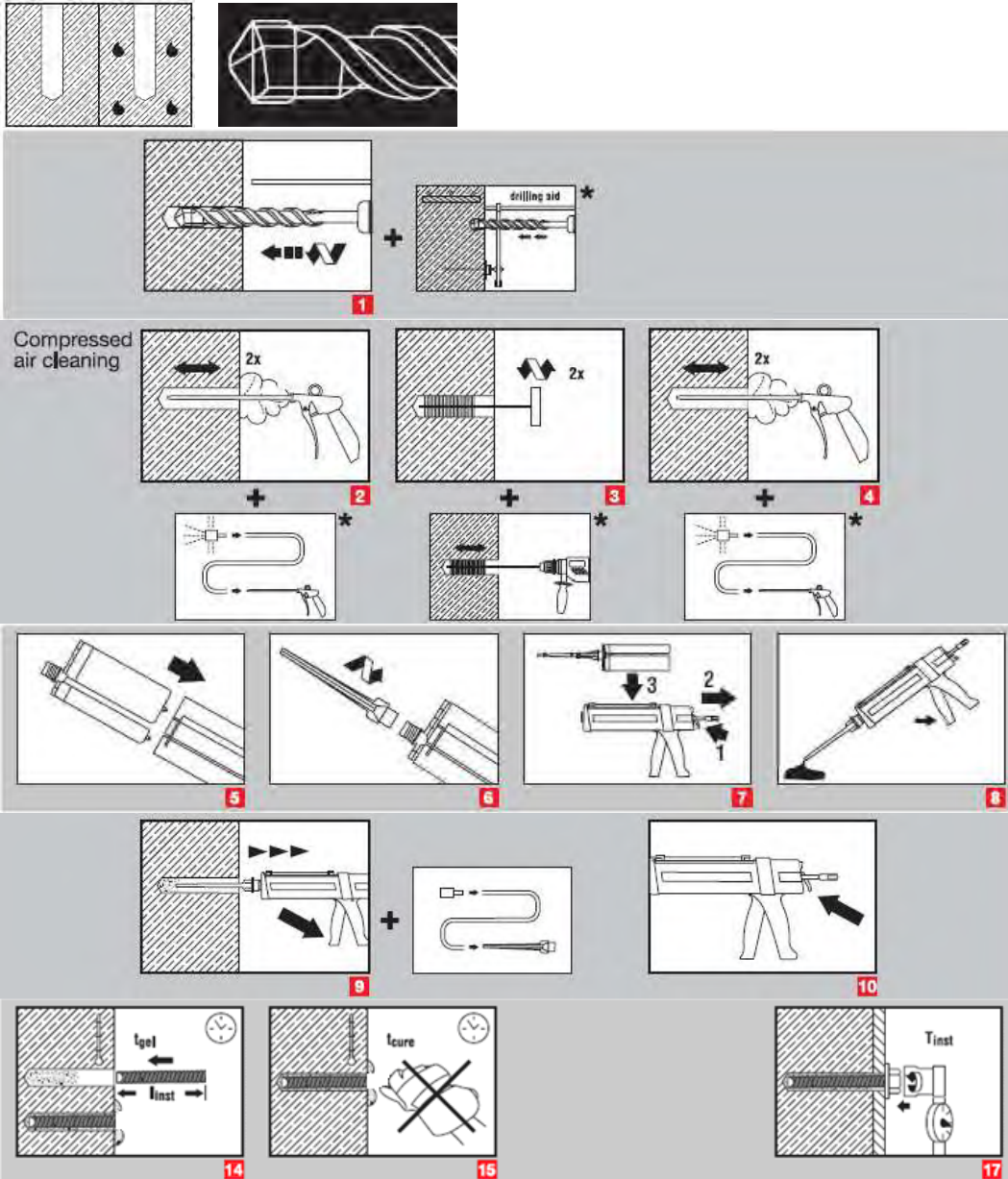
## Setting

### 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

Dry and water-saturated concrete, hammer drilling



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

Data according ETA-07/0260, issue 2009-01-12

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 2009-01-12				
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 <sup>a)</sup>	$c_{cr,sp}$ [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 <sup>b)</sup>	$c_{cr,N}$	$1,5 h_{ef}$				
Torque moment <sup>c)</sup>	$T_{max}$ [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 safe 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 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)

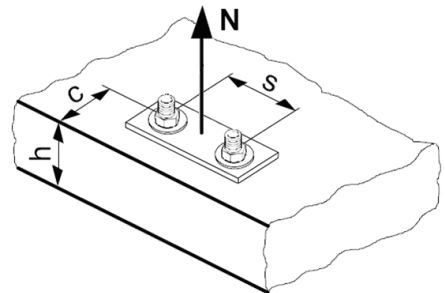
The values are valid for one anchor.

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



## Basic design tensile resistance

### Design steel resistance $N_{Rd,s}$

		Data according ETA-07/0260, issue 2009-01-12				
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

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

Data according ETA-07/0260, issue 2009-01-12					
Anchor size	M8	M10	M12	M16	M20
Embedment depth $h_{ef}$ [mm]	90	110	125	170	205
Non cracked concrete					
$N_{Rd,p}^0$ Temperature range I [kN]	22,2	28,6	45,2	81,0	95,2
$N_{Rd,p}^0$ Temperature range II [kN]	19,4	23,8	35,7	66,7	81,0
$N_{Rd,p}^0$ Temperature range III [kN]	11,1	14,3	19,0	35,7	45,2
Cracked concrete					
$N_{Rd,p}^0$ Temperature range I [kN]	13,9	19,0	28,6	45,2	54,8
$N_{Rd,p}^0$ Temperature range II [kN]	11,1	16,7	19,0	35,7	45,2
$N_{Rd,p}^0$ Temperature range III [kN]	6,7	9,5	11,9	19,0	23,8

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

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

Data according ETA-07/0260, issue 2009-01-12					
Anchor size	M8	M10	M12	M16	M20
$N_{Rd,c}^0$ Non cracked concrete [kN]	24,0	27,7	33,6	53,3	70,6
$N_{Rd,c}^0$ 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 <sup>a)</sup>

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

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 smaller than the critical edge distance.

### Influence of anchor spacing <sup>a)</sup>

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

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

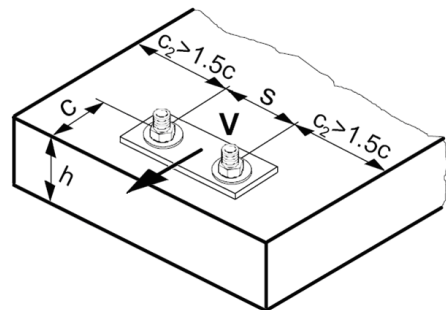
$h_{ef}$ [mm]	80	90	$\geq 100$
$f_{re,N} = 0,5 + h_{ef}/200\text{mm} \leq 1$	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



### Basic design shear resistance

#### Design steel resistance $V_{Rd,s}$

		Data according ETA-07/0260, issue 2009-01-12				
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  $V_{Rd,cp} = \text{lower value}^a)$  of  $k \cdot N_{Rd,p}$  and  $k \cdot N_{Rd,c}$

$$k = 1 \text{ for } h_{ef} < 60 \text{ mm}$$

$$k = 2 \text{ for } h_{ef} \geq 60 \text{ mm}$$

- a)  $N_{Rd,p}$ : Design combined pull-out and concrete cone resistance  
 $N_{Rd,c}$ : Design concrete cone resistance

Design concrete edge resistance  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_\beta \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		M8	M10	M12	M16	M20
Non-cracked concrete						
$V_{Rd,c}^0$	[kN]	12,4	19,6	28,2	40,2	46,2
Cracked concrete						
$V_{Rd,c}^0$	[kN]	8,8	13,9	20,0	28,5	32,7

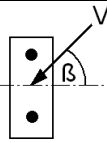
## Influencing factors

### 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
$f_B = (f_{ck,cube}/25\text{N/mm}^2)^{1/2}$ 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 $\beta$	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 <sup>a)</sup> for concrete edge resistance:  $f_4$   
 $f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sup>a)</sup>

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  $c_{min}$ .

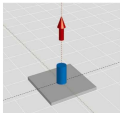
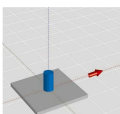
## Combined tension and shear loading

For combined tension and shear loading see section "Anchor Design".

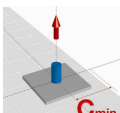
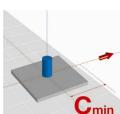
### Precalculated values

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.

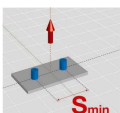
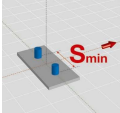
Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I

		Data according ETA-07/0260, issue 2009-01-12				
Anchor size		M8	M10	M12	M16	M20
Embedment depth	$h_{ef} = [\text{mm}]$	90	110	125	170	205
Base material thickness	$h_{min} = [\text{mm}]$	120	150	170	230	270
<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>						
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
<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>						
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I

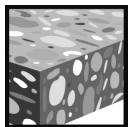
		Data according ETA-07/0260, issue 2009-01-12				
Anchor size		M8	M10	M12	M16	M20
Embedment depth	$h_{ef} = [\text{mm}]$	90	110	125	170	205
Base material thickness	$h_{min} = [\text{mm}]$	120	150	170	230	270
Edge distance	$c = c_{min} = [\text{mm}]$	40	45	55	65	90
<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>						
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
<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>						
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I  
(load values are valid for single anchor)

		Data according ETA-07/0260, issue 2009-01-12				
Anchor size		M8	M10	M12	M16	M20
Embedment depth	$h_{ef} = [\text{mm}]$	90	110	125	170	205
Base material thickness	$h_{min} = [\text{mm}]$	120	150	170	230	270
Spacing	$s = s_{min} = [\text{mm}]$	40	45	55	65	90
<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>						
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
<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>						
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

## Hilti HIT-RE 500-SD with rebar

Injection mortar system		Benefits
    	<p>Hilti HIT-RE 500-SD 330 ml foil pack</p> <p>(also available as 500 ml and 1400 ml foil pack)</p> <p>Statik mixer</p> <p>rebar BSt 500 S</p>	<ul style="list-style-type: none"> <li>- suitable for non-cracked and cracked concrete C 20/25 to C 50/60</li> <li>- high loading capacity</li> <li>- suitable for dry and water saturated concrete</li> <li>- large diameter applications</li> <li>- high corrosion resistant</li> <li>- long working time at elevated temperatures</li> <li>- odourless epoxy</li> <li>- embedment depth range: from 60 ... 160 mm for Ø8 to 128 ... 640 mm for Ø32</li> </ul>



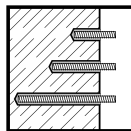
Concrete



Tensile zone



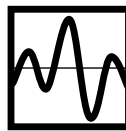
Small edge distance and spacing



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 <sup>a)</sup>	DIBt, Berlin	ETA-07/0260 / 2009-01-12
ES report incl. seismic	ICC evaluation service	ESR 2322 / 2012-02-01
Fire test report	MFPFA, Leipzig	GS-III/B-07-070 / 2008-01-18
Assessment report (fire)	warringtonfire	WF 166402 / 2007-10-26 & suppl. WF 172920 / 2008-05-27

a) All data given in this section according ETA-07/0260, issue 2009-01-12.

### 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- Temperature range I  
(min. base material temperature  $-40^\circ\text{C}$ , max. long term/short term base material temperature:  $+24^\circ\text{C}/40^\circ\text{C}$ )
- Installation temperature range  $+5^\circ\text{C}$  to  $+40^\circ\text{C}$

**Embedment depth <sup>a)</sup> and base material thickness for the basic loading data.**
**Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.**

	Data according ETA-07/0260, issue 2009-01-12								
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor rebar BSt 500 S**

	Data according ETA-07/0260, issue 2009-01-12								
Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Non cracked concrete									
Tensile $N_{R_{u,m}}$ BSt 500 S [kN]	29,4	45,2	65,1	89,3	94,1	149,2	204,9	298,7	349,9
Shear $V_{R_{u,m}}$ 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 $N_{R_{u,m}}$ BSt 500 S [kN]	23,8	33,5	46,1	57,0	65,2	110,8	146,1	228,7	268,1
Shear $V_{R_{u,m}}$ 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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor rebar BSt 500 S**

	Data according ETA-07/0260, issue 2009-01-12								
Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Non cracked concrete									
Tensile $N_{R_k}$ BSt 500 S [kN]	28,0	42,4	58,3	70,6	70,6	111,9	153,7	224,0	262,4
Shear $V_{R_k}$ 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 $N_{R_k}$ BSt 500 S [kN]	16,1	22,6	31,1	38,5	44,0	74,8	109,6	154,4	181,0
Shear $V_{R_k}$ 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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor rebar BSt 500 S**

	Data according ETA-07/0260, issue 2009-01-12								
Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Non cracked concrete									
Tensile $N_{R_d}$ BSt 500 S [kN]	16,8	23,6	32,4	39,2	33,6	53,3	73,2	106,7	125,0
Shear $V_{R_d}$ 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 $N_{R_d}$ BSt 500 S [kN]	8,9	12,6	17,3	21,4	20,9	35,6	52,2	73,5	86,2
Shear $V_{R_d}$ BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3

**Recommended loads <sup>a)</sup>: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor rebar BSt 500 S**

	Data according ETA-07/0260, issue 2009-01-12								
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  $\gamma = 1,4$ . 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 2009-01-12								
Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Nominal tensile strength $f_{uk}$	BSt 500 S	[N/mm <sup>2</sup> ]	550	550	550	550	550	550	550	550	550
Yield strength $f_{yk}$	BSt 500 S	[N/mm <sup>2</sup> ]	500	500	500	500	500	500	500	500	500
Stressed cross-section $A_s$	BSt 500 S	[mm <sup>2</sup> ]	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	[mm <sup>3</sup> ]	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

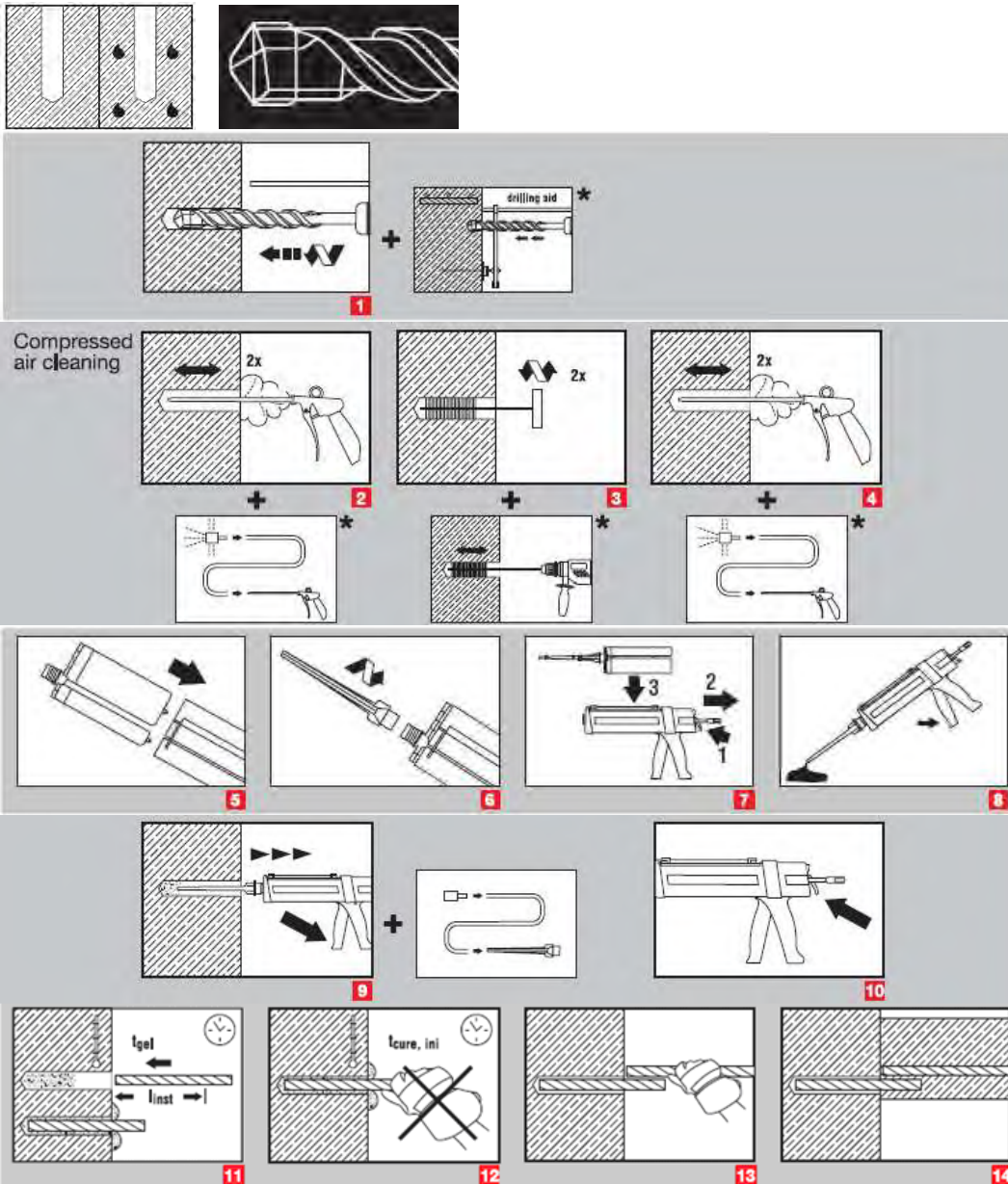
### installation equipment

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

Dry and water-saturated concrete, hammer drilling



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

Data according ETA-07/0260, issue 2009-01-12

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 2009-01-12								
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 <sup>a)</sup>	$h_{ef,min}$	[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]	$h_{ef} + 30 \text{ mm} \geq 100 \text{ mm}$			$h_{ef} + 2 d_0$					
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 <sup>b)</sup>	$c_{cr,sp}$	[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 <sup>c)</sup>	$c_{cr,N}$		$1,5 h_{ef}$								

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

- $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$  ( $h_{ef}$ : embedment depth)
- $h$ : base material thickness ( $h \geq h_{min}$ )
- 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.

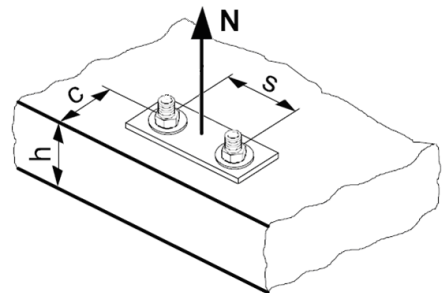
## Tension loading

The design tensile resistance is the lower value of

- Steel resistance:  $N_{Rd,s}$
- Combined pull-out and concrete cone resistance:  

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

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



## Basic design tensile resistance

### Design steel resistance $N_{Rd,s}$

		Data according ETA-07/0260, issue 2009-01-12								
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

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

		Data according ETA-07/0260, issue 2009-01-12								
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										
$N_{Rd,p}^0$	Temperature range I [kN]	16,8	23,6	34,6	42,8	41,9	71,2	102,1	147,0	186,7
$N_{Rd,p}^0$	Temperature range II [kN]	13,4	18,8	27,6	36,7	32,9	56,0	86,4	113,1	143,6
$N_{Rd,p}^0$	Temperature range III [kN]	7,8	11,0	16,1	21,4	20,9	33,1	51,1	67,9	86,2
Cracked concrete										
$N_{Rd,p}^0$	Temperature range I [kN]	8,9	12,6	17,3	21,4	20,9	35,6	55,0	73,5	86,2
$N_{Rd,p}^0$	Temperature range II [kN]	7,3	10,2	13,8	18,3	18,0	28,0	43,2	56,5	71,8
$N_{Rd,p}^0$	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  $N_{Rd,c} = N_{Rd,c}^0 \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$

Design splitting resistance <sup>a)</sup>  $N_{Rd,sp} = N_{Rd,c}^0 \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

		Data according ETA-07/0260, issue 2009-01-12								
Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
$N_{Rd,c}^0$	Non cracked concrete [kN]	20,1	24,0	32,4	39,2	33,6	53,3	73,2	106,7	125,0
$N_{Rd,c}^0$	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
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,1}$ <sup>a)</sup>	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

$f_{h,p} = h_{ef}/h_{ef,typ}$
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### 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
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ <sup>a)</sup>	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 <sup>a)</sup>

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

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 smaller than the critical edge distance.

### Influence of anchor spacing <sup>a)</sup>

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

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

$f_{h,N} = (h_{ef}/h_{ef,typ})^{1,5}$
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### Influence of reinforcement

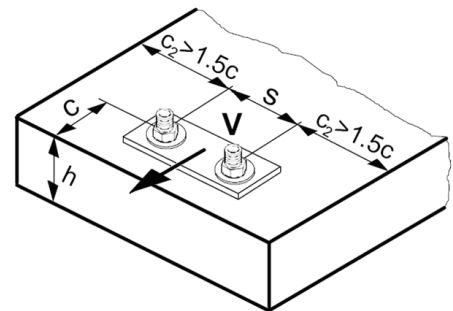
$h_{ef}$ [mm]	40	50	60	70	80	90	$\geq 100$
$f_{re,N} = 0,5 + h_{ef}/200\text{mm} \leq 1$	0,7 <sup>a)</sup>	0,75 <sup>a)</sup>	0,8 <sup>a)</sup>	0,85 <sup>a)</sup>	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



### Basic design shear resistance

#### Design steel resistance $V_{Rd,s}$

		Data according ETA-07/0260, issue 2009-01-12								
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 $V_{Rd,cp} = \text{lower value}^a)$ 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 $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

		Data according ETA-07/0260, issue 2009-01-12								
Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Non-cracked concrete										
$V_{Rd,c}^0$	[kN]	5,9	8,6	11,6	15,0	18,7	27,0	39,2	47,3	59,0
Cracked concrete										
$V_{Rd,c}^0$	[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
$f_B = (f_{ck,cube}/25\text{N/mm}^2)^{1/2}$ 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 $\beta$	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 <sup>a)</sup> for concrete edge resistance: $f_4$

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sub>ef</sub> /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 <sub>ef</sub> /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 <sup>a)</sup>

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

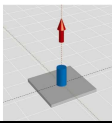
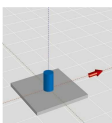
For combined tension and shear loading see section “Anchor Design”.

### Precalculated values

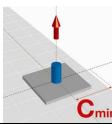
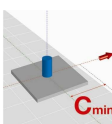
Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action  $\gamma = 1,4$ . The partial safety factors for action depend on the type of loading and shall be taken from national regulations.



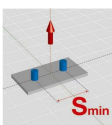
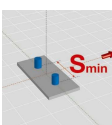
**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I**

		Data according ETA-07/0260, issue 2009-01-12								
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
<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>										
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
<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>										
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I**

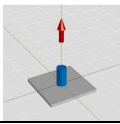
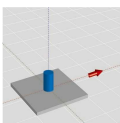
		Data according ETA-07/0260, issue 2009-01-12								
Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Embedment depth $h_{ef,1} =$ [mm]		60	60	72	84	96	120	150	168	192
Base material thickness $h_{min} =$ [mm]		100	100	104	120	136	170	214	238	272
Edge distance $c = c_{min} =$ [mm]		40	50	60	70	80	100	125	140	160
<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>										
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
<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>										
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I  
(load values are valid for single anchor)**

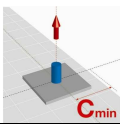
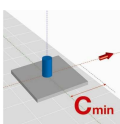
		Data according ETA-07/0260, issue 2009-01-12								
Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Embedment depth $h_{ef,1} =$ [mm]		60	60	72	84	96	120	150	168	192
Base material thickness $h_{min} =$ [mm]		100	100	104	120	136	170	214	238	272
Spacing $s = s_{min} =$ [mm]		40	50	60	70	80	100	125	140	160
<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>										
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
<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>										
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



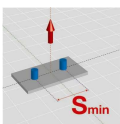
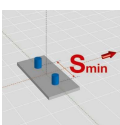
Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I

		Data according ETA-07/0260, issue 2009-01-12								
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
		<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>								
		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
		<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>								
		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

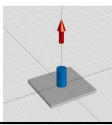
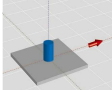
Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I

		Data according ETA-07/0260, issue 2009-01-12								
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
		<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>								
		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
		<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>								
		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

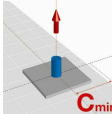
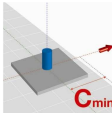
Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I  
(load values are valid for single anchor)

		Data according ETA-07/0260, issue 2009-01-12								
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
		<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>								
		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
		<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>								
		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

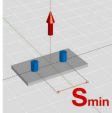
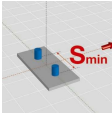
Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I

		Data according ETA-07/0260, issue 2009-01-12								
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
<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>										
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
<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>										
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I






		Data according ETA-07/0260, issue 2009-01-12								
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
<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>										
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
<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>										
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

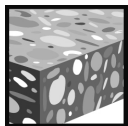
Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I  
(load values are valid for single anchor)

		Data according ETA-07/0260, issue 2009-01-12								
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
<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>										
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
<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>										
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



## Hilti HIT-RE 500 with HIT-V / HAS in hammer drilled holes

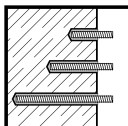
Injection mortar system		Benefits
	Hilti HIT-RE 500 330 ml foil pack  (also available as 500 ml and 1400 ml foil pack)	<ul style="list-style-type: none"> <li>- suitable for non-cracked concrete C 20/25 to C 50/60</li> <li>- high loading capacity</li> <li>- suitable for dry and water saturated concrete</li> <li>- under water application</li> <li>- large diameter applications</li> <li>- high corrosion resistant</li> <li>- long working time at elevated temperatures</li> <li>- odourless epoxy</li> <li>- embedment depth range: from 40 ... 160 mm for M8 to 120 ... 600 mm for M30</li> </ul>
	Statik mixer	
	HAS rod	
	HAS-E rod	
	HIT-V rod	



Concrete



Small edge  
distance  
and spacing



Variable  
embedment  
depth



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-04/0027 / 2009-05-20
Fire test report	IBMB, Braunschweig	UB 3565 / 4595 / 2006-10-29 UB 3588 / 4825 / 2005-11-15
Assessment report (fire)	warringtonfire	WF 166402 / 2007-10-26 & suppl. WF 172920 / 2008-05-27

a) All data given in this section according ETA-04/0027, issue 2009-05-20.

## 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- Temperature range I  
(min. base material temperature  $-40^\circ\text{C}$ , max. long term/short term base material temperature:  $+24^\circ\text{C}/40^\circ\text{C}$ )
- Installation temperature range  $+5^\circ\text{C}$  to  $+40^\circ\text{C}$

**Embedment depth <sup>a)</sup> 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.

**Mean ultimate resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HIT-V 5.8**

			Data according ETA-04/0027, issue 2008-11-03							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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HIT-V 5.8**

			Data according ETA-04/0027, issue 2008-11-03							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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HIT-V 5.8**

			Data according ETA-04/0027, issue 2008-11-03							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 <sup>a)</sup>: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HIT-V 5.8**

			Data according ETA-04/0027, issue 2008-11-03							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  $\gamma = 1,4$ . 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 2008-11-03							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/mm <sup>2</sup> ]	500	500	500	500	500	500	500	500	500	500	500
	HIT-V/HAS 8.8	[N/mm <sup>2</sup> ]	800	800	800	800	800	800	800	800	800	800	800
	HIT-V/HAS -R	[N/mm <sup>2</sup> ]	700	700	700	700	700	700	500	500	500	500	500
	HIT-V/HAS -HCR	[N/mm <sup>2</sup> ]	800	800	800	800	800	700	700	700	500	500	500
Yield strength $f_{yk}$	HIT-V/HAS 5.8	[N/mm <sup>2</sup> ]	400	400	400	400	400	400	400	400	400	400	400
	HIT-V/HAS 8.8	[N/mm <sup>2</sup> ]	640	640	640	640	640	640	640	640	640	640	640
	HIT-V/HAS -R	[N/mm <sup>2</sup> ]	450	450	450	450	450	450	210	210	210	210	210
	HIT-V/HAS -HCR	[N/mm <sup>2</sup> ]	600	600	600	600	600	400	400	400	250	250	250
Stressed cross-section $A_s$	HAS	[mm <sup>2</sup> ]	32,8	52,3	76,2	144	225	324	427	519	647	759	913
	HIT-V	[mm <sup>2</sup> ]	36,6	58,0	84,3	157	245	353	459	561	694	817	976
Moment of resistance $W$	HAS	[mm <sup>3</sup> ]	27,0	54,1	93,8	244	474	809	1274	1706	2321	2949	3891
	HIT-V	[mm <sup>3</sup> ]	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 <sub>5</sub> > 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 <sub>5</sub> > 8% ductile steel galvanized ≥ 5 µm, (F) hot dipped galvanized ≥ 45 µm,
Threaded rod HIT-V-R, HAS-R	Stainless steel grade A4, A <sub>5</sub> > 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 <sub>m</sub> = 800 N/mm <sup>2</sup> , R <sub>p0.2</sub> = 640 N/mm <sup>2</sup> , A <sub>5</sub> > 8% ductile M24 to M30: R <sub>m</sub> = 700 N/mm <sup>2</sup> , R <sub>p0.2</sub> = 400 N/mm <sup>2</sup> , A <sub>5</sub> > 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

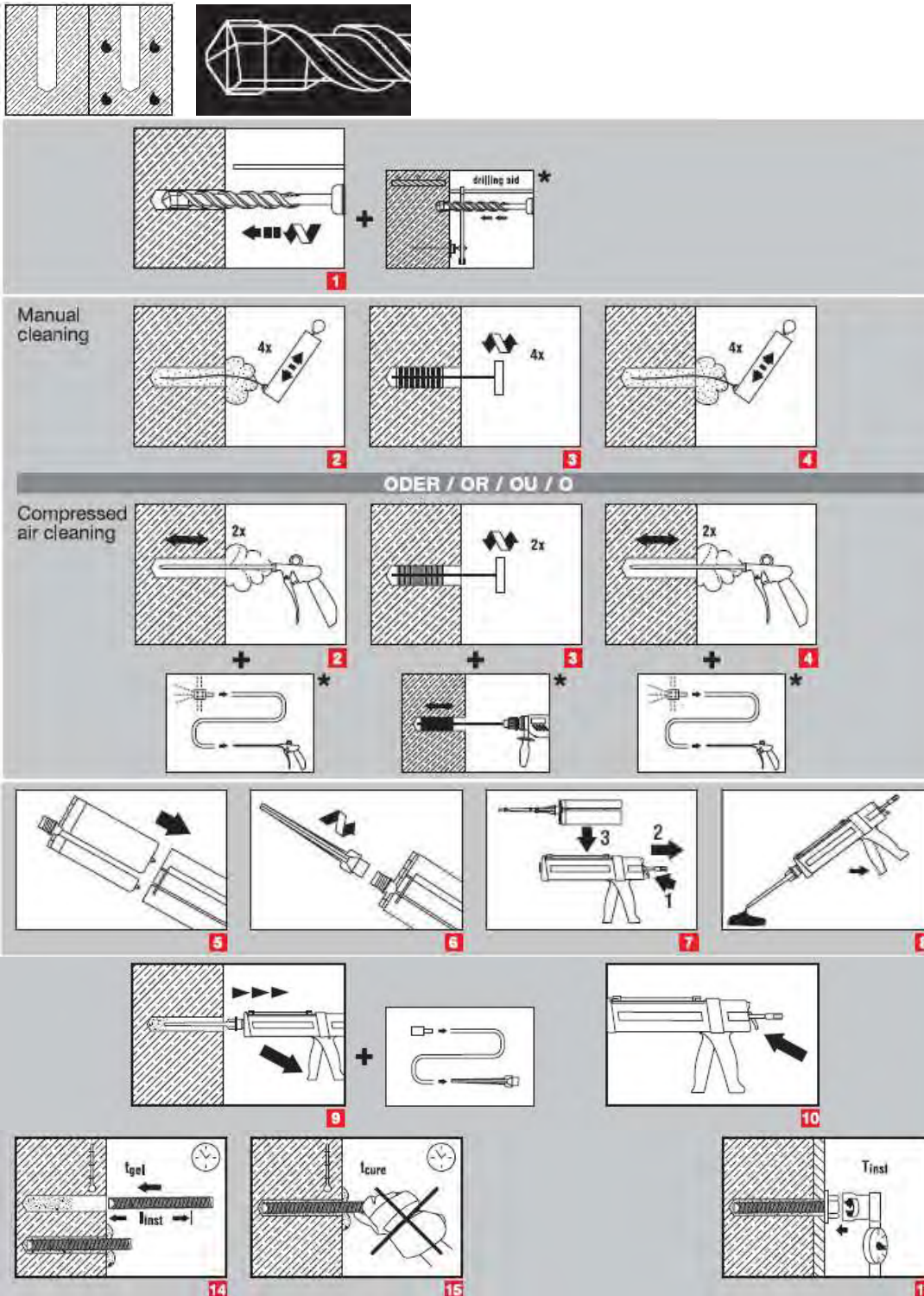
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Rotary hammer	TE2 – TE16				TE40 – TE70			
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser							
<b>Additional Hilti recommended tools</b>	DD EC-1, DD 100 ... DD xxx <sup>a)</sup>							

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

Dry and water-saturated concrete, hammer drilling



a)

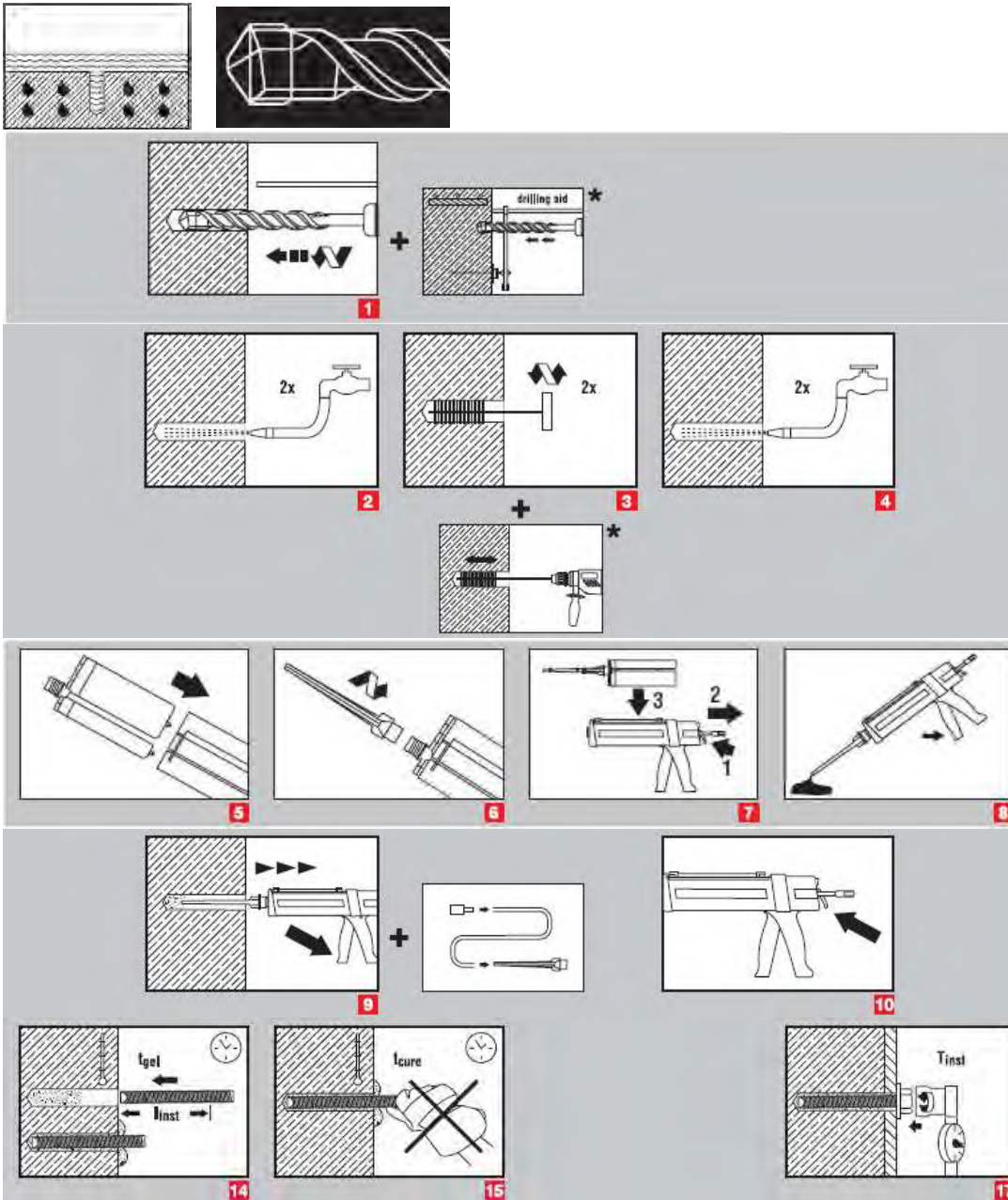
Brush bore hole with required steel brush HIT-RB

**a) Note:** Manual cleaning only for hef ≤ 250 mm and anchor size ≤ M16

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



Water filled bore hole or submerged, hammer drilling



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

Data according ETA-04/0027, issue 2009-05-20		
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.

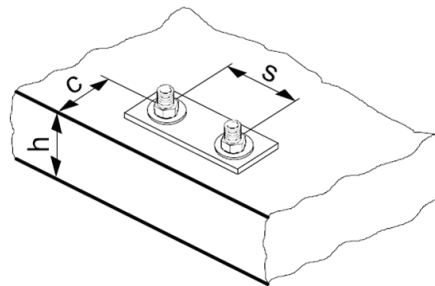
For installation temperatures below +5 °C all load values have to be reduced according to the load reduction factors given below.

### Curing time for dry concrete

Additional Hilti technical data			
Temperature of the base material	Reduced curing time before anchor can be fully loaded $t_{cure,dry}$	Working time in which anchor can be inserted and adjusted $t_{gel}$	Load reduction factor
40 °C	4 h	12 min	1
30 °C	8 h	12 min	1
20 °C	12 h	20 min	1
15 °C	18 h	30 min	1
10 °C	24 h	90 min	1
5 °C	36 h	120 min	1
0 °C	50 h	3 h	0,7
-5 °C	72 h	4 h	0,6

## Setting details

			Data according ETA-04/0027, issue 2009-05-20							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 <sup>a)</sup>	$h_{ef,min}$	[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]	$h_{ef} + 30 \text{ mm} \geq 100 \text{ mm}$				$h_{ef} + 2 d_0$						
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 <sup>b)</sup>	$c_{cr,sp}$	[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 <sup>c)</sup>	$c_{cr,N}$		$1,5 h_{ef}$										
Torque moment <sup>d)</sup>	$T_{max}$	[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 safe 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)

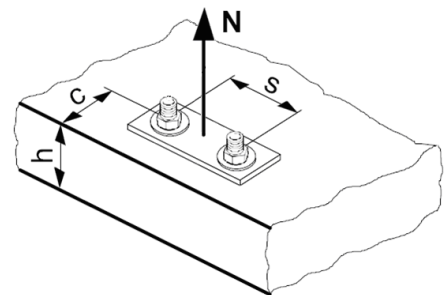
The values are valid for one anchor.

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



## Basic design tensile resistance

### Design steel resistance $N_{Rd,s}$

		Data according ETA-04/0027, issue 2009-05-20							Additional Hilti technical data			
		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 in diamond drilled holes <sup>a)</sup>

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

Anchor size	Data according ETA-04/0027, issue 2009-05-20								Additional Hilti technical data		
	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
$N_{Rd,p}^0$ Temperature range I [kN]	15,3	21,5	31,6	44,9	76,3	105,6	135,7	157,5	171,0	203,3	232,9
$N_{Rd,p}^0$ Temperature range II [kN]	12,4	17,5	25,7	35,9	61,0	82,9	106,6	133,3	136,8	162,6	186,3
$N_{Rd,p}^0$ Temperature range III [kN]	7,7	10,8	15,8	22,4	35,6	52,8	63,0	78,8	82,1	97,6	111,8

### 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** <sup>a)</sup>  $N_{Rd,c} = N_{Rd,c}^0 \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$

**Design splitting resistance** <sup>a)</sup>  $N_{Rd,sp} = N_{Rd,c}^0 \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

Anchor size	Data according ETA-04/0027, issue 2009-05-20								Additional Hilti technical data		
	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
$N_{Rd,c}^0$ [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 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
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,1}$ <sup>a)</sup>	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
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ <sup>a)</sup>	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 <sup>a)</sup>

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

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 <sup>a)</sup>

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

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

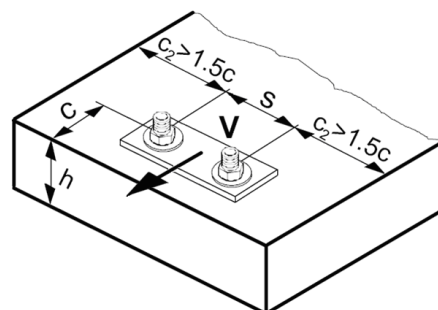
$h_{ef}$ [mm]	40	50	60	70	80	90	$\geq 100$
$f_{re,N} = 0,5 + h_{ef}/200\text{mm} \leq 1$	0,7 <sup>a)</sup>	0,75 <sup>a)</sup>	0,8 <sup>a)</sup>	0,85 <sup>a)</sup>	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



## Basic design shear resistance

### Design steel resistance $V_{Rd,s}$

		Data according ETA-04/0027, issue 2009-05-20								Additional Hilti technical data		
Anchor size		M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
$V_{Rd,s}$	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<sup>a)</sup> of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

$$k = 1 \text{ for } h_{ef} < 60 \text{ mm}$$

$$k = 2 \text{ for } h_{ef} \geq 60 \text{ mm}$$

- a)  $N_{Rd,p}$ : Design combined pull-out and concrete cone resistance  
 $N_{Rd,c}$ : Design concrete cone resistance

### Design concrete edge resistance $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_\beta \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Non-cracked concrete											
$V_{Rd,c}^0$ [kN]	5,9	8,6	11,6	18,7	27,0	36,6	44,5	53,0	62,1	71,7	81,9

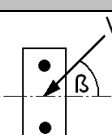
## Influencing factors

### 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
$f_B = (f_{ck,cube}/25\text{N/mm}^2)^{1/2}$ 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 $\beta$	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 <sup>a)</sup> for concrete edge resistance:  $f_4$   
 $f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sub>ef</sub> /d	4	4,5	5	6	7	8	9	10	11
f <sub>hef</sub> = 0,05 · (h <sub>ef</sub> / d) <sup>1,68</sup>	0,51	0,63	0,75	1,01	1,31	1,64	2,00	2,39	2,81
h <sub>ef</sub> /d	12	13	14	15	16	17	18	19	20
f <sub>hef</sub> = 0,05 · (h <sub>ef</sub> / d) <sup>1,68</sup>	3,25	3,72	4,21	4,73	5,27	5,84	6,42	7,04	7,67

### Influence of edge distance <sup>a)</sup>

c/d	4	6	8	10	15	20	30	40
f <sub>c</sub> = (d / c) <sup>0,19</sup>	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

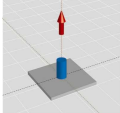
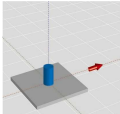
For combined tension and shear loading see section "Anchor Design".

### Precalculated values

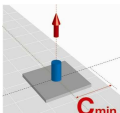
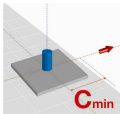
Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action  $\gamma = 1,4$ . The partial safety factors for action depend on the type of loading and shall be taken from national regulations.



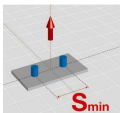
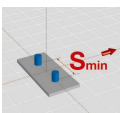
**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I**

	Data according ETA-04/0027, issue 2009-05-20								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
<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>											
 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
<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>											
 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

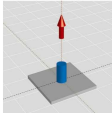
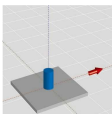
**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I**

	Data according ETA-04/0027, issue 2009-05-20								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
<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>											
 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
<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>											
 HIT-V 5.8 [kN]	3,4	4,9	6,7	10,8	15,7	21,4	26,0	31,1	36,5	42,2	48,3
HIT-V 8.8 [kN]											
HIT-V-R [kN]											
HIT-V-HCR [kN]											

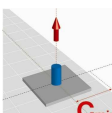
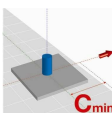
**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I  
(load values are valid for single anchor)**

	Data according ETA-04/0027, issue 2009-05-20								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
<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>											
 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
<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>											
 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

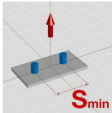
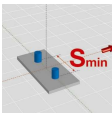
Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I

	Data according ETA-04/0027, issue 2009-05-20								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
<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>											
 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
<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>											
 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

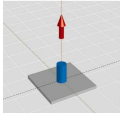
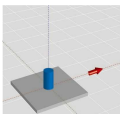
Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I

	Data according ETA-04/0027, issue 2009-05-20								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
<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>											
 HIT-V 5.8 [kN]											
HIT-V 8.8 [kN]	8,2	10,0	13,3	16,9	26,1	35,6	43,3	51,4	60,0	69,1	78,6
HIT-V-R [kN]											
HIT-V-HCR [kN]											
<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>											
 HIT-V 5.8 [kN]											
HIT-V 8.8 [kN]	3,7	5,3	7,3	11,5	17,2	23,6	29,0	34,8	41,1	47,8	54,9
HIT-V-R [kN]											
HIT-V-HCR [kN]											

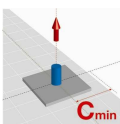
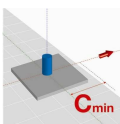
Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I  
(load values are valid for single anchor)

	Data according ETA-04/0027, issue 2009-05-20								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
<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>											
 HIT-V 5.8 [kN]											
HIT-V 8.8 [kN]	9,3	11,6	15,5	19,2	30,1	41,2	50,3	59,9	70,1	80,8	92,0
HIT-V-R [kN]											
HIT-V-HCR [kN]											
<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>											
 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

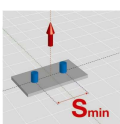
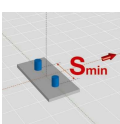
**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I**

	Data according ETA-04/0027, issue 2009-05-20								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
<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>											
 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
<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>											
 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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I**

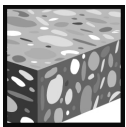
	Data according ETA-04/0027, issue 2009-05-20								Additional Hilti technical data		
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Embedment depth $h_{ef,2} =$ [mm]	96	120	144	192	240	288	324	360	396	432	468
Base material thickness $h_{min} =$ [mm]	126	150	174	228	288	344	384	430	470	512	558
Edge distance $c = c_{min} =$ [mm]	40	50	60	80	100	120	135	150	165	180	195
<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>											
 HIT-V 5.8 [kN]											
HIT-V 8.8 [kN]	9,9	14,1	18,6	28,6	40,0	52,6	62,7	73,5	84,8	96,6	108,9
HIT-V-R [kN]											
HIT-V-HCR [kN]											
<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>											
 HIT-V 5.8 [kN]											
HIT-V 8.8 [kN]	3,9	5,7	7,8	12,9	18,9	25,9	31,8	38,1	45,0	52,3	60,0
HIT-V-R [kN]											
HIT-V-HCR [kN]											

**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I  
(load values are valid for single anchor)**

	Data according ETA-04/0027, issue 2009-05-20								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
<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>											
 HIT-V 5.8 [kN]											
HIT-V 8.8 [kN]	11,5	17,3	22,7	34,9	48,8	64,2	76,6	89,7	103,5	117,9	133,0
HIT-V-R [kN]											
HIT-V-HCR [kN]											
<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>											
 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 with HIT-V / HAS in diamond drilled holes

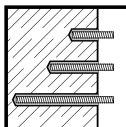
Injection mortar system		Benefits
	Hilti HIT-RE 500 330 ml foil pack  (also available as 500 ml and 1400 ml foil pack)	<ul style="list-style-type: none"> <li>- suitable for non-cracked concrete C 20/25 to C 50/60</li> <li>- high loading capacity</li> <li>- suitable for dry and water saturated concrete</li> <li>- large diameter applications</li> <li>- high corrosion resistant</li> <li>- long working time at elevated temperatures</li> <li>- odourless epoxy</li> <li>- embedment depth range: from 40 ... 160 mm for M8 to 120 ... 600 mm for M30</li> </ul>
	Statik mixer	
	HAS rod	
	HAS-E rod	
	HIT-V rod	



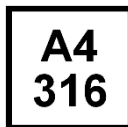
Concrete



Small edge distance and spacing



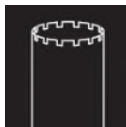
Variable embedment depth



Corrosion resistance



High corrosion resistance



Diamond drilled holes



PROFIS Anchor design software

### 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
- 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- Temperature range I  
(min. base material temperature  $-40^\circ\text{C}$ , max. long term/short term base material temperature:  $+24^\circ\text{C}/40^\circ\text{C}$ )
- Installation temperature range  $+5^\circ\text{C}$  to  $+40^\circ\text{C}$

For details see Simplified design method

**Embedment depth <sup>a)</sup> 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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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	83,0	129,2	185,9	229,7	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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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	66,0	101,5	142,5	173,0	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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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	18,8	27,6	31,4	48,3	67,9	82,4	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 <sup>a)</sup>: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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	13,5	19,7	22,4	34,5	48,5	58,9	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  $\gamma = 1,4$ . 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

Anchor size			Hilti technical data							
			M8	M10	M12	M16	M20	M24	M27	M30
Nominal tensile strength $f_{uk}$	HIT-V/HAS 5.8	[N/mm <sup>2</sup> ]	500	500	500	500	500	500	500	500
	HIT-V/HAS 8.8	[N/mm <sup>2</sup> ]	800	800	800	800	800	800	800	800
	HIT-V/HAS -R	[N/mm <sup>2</sup> ]	700	700	700	700	700	700	500	500
	HIT-V/HAS -HCR	[N/mm <sup>2</sup> ]	800	800	800	800	800	700	700	700
Yield strength $f_{yk}$	HIT-V/HAS 5.8	[N/mm <sup>2</sup> ]	400	400	400	400	400	400	400	400
	HIT-V/HAS 8.8	[N/mm <sup>2</sup> ]	640	640	640	640	640	640	640	640
	HIT-V/HAS -R	[N/mm <sup>2</sup> ]	450	450	450	450	450	450	210	210
	HIT-V/HAS -HCR	[N/mm <sup>2</sup> ]	600	600	600	600	600	400	400	400
Stressed cross-section $A_s$	HAS	[mm <sup>2</sup> ]	32,8	52,3	76,2	144	225	324	427	519
	HIT-V	[mm <sup>2</sup> ]	36,6	58,0	84,3	157	245	353	459	561
Moment of resistance $W$	HAS	[mm <sup>3</sup> ]	27,0	54,1	93,8	244	474	809	1274	1706
	HIT-V	[mm <sup>3</sup> ]	31,2	62,3	109	277	541	935	1387	1874

### Material quality

Part	Material
Threaded rod HIT-V(F), HAS 5.8 M8 – M24	Strength class 5.8, $A_5 > 8\%$ ductile, steel galvanized $\geq 5 \mu\text{m}$ , (F) hot dipped galvanized $\geq 45 \mu\text{m}$ ,
Threaded rod HIT-V(F), HAS 8.8 M27 – M30	Strength class 8.8, $A_5 > 8\%$ ductile, steel galvanized $\geq 5 \mu\text{m}$ , (F) hot dipped galvanized $\geq 45 \mu\text{m}$ ,
Threaded rod HIT-V-R, HAS-R	Stainless steel grade A4, $A_5 > 8\%$ ductile, strength class 70 for $\leq M24$ 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 $\leq M20$ : $R_m = 800 \text{ N/mm}^2$ , $R_{p0.2} = 640 \text{ N/mm}^2$ , $A_5 > 8\%$ ductile M24 to M30: $R_m = 700 \text{ N/mm}^2$ , $R_{p0.2} = 400 \text{ N/mm}^2$ , $A_5 > 8\%$ 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 $\geq 5 \mu\text{m}$ , hot dipped galvanized $\geq 45 \mu\text{m}$ ,
	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

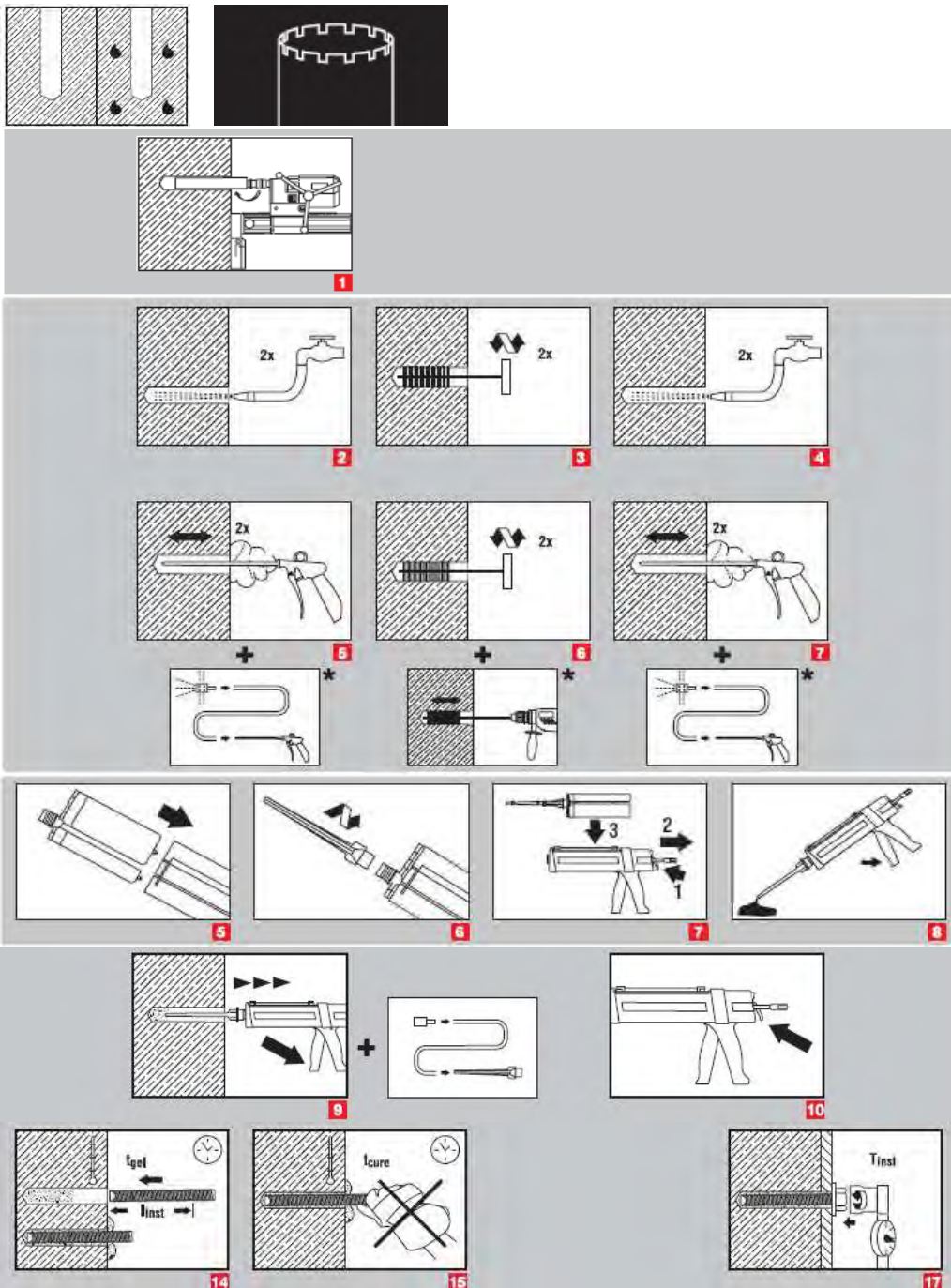
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Anchor rod HAS, HAS-E, HAS-R, HAS-ER HAS-HCR	M8x80	M10x90	M12x110	M16x125	M20x170	M24x210	M27x240	M30x270
Anchor embedment depth [mm]	80	90	110	125	170	210	240	270
Anchor rod HIT-V, HIT-V-R, HIT-V-HCR	Anchor rods HIT-V (-R / -HCR) are available in variable length							

## Setting installation equipment

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Drilling tools	DD EC-1, DD 100 ... DD xxx							
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser							

## Setting instruction

Dry and water-saturated concrete, diamond coring drilling; Hilti technical information 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.

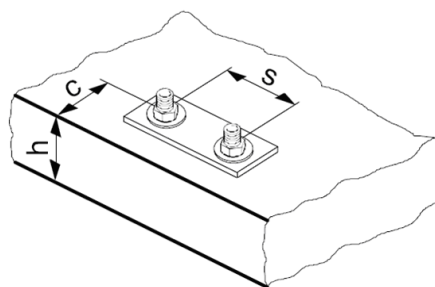
**Important! Remove all water from the borehole and blow out with oil free compressed air until borehole is completely dried before mortar injection (not applicable to hammer drilled hole in underwater application).**

### Curing time for general conditions

Temperature of the base material	Curing time before anchor can be fully loaded $t_{\text{cure}}$	Working time in which anchor can be inserted and adjusted $t_{\text{gel}}$
40 °C	4 h	12 min
30 °C to 39 °C	8 h	12 min
20 °C to 29 °C	12 h	20 min
15 °C to 19 °C	24 h	30 min
10 °C to 14 °C	48 h	90 min
5 °C to 9 °C	72 h	120 min

### Setting details

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 <sup>a)</sup>	$h_{\text{ef,min}}$ [mm]	40	40	48	64	80	96	108	120
	$h_{\text{ef,max}}$ [mm]	160	200	240	320	400	480	540	600
Minimum base material thickness $h_{\text{min}}$ [mm]	$h_{\text{ef}} + 30 \text{ mm}$ $\geq 100 \text{ mm}$			$h_{\text{ef}} + 2 d_0$					
Diameter of clearance hole in the fixture $d_f$ [mm]	9	12	14	18	22	26	30	33	
Minimum spacing $s_{\text{min}}$ [mm]	40	50	60	80	100	120	135	150	
Minimum edge distance $c_{\text{min}}$ [mm]	40	50	60	80	100	120	135	150	
Critical spacing for splitting failure $s_{\text{cr,sp}}$	$2 c_{\text{cr,sp}}$								
Critical edge distance for splitting failure <sup>b)</sup> $c_{\text{cr,sp}}$ [mm]	$1,0 \cdot h_{\text{ef}}$ for $h / h_{\text{ef}} \geq 2,0$								
	$4,6 h_{\text{ef}} - 1,8 h$ for $2,0 > h / h_{\text{ef}} > 1,3$								
	$2,26 h_{\text{ef}}$ for $h / h_{\text{ef}} \leq 1,3$								
Critical spacing for concrete cone failure $s_{\text{cr,N}}$	$2 c_{\text{cr,N}}$								
Critical edge distance for concrete cone failure <sup>c)</sup> $c_{\text{cr,N}}$	$1,5 h_{\text{ef}}$								
Torque moment <sup>d)</sup> $T_{\text{max}}$ [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.



- $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$  ( $h_{ef}$ : embedment depth)
- $h$ : base material thickness ( $h \geq h_{min}$ )
- 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.
- 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.

- 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 conservative: 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)

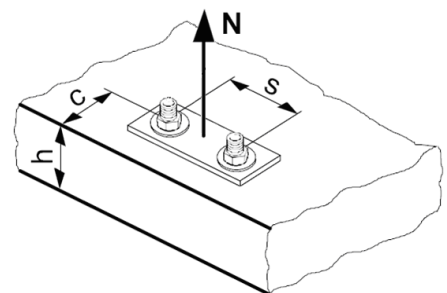
The values are valid for one anchor.

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



## 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 for anchors in diamond drilled holes

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

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Typical embedment depth $h_{ef,typ}$ [mm]		80	90	110	125	170	210	240	270
$N_{Rd,p}^0$	Temperature range I [kN]	13,4	18,8	27,6	31,4	48,3	67,9	82,4	103,0
$N_{Rd,p}^0$	Temperature range II [kN]	10,9	15,3	22,4	25,4	39,1	55,0	66,7	83,4
$N_{Rd,p}^0$	Temperature range III [kN]	6,8	9,6	14,0	15,9	24,5	34,4	41,8	52,3

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

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

		Data according ETA-04/0027, issue 2009-05-20							
Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
$N_{Rd,c}^0$	[kN]	17,2	20,5	27,7	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
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,1}$ 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 <sup>a)</sup>

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

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 <sup>a)</sup>

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

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

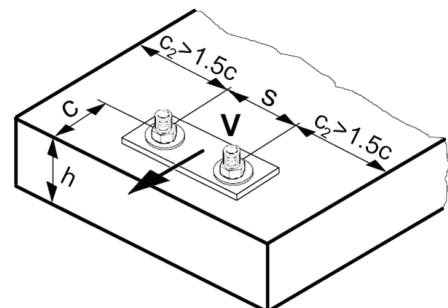
$h_{ef}$ [mm]	40	50	60	70	80	90	$\geq 100$
$f_{re,N} = 0,5 + h_{ef}/200\text{mm} \leq 1$	0,7 <sup>a)</sup>	0,75 <sup>a)</sup>	0,8 <sup>a)</sup>	0,85 <sup>a)</sup>	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



## Basic design shear resistance

### Design steel resistance $V_{Rd,s}$

		Data according ETA-04/0027, issue 2009-05-20								
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<sup>a)</sup> of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

$$k = 1 \text{ for } h_{ef} < 60 \text{ mm}$$

$$k = 2 \text{ for } h_{ef} \geq 60 \text{ mm}$$

- a)  $N_{Rd,p}$ : Design combined pull-out and concrete cone resistance  
 $N_{Rd,c}$ : Design concrete cone resistance

### Design concrete edge resistance $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete								
$V_{Rd,c}^0$ [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
$f_B = (f_{ck,cube}/25\text{N/mm}^2)^{1/2}$ 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 $\beta$	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 <sup>a)</sup> for concrete edge resistance:  $f_4$**

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sub>ef</sub> /d	4	4,5	5	6	7	8	9	10	11
f <sub>hef</sub> = 0,05 · (h <sub>ef</sub> / d) <sup>1,68</sup>	0,51	0,63	0,75	1,01	1,31	1,64	2,00	2,39	2,81
h <sub>ef</sub> /d	12	13	14	15	16	17	18	19	20
f <sub>hef</sub> = 0,05 · (h <sub>ef</sub> / d) <sup>1,68</sup>	3,25	3,72	4,21	4,73	5,27	5,84	6,42	7,04	7,67

**Influence of edge distance <sup>a)</sup>**


c/d	4	6	8	10	15	20	30	40
f <sub>c</sub> = (d / c) <sup>0,19</sup>	0,77	0,71	0,67	0,65	0,60	0,57	0,52	0,50

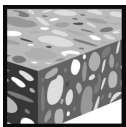
a) The edge distance shall not be smaller than the minimum edge distance  $c_{min}$ .

**Combined tension and shear loading**

For combined tension and shear loading see section "Anchor Design".

## Hilti HIT-RE 500 with HIS-(R)N

Injection mortar system		Benefits
	Hilti HIT-RE 500 330 ml foil pack  (also available as 500 ml and 1400 ml foil pack)	<ul style="list-style-type: none"> <li>- suitable for non-cracked concrete C 20/25 to C 50/60</li> <li>- high loading capacity</li> <li>- suitable for dry and water saturated concrete</li> <li>- under water application for hammer drilled holes</li> <li>- long working time at elevated temperatures</li> <li>- odourless epoxy</li> </ul>
	Statik mixer	
	HIS-(R)N sleeve	



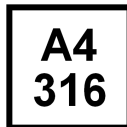
Concrete



Small edge distance and spacing



Fire resistance



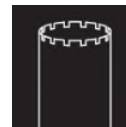
Corrosion resistance



European Technical Approval



CE conformity



Diamond drilled holes



PROFIS Anchor design software

### Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval <sup>a)</sup>	DIBt, Berlin	ETA-04/0027 / 2009-05-20
Fire test report	IBMB, Brunswick	UB 3565 / 4595 / 2006-10-29 UB 3588 / 4825 / 2005-11-15
Assessment report (fire)	warringtonfire	WF 166402 / 2007-10-26 & suppl. WF 172920 / 2008-05-27

a) All data given in this section according ETA-04/0027, issue 2009-05-20.

### 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
- 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- Temperature range I  
(min. base material temperature  $-40^\circ\text{C}$ , max. long term/short term base material temperature:  $+24^\circ\text{C}/40^\circ\text{C}$ )
- Installation temperature range  $+5^\circ\text{C}$  to  $+40^\circ\text{C}$

**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 <sup>a)</sup>: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HIS-N**

Data according ETA-04/0027, issue 2009-05-20						
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HIS-N**

Data according ETA-04/0027, issue 2009-05-20						
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HIS-N**

Data according ETA-04/0027, issue 2009-05-20						
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 <sup>a)</sup>: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HIS-N**

Data according ETA-04/0027, issue 2009-05-20						
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  $\gamma = 1,4$ . 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 2009-05-20				
Anchor size			M8	M10	M12	M16	M20
Nominal tensile strength $f_{uk}$	HIS-N	[N/mm <sup>2</sup> ]	490	490	460	460	460
	Screw 8.8	[N/mm <sup>2</sup> ]	800	800	800	800	800
	HIS-RN	[N/mm <sup>2</sup> ]	700	700	700	700	700
	Screw A4-70	[N/mm <sup>2</sup> ]	700	700	700	700	700
Yield strength $f_{yk}$	HIS-N	[N/mm <sup>2</sup> ]	410	410	375	375	375
	Screw 8.8	[N/mm <sup>2</sup> ]	640	640	640	640	640
	HIS-RN	[N/mm <sup>2</sup> ]	350	350	350	350	350
	Screw A4-70	[N/mm <sup>2</sup> ]	450	450	450	450	450
Stressed cross-section $A_s$	HIS-(R)N	[mm <sup>2</sup> ]	51,5	108,0	169,1	256,1	237,6
	Screw	[mm <sup>2</sup> ]	36,6	58	84,3	157	245
Moment of resistance $W$	HIS-(R)N	[mm <sup>3</sup> ]	145	430	840	1595	1543
	Screw	[mm <sup>3</sup> ]	31,2	62,3	109	277	541

### Material quality

Part	Material
internally threaded sleeves <sup>a)</sup> HIS-N	C-steel 1.0718, steel galvanized $\geq 5\mu\text{m}$
internally threaded sleeves <sup>b)</sup> HIS-RN	stainless steel 1.4401 and 1.4571

a) related fastening screw: strength class 8.8, A5 > 8% Ductile steel galvanized  $\geq 5\mu\text{m}$

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

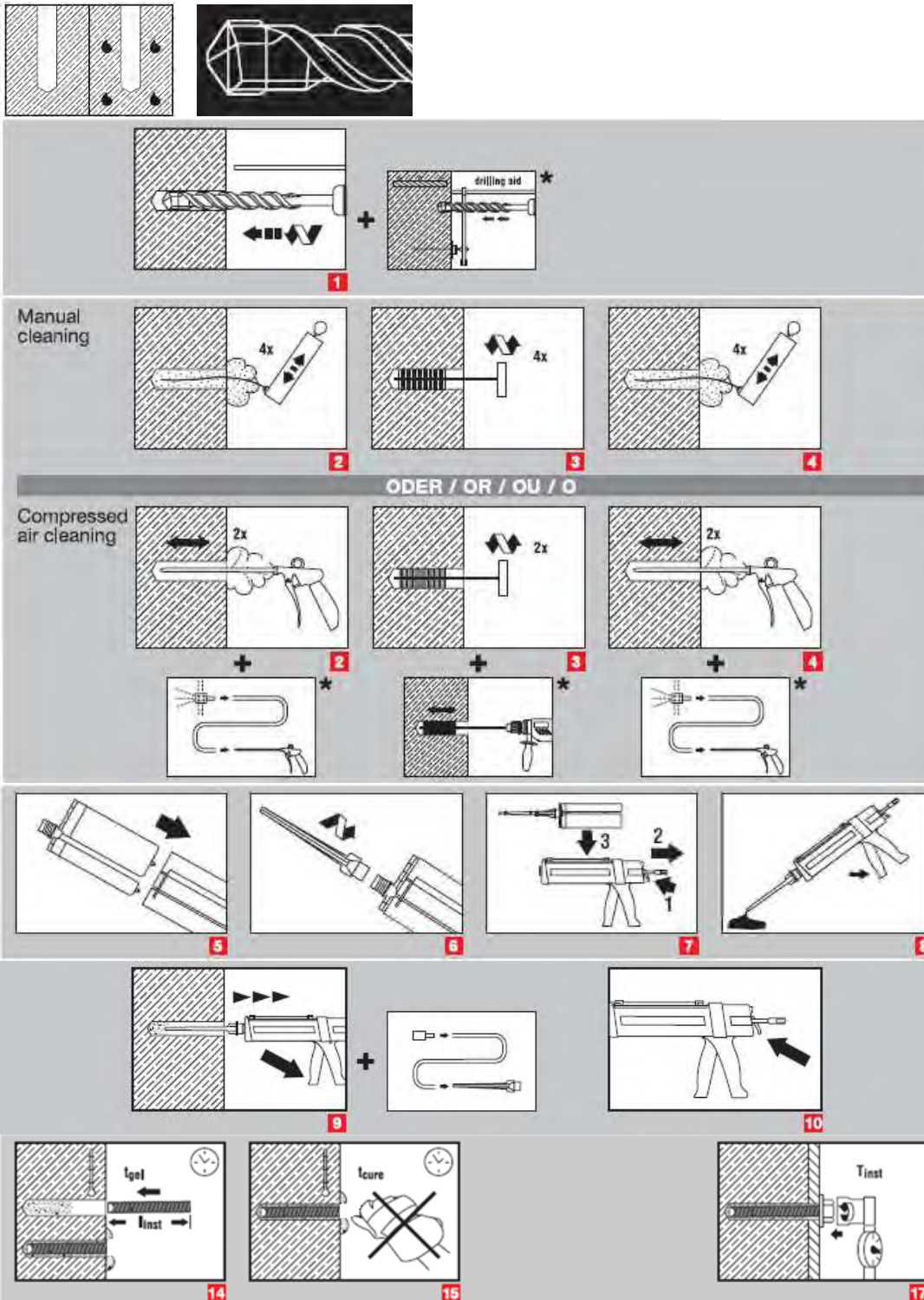
Anchor size	M8	M10	M12	M16	M20
Rotary hammer	TE 2 – TE 16			TE 40 – TE 70	
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser				
<b>Additional Hilti recommended tools</b>	DD EC-1, DD 100 ... DD xxx <sup>a)</sup>				

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

Dry and water-saturated concrete, hammer drilling



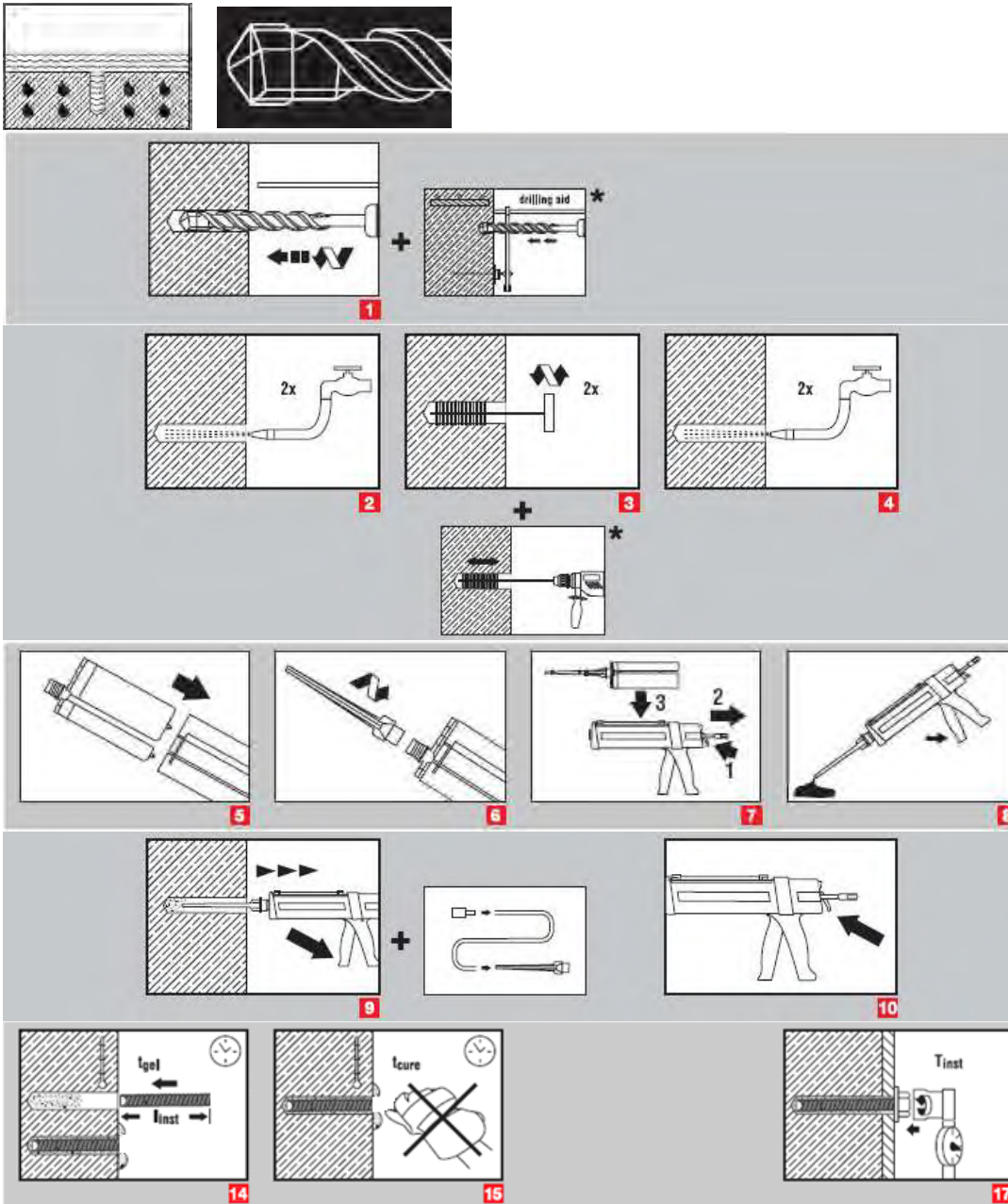
a)

**a) Note: 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.

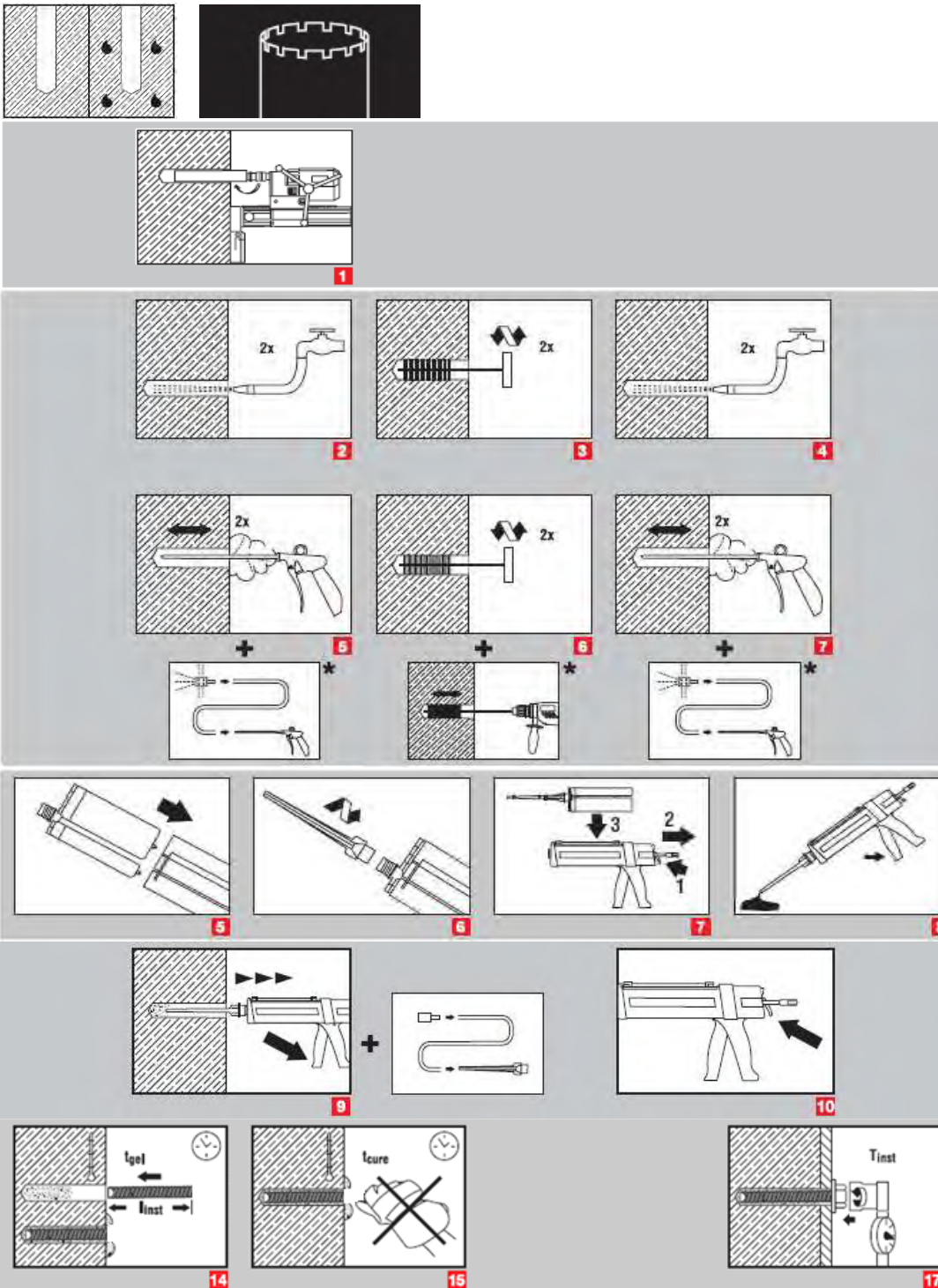
Water filled bore hole or submerged, hammer drilling



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.

Dry and water-saturated concrete, diamond coring drilling; Hilti technical information only



**For anchors in diamond drilled holes load values for combined pull-out and concrete cone resistance have to be reduced. Load reduction factor: 0.7**

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.

**Important! Remove all water from the borehole and blow out with oil free compressed air until borehole is completely dried before mortar injection (not applicable to hammer drilled hole in underwater application).**

### Curing time for general conditions

Data according ETA-04/0027, issue 2009-05-20		
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	Reduced curing time before anchor can be fully loaded $t_{cure,dry}$	Working time in which anchor can be inserted and adjusted $t_{gel}$	Load reduction factor
40 °C	4 h	12 min	1
30 °C	8 h	12 min	1
20 °C	12 h	20 min	1
15 °C	18 h	30 min	1
10 °C	24 h	90 min	1
5 °C	36 h	120 min	1
0 °C	50 h	3 h	0,7
-5 °C	72 h	4 h	0,6



### Setting details

		Data according ETA-04/0027, issue 2009-05-20				
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 <sup>a)</sup>	$c_{cr,sp}$ [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 <sup>c)</sup>	$c_{cr,N}$	$1,5 h_{ef}$				
Torque moment <sup>c)</sup>	$T_{max}$ [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-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 safe 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)

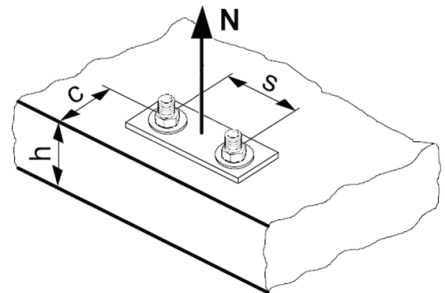
The values are valid for one anchor.

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



## Basic design tensile resistance

### Design steel resistance $N_{Rd,s}$

		Data according ETA-04/0027, issue 2009-05-20				
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 <sup>a)</sup>

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

		Data according ETA-04/0027, issue 2009-05-20				
Anchor size		M8	M10	M12	M16	M20
Embedment depth $h_{ef}$ [mm]		90	110	125	170	205
$N_{Rd,p}^0$	Temperature range I [kN]	19,0	28,6	45,2	81,0	95,2
$N_{Rd,p}^0$	Temperature range II [kN]	16,7	23,8	35,7	66,7	81,0
$N_{Rd,p}^0$	Temperature range III [kN]	9,5	14,3	19,0	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**  $N_{Rd,c} = N_{Rd,c}^0 \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$

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

		Data according ETA-04/0027, issue 2009-05-20				
Anchor size		M8	M10	M12	M16	M20
$N_{Rd,c}^0$	[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

$f_{h,p} = 1$
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#### 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)

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

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)

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

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

$f_{h,N} = 1$
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### Influence of reinforcement

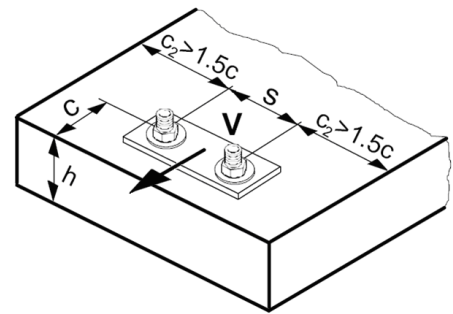
$h_{ef}$ [mm]	80	90	$\geq 100$
$f_{re,N} = 0,5 + h_{ef}/200\text{mm} \leq 1$	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



### Basic design shear resistance

#### Design steel resistance $V_{Rd,s}$

		Data according ETA-04/0027, issue 2009-05-20				
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 $V_{Rd,cp} = \text{lower value}^a)$ 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 $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size	M8	M10	M12	M16	M20
Non-cracked concrete					
$V_{Rd,c}^0$ [kN]	12,4	19,6	28,2	40,2	46,2

### Influencing factors

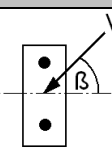
#### Influence of concrete strength

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
$f_B = (f_{ck,cube}/25\text{N/mm}^2)^{1/2}$ 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 $\beta$	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 <sup>a)</sup> for concrete edge resistance: $f_4$

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sup>a)</sup>

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  $c_{min}$ .

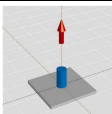
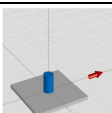
## Combined tension and shear loading

For combined tension and shear loading see section "Anchor Design".

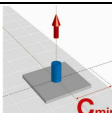
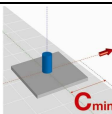
### Precalculated values

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.

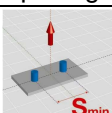
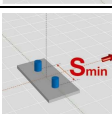
**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I**

		Data according ETA-04/0027, issue 2009-05-20				
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
	<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>					
	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
	<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>					
	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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I**




		Data according ETA-04/0027, issue 2009-05-20				
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
	<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>					
	HIS-(R)N [kN]	9,4	12,4	15,4	23,5	32,0
	<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>					
	HIS-(R)N [kN]	4,2	5,5	7,6	10,8	17,2

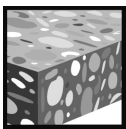
**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I**  
(load values are valid for single anchor)

		Data according ETA-04/0027, issue 2009-05-20				
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
	<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>					
	HIS-(R)N [kN]	11,2	15,2	18,5	29,0	38,8
	<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>					
	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 with rebar in hammer drilled holes

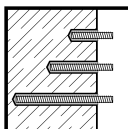
Injection mortar system		Benefits
	Hilti HIT-RE 500 330 ml foil pack  (also available as 500 ml and 1400 ml foil pack)	<ul style="list-style-type: none"> <li>- suitable for non-cracked concrete C 20/25 to C 50/60</li> <li>- high loading capacity</li> <li>- suitable for dry and water saturated concrete</li> <li>- under water application</li> <li>- large diameter applications</li> <li>- long working time at elevated temperatures</li> <li>- odourless epoxy</li> <li>- embedment depth range: from 60 ... 160 mm for Ø8 to 128 ... 640 mm for Ø32</li> </ul>
	Statik mixer	
	rebar BSt 500 S	



Concrete



Small edge distance and spacing



Variable embedment depth



European Technical Approval



CE conformity



PROFIS Anchor design software

### Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval <sup>a)</sup>	DIBt, Berlin	ETA-04/0027 / 2009-05-20

a) All data given in this section according ETA-04/0027, issue 2009-05-20.

### 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- Temperature range I  
(min. base material temperature  $-40^\circ\text{C}$ , max. long term/short term base material temperature:  $+24^\circ\text{C}/40^\circ\text{C}$ )
- Installation temperature range  $+5^\circ\text{C}$  to  $+40^\circ\text{C}$

**Embedment depth <sup>a)</sup> and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.**

	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti tech. data	
	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40	
<b>Anchor size</b>												
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.

**Mean ultimate resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor rebar BSt 500S**

	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti tech. data	
	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40	
<b>Anchor size</b>												
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor rebar BSt 500 S**

	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti tech. data	
	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40	
<b>Anchor size</b>												
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor rebar BSt 500 S**

	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti tech. data	
	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40	
<b>Anchor size</b>												
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 <sup>a)</sup>: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor rebar BSt 500 S**

	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti tech. data	
	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40	
<b>Anchor size</b>												
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  $\gamma = 1,4$ . 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

Anchor size	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti tech. data	
	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40	
Nominal tensile strength $f_{uk}$ BSt 500 S [N/mm <sup>2</sup> ]	550	550	550	550	550	550	550	550	550	550	550	550
Yield strength $f_{yk}$ BSt 500 S [N/mm <sup>2</sup> ]	500	500	500	500	500	500	500	500	500	500	500	500
Stressed cross-section $A_s$ BSt 500 S [mm <sup>2</sup> ]	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 [mm <sup>3</sup> ]	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

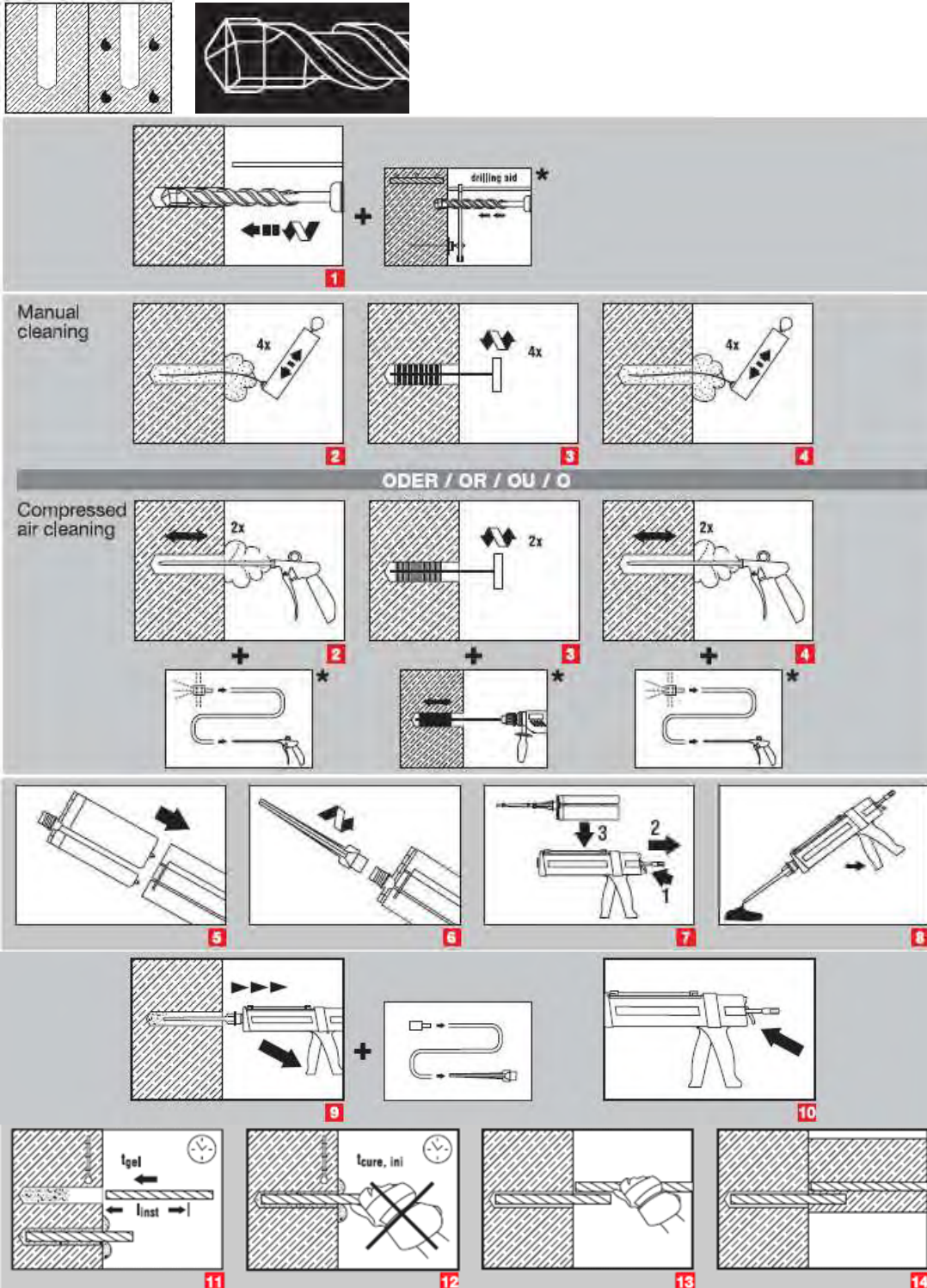
### installation equipment

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

Dry and water-saturated concrete, hammer drilling



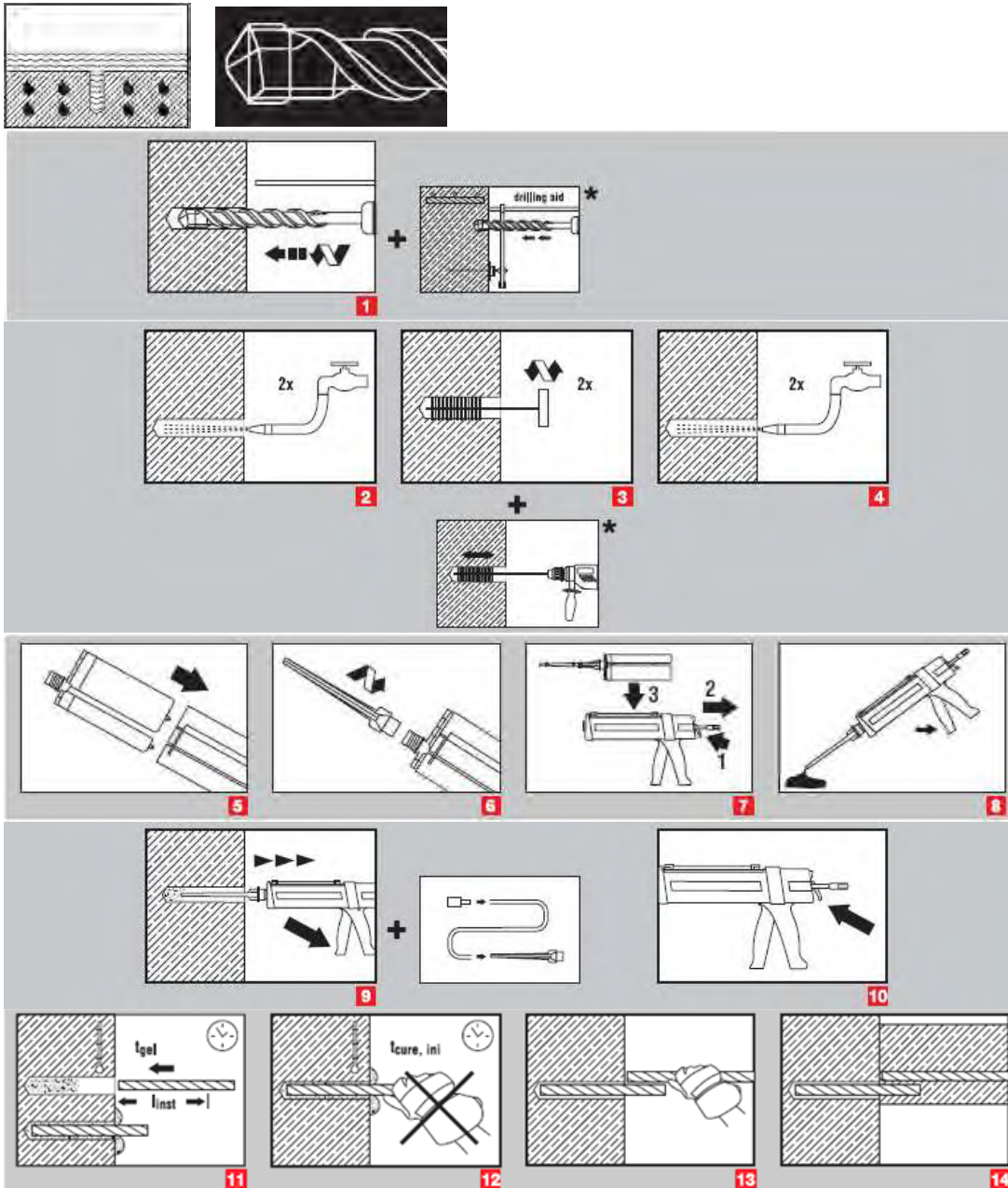
a)

**a) Note:** Manual cleaning only for  $h_{ef} \leq 250$  mm and anchor size  $d \leq 16$  mm

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.

Water filled bore hole or submerged, hammer drilling



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

Data according ETA-04/0027, issue 2009-05-20			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.

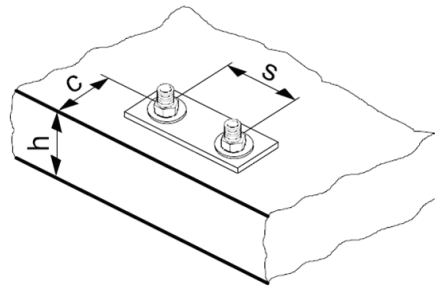
For installation temperatures below +5 °C all load values have to be reduced according to the load reduction factors given below.

### Curing time for dry concrete

Additional Hilti technical data			
Temperature of the base material	Reduced curing time before anchor can be fully loaded $t_{cure, dry}$	Working time in which anchor can be inserted and adjusted $t_{gel}$	Load reduction factor
40 °C	4 h	12 min	1
30 °C	8 h	12 min	1
20 °C	12 h	20 min	1
15 °C	18 h	30 min	1
10 °C	24 h	90 min	1
5 °C	36 h	120 min	1
0 °C	50 h	3 h	0,7
-5 °C	72 h	4 h	0,6

## Setting details

			Data according ETA-04/0027, issue 2009-05-20								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 <sup>a)</sup>	$h_{ef,min}$	[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]	$h_{ef} + 30 \text{ mm}$ $\geq 100 \text{ mm}$			$h_{ef} + 2 d_0$							
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 <sup>b)</sup>	$c_{cr,sp}$	[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 <sup>c)</sup>	$c_{cr,N}$		$1,5 h_{ef}$										



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 safe 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 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)

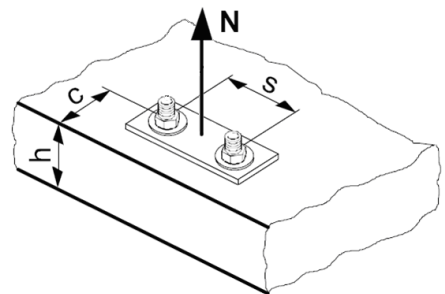
The values are valid for one anchor.

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



## Basic design tensile resistance

### Design steel resistance $N_{Rd,s}$

	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti tech. data	
	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40	
Anchor size												
$N_{Rd,s}$ 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 <sup>a)</sup>

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

	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti tech. data	
	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40	
Anchor size												
Typical embedment depth $h_{ef,typ}$ [mm]	80	90	110	125	125	170	210	270	300	330	360	
$N_{Rd,p}^0$ Temperature 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	
$N_{Rd,p}^0$ Temperature 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	
$N_{Rd,p}^0$ Temperature 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	

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

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

Anchor size	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti tech. data	
	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40	
$N_{Rd,c}^0$ [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

$f_{h,p} = h_{ef}/h_{ef,typ}$
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### 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)

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

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 smaller than the critical 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
$s/s_{cr,sp}$										
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1
$f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp})$										

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

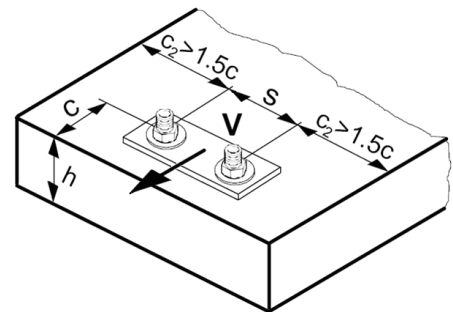
$h_{ef}$ [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N} = 0,5 + h_{ef}/200\text{mm} \leq 1$	0,7 <sup>a)</sup>	0,75 <sup>a)</sup>	0,8 <sup>a)</sup>	0,85 <sup>a)</sup>	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



## Basic design shear resistance

### Design steel resistance $V_{Rd,s}$

Anchor size	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti technical data	
	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  $V_{Rd,cp} = \text{lower value}^a)$  of  $k \cdot N_{Rd,p}$  and  $k \cdot N_{Rd,c}$

$$k = 1 \text{ for } h_{ef} < 60 \text{ mm}$$

$$k = 2 \text{ for } h_{ef} \geq 60 \text{ mm}$$

- a)  $N_{Rd,p}$ : Design combined pull-out and concrete cone resistance  
 $N_{Rd,c}$ : Design concrete cone resistance

Design concrete edge resistance  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40
Non-cracked concrete											
$V_{Rd,c}^0$ [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 $\beta$	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 <sup>a)</sup> for concrete edge resistance: $f_4$

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sup>a)</sup>

$c/d$	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  $c_{min}$ .

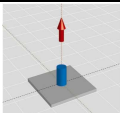
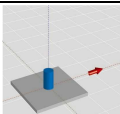
## Combined tension and shear loading

For combined tension and shear loading see section "Anchor Design".

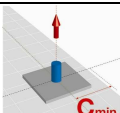
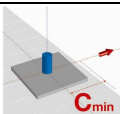
### Precalculated values

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.

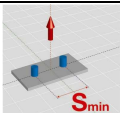
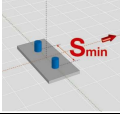
Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I

	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti tech. data	
	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40	
<b>Anchor size</b>												
Embedment depth $h_{ef,1} = [\text{mm}]$	60	60	72	84	96	120	150	168	192	216	240	
Base material thickness $h_{min} = [\text{mm}]$	100	100	104	120	136	170	214	238	272	306	350	
 <b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>												
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	
 <b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>												
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I

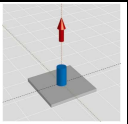
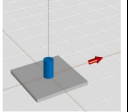
	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti tech. data	
	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40	
<b>Anchor size</b>												
Embedment depth $h_{ef,1} = [\text{mm}]$	60	60	72	84	96	120	150	168	192	216	240	
Base material thickness $h_{min} = [\text{mm}]$	100	100	104	120	136	170	214	238	272	306	350	
Edge distance $c = c_{min} = [\text{mm}]$	40	50	60	70	80	100	125	140	160	180	200	
 <b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>												
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	
 <b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>												
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I  
(load values are valid for single anchor)

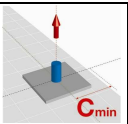
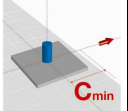
	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti tech. data	
	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40	
<b>Anchor size</b>												
Embedment depth $h_{ef,1} = [\text{mm}]$	60	60	72	84	96	120	150	168	192	216	240	
Base material thickness $h_{min} = [\text{mm}]$	100	100	104	120	136	170	214	238	272	306	350	
Spacing $s = s_{min} = [\text{mm}]$	40	50	60	70	80	100	125	140	160	180	200	
 <b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>												
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	
 <b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>												
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	



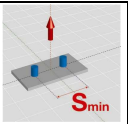
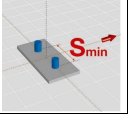
**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I**

	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti tech. data	
	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40	
<b>Anchor size</b>												
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	
 <b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>												
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	
 <b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>												
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	

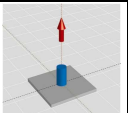
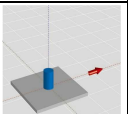
**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I**

	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti tech. data	
	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40	
<b>Anchor size</b>												
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	
 <b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>												
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	
 <b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>												
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	

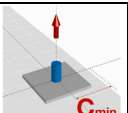
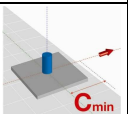
**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I  
(load values are valid for single anchor)**

	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti tech. data	
	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40	
<b>Anchor size</b>												
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	
 <b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>												
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	
 <b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>												
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	

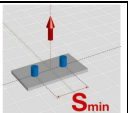
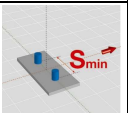
Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I

	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti tech. data	
	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40	
<b>Anchor size</b>												
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	
 <b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>												
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	
 <b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>												
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I


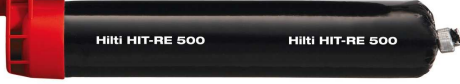


	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti tech. data	
	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40	
<b>Anchor size</b>												
Embedment depth $h_{ef,2} =$ [mm]	96	120	144	168	192	240	300	336	384	432	480	
Base material thickness $h_{min} =$ [mm]	126	150	176	204	232	290	364	406	464	522	590	
Edge distance $c = c_{min} =$ [mm]	40	50	60	70	80	100	125	140	160	180	200	
 <b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>												
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	
 <b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>												
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	

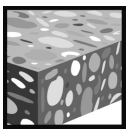
Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I  
(load values are valid for single anchor)

	Data according ETA-04/0027, issue 2009-05-20										Additional Hilti tech. data	
	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40	
<b>Anchor size</b>												
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	
 <b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>												
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	
 <b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>												
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-RE 500 with rebar in diamond drilled holes

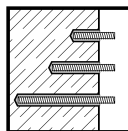
Injection mortar system		Benefits
   	<p>Hilti HIT-RE 500 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)</p> <p>Statik mixer</p> <p>rebar BSt 500 S</p>	<ul style="list-style-type: none"> <li>- suitable for non-cracked concrete C 20/25 to C 50/60</li> <li>- high loading capacity</li> <li>- suitable for dry and water saturated concrete</li> <li>-- large diameter applications</li> <li>- long working time at elevated temperatures</li> <li>- odourless epoxy</li> <li>- embedment depth range: from 60 ... 160 mm for Ø8 to 128 ... 640 mm for Ø32</li> </ul>



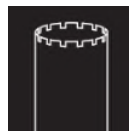
Concrete



Small edge distance and spacing



Variable embedment depth



Diamond drilled holes



PROFIS Anchor design software

### 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
- 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- Temperate range I  
(min. base material temperature  $-40^\circ\text{C}$ , max. long term/short term base material temperature:  $+24^\circ\text{C}/40^\circ\text{C}$ )
- Installation temperature range  $+5^\circ\text{C}$  to  $+40^\circ\text{C}$

For details see Simplified design method

**Embedment depth <sup>a)</sup> 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	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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor rebar BSt 500S**

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Tensile $N_{R_{u,m}}$	BSt 500 S	[kN]	29,4	45,0	65,1	83,9	87,6	134,7	197,1	268,0	320,3
Shear $V_{R_{u,m}}$	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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor rebar BSt 500 S**

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Tensile $N_{R_k}$	BSt 500 S	[kN]	24,1	33,9	49,8	63,2	66,0	101,5	148,4	201,9	241,3
Shear $V_{R_k}$	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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor rebar BSt 500 S**

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Tensile $N_{R_d}$	BSt 500 S	[kN]	13,4	18,8	27,6	30,1	31,4	48,3	70,7	96,1	114,9
Shear $V_{R_d}$	BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0	112,7	147,3

**Recommended loads <sup>a)</sup>: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor rebar BSt 500 S**

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Tensile $N_{rec}$	BSt 500 S	[kN]	9,6	13,5	19,7	21,5	22,4	34,5	50,5	68,7	82,1
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  $\gamma = 1,4$ . 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

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Nominal tensile strength $f_{uk}$	BSt 500 S	[N/mm <sup>2</sup> ]	550	550	550	550	550	550	550	550	550
Yield strength $f_{yk}$	BSt 500 S	[N/mm <sup>2</sup> ]	500	500	500	500	500	500	500	500	500
Stressed cross-section $A_s$	BSt 500 S	[mm <sup>2</sup> ]	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	[mm <sup>3</sup> ]	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

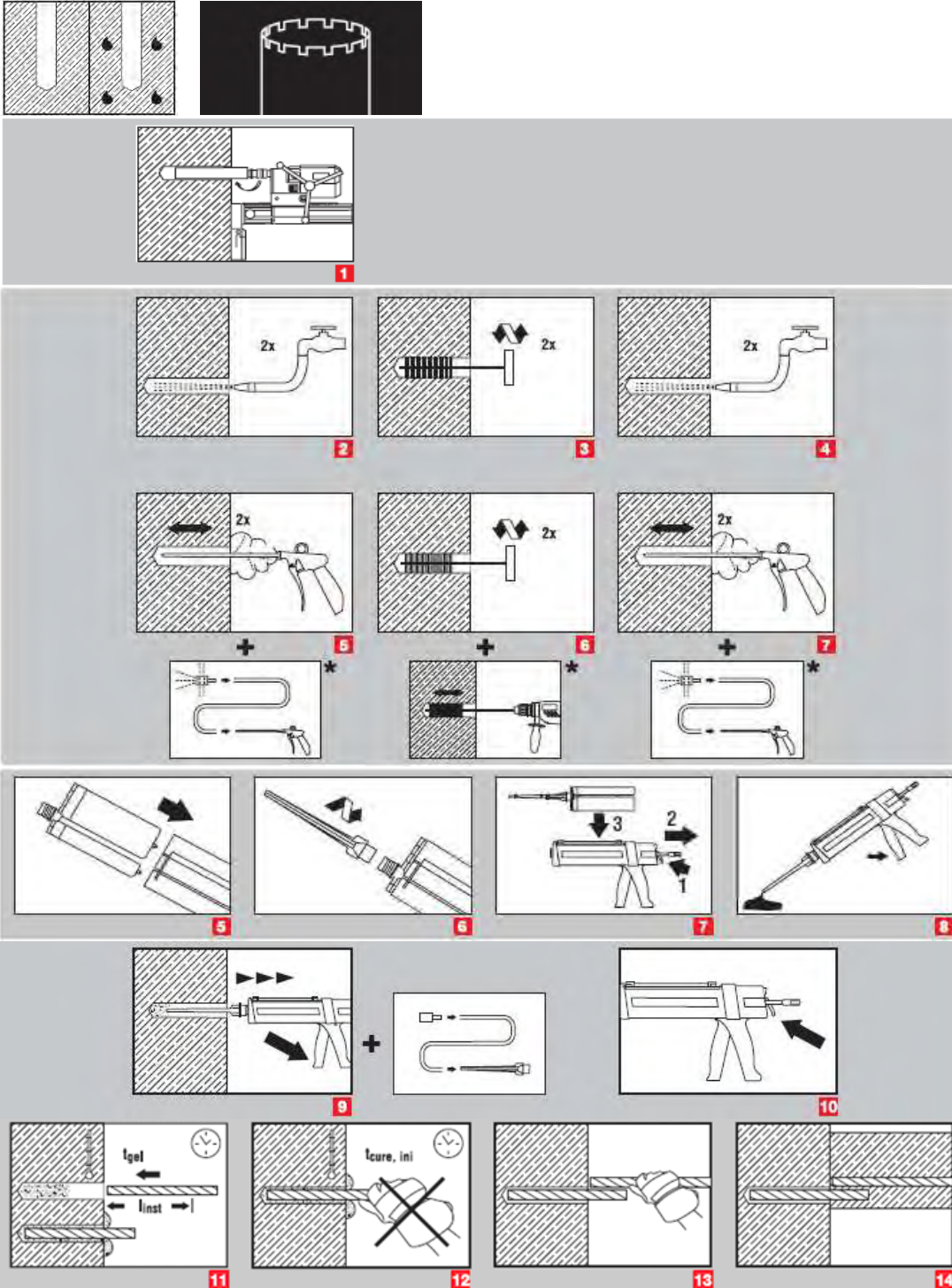
## Setting

### installation equipment

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	
Drilling tools	DD EC-1, DD 100 ... DD xxx									
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser									

## Setting instruction

Dry and water-saturated concrete, diamond coring drilling; Hilti technical information 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.

**Important! Remove all water from the borehole and blow out with oil free compressed air until borehole is completely dried before mortar injection (not applicable to hammer drilled hole in underwater application).**

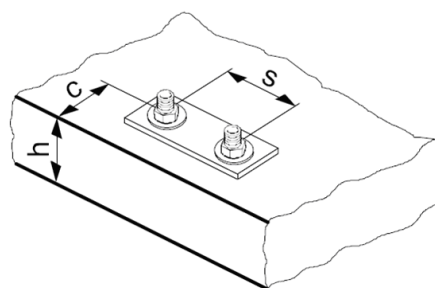
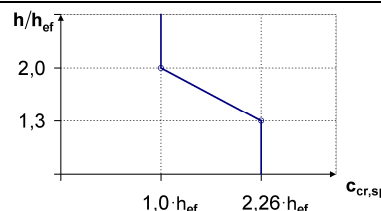


### Curing time for general conditions

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 $t_{cure}$	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

### Setting details

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 <sup>a)</sup>	$h_{ef,min}$ [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]	$h_{ef} + 30 \text{ mm}$ $\geq 100 \text{ mm}$		$h_{ef} + 2 d_0$						
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 <sup>b)</sup>	$C_{cr,sp}$ [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 <sup>c)</sup>	$C_{cr,N}$	$1,5 h_{ef}$								



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 safe 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 safe 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)

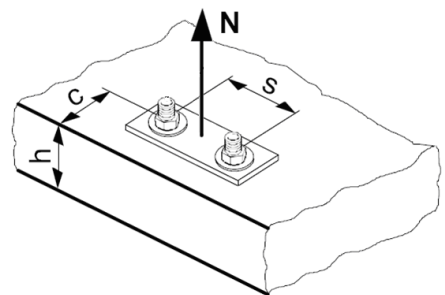
The values are valid for one anchor.

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



### Basic design tensile resistance

#### Design steel resistance $N_{Rd,s}$

Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	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

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

Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Typical embedment depth $h_{ef,typ}$ [mm]		80	90	110	125	125	170	210	270	300
$N_{Rd,p}^0$ Temperature range I	[kN]	13,4	18,8	27,6	30,1	31,4	48,3	70,7	96,1	114,9
$N_{Rd,p}^0$ Temperature range II	[kN]	10,9	15,3	22,4	24,4	25,4	39,1	57,3	77,9	93,1
$N_{Rd,p}^0$ Temperature range III	[kN]	6,8	9,6	14,0	15,3	15,9	24,5	35,9	48,8	58,3

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

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

Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
$N_{Rd,c}^0$	[kN]	17,2	20,5	27,7	33,6	33,6	53,3	73,2	106,7	125,0

## 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
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,1}$ <sup>a)</sup>	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
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ <sup>a)</sup>	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 <sup>a)</sup>

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

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 smaller than the critical edge distance.

### Influence of anchor spacing <sup>a)</sup>

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

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

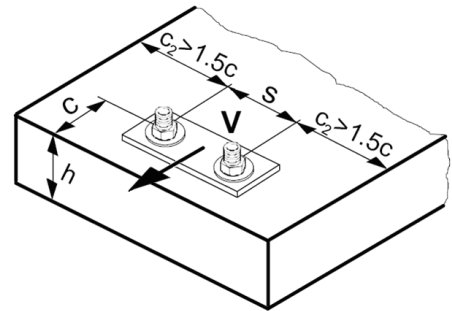
$h_{ef}$ [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,7 <sup>a)</sup>	0,75 <sup>a)</sup>	0,8 <sup>a)</sup>	0,85 <sup>a)</sup>	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_\beta \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



## Basic design shear resistance

### Design steel resistance $V_{Rd,s}$

Anchor size	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 $V_{Rd,cp} = \text{lower value}^a)$ of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

$$k = 1 \text{ for } h_{ef} < 60 \text{ mm}$$

$$k = 2 \text{ for } h_{ef} \geq 60 \text{ mm}$$

- a)  $N_{Rd,p}$ : Design combined pull-out and concrete cone resistance  
 $N_{Rd,c}$ : Design concrete cone resistance

### Design concrete edge resistance $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_\beta \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	Ø36	Ø40
Non-cracked concrete											
$V_{Rd,c}^0$ [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 $\beta$	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 <sup>a)</sup> for concrete edge resistance:  $f_4$   
 $f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sub>ef</sub> /d	4	4,5	5	6	7	8	9	10	11
f <sub>hef</sub> = 0,05 · (h <sub>ef</sub> / d) <sup>1,68</sup>	0,51	0,63	0,75	1,01	1,31	1,64	2,00	2,39	2,81
h <sub>ef</sub> /d	12	13	14	15	16	17	18	19	20
f <sub>hef</sub> = 0,05 · (h <sub>ef</sub> / d) <sup>1,68</sup>	3,25	3,72	4,21	4,73	5,27	5,84	6,42	7,04	7,67

### Influence of edge distance <sup>a)</sup>

c/d	4	6	8	10	15	20	30	40
f <sub>c</sub> = (d / c) <sup>0,19</sup>	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  $c_{min}$ .

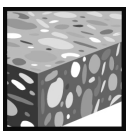
## Combined tension and shear loading

For combined tension and shear loading see section "Anchor Design".



## Hilti HIT-HY 200 with HIT-Z

Injection mortar system		Benefits
	Hilti HIT-HY 200-A 500 ml foil pack (also available as 330 ml foil pack)	<ul style="list-style-type: none"> <li>- No cleaning required: Zero susceptibility to borehole cleaning conditions with dry and water saturated concrete base material</li> <li>- Maximum load performance in cracked concrete and uncracked concrete</li> <li>- Suitable for cracked and non-cracked concrete C 20/25 to C 50/60</li> <li>- Suitable for use with diamond cored holes in non-cracked or cracked concrete with no load reductions</li> <li>- Two mortar (Hilti HIT-HY 200-A and Hilti HIT-HY 200-R) versions available with different curing times and same performance</li> </ul>
	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



Corrosion resistance



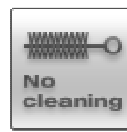
European Technical Approval



CE conformity



PROFIS Anchor design software



No cleaning required for approved loads

### Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval <sup>a)</sup>	DIBt, Berlin	ETA-12/0006 / 2012-04-04 (HIT-HY 200-A) ETA-12/0028 / 2012-04-04 (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 2012-04-04.

### 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
- 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- Temperate range I  
(min. base material temperature  $-40^\circ\text{C}$ , max. long term/short term base material temperature:  $+24^\circ\text{C}/40^\circ\text{C}$ )
- Installation temperature range  $+5^\circ\text{C}$  to  $+40^\circ\text{C}$

For details see Simplified design method

**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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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 <sup>a)</sup>: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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  $\gamma = 1,4$ . 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 [N/mm <sup>2</sup> ]	650	650	650	610	595
	HIT-Z-R					
Yield strength $f_{yk}$	HIT-Z [N/mm <sup>2</sup> ]	520	520	520	490	480
	HIT-Z-R					
Stressed cross-section of thread $A_s$	HIT-Z [mm <sup>2</sup> ]	36,6	58,0	84,3	157	245
Moment of resistance $W$	HIT-Z [mm <sup>3</sup> ]	31,9	62,5	109,7	278	542

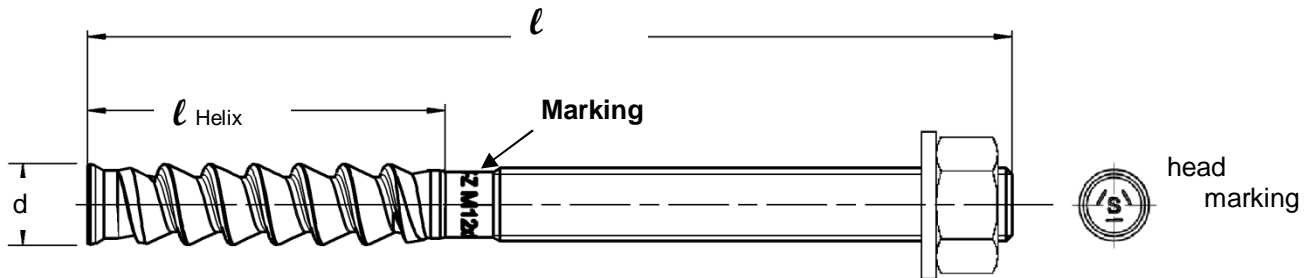
### Material quality

Part	Material
HIT-Z	C-steel cold formed, steel galvanized $\geq 5\mu\text{m}$
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	$l_{\text{Helix}}$ [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

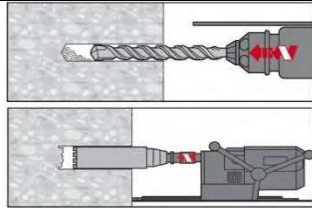
Temperature of the base material	HIT-HY 200-R	
	Working time in which anchor can be inserted and adjusted $t_{\text{work}}$	Curing time before anchor can be loaded $t_{\text{cure}}$
5 °C	1 hour	3 hour
6 °C to 10 °C	40 min	2 hour
11 °C to 20 °C	15 min	1 hour
21 °C to 30 °C	9 min	1 hour
31 °C to 40 °C	6 min	1 hour

### Curing and working time

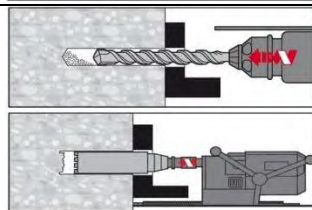
Temperature of the base material	HIT-HY 200-A	
	Working time in which anchor can be inserted and adjusted $t_{\text{work}}$	Curing time before anchor can be loaded $t_{\text{cure}}$
5 °C	25 min	2 hour
6 °C to 10 °C	15 min	1 hour
11 °C to 20 °C	7 min	30 min
21 °C to 30 °C	4 min	30 min
31 °C to 40 °C	3 min	30 min

## Setting instruction

### 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.

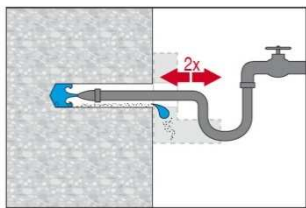


**Through-setting:** Drill hole through the clearance hole in the fixture to the required drilling depth with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit. Diamond coring is permissible when diamond core drilling machine and the corresponding core bit are used.

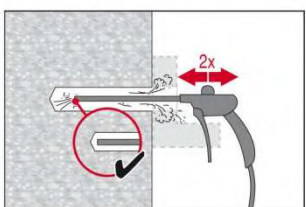
### Bore hole cleaning<sup>a)</sup>

a) No cleaning required for hammer drilled boreholes

b) Hole flushing and evacuation for wet-drilled diamond cored holes or flooded holes

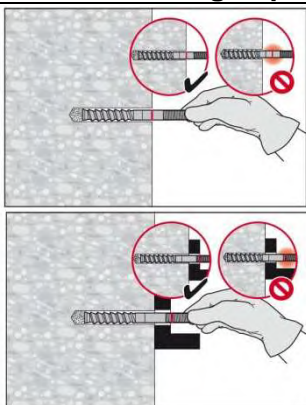


Flush 2 times from the back of the hole over the hole length.



Blow 2 times the hole with oil-free compressed air (min. 6 bar at 6 m<sup>3</sup>/h) to evacuate the water

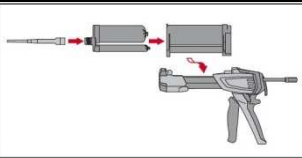
### Check of setting depth and compress of the drilling dust



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.

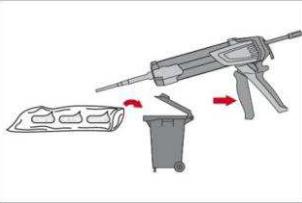
a) When drilling downward with non-cleaning the required drilling depths can vary due to accumulation of dust in the hole.

### 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.



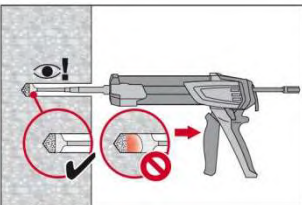
Discard initial adhesive. The foil pack opens automatically as dispensing is initiated. Depending on the size of the foil pack an initial amount of adhesive has to be discarded.

Discard quantities are

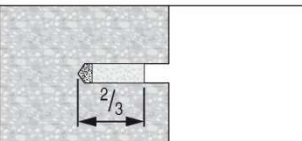
2 strokes for 330 ml foil pack

3 strokes for 500 ml foil pack

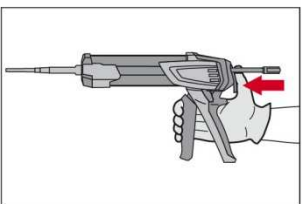
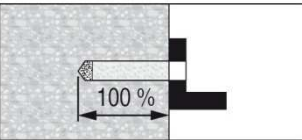
### Inject adhesive from the back of the borehole without forming air voids



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

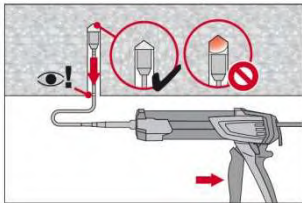


Fill holes approximately 2/3 full for Pre-setting and 100% full for through-setting, or as required to ensure that the annular gap between the anchor and the concrete is completely filled with adhesive along the embedment length.



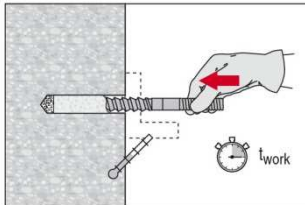
After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further adhesive discharge from the mixer.

### Overhead installation

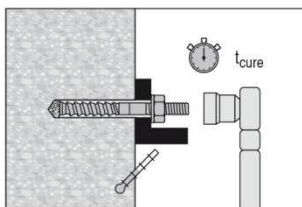


For overhead installation the injection is only possible with the aid of extensions and piston plugs. Assemble HIT-RE-M mixer, extension(s) and appropriately piston plug HIT-SZ. Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded out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

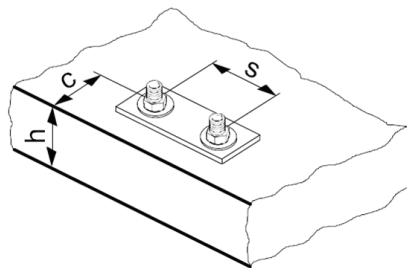
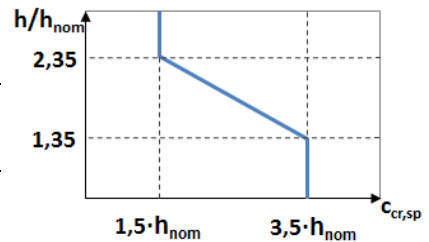
For detailed information on installation see instruction for use given with the package of the product.

### Setting details

Anchor size		M8	M10	M12	M16	M20
Nominal diameter of drill bit	$d_0$ [mm]	10	12	14	18	22
Effective embedment depth range	$h_{nom,min}$ [mm]	60	60	60	96	100
	$h_{nom,max}$ [mm]	100	120	150	200	220
Minimum base material thickness	$h_{min}$ [mm]	$h_{nom} + 60$ mm			$h_{nom} + 100$ mm	
Pre-setting: Diameter of clearance hole in the fixture	$d_f \leq$ [mm]	9	12	14	18	22
Through-setting: Diameter of clearance hole in the fixture	$d_f \leq$ [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]	$1,5 h_{nom}$

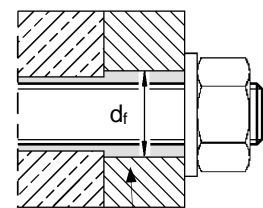
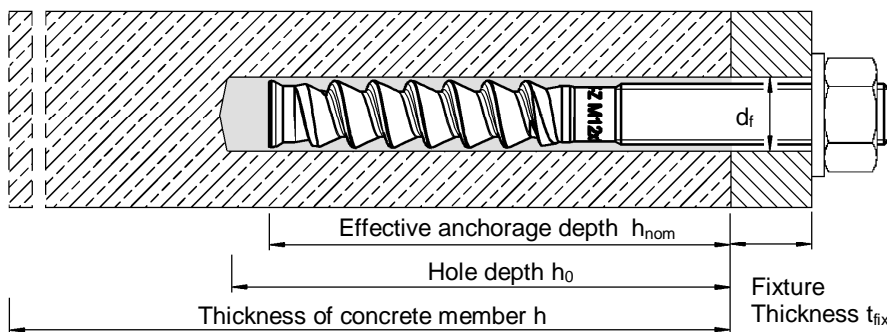


For spacing (or edge distance) smaller than critical spacing (or critical edge distance) the design loads have to be reduced.

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



annular gap  
filled with Hilti  
HIT-HY 200

## 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	[mm <sup>2</sup> ]	19200	40800	58800	94700	148000
Uncracked concrete	[mm <sup>2</sup> ]	22200	57400	80800	128000	198000

### Calculate interaction area $A_{i,cal}$

<p><b>Member thickness <math>h \geq h_{nom} + 1,5 \cdot c</math></b></p>			
Single anchor and group of anchors with $s > 3 \cdot c$	[mm <sup>2</sup> ]	$A_{i,cal} = (6 \cdot c) \cdot (h_{nom} + 1,5 \cdot c)$	with $c \geq 5 \cdot d$
Group of anchors with $s \leq 3 \cdot c$	[mm <sup>2</sup> ]	$A_{i,cal} = (3 \cdot c + s) \cdot (h_{nom} + 1,5 \cdot c)$	with $c \geq 5 \cdot d$ and $s \geq 5 \cdot d$
<p><b>Member thickness <math>h \leq h_{nom} + 1,5 \cdot c</math></b></p>			
Single anchor and group of anchors with $s > 3 \cdot c$	[mm <sup>2</sup> ]	$A_{i,cal} = (6 \cdot c) \cdot h$	with $c \geq 5 \cdot d$
Group of anchors with $s \leq 3 \cdot c$	[mm <sup>2</sup> ]	$A_{i,cal} = (3 \cdot c + s) \cdot h$	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
<b>Cracked concrete</b>						
Member thickness	$h \geq$ [mm]	140	200	240	300	370
Embedment depth	$h_{nom} \geq$ [mm]	80	120	150	200	220
Minimum spacing	$s_{min}$ [mm]	40	50	60	80	100
Corresponding edge distance	$c \geq$ [mm]	40	55	65	80	100
Minimum edge distance	$c_{min} =$ [mm]	40	50	60	80	100
Corresponding spacing	$s \geq$ [mm]	40	60	65	80	100
<b>Non cracked concrete</b>						
Member thickness	$h \geq$ [mm]	140	230	270	340	410
Embedment depth	$h_{nom} \geq$ [mm]	80	120	150	200	220
Minimum spacing	$s_{min}$ [mm]	40	50	60	80	100
Corresponding edge distance	$c \geq$ [mm]	40	70	80	100	130
Minimum edge distance	$c_{min}$ [mm]	40	50	60	80	100
Corresponding spacing	$s \geq$ [mm]	40	145	160	160	235

**Best case minimum member thickness and embedment depth  
 with required minimum edge distance and spacing**

Anchor size		M8	M10	M12	M16	M20
<b>Cracked concrete</b>						
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	$c \geq$ [mm]	40	100	140	135	215
Minimum edge distance	$c_{min} =$ [mm]	40	60	90	80	125
Corresponding spacing	$s \geq$ [mm]	40	160	220	235	365
<b>Non cracked concrete</b>						
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	$c \geq$ [mm]	50	145	200	190	300
Minimum edge distance	$c_{min}$ [mm]	40	80	115	110	165
Corresponding spacing	$s \geq$ [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:**

<b>Cracked or uncracked concrete</b>	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
<b>Anchor diameter</b>	For smaller anchor diameter a smaller installation torque is required, allowing smaller values for minimum edge distance and minimum spacing
<b>Slab thickness and embedment depth</b>	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 2012-04-04

- 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 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)

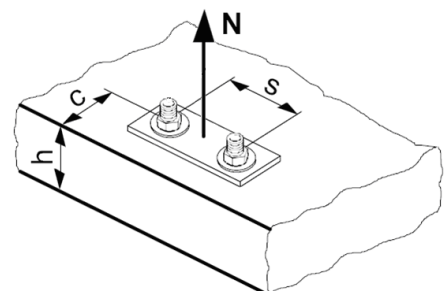
The values are valid for one anchor.

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





## 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 $N_{Rd,p}$ <sup>a)</sup>

Anchor size		M8	M10	M12	M16	M20
Non-cracked concrete						
$N_{Rd,p}^0$ Temperature range I	[kN]	20,1	30,2	36,2	77,2	100,5
$N_{Rd,p}^0$ Temperature range II	[kN]	18,4	27,6	33,2	70,8	92,2
$N_{Rd,p}^0$ Temperature range III	[kN]	16,8	25,1	30,2	64,3	83,8
Cracked concrete						
$N_{Rd,p}^0$ Temperature range I	[kN]	18,4	27,6	33,2	70,8	92,2
$N_{Rd,p}^0$ Temperature range II	[kN]	16,8	25,1	30,2	64,3	83,8
$N_{Rd,p}^0$ 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 $N_{Rd,c} = N_{Rd,c}^0 \cdot f_B \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,N} \cdot f_{re,N}$

### Design splitting resistance <sup>a)</sup> $N_{Rd,sp} = N_{Rd,c}^0 \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

Anchor size		M8	M10	M12	M16	M20
$h_{nom,typ}$	[mm]	70	90	110	145	180
$N_{Rd,c}^0$ Non cracked concrete	[kN]	19,7	28,7	38,8	58,8	81,3
$N_{Rd,c}^0$ 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
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ <sup>a)</sup>	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 <sup>a)</sup>

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

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 <sup>a)</sup>

$s/s_{cr,N}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$s/s_{cr,sp}$										
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N}) \leq 1$										
$f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp}) \leq 1$	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

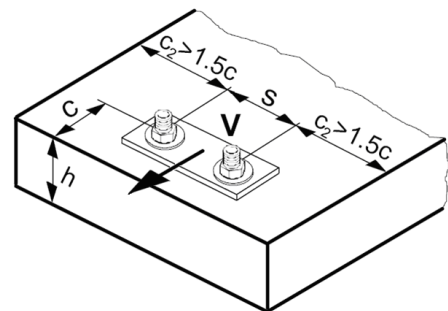
$h_{nom}$ [mm]	60	70	80	90	≥ 100
$f_{re,N} = 0,5 + h_{nom}/200mm \leq 1$	0,8 <sup>a)</sup>	0,85 <sup>a)</sup>	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

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:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



### 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 $V_{Rd,cp} = \text{lower value}^a)$ of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

$$k = 2 \text{ for } h_{ef} \geq 60 \text{ mm}$$

- a)  $N_{Rd,p}$ : Design combined pull-out and concrete cone resistance  
 $N_{Rd,c}$ : Design concrete cone resistance

#### Design concrete edge resistance <sup>a)</sup> $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_h \cdot f_4$

Anchor size		Non-cracked concrete					Cracked concrete				
		M8	M10	M12	M16	M20	M8	M10	M12	M16	M20
$V_{Rd,c}^0$	[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.

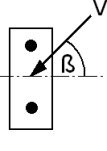
### Influencing factors

#### 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 $\beta$	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: $f_4$

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

c/h <sub>nom</sub>	Single anchor	Group of two anchors s/h <sub>nom</sub>														
		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 <sup>a)</sup>

$c/d$	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

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 – $f_{ck,cube} = 25 \text{ N/mm}^2$

Anchor size	M8	M10	M12	M16	M20	
Embedment depth $h_{nom,min} = [\text{mm}]$	60	60	60	96	100	
Base material thickness $h_{min} = [\text{mm}]$	120	120	120	196	200	
	<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>					
	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	
	<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>					
	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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$

Anchor size	M8	M10	M12	M16	M20
Embedment depth $h_{nom,min} = [\text{mm}]$	60	60	60	96	100
Base material thickness $h_{min} = [\text{mm}]$	120	120	120	196	200
<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>					
Non-cracked concrete					
$c_{min} [\text{mm}]$	40	80	115	110	165
HIT-Z / HIT-Z-R [kN]	7,8	10,5	13,2	20,1	25,7
Cracked concrete					
$c_{min} [\text{mm}]$	40	80	115	110	165
HIT-Z / HIT-Z-R [kN]	6,7	10,2	11,2	18,5	24,0
<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>) , without lever arm</b>					
Non-cracked concrete					
$c_{min} [\text{mm}]$	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					
$c_{min} [\text{mm}]$	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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$   
(load values are valid for single anchor)

Anchor size	M8	M10	M12	M16	M20
Embedment depth $h_{nom,min} = [\text{mm}]$	60	60	60	96	100
Base material thickness $h_{min} = [\text{mm}]$	120	120	120	196	200
<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>					
Non-cracked concrete					
$s_{min} [\text{mm}]$	40	50	60	80	100
HIT-Z / HIT-Z-R [kN]	8,9	9,2	9,5	18,7	20,3
Cracked concrete					
$s_{min} [\text{mm}]$	40	50	60	80	100
HIT-Z / HIT-Z-R [kN]	6,8	7,1	7,4	14,4	16,0
<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>) , without lever arm</b>					
Non-cracked concrete					
$s_{min} [\text{mm}]$	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					
$s_{min} [\text{mm}]$	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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$**

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	
	<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>					
	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	
	<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>					
	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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$**

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	
	<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>					
	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	
	<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>					
	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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$   
(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
<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>					
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
<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>					
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$

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
<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>					
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
<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>					
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$

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
<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>					
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
<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>					
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$   
(load values are valid for single anchor)

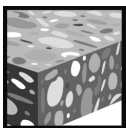
Anchor size	M8	M10	M12	M16	M20
Embedment depth $h_{nom,max} =$ [mm]	100	120	150	200	220
Base material thickness $h_{min} =$ [mm]	160	180	210	300	320
<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>					
Non-cracked concrete					
$s_{min}$ [mm]	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
<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>					
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





## Hilti HIT-HY 200 with HIT-V

Injection mortar system		Benefits
	Hilti HIT-HY 200-A 500 ml foil pack (also available as 330 ml foil pack)	<ul style="list-style-type: none"> <li>- Suitable for non-cracked and cracked concrete C 20/25 to C 50/60</li> <li>- Suitable for dry and water saturated concrete</li> <li>- High loading capacity, excellent handling and fast curing</li> <li>- Small edge distance and anchor spacing possible</li> <li>- Large diameter applications</li> <li>- Max In service temperature range up to 120°C short term/ 72°C long term</li> <li>- Manual cleaning for borehole diameter up to 20mm and <math>h_{ef} \leq 10d</math> for non-cracked concrete only</li> <li>- Embedment depth range: from 60 ... 160 mm for M8 to 120 ... 600 mm for M30</li> <li>- Two mortar (A and R) versions available with different curing times and same performance</li> </ul>
	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	



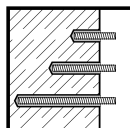
Concrete



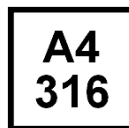
Tensile zone



Small edge distance and spacing



Variable embedment depth



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 <sup>a)</sup>	DIBt, Berlin	ETA-11/0493 / 2012-08-08 (Hilti HIT-HY 200-A) ETA-12/0084 / 2012-08-08 (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 2012-08-08.

## 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
- **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,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- Temperate range I  
(min. base material temperature  $-40^\circ\text{C}$ , max. long term/short term base material temperature:  $+24^\circ\text{C}/40^\circ\text{C}$ )
- Installation temperature range  $-10^\circ\text{C}$  to  $+40^\circ\text{C}$

### Embedment depth <sup>a)</sup> 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 <sup>a)</sup>: concrete C 20/25 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete										
Tensile N <sub>rec</sub>	HIT-V 5.8	[kN]	8,6	13,8	20,0	28,0	44,4	61,0	74,5	88,9
Shear V <sub>rec</sub>	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 <sub>rec</sub>	HIT-V 5.8	[kN]	4,8	6,7	13,2	19,9	31,7	43,5	53,1	63,4
Shear V <sub>rec</sub>	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  $\gamma = 1,4$ . 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 <sub>uk</sub>	HIT-V 5.8	[N/mm <sup>2</sup> ]	500	500	500	500	500	500	500	500
	HIT-V 8.8	[N/mm <sup>2</sup> ]	800	800	800	800	800	800	800	800
	HIT-V-R	[N/mm <sup>2</sup> ]	700	700	700	700	700	700	500	500
	HIT-V-HCR	[N/mm <sup>2</sup> ]	800	800	800	800	800	700	700	700
Yield strength f <sub>yk</sub>	HIT-V 5.8	[N/mm <sup>2</sup> ]	400	400	400	400	400	400	400	400
	HIT-V 8.8	[N/mm <sup>2</sup> ]	640	640	640	640	640	640	640	640
	HIT-V -R	[N/mm <sup>2</sup> ]	450	450	450	450	450	450	210	210
	HIT-V-HCR	[N/mm <sup>2</sup> ]	640	640	640	640	640	400	400	400
Stressed cross-section A <sub>s</sub>	HIT-V	[mm <sup>2</sup> ]	36,6	58,0	84,3	157	245	353	459	561
Moment of resistance W	HIT-V	[mm <sup>3</sup> ]	31,2	62,3	109	277	541	935	1387	1874

### Material quality

Part	Material
Threaded rod HIT-V(F)	Strength class 5.8, A <sub>5</sub> > 8% ductile steel galvanized ≥ 5 μm, (F) hot dipped galvanized ≥ 45 μm,
Threaded rod HIT-V(F)	Strength class 8.8, A <sub>5</sub> > 8% ductile steel galvanized ≥ 5 μm, (F) hot dipped galvanized ≥ 45 μm,
Threaded rod HIT-V-R	Stainless steel grade A4, A <sub>5</sub> > 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 <sub>m</sub> = 800 N/mm <sup>2</sup> , R <sub>p0.2</sub> = 640 N/mm <sup>2</sup> , A <sub>5</sub> > 8% ductile M24 to M30: R <sub>m</sub> = 700 N/mm <sup>2</sup> , R <sub>p0.2</sub> = 400 N/mm <sup>2</sup> , A <sub>5</sub> > 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

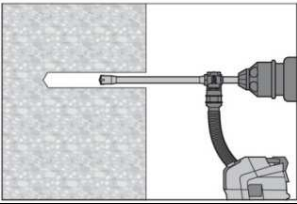
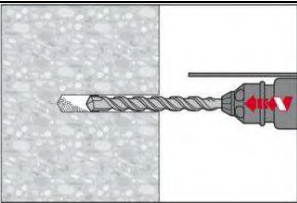
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Anchor rod HIT-V, HIT-V-R, HIT-V-HCR	Anchor rods HIT-V (-R / -HCR) are available in variable length							

### 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							

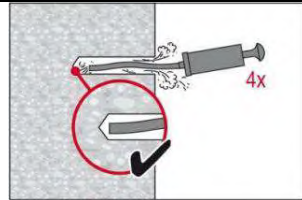
#### Setting instruction

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.

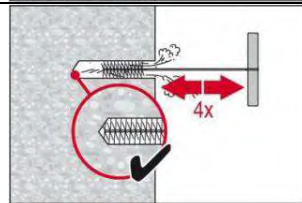
**Bore hole cleaning** Just before setting an anchor, the bore hole must be free of dust and debris.

**a) Manual Cleaning (MC) non-cracked concrete only**

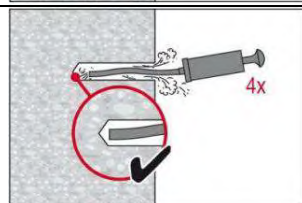
for bore hole diameters  $d_0 \leq 20\text{mm}$  and bore hole depth  $h_0 \leq 10d$



The Hilti manual pump may be used for blowing out bore holes up to diameters  $d_0 \leq 20\text{ mm}$  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



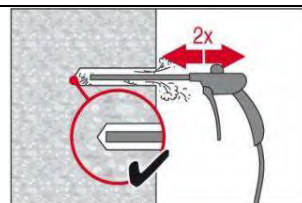
Brush 4 times with the specified brush size by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it. The brush must produce natural resistance as it enters the bore hole -- if not the brush is too small and must be replaced with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



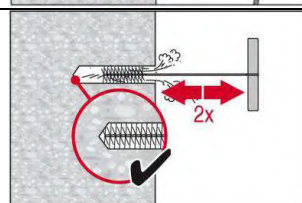
Blow out again with manual pump at least 4 times until return air stream is free of noticeable dust.

**b) Compressed air cleaning (CAC)**

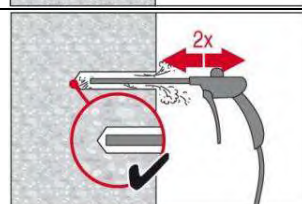
for all bore hole diameters  $d_0$  and all bore hole depth  $h_0$



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 m<sup>3</sup>/h) until return air stream is free of noticeable dust. Bore hole diameter  $\geq 32\text{ mm}$  the compressor must supply a minimum air flow of 140 m<sup>3</sup>/hour.



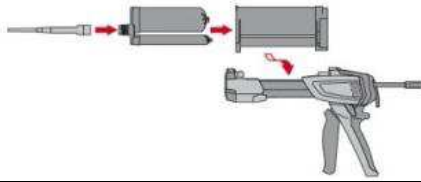
Brush 2 times with the specified brush size by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it. The brush must produce natural resistance as it enters the bore hole -- if not the brush is too small and must be replaced with the proper brush diameter.



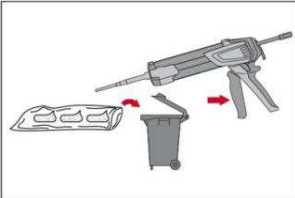
Blow again with compressed air 2 times until return air stream is free of noticeable dust.



### 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.

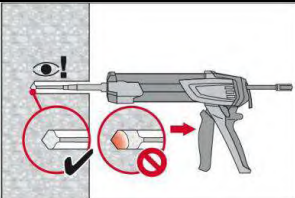


Discard initial adhesive. The foil pack opens automatically as dispensing is initiated. Depending on the size of the foil pack an initial amount of adhesive has to be discarded.

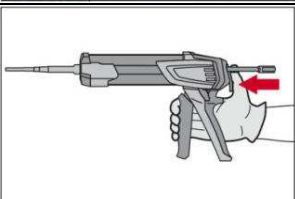
Discard quantities are:

- 2 strokes for 330 ml foil pack,
- 3 strokes for 500 ml foil pack,
- 4 strokes for 500 ml foil pack  $\leq 5^{\circ}\text{C}$ .

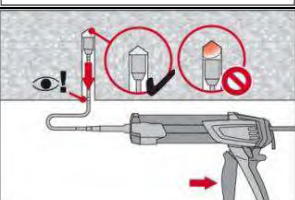
### Inject adhesive from the back of the borehole without forming air voids



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.

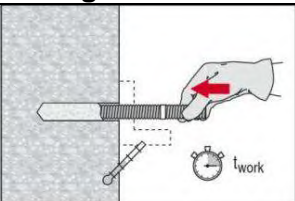


After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further adhesive discharge from the mixer.

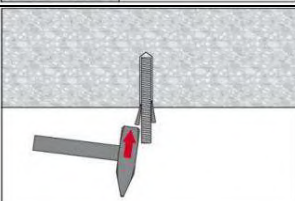


Overhead installation and/or installation with embedment depth  $h_{ef} > 250\text{mm}$ . For overhead installation the injection is only possible with the aid of extensions and piston plugs. Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug. Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded out of the bore hole by the adhesive pressure.

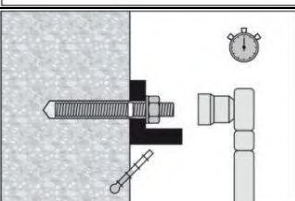
### Setting the element



Before use, verify that the element is dry and free of oil and other contaminants. Mark and set element to the required embedment depth until 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  $T_{max}$ .

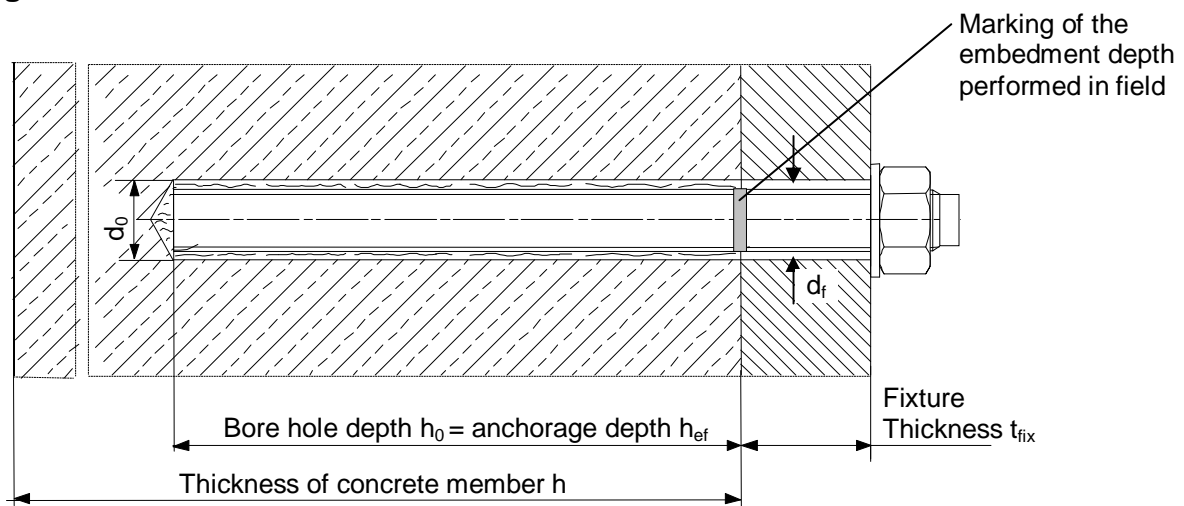
For detailed information on installation see instruction for use given with the package of the product.

## 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	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	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	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 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 <sup>a)</sup> <b>for HIT-V</b>	$h_{ef,min}$ [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]	$h_{ef} + 30 \text{ mm}$			$h_{ef} + 2 d_0$				
Diameter of clearance hole in the fixture	$d_f$ [mm]	9	12	14	18	22	26	30	33
Torque moment	$T_{max}$ <sup>b)</sup> [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 <sup>c)</sup>	$c_{cr,sp}$ [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 <sup>d)</sup>	$c_{cr,N}$ [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 2012-08-08 for HIT-HY 200-A and ETA-12/0084 issued 2012-08-08 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)

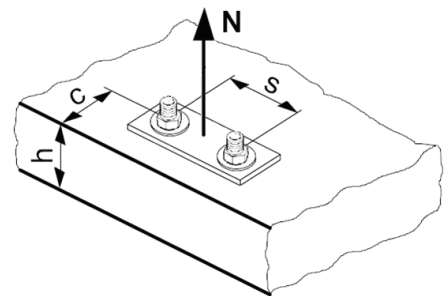
The values are valid for one anchor.

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



## 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

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

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								
$N_{Rd,p}^0$ Temperature range I [kN]	22,3	31,4	46,1	69,8	118,7	175,9	169,6	212,1
$N_{Rd,p}^0$ Temperature range II [kN]	19,0	26,7	39,2	59,3	100,9	149,5	135,7	169,6
$N_{Rd,p}^0$ Temperature range III [kN]	15,6	22,0	32,3	48,9	83,1	123,2	124,4	155,5
Cracked concrete								
$N_{Rd,p}^0$ Temperature range I [kN]	6,7	9,4	18,4	27,9	47,5	70,4	90,5	113,1
$N_{Rd,p}^0$ Temperature range II [kN]	5,0	7,1	15,0	22,7	38,6	57,2	73,5	91,9
$N_{Rd,p}^0$ Temperature range III [kN]	4,5	6,3	12,7	19,2	32,6	48,4	62,2	77,8

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

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

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
$N_{Rd,c}^0$ Non-cracked concrete [kN]	20,1	24,0	32,4	39,2	62,2	85,4	104,3	124,5
$N_{Rd,c}^0$ 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)

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

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 <sup>a)</sup>

$s/s_{cr,N}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$s/s_{cr,sp}$										
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N}) \leq 1$										
$f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp}) \leq 1$	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

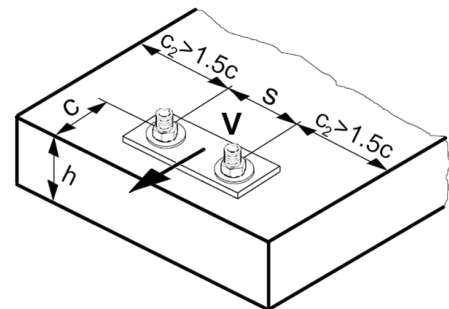
$h_{ef}$ [mm]	60	70	80	90	$\geq 100$
$f_{re,N} = 0,5 + h_{ef}/200\text{mm} \leq 1$	0,8 <sup>a)</sup>	0,85 <sup>a)</sup>	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



### 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 $V_{Rd,cp} = \text{lower value}^a)$ 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 $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete									
$V_{Rd,c}^0$ [kN]		5,9	8,6	11,6	18,7	27,0	36,6	44,5	53,0
Cracked concrete									
$V_{Rd,c}^0$ [kN]		4,2	6,1	8,2	13,2	19,2	25,9	31,5	37,5

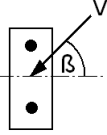
### Influencing factors

#### 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 $\beta$	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 <sup>a)</sup> for concrete edge resistance: $f_4$

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sup>a)</sup>

$c/d$	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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$
- 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  $\gamma = 1,4$ . 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 – $f_{ck,cube} = 25 \text{ N/mm}^2$ - 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
<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>								
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 [kN]	5,0	6,3	11,7	14,3	17,1	18,8	22,4	26,3
HIT-V-R / -HCR [kN]	5,0	6,3	11,7	14,3	17,1	18,8	22,4	26,3
<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>								
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 – $f_{ck,cube} = 25 \text{ N/mm}^2$ - 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
<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>								
Non-cracked concrete								
HIT-V 5.8 / 8.8 [kN]	7,1	7,8	9,7	12,8	16,5	20,7	24,2	28,9
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 [kN]	3,0	4,2	8,0	10,7	13,7	16,4	19,5	22,9
HIT-V-R / -HCR [kN]	3,0	4,2	8,0	10,7	13,7	16,4	19,5	22,9
<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>								
Non-cracked concrete								
HIT-V 5.8 / 8.8 [kN]	3,5	4,9	6,6	10,2	13,9	17,9	21,5	25,9
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 [kN]	2,5	3,5	4,7	7,2	9,9	12,7	15,3	18,3
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - minimum embedment depth  
(load values are valid for single anchor)


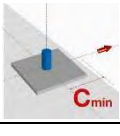
Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth $h_{ef} = h_{ef,min}$ [mm]		60	60	70	80	90	96	108	120
Base material thickness $h = h_{min}$ [mm]		90	90	100	116	134	152	168	190
Spacing $s = s_{min}$ [mm]		40	50	60	80	100	120	135	150
	<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>								
	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
		<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>							
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - typical embedment depth

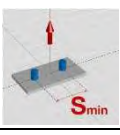
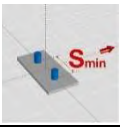
Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth $h_{ef} = h_{ef,typ}$ [mm]		80	90	110	125	170	210	240	270
Base material thickness $h = h_{min}$ [mm]		110	120	140	161	214	266	300	340
	<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>								
	Non-cracked concrete								
	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
	<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>								
	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 – $f_{ck,cube} = 25 \text{ N/mm}^2$ - 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	
	<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>								
	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
		<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>							
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 – $f_{ck,cube} = 25 \text{ N/mm}^2$ - 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	
	<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>								
	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
		<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>							
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - embedment depth = 12 d<sup>a)</sup>

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
<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>								
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 [kN]	8,0	12,6	24,1	42,9	67,0	96,5	116,6	136,6
HIT-V-R / -HCR [kN]	8,0	12,6	24,1	42,9	67,0	96,5	116,6	136,6
<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>								
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

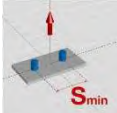
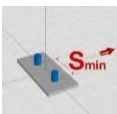
a) d = element diameter

Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - embedment depth = 12 d<sup>a)</sup>

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
<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>								
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 [kN]	4,2	6,5	12,5	22,2	34,7	48,9	58,4	68,4
HIT-V-R / -HCR [kN]	4,2	6,5	12,5	22,2	34,7	48,9	58,4	68,4
<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>								
Non-cracked concrete								
HIT-V 5.8 / 8.8 [kN]	3,9	5,7	7,8	12,9	18,9	25,9	31,8	38,1
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 [kN]	2,8	4,0	5,5	9,1	13,4	18,4	22,5	27,0
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

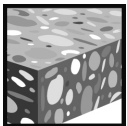
Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - embedment depth =  $12 d^a$   
(load values are valid for single anchor)

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	
	<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>								
	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 [kN]	5,5	8,5	15,4	26,5	40,1	55,7	66,4	77,8
	HIT-V-R / -HCR [kN]								
		<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>							
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

## Hilti HIT-HY 200 with HIS-(R)N

Injection mortar system		Benefits
	Hilti HIT-HY 200-A 500 ml foil pack (also available as 330 ml)	<ul style="list-style-type: none"> <li>- Suitable for cracked and non-cracked concrete C 20/25 to C 50/60.</li> <li>- Suitable for dry and water saturated concrete</li> <li>- High loading capacity, excellent handling, and fast curing</li> <li>- Small edge distance and anchor spacing possible</li> <li>- Corrosion resistant</li> <li>- In service temperature range up to 120°C short term/72°C long term</li> <li>- Manual cleaning for anchor size M8 and M10</li> <li>- Two mortar (A and R) versions available with different curing times and same performance</li> </ul>
	Hilti HIT-HY 200-R 500 ml foil pack (also available as 330 ml)	
	Static mixer	
	Internal threaded sleeve HIS-N HIS-RN	



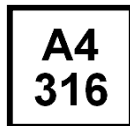
Concrete



Tensile zone



Small edge distance and spacing



Corrosion resistance



European Technical Approval



CE conformity



PROFIS Anchor design software

### Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval <sup>a)</sup>	DIBt, Berlin	ETA-11/0493 / 2012-08-08 (Hilti HIT-HY 200-A) ETA-12/0084 / 2012-08-08 (Hilti HIT-HY 200-R)

a) All data given in this section according ETA-11/0493 and ETA-12/0084, issue 2012-08-08.

## 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
- Steel failure
- Base material thickness, as specified in the table
- One anchor material, as specified in the tables
- Concrete C 20/25,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- Temperate range I  
(min. base material temperature  $-40^\circ\text{C}$ , max. long term/short term base material temperature:  $+24^\circ\text{C}/40^\circ\text{C}$ )
- Installation temperature range  $-10^\circ\text{C}$  to  $+40^\circ\text{C}$

### 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 $N_{Ru,m}$	HIS-N [kN]	24,7	39,9	50,3	79,8	105,7
Shear $V_{Ru,m}$	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 $N_{Ru,m}$	HIS-N [kN]	16,5	26,6	33,5	53,2	70,4
Shear $V_{Ru,m}$	HIS-N [kN]	10,4	18,4	26,0	39,3	36,7

**Recommended loads <sup>a)</sup>: 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 $N_{Ru,m}$	HIS-N	[kN]	11,8	19,0	24,0	38,0	50,3
Shear $V_{Ru,m}$	HIS-N	[kN]	7,4	13,1	18,6	28,1	26,2

a) With 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.

**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/mm <sup>2</sup> ]	490	460	460	460	460
	Screw 8.8	[N/mm <sup>2</sup> ]	800	800	800	800	800
	HIS-RN	[N/mm <sup>2</sup> ]	700	700	700	700	700
	Screw A4-70	[N/mm <sup>2</sup> ]	700	700	700	700	700
Yield strength $f_{yk}$	HIS-N	[N/mm <sup>2</sup> ]	410	375	375	375	375
	Screw 8.8	[N/mm <sup>2</sup> ]	640	640	640	640	640
	HIS-RN	[N/mm <sup>2</sup> ]	350	350	350	350	350
	Screw A4-70	[N/mm <sup>2</sup> ]	450	450	450	450	450
Stressed cross-section $A_s$	HIS-(R)N	[mm <sup>2</sup> ]	51,5	108,0	169,1	256,1	237,6
	Screw	[mm <sup>2</sup> ]	36,6	58	84,3	157	245
Moment of resistance $W$	HIS-(R)N	[mm <sup>3</sup> ]	145	430	840	1595	1543
	Screw	[mm <sup>3</sup> ]	31,2	62,3	109	277	541

## Material quality

Part	Material
Internal threaded sleeve <sup>a)</sup> HIS-N	C-steel 1.0718, Steel galvanized $\geq 5\mu\text{m}$
Internal threaded sleeve <sup>b)</sup> HIS-RN	Stainless steel 1.4401 and 1.4571

a) related fastening screw: strength class 8.8, A5 > 8% Ductile  
steel galvanized  $\geq 5\mu\text{m}$

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

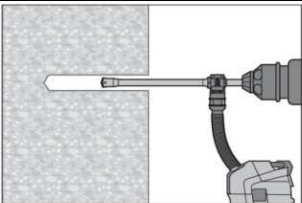
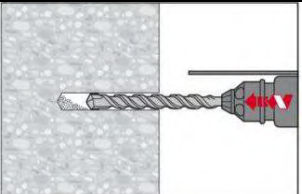
Anchor size	M8x90	M10x110	M12x125	M16x170	M20x205
Internal threaded sleeve HIS-N / HIS-RN					
Embedment depth $h_{\text{ef}}$ [mm]	90	110	125	170	205

## 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  $d_0 \leq 20\text{mm}$  and bore hole depth  $h_0 \leq 10d$

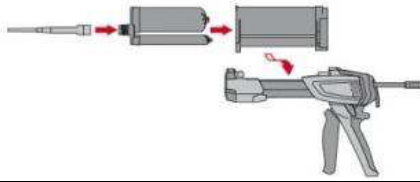
	<p>The Hilti manual pump may be used for blowing out bore holes up to diameters <math>d_0 \leq 20\text{ mm}</math> and embedment depths up to <math>h_{ef} \leq 10d</math>. Blow out at least 4 times from the back of the bore hole until return air stream is free of noticeable dust</p>
	<p>Brush 4 times 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.</p>
	<p>Blow out again with manual pump at least 4 times until return air stream is free of noticeable dust.</p>

**b) Compressed air cleaning (CAC)**  
for all bore hole diameters  $d_0$  and all bore hole depth  $h_0$

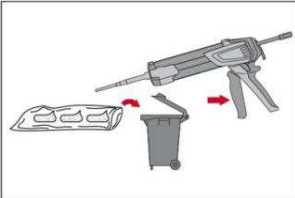
	<p>Blow 2 times from the back of the hole (if needed with nozzle extension) over the hole length with oil-free compressed air (min. 6 bar at 6 m<sup>3</sup>/h) until return air stream is free of noticeable dust.</p>
	<p>Brush 2 times with the specified brush size by inserting the steel brush Hilti HIT-RB 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.</p>
	<p>Blow again with compressed air 2 times until return air stream is free of noticeable dust.</p>



### 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.

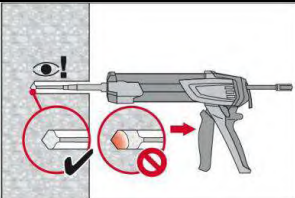


Discard initial adhesive. The foil pack opens automatically as dispensing is initiated. Depending on the size of the foil pack an initial amount of adhesive has to be discarded.

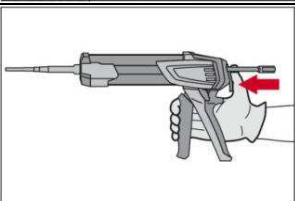
Discard quantities are

- 2 strokes for 330 ml foil pack,
- 3 strokes for 500 ml foil pack,
- 4 strokes for 500 ml foil pack  $\leq 5^{\circ}\text{C}$ .

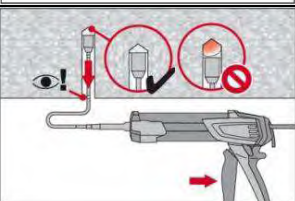
### Inject adhesive from the back of the borehole without forming air voids



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.



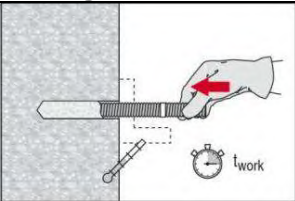
After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further adhesive discharge from the mixer.



Overhead installation.

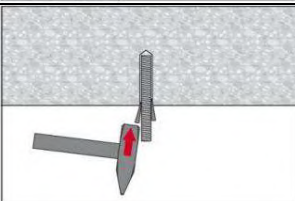
For overhead installation the injection is only possible with the aid of extensions and piston plugs. Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug. Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded out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

### Setting the element

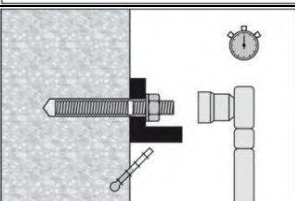


Before use, verify that the element is dry and free of oil and other contaminants.

Mark and set element to the required embedment depth until working time  $t_{\text{work}}$  has elapsed.



For overhead installation use piston plugs and fix embedded parts with e.g. wedges



Loading the anchor:

After required curing time  $t_{\text{cure}}$  the anchor can be loaded.

The applied installation torque shall not exceed  $T_{\text{max}}$ .

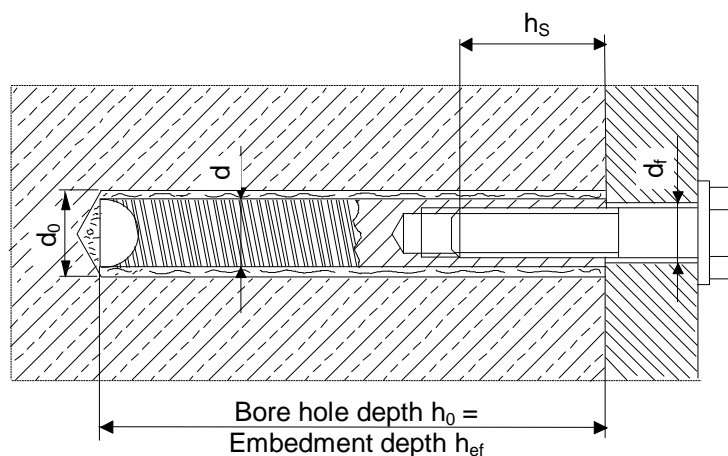
For detailed information on installation see instruction for use given with the package of the product.

## 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	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	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	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 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 <sup>a)</sup>	$T_{max}$	[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 <sup>b)</sup>	$c_{cr,sp}$	[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 <sup>c)</sup>	$c_{cr,N}$	[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 2012-08-08 for HIT-HY 200-A and ETA-12/0084 issued 2012-08-08 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)

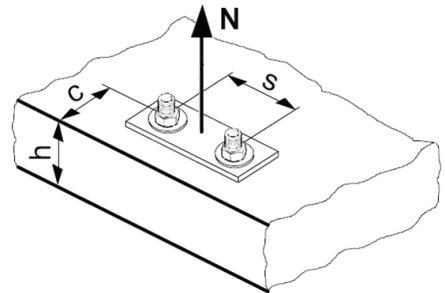
The values are valid for one anchor.

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



## 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

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

Anchor size		M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth	$h_{ef}$ [mm]	90	110	125	170	205
Non cracked concrete						
$N_{Rd,p}^0$	Temperature range I [kN]	30,6	49,4	69,8	117,6	154,7
$N_{Rd,p}^0$	Temperature range II [kN]	25,9	41,8	59,0	99,5	130,4
$N_{Rd,p}^0$	Temperature range III [kN]	22,4	36,1	51,0	85,9	112,6
Cracked concrete						
$N_{Rd,p}^0$	Temperature range I [kN]	16,5	26,6	37,6	63,3	83,0
$N_{Rd,p}^0$	Temperature range II [kN]	13,0	20,9	29,5	49,7	65,2
$N_{Rd,p}^0$	Temperature range III [kN]	11,8	19,0	26,8	45,2	59,3

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

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

Anchor size		M8	M10	M12	M16	M20
Non cracked concrete						
$N_{Rd,c}^0$	[kN]	28,7	38,8	47,1	74,6	98,8
Cracked concrete						
$N_{Rd,c}^0$	[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)

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

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 <sup>a)</sup>

$s/s_{cr,N}$	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1
$s/s_{cr,sp}$										
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N}) \leq 1$										
$f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp}) \leq 1$	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

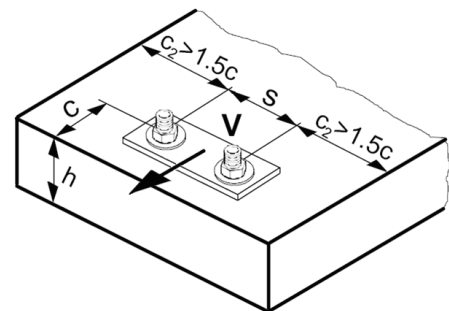
$h_{ef}$ [mm]	40	50	60	70	80	90	$\geq 100$
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,7 <sup>a)</sup>	0,75 <sup>a)</sup>	0,8 <sup>a)</sup>	0,85 <sup>a)</sup>	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



### 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 $V_{Rd,cp} = \text{lower value}^a)$ 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**  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		M8	M10	M12	M16	M20
Non-cracked concrete						
$V_{Rd,c}^0$ [kN]		12,4	19,6	28,2	40,2	46,2
Cracked concrete						
$V_{Rd,c}^0$ [kN]		8,8	13,9	20,0	28,5	32,7

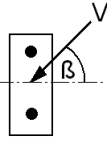
## Influencing factors

### 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 $\beta$	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 <sup>a)</sup> for concrete edge resistance:  $f_4$   
 $f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sup>a)</sup>

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


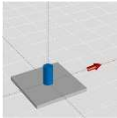
All data applies to:

- non-cracked concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$
- temperature range I (see service temperature range)
- minimum thickness of base material
- no effects of dense reinforcement

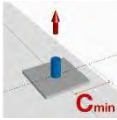



Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action  $\gamma = 1,4$ . The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

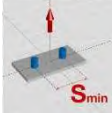
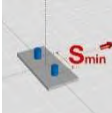
### Design resistance: non-cracked- concrete C 20/25

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	
	<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>						
	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	
	<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>						
	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	
	<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>						
	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	
	<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>						
	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	

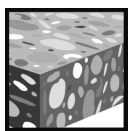
Design resistance: non-cracked- concrete C 20/25

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
<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>						
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
<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>						
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 with rebar

Injection mortar system		Benefits
	Hilti HIT-HY 200-A 500 ml foil pack (also available as 330 ml)	<ul style="list-style-type: none"> <li>- suitable for cracked and non-cracked concrete C 20/25 to C 50/60.</li> <li>- suitable for dry and water saturated concrete</li> <li>- high loading capacity, excellent handling</li> <li>- HY 200-R version with extended curing time for rebar applications</li> <li>- small edge distance and anchor spacing possible</li> <li>- large diameter applications</li> <li>- in service temperature range up to 120°C short term/72°C long term</li> <li>- manual cleaning for anchor size Ø8 to Ø16 and embedment depth <math>h_{ef} \leq 10d</math> for non-cracked concrete</li> <li>- embedment depth range: from 60 ... 160 mm for Ø8 to 128 ... 640 mm for Ø32</li> <li>- two mortar (A and R) versions available with different curing times and same performance</li> </ul>
	Hilti HIT-HY 200-R 500 ml foil pack (also available as 330 ml)	
	Static mixer	
	rebar BSt 500 S	



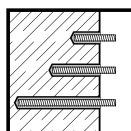
Concrete



Tensile zone



Small edge distance and spacing



Variable embedment depth



European Technical Approval



CE conformity



PROFIS Anchor design software

### Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval <sup>a)</sup>	DIBt, Berlin	ETA-11/0493 / 2012-08-08 (Hilti HIT-HY 200-A) ETA-12/0084 / 2012-08-08 (Hilti HIT-HY 200-R)

a) All data given in this section according ETA-11/0493 and ETA-12/0084, issue 2012-08-08.

### 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
- 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- Temperate range I  
(min. base material temperature  $-40^\circ\text{C}$ , max. long term/short term base material temperature:  $+24^\circ\text{C}/40^\circ\text{C}$ )
- Installation temperature range  $+5^\circ\text{C}$  to  $+40^\circ\text{C}$

### Embedment depth <sup>a)</sup> 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 2012-02-06								
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 – $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor rebar BSt 500S

	Data according ETA-11/0493 and ETA-12/0084, issue 2012-02-06								
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 – $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor rebar BSt 500 S

	Data according ETA-11/0493 and ETA-12/0084, issue 2012-02-06								
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 – $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor rebar BSt 500 S

	Data according ETA-11/0493 and ETA-12/0084, issue 2012-02-06								
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 <sup>a)</sup>: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor rebar BSt 500 S**

		Data according ETA-11/0493 and ETA-12/0084, issue 2012-02-06									
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  $\gamma = 1,4$ . 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 2012-02-06									
Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	
Nominal tensile strength $f_{uk}$	BSt 500 S [N/mm <sup>2</sup> ]	550	550	550	550	550	550	550	550	550	
Yield strength $f_{yk}$	BSt 500 S [N/mm <sup>2</sup> ]	500	500	500	500	500	500	500	500	500	
Stressed cross-section $A_s$	BSt 500 S [mm <sup>2</sup> ]	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 [mm <sup>3</sup> ]	50,3	98,2	169,6	269,4	402,1	785,4	1534	2155	3217	

### Material quality

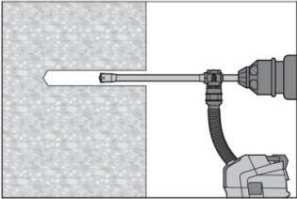
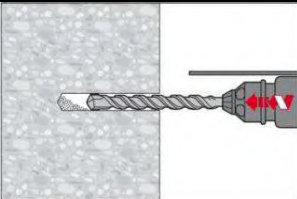
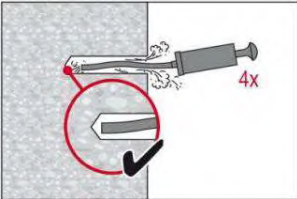
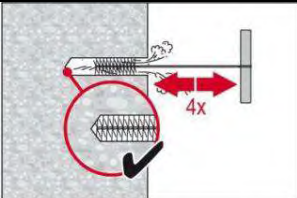
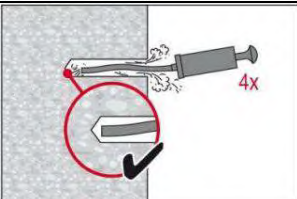
Part	Material
rebar BSt 500 S	Geometry and mechanical properties according to DIN 488-2:1986 or E DIN 488-2:2006

### 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 $d_0 \leq 20\text{mm}$ and bore hole depth $h_0 \leq 10d$	
	The Hilti manual pump may be used for blowing out bore holes up to diameters $d_0 \leq 20\text{ mm}$ 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  $h_0$

	<p>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<sup>3</sup>/h) until return air stream is free of noticeable dust. Bore hole diameter <math>\geq 32</math> mm the compressor must supply a minimum air flow of 140 m<sup>3</sup>/hour.</p>
	<p>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.</p>
	<p>Blow again with compressed air 2 times until return air stream is free of noticeable dust.</p>

**Injection preparation**

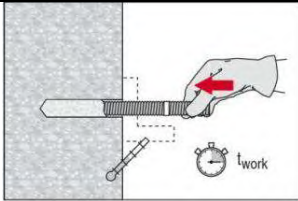
	<p>Tightly attach new Hilti mixing nozzle HIT-RE-M to foil pack manifold (snug fit). Do not modify the mixing nozzle. Observe the instruction for use of the dispenser. Check foil pack holder for proper function. Do not use damaged foil packs / holders. Swing foil pack holder with foil pack into HIT-dispenser.</p>
	<p>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 <math>\leq 5^\circ\text{C}</math>.</p>

**Inject adhesive** from the back of the borehole without forming air voids

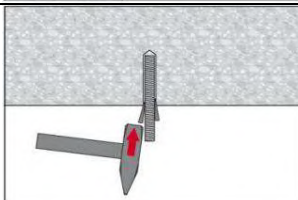
	<p>Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull. Fill holes approximately 2/3 full, or as required to ensure that the annular gap between the anchor and the concrete is completely filled with adhesive along the embedment length.</p>
	<p>After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further adhesive discharge from the mixer.</p>
	<p>Overhead installation and installation with embedment depth <math>h_{ef} &gt; 250\text{mm}</math>. 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.</p>



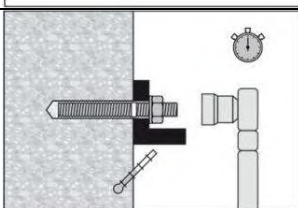
## Setting the element



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.



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.

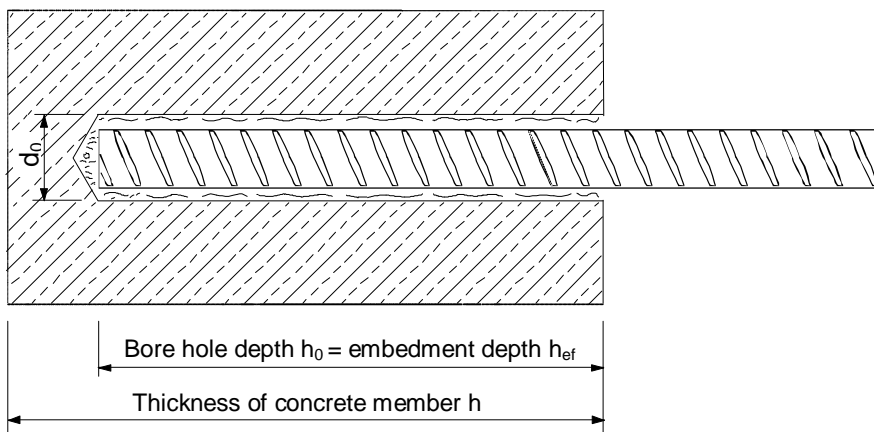
For detailed information on installation see instruction for use given with the package of the product.

### 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	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	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	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 details



### Setting details

			Data according ETA-11/0493 and ETA-12/0084, issue 2012-02-06								
Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Nominal diameter of drill bit	$d_0$	[mm]	12 (10) <sup>a)</sup>	14 (12) <sup>a)</sup>	16 (14) <sup>a)</sup>	18	20	25	32	35	40
Effective anchorage and drill hole depth range <sup>b)</sup>	$h_{ef,min}$	[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 <sup>c)</sup>	$c_{cr,sp}$	[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 <sup>d)</sup>	$c_{cr,N}$		$1,5 h_{ef}$								

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

- both given values for drill bit diameter can be used
- $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$  ( $h_{ef}$ : embedment depth)
- $h$ : base material thickness ( $h \geq h_{min}$ )
- 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 2012-08-08 for HIT-HY 200-A and ETA-12/0084 issued 2012-08-08 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)

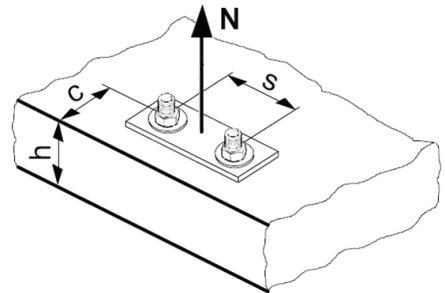
The values are valid for one anchor.

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



## Basic design tensile resistance

### Design steel resistance $N_{Rd,s}$

			Data according ETA-11/0493 and ETA-12/0084, issue 2012-02-06								
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

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

Data according ETA-11/0493 and ETA-12/0084, issue 2012-02-06										
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										
$N_{Rd,p}^0$ Temperature range I [kN]	16,1	22,6	33,2	44,0	58,3	85,5	131,9	190,0	241,3	
$N_{Rd,p}^0$ Temperature range II [kN]	13,4	18,8	27,6	36,7	48,6	71,2	110,0	158,3	201,1	
$N_{Rd,p}^0$ Temperature range III [kN]	11,4	16,0	23,5	31,2	41,3	60,5	93,5	134,6	170,9	
Cracked concrete										
$N_{Rd,p}^0$ Temperature range I [kN]	-	9,4	19,4	25,7	34,0	49,8	77,0	110,8	140,7	
$N_{Rd,p}^0$ Temperature range II [kN]	-	7,5	15,2	20,2	26,7	39,2	60,5	87,1	110,6	
$N_{Rd,p}^0$ Temperature range III [kN]	-	6,6	13,8	18,3	24,3	35,6	55,0	79,2	100,5	

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

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

Data according ETA-11/0493 and ETA-12/0084, issue 2012-02-06										
Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	
$N_{Rd,c}^0$ Non cracked concrete [kN]	24,1	28,7	38,8	47,1	58,8	74,6	102,5	149,4	174,9	
$N_{Rd,c}^0$ 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 <sup>a)</sup>

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

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 smaller than the critical edge distance.

### Influence of anchor spacing <sup>a)</sup>

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

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

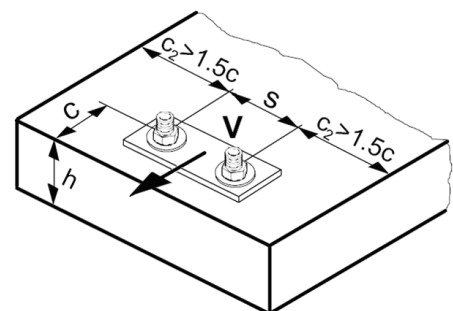
$h_{ef}$ [mm]	60	70	80	90	≥ 100
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,8 <sup>a)</sup>	0,85 <sup>a)</sup>	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

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:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



## Basic design shear resistance

### Design steel resistance $V_{Rd,s}$

Data according ETA-11/0493 and ETA-12/0084, issue 2012-02-06											
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  $V_{Rd,cp} = \text{lower value}^a)$  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  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_\beta \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

		Data according ETA-11/0493 and ETA-12/0084, issue 2012-02-06								
Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Non-cracked concrete										
$V_{Rd,c}^0$	[kN]	5,9	8,6	11,6	15,0	18,7	27,0	39,2	47,3	59,0
Cracked concrete										
$V_{Rd,c}^0$	[kN]	-	6,1	8,2	10,6	13,2	19,2	27,7	33,5	41,8

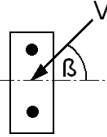
### Influencing factors

#### 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 $\beta$	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 <sup>a)</sup> for concrete edge resistance:  $f_4$   
 $f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sub>ef</sub> /d	4	4,5	5	6	7	8	9	10	11
f <sub>hef</sub> = 0,05 · (h <sub>ef</sub> / d) <sup>1,68</sup>	0,51	0,63	0,75	1,01	1,31	1,64	2,00	2,39	2,81
h <sub>ef</sub> /d	12	13	14	15	16	17	18	19	20
f <sub>hef</sub> = 0,05 · (h <sub>ef</sub> / d) <sup>1,68</sup>	3,25	3,72	4,21	4,73	5,27	5,84	6,42	7,04	7,67

### Influence of edge distance <sup>a)</sup>

c/d	4	6	8	10	15	20	30	40
f <sub>c</sub> = (d / c) <sup>0,19</sup>	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

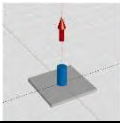
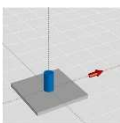
For combined tension and shear loading see section "Anchor Design".

### Precalculated values

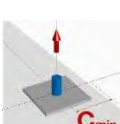

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action  $\gamma = 1,4$ . The partial safety factors for action depend on the type of loading and shall be taken from national regulations.



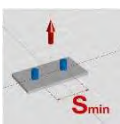

Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I

		Data according ETA-11/0493 and ETA-12/0084, issue 2012-02-06									
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	
	<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>										
	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		
	<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>										
	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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I

		Data according ETA-11/0493 and ETA-12/0084, issue 2012-02-06									
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	
	<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>										
	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		
	<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>										
	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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I  
(load values are valid for single anchor)

		Data according ETA-11/0493 and ETA-12/0084, issue 2012-02-06									
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	
	<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>										
	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		
	<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>										
	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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I

		Data according ETA-11/0493 and ETA-12/0084, issue 2012-02-06									
Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	
Embedment depth	$h_{ef,typ} = [\text{mm}]$	80	90	110	125	145	170	210	270	300	
Base material thickness	$h_{min} = [\text{mm}]$	110	120	142	161	185	220	274	340	380	
	<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>										
	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
	<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>										
	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	

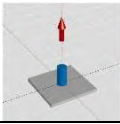
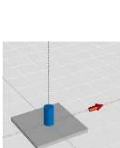
Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I

		Data according ETA-11/0493 and ETA-12/0084, issue 2012-02-06									
Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	
Embedment depth	$h_{ef,typ} = [\text{mm}]$	80	90	110	125	145	170	210	270	300	
Base material thickness	$h_{min} = [\text{mm}]$	110	120	142	161	185	220	274	340	380	
Edge distance	$c = c_{min} = [\text{mm}]$	40	50	60	80	100	120	135	150	150	
	<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>										
	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
	<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>										
	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	

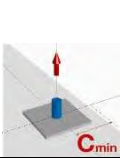
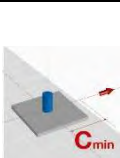
Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I  
(load values are valid for single anchor)

		Data according ETA-11/0493 and ETA-12/0084, issue 2012-02-06									
Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	
Embedment depth	$h_{ef,typ} = [\text{mm}]$	80	90	110	125	145	170	210	270	300	
Base material thickness	$h_{min} = [\text{mm}]$	110	120	142	161	185	220	274	340	380	
Spacing	$s = s_{min} = [\text{mm}]$	40	50	60	80	100	120	135	150	150	
	<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>										
	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
	<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>										
	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	

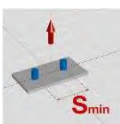
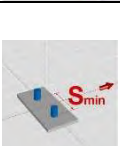
**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I**

		Data according ETA-11/0493 and ETA-12/0084, issue 2012-02-06									
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	
	<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>										
	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	
	<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>										
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I**

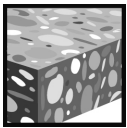
		Data according ETA-11/0493 and ETA-12/0084, issue 2012-02-06									
Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32	
Embedment depth $h_{ef,2} =$ [mm]		96	120	144	168	192	240	300	336	384	
Base material thickness $h_{min} =$ [mm]		126	150	176	204	232	290	364	406	464	
Edge distance $c = c_{min} =$ [mm]		40	50	60	80	100	120	135	150	150	
	<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>										
	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	
	<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>										
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , Temperature range I  
(load values are valid for single anchor)**

		Data according ETA-11/0493 and ETA-12/0084, issue 2012-02-06									
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	
	<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>										
	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	
	<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>										
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		

## Hilti HIT-HY 150 MAX with HIT-TZ

Injection mortar system		Benefits
   	<p>Hilti HIT-HY 150 MAX 330 ml foil pack</p> <p>(also available as 500 ml and 1400 ml foil pack)</p> <p>Statik mixer</p> <p>HIT-TZ HIT-RTZ rod</p>	<ul style="list-style-type: none"> <li>- suitable for cracked and non-cracked concrete C 20/25 to C 50/60</li> <li>- hammer drilled and diamond cored bore holes</li> <li>- high loading capacity</li> <li>- suitable for dry and water saturated concrete</li> <li>- under water application</li> <li>- No cleaning required</li> </ul>



Concrete



Tensile zone



Corrosion resistance



European Technical Approval



CE conformity



PROFIS Anchor design software

### Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval <sup>a)</sup>	DIBt, Berlin	ETA-04/0084 / 2009-12-09

a) All data given in this section according ETA-04/0084, issue 2009-12-09.

### 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
- 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- Temperate range I  
(min. base material temperature  $-40^\circ\text{C}$ , max. long term/short term base material temperature:  $+50^\circ\text{C}/80^\circ\text{C}$ )
- Installation temperature range  $+5^\circ\text{C}$  to  $+40^\circ\text{C}$

For details see Simplified design method

**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]	55	65	75	90	120
Base material thickness [mm]	110	130	150	180	240

**Mean ultimate resistance <sup>a)</sup>: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HIT-TZ**

Anchor size	M8	M10	M12	M16	M20
Non-cracked concrete					
Tensile $N_{Ru,m}$ HIT-TZ [kN]	21,3	26,7	33,3	57,5	88,5
Shear $V_{Ru,m}$ HIT-TZ [kN]	11,6	17,9	26,3	49,4	77,7
Cracked concrete					
Tensile $N_{Ru,m}$ HIT-TZ [kN]	12,0	21,3	26,7	40,0	53,3
Shear $V_{Ru,m}$ HIT-TZ [kN]	12,0	17,9	26,3	49,4	77,7

**Characteristic resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HIT-TZ**

Anchor size	M8	M10	M12	M16	M20
Non-cracked concrete					
Tensile $N_{Rk}$ HIT-TZ [kN]	16,0	20,0	25,0	43,1	66,4
Shear $V_{Rk}$ HIT-TZ [kN]	11,0	17,0	25,0	47,0	74,0
Cracked concrete					
Tensile $N_{Rk}$ HIT-TZ [kN]	9,0	16,0	20,0	30,0	40,0
Shear $V_{Rk}$ HIT-TZ [kN]	9,0	17,0	25,0	47,0	74,0

**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HIT-TZ**

Anchor size	M8	M10	M12	M16	M20
Non-cracked concrete					
Tensile $N_{Rd}$ HIT-TZ [kN]	10,7	13,3	16,7	28,7	44,3
Shear $V_{Rd}$ HIT-TZ [kN]	8,8	13,6	20,0	37,6	59,2
Cracked concrete					
Tensile $N_{Rd}$ HIT-TZ [kN]	6,0	10,7	13,3	20,0	26,7
Shear $V_{Rd}$ HIT-TZ [kN]	6,0	13,6	20,0	37,6	53,3

**Recommended loads <sup>a)</sup>: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HIT-TZ**

Anchor size	M8	M10	M12	M16	M20
Non-cracked concrete					
Tensile $N_{rec}$ HIT-TZ [kN]	7,6	9,5	11,9	20,5	31,6
Shear $V_{rec}$ HIT-TZ [kN]	6,3	9,7	14,3	26,9	42,3
Cracked concrete					
Tensile $N_{rec}$ HIT-TZ [kN]	4,3	7,6	9,5	14,3	19,0
Shear $V_{rec}$ HIT-TZ [kN]	4,3	9,7	14,3	26,9	38,1

a) With 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.

## Service temperature range

Hilti HIT-HY 150 MAX injection mortar with anchor rod HIT-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 HIT-(R)TZ

Anchor size			M8	M10	M12	M16	M20
Nominal tensile strength $f_{uk}$	HIT-TZ	[N/mm <sup>2</sup> ]	600	600	600	600	600
	HIT-RTZ	[N/mm <sup>2</sup> ]	600	600	600	600	600
Yield strength $f_{yk}$	HIT-TZ	[N/mm <sup>2</sup> ]	480	480	480	480	480
	HIT-RTZ	[N/mm <sup>2</sup> ]	480	480	480	480	480
Stressed cross-section $A_s$	HIT-TZ	[mm <sup>2</sup> ]	36,6	58,0	84,3	157	245
Moment of resistance $W$	HIT-TZ	[mm <sup>3</sup> ]	31,9	62,5	109,7	278	542

### Material quality

Part	Material
HIT-TZ	C-steel cold formed steel galvanized $\geq 5\mu\text{m}$
HIT-RTZ	stainless steel cold formed 1.4404 and 1.4401

## Anchor dimensions

Anchor size	M8	M10	M12	M16	M20
HIT-(R)TZ	M8x55	M10x65	M12x75	M16x90	M20x120
Anchor embedment depth [mm]	55	65	75	90	120

## Setting

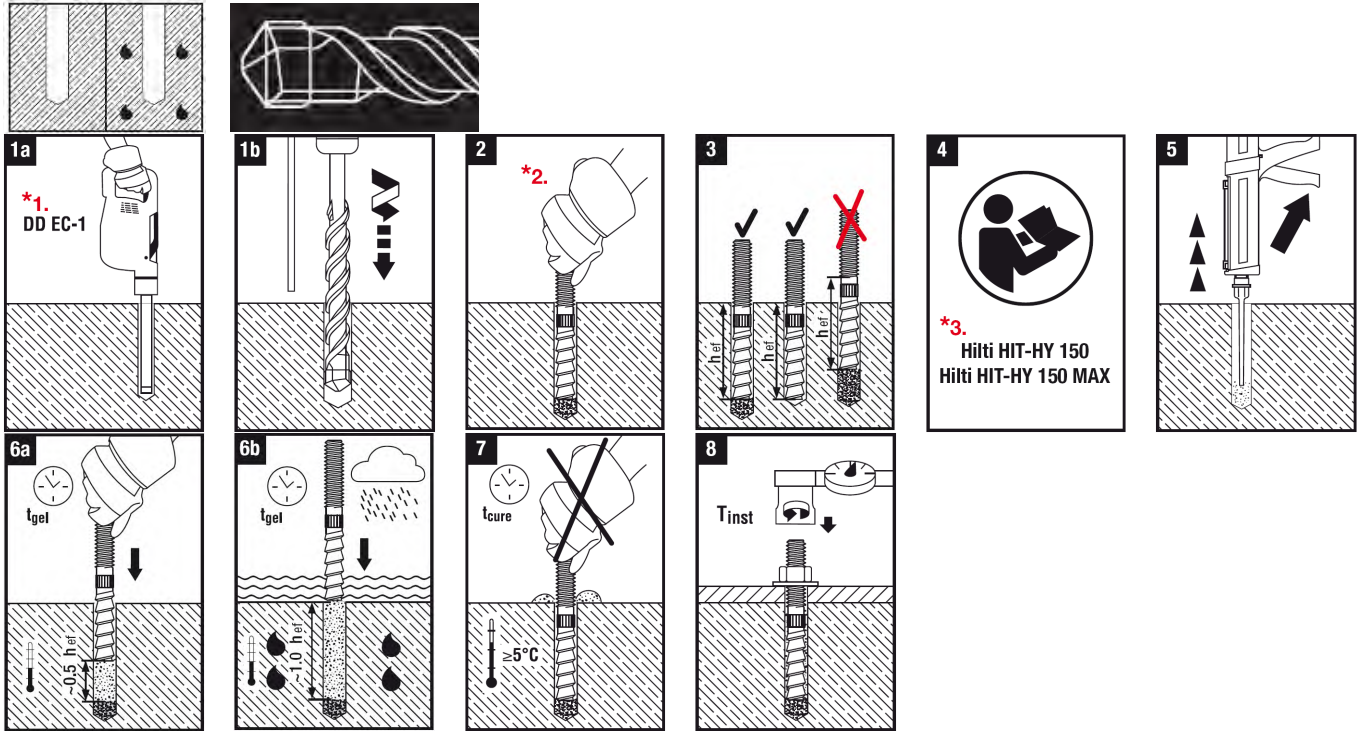
### installation equipment

Anchor size	M8	M10	M12	M16	M20
Rotary hammer	TE 2 – TE 16				TE 40 - TE 70



### Setting instruction

Dry, water-saturated concrete, under water, hammer drilling and diamond coring



1. Diamond coring is permissible only when the Hilti DD EC-1 diamond core drilling machine and the corresponding DD-C core bit are used.
2. Check the setting depth and compress the drilling dust. It is not necessary to clean the hole.
3. For use with Hilti HIT-HY 150 / Hilti HIT-HY 150 MAX. Read the instructions before use.

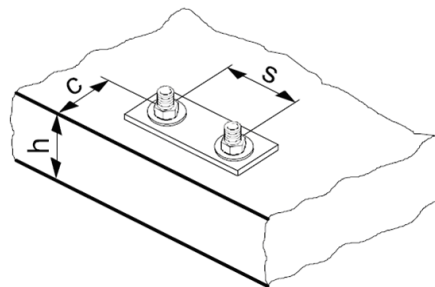
For detailed information on installation see instruction for use given with the package of the product.

### Curing time for general conditions

Temperature of the base material	Curing time before anchor can be fully loaded $t_{cure}$
30 °C to 40 °C	30 min
20 °C to <30 °C	30 min
5 °C to <20 °C	60 min

### Setting details

Anchor size			M8	M10	M12	M16	M20
Nominal diameter of drill bit	$d_0$	[mm]	10	12	14	18	22
Diameter of element	$d$	[mm]	8	10	12	16	20
Effective anchorage depth	$h_{ef}$	[mm]	55	65	75	90	120
Drill hole depth	$h_0$	[mm]	60	70	80	95	125
Minimum base material thickness	$h_{min}^{a)}$	[mm]	110	130	150	180	240
Diameter of clearance hole in the fixture	$d_f$	[mm]	9	12	14	18	22
Non cracked concrete							
Minimum spacing	$s_{min}$	[mm]	40	50	55	70	80
for	$c$	[mm]	50	70	75	80	90
Minimum edge distance	$c_{min}$	[mm]	40	50	55	70	80
for	$s$	[mm]	70	80	85	85	90
Cracked concrete							
Minimum spacing	$s_{min}$	[mm]	40	60	70	80	100
for	$c$	[mm]	65	85	100	100	120
Minimum edge distance	$c_{min}$	[mm]	50	60	70	80	100
for	$s$	[mm]	80	120	130	140	150
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	$2 c_{cr,sp}$				
Critical edge distance for splitting failure	$c_{cr,sp}$	[mm]	$2 h_{ef}$				
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	$T_{inst}$	[Nm]	12	23	40	70	130



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. Design resistance according data given in ETA-04/0084, issue 2009-12-09.

- 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)

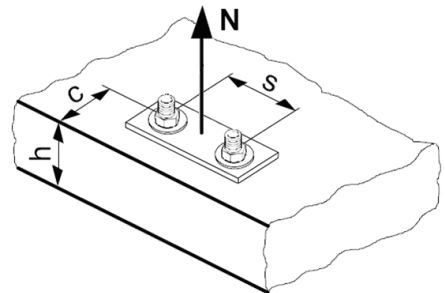
The values are valid for one anchor.

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



### Basic design tensile resistance

#### Design steel resistance $N_{Rd,s}$

Anchor size	M8	M10	M12	M16	M20
$N_{Rd,s}$ HIT-TZ [kN]	14,7	23,3	34,0	62,7	98,0

#### Design combined pull-out and concrete cone resistance $N_{Rd,p} = N_{Rd,p}^0 \cdot f_{B,p} \cdot f_{h,p}$

Anchor size	M8	M10	M12	M16	M20
Embedment depth $h_{ef}$ [mm]	55	65	75	90	120
Non-cracked concrete					
$N_{Rd,p}^0$ Temperature range I [kN]	10,7	13,3	16,7	28,7	44,3
Cracked concrete					
$N_{Rd,p}^0$ Temperature range I [kN]	6,0	10,7	13,3	20,0	26,7

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

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

Anchor size	M8	M10	M12	M16	M20
$N_{Rd,c}^0$ Non cracked concrete [kN]	13,7	17,6	21,9	28,7	44,3
$N_{Rd,c}^0$ Cracked concrete [kN]	9,8	12,6	15,6	20,5	31,5

## 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
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0.1}$ <sup>a)</sup>	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

$f_{h,p} = h_{ef}/h_{ef,typ}$
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### 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
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ <sup>a)</sup>	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 <sup>a)</sup>

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

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 smaller than the critical edge distance.

### Influence of anchor spacing <sup>a)</sup>

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

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

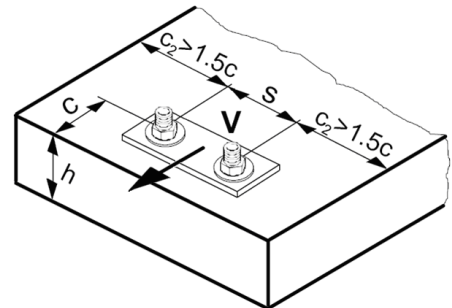
$h_{ef}$ [mm]	80	90	≥ 100
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_h \cdot f_4$



### Basic design shear resistance

#### Design steel resistance $V_{Rd,s}$

Anchor size	M8	M10	M12	M16	M20
$V_{Rd,s}$ HIT-(R)TZ [kN]	8,8	13,6	20,0	37,6	59,2

#### Design concrete pryout resistance $V_{Rd,cp} = \text{lower value}^a)$ of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

$$k = 1 \text{ for } h_{ef} < 60 \text{ mm}$$

$$k = 2 \text{ for } h_{ef} \geq 60 \text{ mm}$$

- a)  $N_{Rd,p}$ : Design combined pull-out and concrete cone resistance  
 $N_{Rd,c}$ : Design concrete cone resistance

#### Design concrete edge resistance $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_h \cdot f_4$

Anchor size	Non-cracked concrete					Cracked concrete				
	M8	M10	M12	M16	M20	M8	M10	M12	M16	M20
$V_{Rd,c}^0$ [kN]	3,1	4,5	6,1	8,5	13,4	1,6	2,4	3,1	5,0	6,9

- 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 $\beta$	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
$f_h = \{h/(1,5 \cdot c)\}^{2/3} \leq 1$	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 <sup>a)</sup> for concrete edge resistance:  $f_4$   
 $f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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  $c_{min}$ .

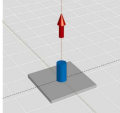
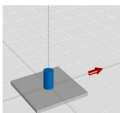
## Combined tension and shear loading

For combined tension and shear loading see section "Anchor Design".

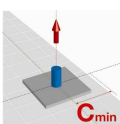
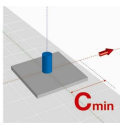
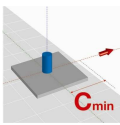
### Precalculated values

Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action  $\gamma = 1,4$ . 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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$**

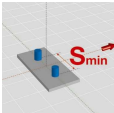
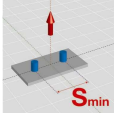
Anchor size		M8	M10	M12	M16	M20
Embedment depth $h_{ef} =$ [mm]		55	65	75	90	120
Base material thickness $h_{min} =$ [mm]		110	130	150	180	240
	<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>					
	Non-cracked concrete					
	HIT-(R)TZ [kN]	10,7	13,3	16,7	28,7	44,3
	Cracked concrete					
HIT-(R)TZ [kN]	6,0	10,7	13,3	20,0	26,7	
	<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>					
	Non-cracked concrete					
	HIT-(R)TZ [kN]	8,8	13,6	20,0	37,6	59,2
	Cracked concrete					
HIT-(R)TZ [kN]	6,0	13,6	20,0	37,6	53,3	

**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$**

Anchor size		M8	M10	M12	M16	M20
Embedment depth $h_{ef} =$ [mm]		55	65	75	90	120
Base material thickness $h_{min} =$ [mm]		110	130	150	180	240
	<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>					
	Non-cracked concrete					
	$c_{min}$ [mm]	50	60	70	80	100
	HIT-(R)TZ [kN]	6,5	8,2	10,3	17,3	25,9
	<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>					
	Non-cracked concrete					
	$c_{min}$ [mm]	50	60	70	80	100
	HIT-(R)TZ [kN]	3,1	4,5	6,1	8,5	13,4
	Cracked concrete					
	$c_{min}$ [mm]	40	50	55	70	80
HIT-(R)TZ [kN]	1,6	2,4	3,1	5,0	6,9	






Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$   
(load values are valid for single anchor)

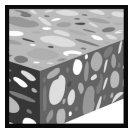
Anchor size		M8	M10	M12	M16	M20
Embedment depth $h_{ef} =$ [mm]		55	65	75	90	120
Base material thickness $h_{min} =$ [mm]		110	130	150	180	240
<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>						
Non-cracked concrete						
$s_{min}$	[mm]	40	60	70	80	100
HIT-(R)TZ	[kN]	6,3	8,2	10,3	17,6	26,7
Cracked concrete						
$s_{min}$	[mm]	40	50	55	70	80
HIT-(R)TZ	[kN]	3,5	6,4	7,9	11,9	15,6
<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>) , without lever arm</b>						
Non-cracked concrete						
$s_{min}$	[mm]	40	60	70	80	100
HIT-(R)TZ	[kN]	6,6	13,6	20,0	37,3	56,5
Cracked concrete						
$s_{min}$	[mm]	40	50	55	70	80
HIT-(R)TZ	[kN]	3,7	13,4	16,6	25,2	32,6





## Hilti HIT-HY 150 MAX with HIT-V / HAS

Injection mortar system		Benefits
	<p>Hilti HIT-HY 150 MAX 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)</p>	<ul style="list-style-type: none"> <li>- suitable for non-cracked concrete and cracked concrete C 20/25 to C 50/60</li> <li>- suitable for dry and water saturated concrete</li> <li>- high loading capacity</li> <li>- rapid curing</li> </ul>
	<p>Static mixer</p>	<ul style="list-style-type: none"> <li>- small edge distance and anchor spacing possible</li> <li>- large diameter applications</li> </ul>
	<p>HAS rods HAS-R rods HAS-HCR rods</p>	<ul style="list-style-type: none"> <li>- high corrosion resistant</li> <li>- in service temperature range up to 120°C short term/ 72°C long term</li> </ul>
	<p>HAS-E rods HAS-E-R rods</p>	<ul style="list-style-type: none"> <li>- manual cleaning for anchor size M8 to M16 and embedment depth <math>h_{ef} \leq 10d</math> for non-cracked concrete only</li> </ul>
	<p>HIT-V rods HIT-V-R rods HIT-V-HCR rods</p>	<ul style="list-style-type: none"> <li>- embedment depth range: from 60 ... 160 mm for M8 to 120 ... 600 mm for M30</li> </ul>



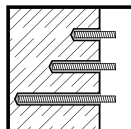
Concrete



Tensile zone



Small edge distance and spacing



Variable embedment depth



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 <sup>a)</sup>	DIBt, Berlin	ETA-08/0352 / 2010-04-01
Fire test report	MFPA, Leipzig	GS 3.2/09-121 Ä / 2011-08-19

a) All data given in this section according ETA-08/0352 issue 2010-04-01.



## 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- Temperate range I  
(min. base material temperature  $-40^\circ\text{C}$ , max. long term/short term base material temperature:  $+24^\circ\text{C}/40^\circ\text{C}$ )
- Installation temperature range  $-10^\circ\text{C}$  to  $+40^\circ\text{C}$

### Embedment depth <sup>a)</sup> 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	288,4
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]	-	20,7	30,4	50,3	85,5	126,7	-	-
Shear $V_{Ru,m}$ HIT-V 5.8 [kN]	-	15,8	22,1	41,0	64,1	92,4	-	-

### 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 $N_{Rk}$ HIT-V 5.8 [kN]	-	15,6	22,8	37,7	64,1	95,0	-	-
Shear $V_{Rk}$ HIT-V 5.8 [kN]	-	15,0	21,0	39,0	61,0	88,0	-	-

### 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	47,1	74,6	102,5	125,2	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 $N_{Rd}$ HIT-V 5.8 [kN]	-	10,4	15,2	25,1	42,7	63,3	-	-
Shear $V_{Rd}$ HIT-V 5.8 [kN]	-	12,0	16,8	31,2	48,8	70,4	-	-

### Recommended loads <sup>a)</sup>: concrete C 20/25 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete										
Tensile N <sub>rec</sub>	HIT-V 5.8	[kN]	8,6	13,8	20,0	33,6	53,3	73,2	89,4	85,8
Shear V <sub>rec</sub>	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 <sub>rec</sub>	HIT-V 5.8	[kN]	-	7,4	10,9	18,0	30,5	45,2	-	-
Shear V <sub>rec</sub>	HIT-V 5.8	[kN]	-	8,6	12,0	22,3	34,9	50,3	-	-

a) With 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.

### Service temperature range

Hilti HIT-HY 150 MAX 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 <sub>uk</sub>	HIT-V/HAS 5.8	[N/mm <sup>2</sup> ]	500	500	500	500	500	500	500	500
	HIT-V/HAS 8.8	[N/mm <sup>2</sup> ]	800	800	800	800	800	800	800	800
	HIT-V/HAS -R	[N/mm <sup>2</sup> ]	700	700	700	700	700	700	500	500
	HIT-V/HAS -HCR	[N/mm <sup>2</sup> ]	800	800	800	800	800	700	700	700
Yield strength f <sub>yk</sub>	HIT-V/HAS 5.8	[N/mm <sup>2</sup> ]	400	400	400	400	400	400	400	400
	HIT-V/HAS 8.8	[N/mm <sup>2</sup> ]	640	640	640	640	640	640	640	640
	HIT-V/HAS -R	[N/mm <sup>2</sup> ]	450	450	450	450	450	450	210	210
	HIT-V/HAS -HCR	[N/mm <sup>2</sup> ]	600	600	600	600	600	400	400	400
Stressed cross-section A <sub>s</sub>	HAS	[mm <sup>2</sup> ]	32,8	52,3	76,2	144	225	324	427	519
	HIT-V	[mm <sup>2</sup> ]	36,6	58,0	84,3	157	245	353	459	561
Moment of resistance W	HAS	[mm <sup>3</sup> ]	27,0	54,1	93,8	244	474	809	1274	1706
	HIT-V	[mm <sup>3</sup> ]	31,2	62,3	109	277	541	935	1387	1874

## Material quality

Part	Material
Threaded rod HIT-V(F), HAS 5.8: M8 – M24	Strength class 5.8, A <sub>5</sub> > 8% ductile steel galvanized ≥ 5 µm, (F) hot dipped galvanized ≥ 45 µm,
Threaded rod HIT-V(F), HAS 8.8 M27 – M30	Strength class 8.8, A <sub>5</sub> > 8% ductile steel galvanized ≥ 5 µm, (F) hot dipped galvanized ≥ 45 µm,
Threaded rod HIT-V-R, HAS-R	Stainless steel grade A4, A <sub>5</sub> > 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 <sub>m</sub> = 800 N/mm <sup>2</sup> , R <sub>p 0.2</sub> = 640 N/mm <sup>2</sup> , A <sub>5</sub> > 8% ductile M24 to M30: R <sub>m</sub> = 700 N/mm <sup>2</sup> , R <sub>p 0.2</sub> = 400 N/mm <sup>2</sup> , A <sub>5</sub> > 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-R, HAS-HCR HAS-E, HAS-E-R	M8x80	M10x90	M12x110	M16x125	M20x170	M24x210	M27x240	M30x270
Embedment depth h <sub>ef</sub> [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							

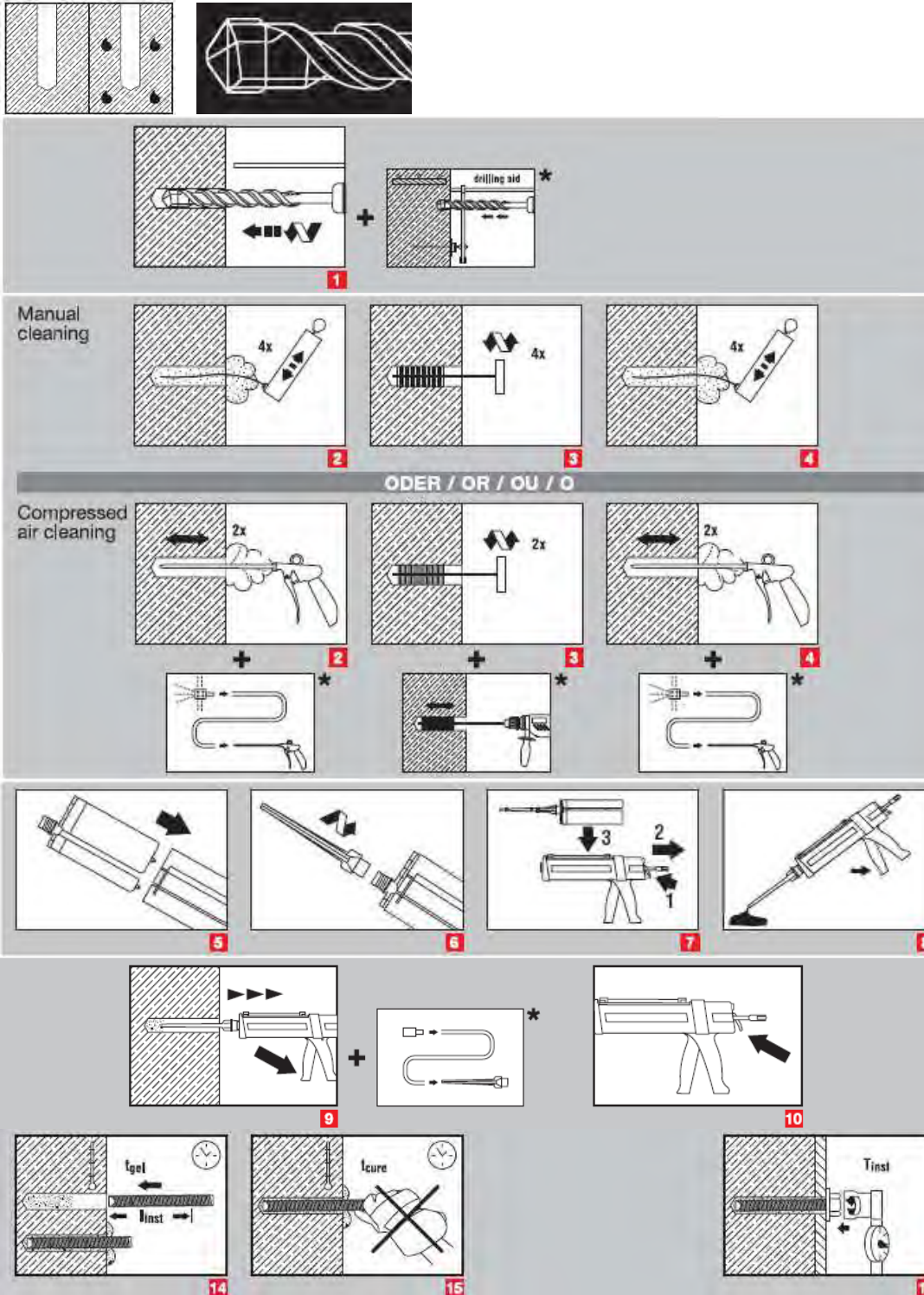
## Setting

### installation equipment

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Rotary hammer	TE 2 – TE 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)

b)

**a) Note:** Manual cleaning for non-cracked concrete, element sizes  $d \leq 16\text{mm}$  and embedment depth  $h_{ef} \leq 10 d$  only!

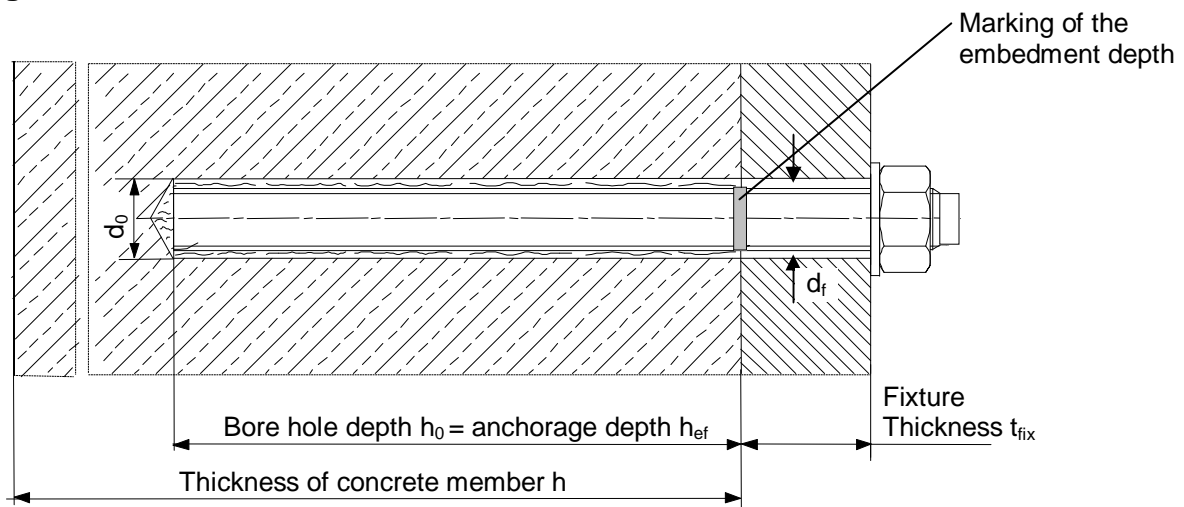
**b) Note:** Extension and piston plug needed for overhead installation and/or embedment depth  $> 250\text{mm}$ !

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

## Working time, Curing time

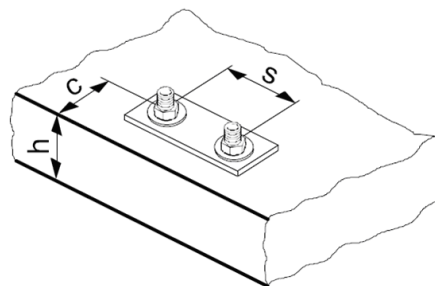
Temperature of the base material $T_{BM}$	Working time $t_{gel}$	Curing time $t_{cure}$
$-10\text{ °C} \leq T_{BM} < -5\text{ °C}$	180 min	12 h
$-5\text{ °C} \leq T_{BM} < 0\text{ °C}$	40 min	4 h
$0\text{ °C} \leq T_{BM} < 5\text{ °C}$	20 min	2 h
$5\text{ °C} \leq T_{BM} < 20\text{ °C}$	8 min	1 h
$20\text{ °C} \leq T_{BM} < 30\text{ °C}$	5 min	30 min
$30\text{ °C} \leq T_{BM} \leq 40\text{ °C}$	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	24	28	30	35
Effective embedment and drill hole depth range <sup>a)</sup> <b>for HIT-V</b>	$h_{ef,min}$	[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 <b>for HAS</b>	$h_{ef}$	[mm]	80	90	110	125	170	210	240	270
Minimum base material thickness	$h_{min}$	[mm]	$h_{ef} + 30 \text{ mm}$ $\geq 100 \text{ mm}$			$h_{ef} + 2 d_0$				
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 <sup>c)</sup>	$c_{cr,sp}$	[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 <sup>d)</sup>	$c_{cr,N}$	[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-08/0352, issue 2010-04-01.

- 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)

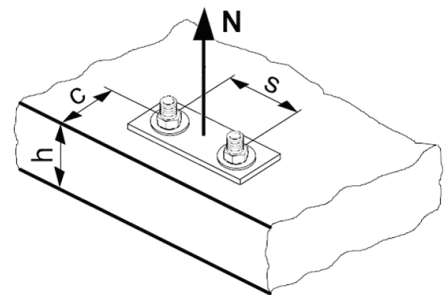
The values are valid for one anchor.

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



### 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

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

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								
$N_{Rd,p}^0$ Temperature range I [kN]	15,6	22,0	32,3	54,5	85,5	116,1	135,7	120,2
$N_{Rd,p}^0$ Temperature range II [kN]	13,4	18,8	27,6	50,3	78,3	105,6	122,1	99,0
$N_{Rd,p}^0$ Temperature range III [kN]	8,9	12,6	18,4	29,3	46,3	63,3	74,6	63,6
Cracked concrete								
$N_{Rd,p}^0$ Temperature range I [kN]	-	10,4	15,2	25,1	42,7	63,3	-	-
$N_{Rd,p}^0$ Temperature range II [kN]	-	8,5	13,8	23,0	42,7	63,3	-	-
$N_{Rd,p}^0$ Temperature range III [kN]	-	5,7	8,3	14,7	24,9	42,2	-	-

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

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

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
$N_{Rd,c}^0$ Non-cracked concrete [kN]	20,1	24,0	32,4	47,1	74,6	102,5	125,2	124,5
$N_{Rd,c}^0$ Cracked concrete [kN]	-	20,5	27,7	33,5	53,2	73,0	-	-

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
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,10}$ 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)

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

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 <sup>a)</sup>

$s/s_{cr,N}$	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
$f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp}) \leq 1$										

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

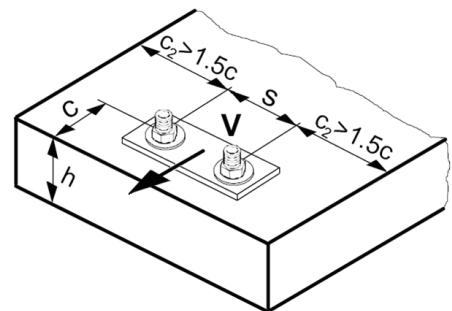
$h_{ef}$ [mm]	40	50	60	70	80	90	$\geq 100$
$f_{re,N} = 0,5 + h_{ef}/200\text{mm} \leq 1$	0,7 <sup>a)</sup>	0,75 <sup>a)</sup>	0,8 <sup>a)</sup>	0,85 <sup>a)</sup>	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



### 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 $V_{Rd,cp} = \text{lower value}^a)$ of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

$$k = 2 \text{ for } h_{ef} \geq 60 \text{ mm}$$

- a)  $N_{Rd,p}$ : Design combined pull-out and concrete cone resistance  
 $N_{Rd,c}$ : Design concrete cone resistance

$$\text{Design concrete edge resistance } V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_\beta \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$$

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete									
$V_{Rd,c}^0$	[kN]	5,9	8,6	11,6	18,7	27,0	36,6	44,5	53,0
Cracked concrete									
$V_{Rd,c}^0$	[kN]	-	6,1	8,2	13,2	19,2	25,9	31,5	-

## 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
$f_B = (f_{ck,cube}/25\text{N/mm}^2)^{1/2}$ 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 $\beta$	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 <sup>a)</sup> for concrete edge resistance:  $f_4$

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sub>ef</sub> /d	4	4,5	5	6	7	8	9	10	11
f <sub>hef</sub> = 0,05 · (h <sub>ef</sub> / d) <sup>1,68</sup>	0,51	0,63	0,75	1,01	1,31	1,64	2,00	2,39	2,81
h <sub>ef</sub> /d	12	13	14	15	16	17	18	19	20
f <sub>hef</sub> = 0,05 · (h <sub>ef</sub> / d) <sup>1,68</sup>	3,25	3,72	4,21	4,73	5,27	5,84	6,42	7,04	7,67

### Influence of edge distance <sup>a)</sup>

c/d	4	6	8	10	15	20	30	40
f <sub>c</sub> = (d / c) <sup>0,19</sup>	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:

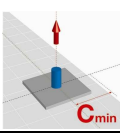
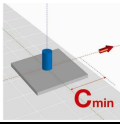
- non-cracked concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$
- temperature range I (see service temperature range)
- minimum thickness of base material
- no effects of dense reinforcement

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

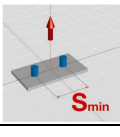
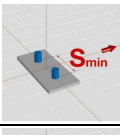
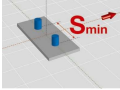
### Design resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$ - minimum embedment depth

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	
<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>										
Non-cracked concrete										
	HIT-V 5.8 / 8.8									
	HIT-V-R / -HCR [kN]	11,7	13,0	16,4	24,1	28,7	33,7	38,8	36,9	
Cracked concrete										
	HIT-V 5.8 / 8.8									
	HIT-V-R / -HCR [kN]	-	6,9	9,7	16,1	20,5	24,0	-	-	
<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>										
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	31,2	41,0	48,0	-	-
	HIT-V 8.8	[kN]	-	13,8	19,4	32,2	41,0	48,0	-	-
	HIT-V-R	[kN]	-	12,8	19,2	32,2	41,0	48,0	-	-
	HIT-V-HCR	[kN]	-	13,8	19,4	32,2	41,0	48,0	-	-

### Design resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$ - 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	
	<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>								
	Non-cracked concrete								
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR [kN]	7,1	8,5	9,7	15,4	20,3	25,3	29,4	28,9
	Cracked concrete								
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR [kN]	-	4,7	6,6	12,1	16,4	20,3	-	-
		<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>							
Non-cracked concrete									
HIT-V 5.8 / 8.8 HIT-V-R / -HCR [kN]		3,5	4,9	6,6	10,2	14,1	18,3	21,8	25,9
Cracked concrete									
HIT-V 5.8 / 8.8 HIT-V-R / -HCR [kN]		-	3,5	4,7	7,2	10,0	12,9	-	-

### Design resistance: concrete C 20/25 – $f_{ck,cube} = 25 \text{ N/mm}^2$ - 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	
	<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>								
	Non-cracked concrete								
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR [kN]	7,4	8,2	10,0	15,1	18,7	22,5	26,0	25,0
	Cracked concrete								
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR [kN]	-	4,9	6,7	10,7	13,3	16,0	-	-
		<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>							
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	18,4	25,4	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	18,4	25,4	32,1	39,4	47,1	54,7	62,7
	Cracked concrete								
	HIT-V 5.8 / 8.8 HIT-V-R / -HCR [kN]	-	8,8	12,4	21,4	28,1	33,6	-	-

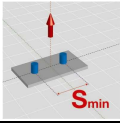
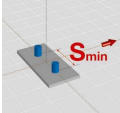
**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - typical embedment depth**

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
	<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>								
	Non-cracked concrete								
	HIT-V 5.8 [kN]	12,0	19,3	28,0	47,1	74,6	102,5	125,2	120,2
	HIT-V 8.8 [kN]	15,6	22,0	32,3	47,1	74,6	102,5	125,2	120,2
	HIT-V-R [kN]	13,9	21,9	31,6	47,1	74,6	102,5	80,4	98,3
	HIT-V-HCR [kN]	15,6	22,0	32,3	47,1	74,6	102,5	125,2	120,2
	Cracked concrete								
	HIT-V 5.8 / 8.8 [kN]	-	10,4	15,2	25,1	42,7	63,3	-	-
	HIT-V-R / -HCR [kN]	-	-	-	-	-	-	-	-
		<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>							
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	48,8	70,4	-	-
HIT-V 8.8 [kN]		-	18,4	27,2	50,3	78,4	112,8	-	-
HIT-V-R [kN]		-	12,8	19,2	35,3	55,1	79,5	-	-
HIT-V-HCR [kN]	-	18,4	27,2	50,3	78,4	70,9	-	-	

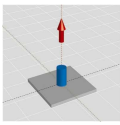
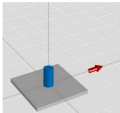
**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - typical embedment depth**

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
	<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>								
	Non-cracked concrete								
	HIT-V 5.8 / 8.8 [kN]	8,6	11,6	15,5	23,7	36,6	49,8	60,6	60,0
	HIT-V-R / -HCR [kN]	-	-	-	-	-	-	-	-
	Cracked concrete								
	HIT-V 5.8 / 8.8 [kN]	-	5,8	8,4	14,8	24,4	36,9	-	-
HIT-V-R / -HCR [kN]	-	-	-	-	-	-	-	-	
	<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>								
	Non-cracked concrete								
	HIT-V 5.8 / 8.8 [kN]	3,7	5,3	7,3	11,5	17,2	23,6	29,0	34,8
	HIT-V-R / -HCR [kN]	-	-	-	-	-	-	-	-
	Cracked concrete								
	HIT-V 5.8 / 8.8 [kN]	-	3,8	5,2	8,1	12,2	16,7	-	-
HIT-V-R / -HCR [kN]	-	-	-	-	-	-	-	-	

**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - 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	
	<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>								
	Non-cracked concrete								
	HIT-V 5.8 / 8.8 [kN]	9,9	13,4	18,1	26,9	42,2	57,7	70,4	69,9
	HIT-V-R / -HCR [kN]								
	Cracked concrete								
	HIT-V 5.8 / 8.8 [kN]	-	7,1	10,3	16,5	27,3	39,9	-	-
HIT-V-R / -HCR [kN]									
	<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>								
	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	170,9
	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	30,5	48,8	70,4	-	-
	HIT-V 8.8 [kN]	-	12,3	18,0	30,5	51,1	75,4	-	-
	HIT-V-R [kN]	-	12,3	18,0	30,5	51,1	75,4	-	-
HIT-V-HCR [kN]	-	12,3	18,0	30,5	51,1	70,9	-	-	

**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - 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	
	<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>								
	Non-cracked concrete								
	HIT-V 5.8 [kN]	12,0	19,3	28,0	52,7	82,0	118,0	153,3	160,2
	HIT-V 8.8 [kN]	18,8	29,3	42,2	83,6	120,6	159,2	183,2	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	83,6	120,6	117,6	152,9	160,2
	Cracked concrete								
	HIT-V 5.8 / 8.8 [kN]	-	13,8	19,9	38,6	60,3	86,9	-	-
	HIT-V-R / -HCR [kN]								
	<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>								
	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	48,8	70,4	-	-	
HIT-V 8.8 [kN]	-	18,4	27,2	50,4	78,4	112,8	-	-	
HIT-V-R [kN]	-	12,8	19,2	35,3	55,1	79,5	-	-	
HIT-V-HCR [kN]	-	18,4	27,2	50,4	78,4	70,9	-	-	

a)  $d$  = element diameter

Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - 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	
	<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>								
	Non-cracked concrete								
	HIT-V 5.8 [kN]	10,4	16,2	21,7	40,1	56,0	73,6	87,8	85,7
	HIT-V 8.8 [kN]	10,4	16,2	21,7	40,1	56,0	73,6	87,8	85,7
	HIT-V-R [kN]	10,4	16,2	21,7	40,1	56,0	73,6	80,4	85,7
	HIT-V-HCR [kN]	10,4	16,2	21,7	40,1	56,0	73,6	87,8	85,7
	Cracked concrete								
	HIT-V 5.8 / 8.8 [kN]	-	7,6	11,0	21,7	34,4	50,6	-	-
	HIT-V-R / -HCR [kN]	-	7,6	11,0	21,7	34,4	50,6	-	-
		<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>							
Non-cracked concrete									
HIT-V 5.8 / 8.8 [kN]		3,9	5,7	7,8	12,9	18,9	25,9	31,8	38,1
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 [kN]		-	4,0	5,5	9,1	13,4	18,4	-	-
HIT-V-R / -HCR [kN]		-	4,0	5,5	9,1	13,4	18,4	-	-

a)  $d$  = element diameter

Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - 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	
	<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>								
	Non-cracked concrete								
	HIT-V 5.8 [kN]	12,0	18,5	26,0	48,9	68,4	89,9	107,2	103,8
	HIT-V 8.8 [kN]	12,1	18,5	26,0	48,9	68,4	89,9	107,2	103,8
	HIT-V-R [kN]	12,1	18,5	26,0	48,9	68,4	89,9	80,4	98,3
	HIT-V-HCR [kN]	12,1	18,5	26,0	48,9	68,4	89,9	107,2	103,8
	Cracked concrete								
	HIT-V 5.8 / 8.8 [kN]	-	9,6	13,6	25,8	39,8	56,7	-	-
	HIT-V-R / -HCR [kN]	-	9,6	13,6	25,8	39,8	56,7	-	-
		<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>							
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	48,8	70,4	-	-
HIT-V 8.8 [kN]		-	15,7	22,7	44,0	68,7	98,9	-	-
HIT-V-R [kN]		-	12,8	19,2	35,3	55,1	79,5	-	-
HIT-V-HCR [kN]	-	15,7	22,7	44,0	68,7	70,9	-	-	

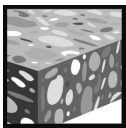
a)  $d$  = element diameter





## Hilti HIT-HY 150 MAX with HIS-(R)N

Injection mortar system		Benefits
	Hilti HIT-HY 150 MAX 330 ml foil pack  (also available as 500 ml and 1400 ml foil pack)	<ul style="list-style-type: none"> <li>- suitable for non-cracked concrete C 20/25 to C 50/60</li> <li>- suitable for dry and water saturated concrete</li> <li>- high loading capacity</li> <li>- rapid curing</li> <li>- small edge distance and anchor spacing possible</li> <li>- corrosion resistant</li> <li>- in service temperature range up to 120°C short term/72°C long term</li> <li>- manual cleaning for anchor size M8 and M10</li> </ul>
	Static mixer	
	Internal threaded sleeve HIS-N HIS-RN	



Concrete



Small edge distance and spacing



Corrosion resistance



European Technical Approval



CE conformity



PROFIS Anchor design software

### Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval <sup>a)</sup>	DIBt, Berlin	ETA-08/0352 / 2010-04-01

a) All data given in this section according ETA-08/0352 issue 2010-04-01

### 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- Temperature 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	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 <sup>a)</sup>: 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	31,9	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  $\gamma = 1,4$ . 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 150 MAX 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/mm <sup>2</sup> ]	490	490	460	460	460
	Screw 8.8	[N/mm <sup>2</sup> ]	800	800	800	800	800
	HIS-RN	[N/mm <sup>2</sup> ]	700	700	700	700	700
	Screw A4-70	[N/mm <sup>2</sup> ]	700	700	700	700	700
Yield strength $f_{yk}$	HIS-N	[N/mm <sup>2</sup> ]	410	410	375	375	375
	Screw 8.8	[N/mm <sup>2</sup> ]	640	640	640	640	640
	HIS-RN	[N/mm <sup>2</sup> ]	350	350	350	350	350
	Screw A4-70	[N/mm <sup>2</sup> ]	450	450	450	450	450
Stressed cross-section $A_s$	HIS-(R)N	[mm <sup>2</sup> ]	51,5	108,0	169,1	256,1	237,6
	Screw	[mm <sup>2</sup> ]	36,6	58	84,3	157	245
Moment of resistance $W$	HIS-(R)N	[mm <sup>3</sup> ]	145	430	840	1595	1543
	Screw	[mm <sup>3</sup> ]	31,2	62,3	109	277	541

### Material quality

Part	Material
Internal threaded sleeve <sup>a)</sup> HIS-N	C-steel 1.0718, Steel galvanized $\geq 5\mu\text{m}$
Internal threaded sleeve <sup>a)</sup> HIS-RN	Stainless steel 1.4401 and 1.4571

- a) related fastening screw: strength class 8.8, A5 > 8% Ductile  
steel galvanized  $\geq 5\mu\text{m}$
- 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			M8x90	M10x110	M12x125	M16x170	M20x205
Internal threaded sleeve HIS-N / HIS-RN							
Embedment depth	$h_{ef}$	[mm]	80	90	110	125	170

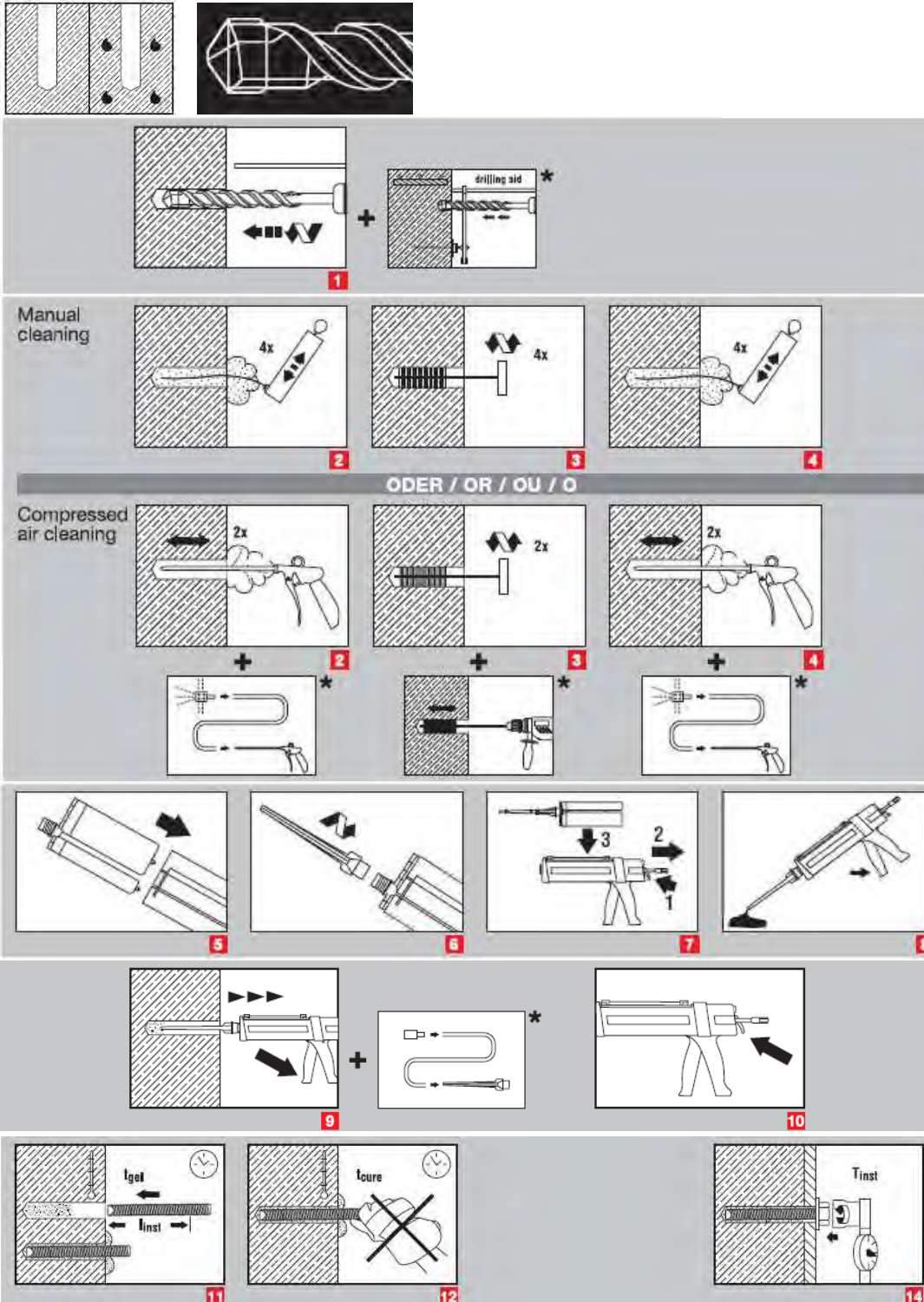
## Setting

### installation equipment

Anchor size	M8x90	M10x110	M12x125	M16x170	M20x205
Rotary hammer	TE 2 – TE 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)

b)

**a) Note:** Manual cleaning for HIS-(R)N M8 and HIS-(R)N M10 only!

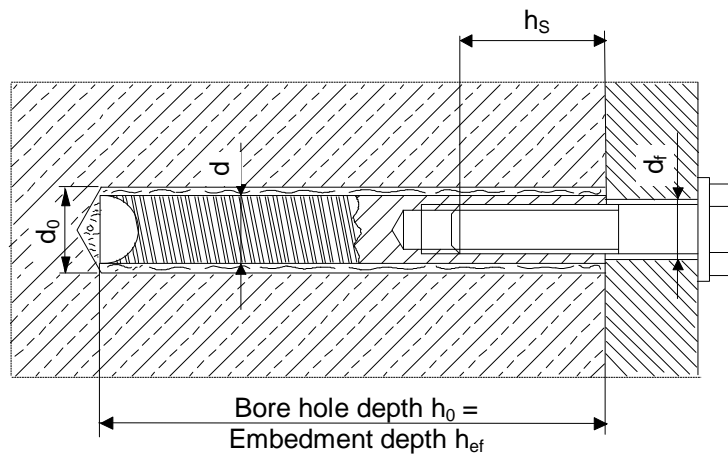
**b) Note:** Extension and piston plug needed for overhead installation!

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

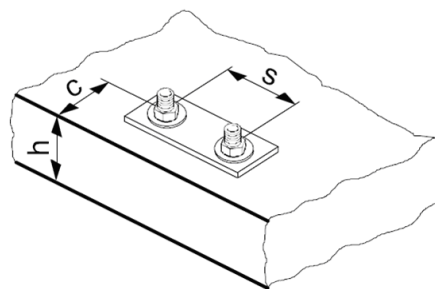
### Working time, Curing time

Temperature of the base material $T_{BM}$	Working time $t_{gel}$	Curing time $t_{cure}$
$-10\text{ °C} \leq T_{BM} < -5\text{ °C}$	180 min	12 h
$-5\text{ °C} \leq T_{BM} < 0\text{ °C}$	40 min	4 h
$0\text{ °C} \leq T_{BM} < 5\text{ °C}$	20 min	2 h
$5\text{ °C} \leq T_{BM} < 20\text{ °C}$	8 min	1 h
$20\text{ °C} \leq T_{BM} < 30\text{ °C}$	5 min	30 min
$30\text{ °C} \leq T_{BM} \leq 40\text{ °C}$	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 <sup>a)</sup>	$T_{max}$	[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 <sup>c)</sup>	$c_{cr,sp}$	[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 <sup>c)</sup>	$c_{cr,N}$	[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.

- Maximum recommended torque moment to avoid splitting failure during installation with minimum spacing and/or edge distance.
- $h$ : base material thickness ( $h \geq h_{min}$ ),  $h_{ef}$ : embedment depth
- 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-08/0352, issue 2010-04-01.

- 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)

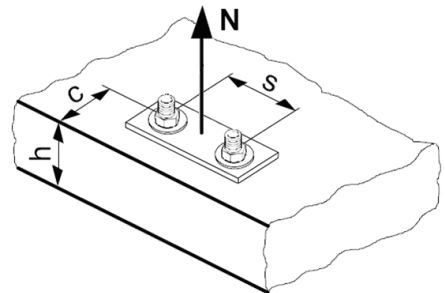
The values are valid for one anchor.

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



## 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

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

Anchor size		M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth	$h_{ef}$ [mm]	90	110	125	170	205
$N_{Rd,p}^0$	Temperature range I [kN]	19,4	27,8	50,0	63,3	76,7
$N_{Rd,p}^0$	Temperature range II [kN]	16,7	27,8	40,0	63,3	63,3
$N_{Rd,p}^0$	Temperature range III [kN]	11,1	16,7	26,7	40,0	40,0

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

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

Anchor size		M8	M10	M12	M16	M20
$N_{Rd,c}^0$	[kN]	24,0	32,4	47,1	74,6	98,8



### 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
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,10}$ <sup>a)</sup>	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
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ <sup>a)</sup>	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 <sup>a)</sup>

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

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 <sup>a)</sup>

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

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

$f_{h,N} = 1$
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#### Influence of reinforcement

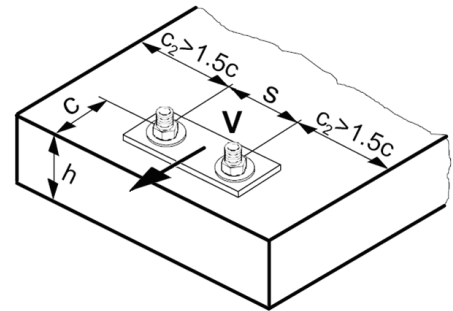
$h_{ef}$ [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,7 <sup>a)</sup>	0,75 <sup>a)</sup>	0,8 <sup>a)</sup>	0,85 <sup>a)</sup>	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



## Basic design shear resistance

### Design steel resistance $V_{Rd,s}$

Anchor size		M8x90	M10x110	M12x125	M16x170	M20x205
$V_{Rd,s}$	HIS-N [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<sup>a)</sup> of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

$$k = 2 \text{ for } h_{ef} \geq 60 \text{ mm}$$

- a)  $N_{Rd,p}$ : Design combined pull-out and concrete cone resistance  
 $N_{Rd,c}$ : Design concrete cone resistance

### Design concrete edge resistance $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		M8	M10	M12	M16	M20
Non-cracked concrete						
$V_{Rd,c}^0$ [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 $\beta$	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 <sup>a)</sup> for concrete edge resistance:  $f_4$**

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sup>a)</sup>

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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$
- 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  $\gamma = 1,4$ . 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
	<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>					
	HIS-N [kN]	17,5	27,8	44,7	63,3	74,1
	HIS-RN [kN]	13,9	21,9	31,6	58,8	69,2
	<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>					
	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
	<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>					
	HIS-N [kN]	9,9	13,8	21,6	31,2	41,7
	HIS-RN [kN]	9,9	13,8	21,6	31,2	41,7
	<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>					
	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

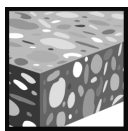
### Design resistance: non-cracked- concrete C 20/25

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
	<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>					
	HIS-N [kN]	11,9	16,6	25,9	37,9	48,4
	HIS-RN [kN]	11,9	16,6	25,9	37,9	48,4
	<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>					
	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 150 MAX with rebar

Injection mortar system		Benefits
    	<p>Hilti HIT-HY 150 MAX 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)</p> <p>Static mixer</p> <p>rebar BSt 500 S</p>	<ul style="list-style-type: none"> <li>- suitable for non-cracked and cracked concrete C 20/25 to C 50/60</li> <li>- suitable for dry and water saturated concrete</li> <li>- high loading capacity</li> <li>- rapid curing</li> <li>- small edge distance and anchor spacing possible</li> <li>- large diameter applications</li> <li>- in service temperature range up to 120°C short term/72°C long term</li> <li>- manual cleaning for anchor size Ø8 to Ø14 and embedment depth <math>h_{ef} \leq 10d</math> for non-cracked concrete</li> <li>- embedment depth range: from 60 ... 160 mm for Ø8 to 100 ... 500 mm for Ø25</li> </ul>



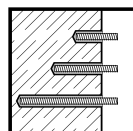
Concrete



Tensile zone



Small edge distance and spacing



Variable embedment depth



European Technical Approval



CE conformity



PROFIS Anchor design software

### Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval <sup>a)</sup>	DIBt, Berlin	ETA-08/0352 / 2010-04-01

a) All data given in this section according ETA-08/0352 issue 2010-04-01.

### 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
- 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- Temperature 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

For details see Simplified design method

**Embedment depth <sup>a)</sup> 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 $h_{ef} = h_{ef,typ}$ <sup>b)</sup> [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: non-cracked concrete C 20/25 , anchor BSt 500 S**

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Non-cracked concrete							
Tensile $N_{Ru,m}$ BSt 500 S [kN]	25,5	35,8	52,5	69,6	92,3	135,3	204,9
Shear $V_{Ru,m}$ BSt 500 S [kN]	14,7	23,1	32,6	44,1	57,8	90,3	141,8
Cracked concrete							
Tensile $N_{Ru,m}$ BSt 500 S [kN]	-	20,7	30,4	44,0	58,3	85,5	131,9
Shear $V_{Ru,m}$ BSt 500 S [kN]	-	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
Non-cracked concrete							
Tensile $N_{Rk}$ BSt 500 S [kN]	19,1	26,9	39,4	52,2	69,2	101,5	153,7
Shear $V_{Rk}$ BSt 500 S [kN]	14,0	22,0	31,0	42,0	55,0	86,0	135,0
Cracked concrete							
Tensile $N_{Rk}$ BSt 500 S [kN]	-	15,6	22,8	33,0	43,7	64,1	99,0
Shear $V_{Rk}$ BSt 500 S [kN]	-	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
Non-cracked concrete							
Tensile $N_{Rd}$ BSt 500 S [kN]	10,6	14,9	21,9	29,0	46,2	67,6	85,4
Shear $V_{Rd}$ BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0
Cracked concrete							
Tensile $N_{Rd}$ BSt 500 S [kN]	-	10,4	15,2	22,0	29,2	42,7	55,0
Shear $V_{Rd}$ BSt 500 S [kN]	-	14,7	20,7	28,0	36,7	57,3	90,0

**Recommended loads <sup>a)</sup>: non-cracked concrete C 20/25 , anchor BSt 500 S**

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Non-cracked concrete							
Tensile $N_{rec}$ BSt 500 S [kN]	7,6	10,7	15,6	20,7	33,0	48,3	61,0
Shear $V_{rec}$ BSt 500 S [kN]	6,7	10,5	14,8	20,0	26,2	41,0	64,3
Cracked concrete							
Tensile $N_{rec}$ BSt 500 S [kN]	-	7,4	10,9	15,7	20,8	30,5	39,3
Shear $V_{rec}$ BSt 500 S [kN]	-	10,5	14,8	20,0	26,2	41,0	64,3

a) With 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.

## Service temperature range

Hilti HIT-HY 150 MAX 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/mm <sup>2</sup> ]	550						
Yield strength $f_{yk}$	BSt 500 S	[N/mm <sup>2</sup> ]	500						
Stressed cross-section $A_s$	BSt 500 S	[mm <sup>2</sup> ]	50,3	78,5	113,1	153,9	201,1	314,2	490,9
Moment of resistance $W$	BSt 500 S	[mm <sup>3</sup> ]	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

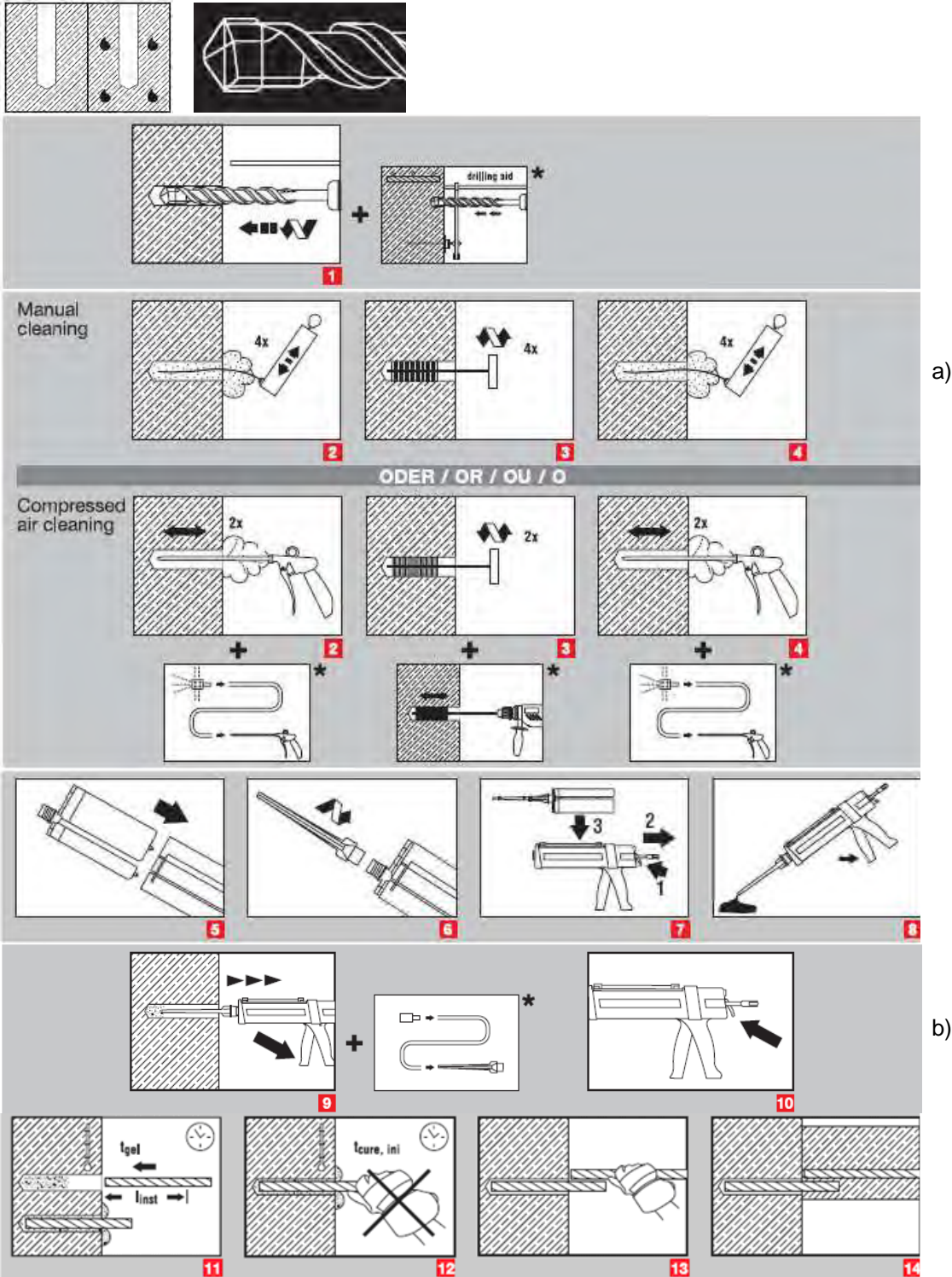
### installation equipment

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Rotary hammer	TE 2 – TE 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) Note:** Manual cleaning for non-cracked concrete, element sizes  $d \leq 14\text{mm}$  and embedment depth  $h_{ef} \leq 10 d$  only!

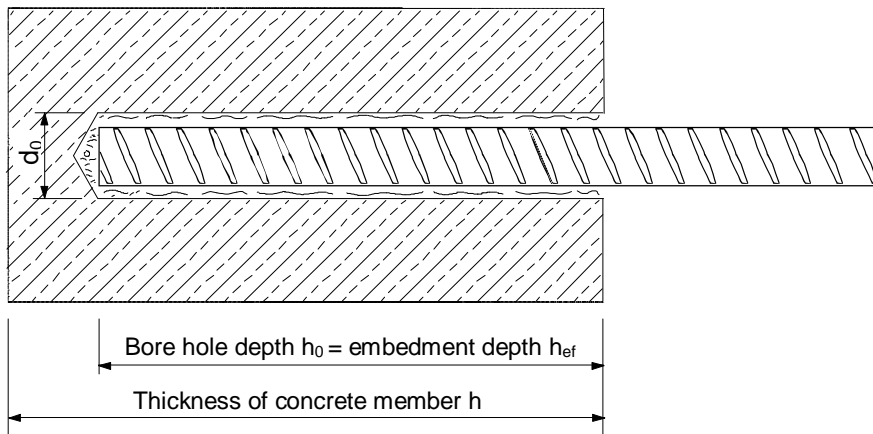
**b) Note:** Extension and piston plug needed for overhead installation and/or embedment depth  $> 250\text{mm}$ !

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 $t_{cure}$
$-10\text{ °C} \leq T_{BM} < -5\text{ °C}$	180 min	12 h
$-5\text{ °C} \leq T_{BM} < 0\text{ °C}$	40 min	4 h
$0\text{ °C} \leq T_{BM} < 5\text{ °C}$	20 min	2 h
$5\text{ °C} \leq T_{BM} < 20\text{ °C}$	8 min	1 h
$20\text{ °C} \leq T_{BM} < 30\text{ °C}$	5 min	30 min
$30\text{ °C} \leq T_{BM} \leq 40\text{ °C}$	2 min	30 min

### Setting details



Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Nominal diameter of drill bit	$d_0$	[mm]	10-12 <sup>d)</sup>	12-14 <sup>d)</sup>	14-16 <sup>d)</sup>	18	20	25	32
Effective embedment and drill hole depth range <sup>a)</sup> <b>for rebar BSt 500 S</b>	$h_{ef,min}$	[mm]	60	60	70	75	80	90	100
	$h_{ef,max}$	[mm]	160	200	240	280	320	400	500
Minimum base material thickness	$h_{min}$	[mm]	$h_{ef} + 30 \text{ mm}$ $\geq 100 \text{ mm}$			$h_{ef} + 2 d_0$			
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 <sup>c)</sup>	$c_{cr,sp}$	[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 <sup>c)</sup>	$c_{cr,N}$	[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 safe side.
- d) both given values for drill bit diameter can be used

## Simplified design method

Simplified version of the design method according ETAG 001, TR 029. Design resistance according data given in ETA-08/0352, issue 2010-04-01.

- 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)

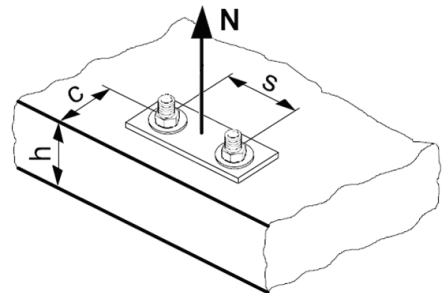
The values are valid for one anchor.

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



## 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

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

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								
$N_{Rd,p}^0$ Temperature range I	[kN]	10,6	14,9	21,9	29,0	46,2	67,6	87,0
$N_{Rd,p}^0$ Temperature range II	[kN]	8,9	12,6	18,4	24,4	38,9	57,0	73,3
$N_{Rd,p}^0$ Temperature range III	[kN]	5,6	7,9	11,5	15,3	24,3	35,6	45,8
Cracked concrete								
$N_{Rd,p}^0$ Temperature range I	[kN]	-	10,4	15,2	22,0	29,2	42,7	55,0
$N_{Rd,p}^0$ Temperature range II	[kN]	-	8,5	13,8	18,3	26,7	42,7	55,0
$N_{Rd,p}^0$ Temperature range III	[kN]	-	5,7	8,3	12,8	17,0	24,9	36,7

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

Design splitting resistance <sup>a)</sup>  $N_{Rd,sp} = N_{Rd,c}^0 \cdot f_B \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{h,N} \cdot f_{re,N}$

Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
$N_{Rd,c}^0$ Non-cracked concrete [kN]		20,1	24,0	32,4	39,2	58,8	74,6	85,4
$N_{Rd,c}^0$ Cracked concrete [kN]		-	28,7	38,8	47,1	58,8	74,6	85,4

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
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,10}$ <sup>a)</sup>	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

$f_{h,p} = h_{ef}/h_{ef,typ}$
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#### 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
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ <sup>a)</sup>	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 <sup>a)</sup>

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

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 <sup>a)</sup>

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

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

$f_{h,N} = (h_{ef}/h_{ef,typ})^{1,5}$
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### Influence of reinforcement

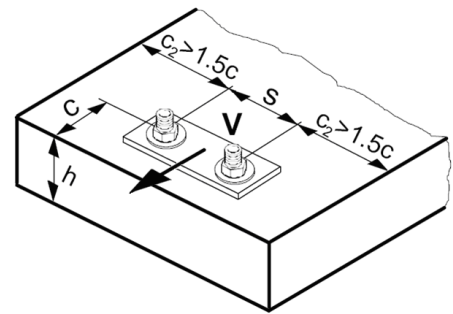
$h_{ef}$ [mm]	40	50	60	70	80	90	$\geq 100$
$f_{re,N} = 0,5 + h_{ef}/200\text{mm} \leq 1$	0,7 <sup>a)</sup>	0,75 <sup>a)</sup>	0,8 <sup>a)</sup>	0,85 <sup>a)</sup>	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V^0_{Rd,c} \cdot f_B \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



### Basic design shear resistance

#### Design steel resistance $V_{Rd,s}$

Anchor size	$\emptyset 8$	$\emptyset 10$	$\emptyset 12$	$\emptyset 14$	$\emptyset 16$	$\emptyset 20$	$\emptyset 25$
$V_{Rd,s}$ Rebar BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0

#### Design concrete pryout resistance $V_{Rd,cp} = \text{lower value}^a)$ of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

$$k = 2 \text{ for } h_{ef} \geq 60 \text{ mm}$$

- a)  $N_{Rd,p}$ : Design combined pull-out and concrete cone resistance  
 $N_{Rd,c}$ : Design concrete cone resistance

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

Anchor size	$\emptyset 8$	$\emptyset 10$	$\emptyset 12$	$\emptyset 14$	$\emptyset 16$	$\emptyset 20$	$\emptyset 25$
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	19,2	27,7

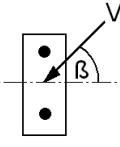
### Influencing factors

#### 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
$f_B = (f_{ck,cube}/25\text{N/mm}^2)^{1/2}$ 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 $\beta$	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 <sup>a)</sup> for concrete edge resistance: $f_4$

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sub>ef</sub> /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 <sub>ef</sub> /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 <sup>a)</sup>

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

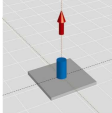
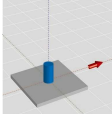
All data applies to:

- non-cracked concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$
- temperature range I (see service temperature range)
- minimum thickness of base material
- no effects of dense reinforcement

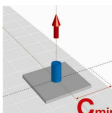
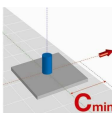
Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action  $\gamma = 1,4$ . The partial safety factors for action depend on the type of loading and shall be taken from national regulations.



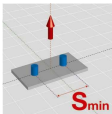
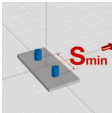
### Design resistance: concrete C 20/25 - minimum embedment depth

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
	<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>							
	Non-cracked concrete							
	BSt 500 S [kN]	8,0	9,9	13,9	18,6	28,7	33,7	32,4
	Cracked concrete							
BSt 500 S [kN]	-	6,9	9,7	14,1	18,1	24,0	23,1	
	<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>							
	Non-cracked concrete							
	BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	64,7
	Cracked concrete							
BSt 500 S [kN]	-	13,8	19,4	28,0	36,2	48,0	46,1	

### 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	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
	<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>							
	Non-cracked concrete							
	BSt 500 S [kN]	4,8	6,7	9,5	12,8	19,4	24,4	25,0
	Cracked concrete							
BSt 500 S [kN]	-	4,7	6,6	10,6	14,5	20,3	19,8	
	<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>							
	Non-cracked concrete							
	BSt 500 S [kN]	3,5	4,9	6,6	10,0	13,2	17,4	21,8
	Cracked concrete							
BSt 500 S [kN]	-	3,5	4,7	7,1	9,4	12,3	15,4	

### 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	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
	<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>							
	Non-cracked concrete							
	BSt 500 S [kN]	5,4	6,8	9,3	12,2	17,6	21,3	22,5
	Cracked concrete							
BSt 500 S [kN]	-	4,9	6,7	9,5	12,1	15,2	16,0	
	<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>							
	Non-cracked concrete							
	BSt 500 S [kN]	9,3	12,7	17,9	24,0	36,7	44,9	47,1
	Cracked concrete							
BSt 500 S [kN]	-	8,8	12,4	18,2	23,5	32,0	33,6	

**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
	<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>							
	Non-cracked concrete							
	BSt 500 S [kN]	10,6	14,9	21,9	29,0	46,2	67,6	85,4
	Cracked concrete							
BSt 500 S [kN]	-	10,4	15,2	22,0	29,2	42,7	55,0	
	<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>							
	Non-cracked concrete							
	BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0
	Cracked concrete							
BSt 500 S [kN]	-	14,7	20,7	28,0	36,7	57,3	90,0	

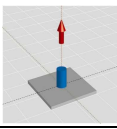
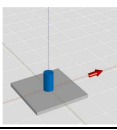
**Design resistance: concrete C 20/25 - typical embedment depth**

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
Edge distance $c = c_{min}$ [mm]		40	50	60	80	100	120	135
	<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>							
	Non-cracked concrete							
	BSt 500 S [kN]	6,4	9,0	13,2	18,6	30,4	38,9	43,1
	Cracked concrete							
BSt 500 S [kN]	-	6,2	9,1	14,1	19,6	28,2	34,3	
	<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>							
	Non-cracked concrete							
	BSt 500 S [kN]	3,7	5,3	7,3	11,2	15,8	21,5	27,5
	Cracked concrete							
BSt 500 S [kN]	-	3,8	5,2	7,9	11,2	15,2	19,5	

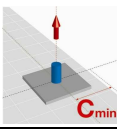
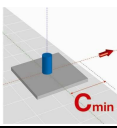
**Design resistance concrete C 20/25 - typical embedment depth (load values are valid for single anchor)**

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	142	161	185	220	274
Spacing $s = s_{min}$ [mm]		40	50	60	80	100	120	135
	<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>							
	Non-cracked concrete							
	BSt 500 S [kN]	7,4	10,1	14,7	19,1	30,1	42,2	49,5
	Cracked concrete							
BSt 500 S [kN]	-	7,2	10,5	14,8	19,5	27,7	35,3	
	<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>							
	Non-cracked concrete							
	BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0
	Cracked concrete							
BSt 500 S [kN]	-	12,3	18,0	26,1	34,5	51,1	68,1	

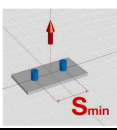
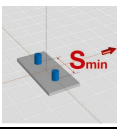
### Design resistance: concrete C 20/25 - embedment depth = 12 d<sup>a)</sup>

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
	<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>							
	Non-cracked concrete							
	BSt 500 S [kN]	12,7	19,9	28,7	39,0	61,1	95,5	124,4
	Cracked concrete							
BSt 500 S [kN]	-	13,8	19,9	29,6	38,6	60,3	78,5	
	<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>							
	Non-cracked concrete							
	BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0
	Cracked concrete							
BSt 500 S [kN]	-	14,7	20,7	28,0	36,7	57,3	90,0	

### Design resistance: concrete C 20/25 - embedment depth = 12 d<sup>a)</sup>




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
	<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>							
	Non-cracked concrete							
	BSt 500 S [kN]	7,7	12,0	17,2	25,1	41,2	58,6	66,4
	Cracked concrete							
BSt 500 S [kN]	-	8,3	12,0	19,0	26,0	39,8	49,0	
	<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>							
	Non-cracked concrete							
	BSt 500 S [kN]	3,9	5,7	7,8	12,0	16,9	23,6	30,5
	Cracked concrete							
BSt 500 S [kN]	-	4,0	5,5	8,5	12,0	16,7	21,6	

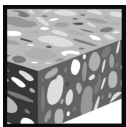
### Design resistance: concrete C 20/25 - embedment depth = 12 d<sup>a)</sup> (load values are valid for single anchor)

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
	<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>							
	Non-cracked concrete							
	BSt 500 S [kN]	8,9	13,8	19,6	26,4	40,9	62,6	81,0
	Cracked concrete							
BSt 500 S [kN]	-	9,8	13,9	20,3	26,3	40,5	53,2	
	<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>							
	Non-cracked concrete							
	BSt 500 S [kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0
	Cracked concrete							
BSt 500 S [kN]	-	14,7	20,7	28,0	36,7	57,3	90,0	

a) d = element diameter

## Hilti HIT-CT 1 with HIT-V

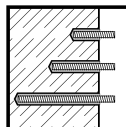
Injection mortar system	Benefits
 <p>Hilti HIT-CT 1 330 ml foil pack (also available as 500 ml foil pack)</p>  <p>Static mixer</p>  <p>HIT-V(-F) rods HIT-V-R rods HIT-V-HCR rods</p>	<ul style="list-style-type: none"> <li>- Hilti Clean technology (clean-Tec)</li> <li>- Environmentally and user friendly: clean of critical hazardous substances</li> <li>- suitable for non-cracked concrete C 20/25 to C 50/60</li> <li>- suitable for dry and water saturated concrete</li> <li>- high loading capacity</li> <li>- rapid curing</li> <li>- large diameter applications</li> <li>- in service temperature range up to 80°C short term/50°C long term</li> <li>- manual cleaning for anchor size M8 to M16 and embedment depth <math>8d \leq h_{ef} \leq 10d</math></li> <li>- compressed air cleaning for anchor size M8 to M25 and embedment depth <math>8d \leq h_{ef} \leq 12d</math></li> </ul>



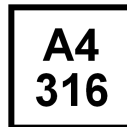
Concrete



Small edge distance and spacing



Variable embedment depth



Corrosion resistance



High corrosion resistance



Hilti Clean technology



European Technical Approval



CE conformity



PROFIS Anchor design software

### Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval <sup>a)</sup>	CSTB, Paris	ETA-11/0354 / 2011-09-30

a) All data given in this section according ETA-11/0354 issue 2011-09-30.

### 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- Temperate range I  
(min. base material temperature  $-40^\circ\text{C}$ , max. long term/short term base material temperature:  $+24^\circ\text{C}/40^\circ\text{C}$ )
- Installation temperature range  $-5^\circ\text{C}$  to  $+40^\circ\text{C}$

### Embedment depth <sup>a)</sup> 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 $N_{R_{u,m}}$ HIT-V 5.8 [kN]	18,9	30,5	44,1	87,1	135,3	190,0
Shear $V_{R_{u,m}}$ 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 $N_{R_k}$ HIT-V 5.8 [kN]	18,0	29,0	42,0	65,3	101,5	142,5
Shear $V_{R_k}$ 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 $N_{R_d}$ HIT-V 5.8 [kN]	12,0	17,3	25,3	36,3	56,4	79,2
Shear $V_{R_d}$ HIT-V 5.8 [kN]	7,2	12,0	16,8	31,2	48,8	70,4

### Recommended loads <sup>a)</sup>: 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  $\gamma = 1,4$ . 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  $\gamma_G = 1,35$  for permanent actions and  $\gamma_Q = 1,5$  for variable actions.

## Service temperature range

Hilti HIT-CT 1 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
Nominal tensile strength $f_{uk}$	HIT-V(-F) 5.8	[N/mm <sup>2</sup> ]	500	500	500	500	500	500
	HIT-V(-F) 8.8	[N/mm <sup>2</sup> ]	800	800	800	800	800	800
	HIT-V -R	[N/mm <sup>2</sup> ]	700	700	700	700	700	700
	HIT-V -HCR	[N/mm <sup>2</sup> ]	800	800	800	800	800	700
Yield strength $f_{yk}$	HIT-V(-F) 5.8	[N/mm <sup>2</sup> ]	400	400	400	400	400	400
	HIT-V(-F) 8.8	[N/mm <sup>2</sup> ]	640	640	640	640	640	640
	HIT-V -R	[N/mm <sup>2</sup> ]	450	450	450	450	450	450
	HIT-V -HCR	[N/mm <sup>2</sup> ]	600	600	600	600	600	400
Stressed cross-section $A_s$	HIT-V	[mm <sup>2</sup> ]	36,6	58,0	84,3	157	245	353
Moment of resistance $W$	HIT-V	[mm <sup>3</sup> ]	31,2	62,3	109	277	541	935

## Material quality

Part	Material
Threaded rod HIT-V(-F) 5.8	Strength class 5.8, A <sub>5</sub> > 8% ductile steel galvanized ≥ 5 μm (-F) hot dipped galvanized ≥ 45 μm
Threaded rod HIT-V(-F) 8.8	Strength class 8.8, A <sub>5</sub> > 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 <sub>5</sub> > 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 <sub>m</sub> = 800 N/mm <sup>2</sup> , R <sub>p0.2</sub> = 640 N/mm <sup>2</sup> , A <sub>5</sub> > 8% ductile M24: R <sub>m</sub> = 700 N/mm <sup>2</sup> , R <sub>p0.2</sub> = 400 N/mm <sup>2</sup> , A <sub>5</sub> > 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

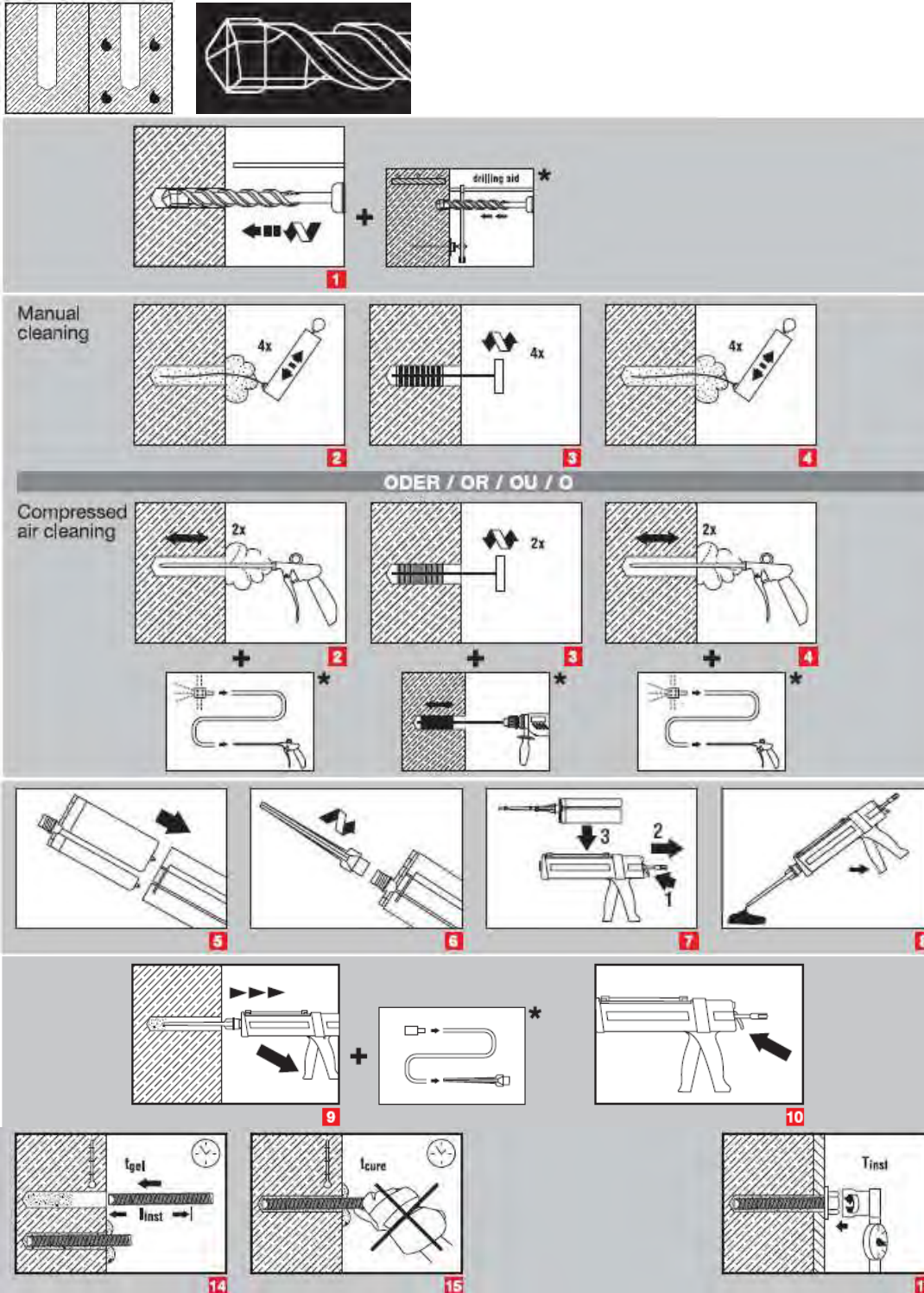
## Anchor dimensions

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



a)

b)

**a) Note:** Manual cleaning for element sizes  $d \leq 16\text{mm}$  and embedment depth  $h_{ef} \leq 10 d$  only!

**b) Note:** Extension and piston plug needed for overhead installation and/or embedment depth  $> 250\text{mm}$ !

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 $t_{cure}^{a)}$
$-5\text{ °C} \leq T_{BM} < 0\text{ °C}$	60 min	6 h
$0\text{ °C} \leq T_{BM} < 5\text{ °C}$	40 min	3 h
$5\text{ °C} \leq T_{BM} < 10\text{ °C}$	25 min	2 h
$10\text{ °C} \leq T_{BM} < 20\text{ °C}$	10 min	90 min
$20\text{ °C} \leq T_{BM} < 30\text{ °C}$	4 min	75 min
$30\text{ °C} \leq T_{BM} \leq 40\text{ °C}$	2 min	60 min

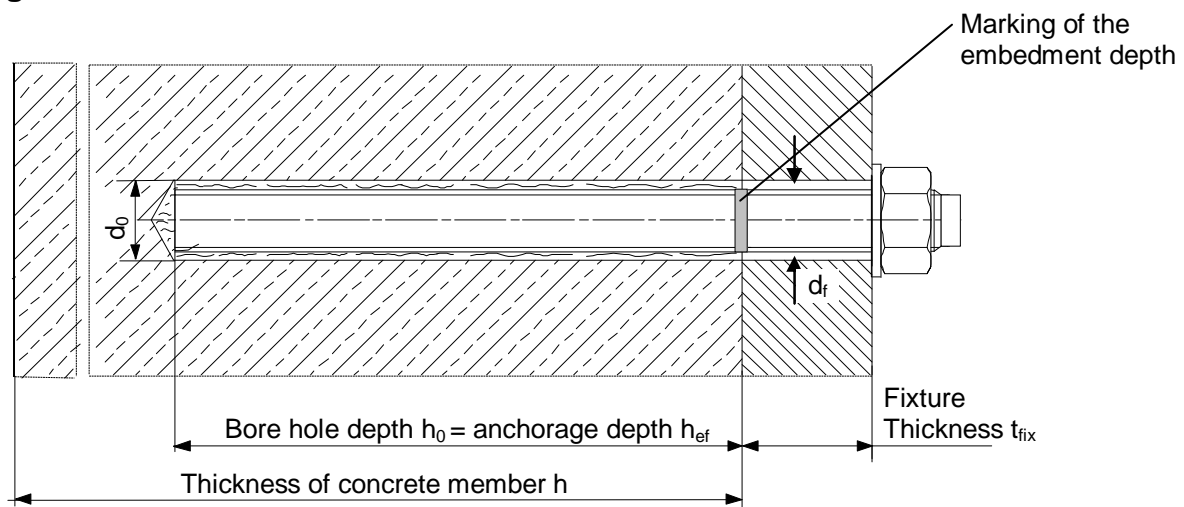
a) The curing time data are valid for dry anchorage base only. For water saturated anchorage bases the curing times must be doubled.

## 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 <sup>a)</sup> <b>for HIT-V</b>	$h_{ef,min}$ [mm]	64	80	96	128	160	192
	$h_{ef,max}$ [mm]	96	120	144	192	240	288
Minimum base material thickness	$h_{min}$ [mm]	$h_{ef} + 30 \text{ mm}$ $\geq 100 \text{ mm}$			$h_{ef} + 2 d_0$		
Diameter of clearance hole in the fixture	$d_f$ [mm]	9	12	14	18	22	26
Torque moment	$T_{max}$ <sup>b)</sup> [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 <sup>c)</sup>	$c_{cr,sp}$ [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 <sup>d)</sup>	$c_{cr,N}$ [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)

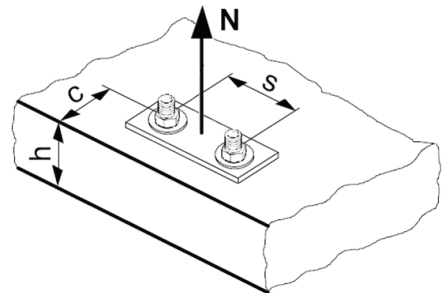
The values are valid for one anchor.

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



### 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

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

Anchor size		M8	M10	M12	M16	M20	M24
Typical embedment depth $h_{ef} = h_{ef,typ}$ [mm]		80	90	110	130	170	210
$N_{Rd,p}^0$	Temperature range I [kN]	13,4	17,3	25,3	36,3	56,4	79,2
$N_{Rd,p}^0$	Temperature range II [kN]	12,3	17,3	23,0	34,5	53,4	74,8

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

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

Anchor size		M8	M10	M12	M16	M20	M24
$N_{Rd,c}^0$	[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)

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

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)

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

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

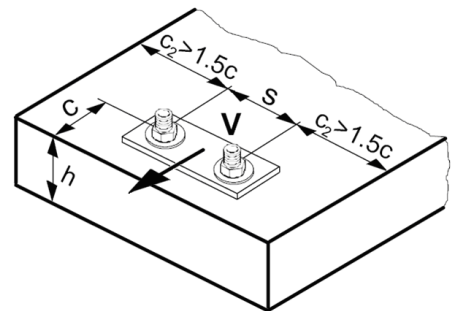
$h_{ef}$ [mm]	40	50	60	70	80	90	$\geq 100$
$f_{re,N} = 0,5 + h_{ef}/200\text{mm} \leq 1$	0,7 <sup>a)</sup>	0,75 <sup>a)</sup>	0,8 <sup>a)</sup>	0,85 <sup>a)</sup>	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



### 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 $V_{Rd,cp} = \text{lower value}^a)$ of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

$$k = 2 \text{ for } h_{ef} \geq 60 \text{ mm}$$

- a)  $N_{Rd,p}$ : Design combined pull-out and concrete cone resistance  
 $N_{Rd,c}$ : Design concrete cone resistance

#### Design concrete edge resistance $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		M8	M10	M12	M16	M20	M24
Non-cracked concrete							
$V_{Rd,c}^0$ [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
$f_B = (f_{ck,cube}/25\text{N/mm}^2)^{1/2 \text{ a)}$	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 $\beta$	0°	10°	20°	30°	40°	50°	60°	70°	80°	≥ 90°
$f_{\beta}$	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 <sup>a)</sup> 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 <sup>a)</sup>

$c/d$	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".

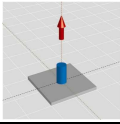
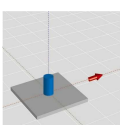
### Precalculated values – design resistance values

All data applies to:

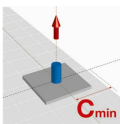
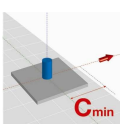
- non-cracked concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$
- temperature range I (see Service temperature range)
- minimum thickness of base material
- no effects of dense reinforcement

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

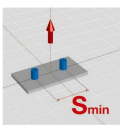
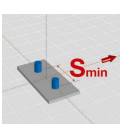
**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - minimum embedment depth**

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
 <b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>						
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
 <b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>						
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - minimum embedment depth**

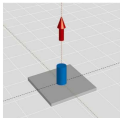
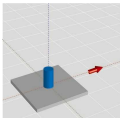
Anchor size	M8	M10	M12	M16	M20	M24
Embedment depth $h_{ef} = h_{ef,min}$ [mm]	64	80	96	128	160	192
Base material thickness $h = h_{min}$ [mm]	100	110	126	164	204	248
Edge distance $c = c_{min}$ [mm]	40	50	60	80	100	120
 <b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>						
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
 <b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>						
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - minimum embedment depth  
(load values are valid for single anchor)**

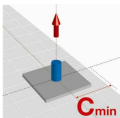
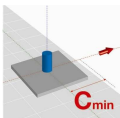
Anchor size	M8	M10	M12	M16	M20	M24
Embedment depth $h_{ef} = h_{ef,min}$ [mm]	64	80	96	128	160	192
Base material thickness $h = h_{min}$ [mm]	100	110	126	164	204	248
Spacing $s = s_{min}$ [mm]	40	50	60	80	100	120
 <b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>						
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
 <b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>						
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



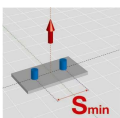
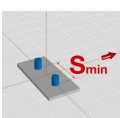
**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - typical embedment depth**

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
	<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>						
	HIT-V(-F) 5.8 [kN]	12,0	17,3	25,3	36,3	56,4	79,2
	HIT-V(-F) 8.8 [kN]						
	HIT-V-R HIT-V-HCR	13,4	17,3	25,3	36,3	56,4	79,2
	<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>						
	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 HIT-V-HCR	8,3	12,8	19,2	35,3	55,1	79,5

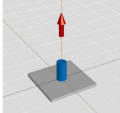
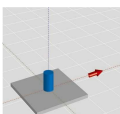
**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - typical embedment depth**

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
	<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>						
	HIT-V(-F) 5.8 [kN]						
	HIT-V(-F) 8.8 [kN]	7,7	10,1	14,7	21,6	33,9	48,0
	HIT-V-R HIT-V-HCR						
	<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>						
	HIT-V(-F) 5.8 [kN]						
	HIT-V(-F) 8.8 [kN]	3,7	5,3	7,3	11,6	17,2	23,6
	HIT-V-R HIT-V-HCR						

**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - typical embedment depth  
(load values are valid for single anchor)**

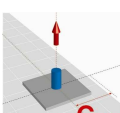
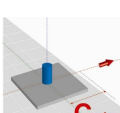
Anchor size		M8	M10	M12	M16	M20	M24
Embedment depth $h_{ef} = h_{ef,typ}$ [mm]		80	90	110	130	170	210
Base material thickness $h = h_{min}$ [mm]		110	120	140	166	214	266
Spacing $s$ [mm]		40	50	60	80	100	120
	<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>						
	HIT-V(-F) 5.8 [kN]						
	HIT-V(-F) 8.8 [kN]	8,9	11,3	16,3	23,0	35,4	49,7
	HIT-V-R HIT-V-HCR						
	<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>						
	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 HIT-V-HCR	8,3	12,8	19,2	35,3	55,1	79,5

Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - embedment depth = 12 d <sup>a)</sup>

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
 <b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>						
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
 <b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>						
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

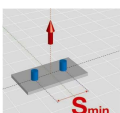
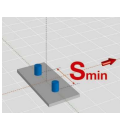
a) d = element diameter

Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - embedment depth = 12 d <sup>a)</sup>

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
 <b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>						
HIT-V(-F) 5.8 [kN]	9,2	13,4	19,3	31,9	47,9	66,2
HIT-V(-F) 8.8						
HIT-V-R						
HIT-V-HCR						
 <b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>						
HIT-V(-F) 5.8 [kN]	3,9	5,7	7,8	12,9	18,9	25,9
HIT-V(-F) 8.8						
HIT-V-R						
HIT-V-HCR						

a) d = element diameter






Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - embedment depth = 12 d <sup>a)</sup>  
(load values are valid for single anchor)

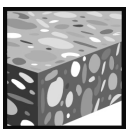
Anchor size	M8	M10	M12	M16	M20	M24
Embedment depth $h_{ef} = 12 d^a$ [mm]	96	120	144	192	240	288
Base material thickness $h = h_{min}$ [mm]	126	150	174	228	284	344
Spacing $s = s_{min}$ [mm]	40	50	60	80	100	120
 <b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>						
HIT-V(-F) 5.8 [kN]	10,8	15,5	22,0	35,4	52,1	70,9
HIT-V(-F) 8.8						
HIT-V-R						
HIT-V-HCR						
 <b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>						
HIT-V(-F) 5.8 [kN]	7,2	12,0	16,8	31,2	48,8	70,4
HIT-V(-F) 8.8 [kN]						
HIT-V-R [kN]						
HIT-V-HCR [kN]						

a) d = element diameter



## Hilti HIT-HY 150 with HIT-V / HAS

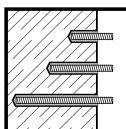
Injection mortar system		Benefits
	<p>Hilti HIT-HY 150 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)</p>	<ul style="list-style-type: none"> <li>- suitable for non-cracked concrete C 20/25 to C 50/60</li> <li>- suitable for dry and water saturated concrete</li> <li>- high loading capacity</li> <li>- rapid curing</li> </ul>
	<p>Static mixer</p>	<ul style="list-style-type: none"> <li>- small edge distance and anchor spacing possible</li> <li>- large diameter applications</li> </ul>
	<p>HAS rods HAS-R rods HAS-HCR rods</p>	<ul style="list-style-type: none"> <li>- high corrosion resistant</li> <li>- in service temperature range up to 120°C short term/72°C long term</li> </ul>
	<p>HAS-E rods HAS-E-R rods</p>	<ul style="list-style-type: none"> <li>- manual cleaning for anchor size M8 to M16 and embedment depth <math>h_{ef} \leq 10d</math></li> </ul>
	<p>HIT-V rods HIT-V-R rods HIT-V-HCR rods</p>	<ul style="list-style-type: none"> <li>- embedment depth range M8: 60 to 160 mm M30: 120 to 600 mm</li> </ul>



Concrete



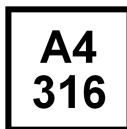
Small edge distance and spacing



Variable embedment depth



Fire resistance



Corrosion resistance



High corrosion resistance



PROFIS Anchor design software

### Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Fire test report	MFPA Braunschweig	UB 3027 / 0274-6 / 1994-06-30
Assessment report (fire)	warringtonfire	WF 166402 / 2007-10-26

a) All data given in this section according ETA-05/0051 issue 2011-03-17.

### 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- Temperate range I  
(min. base material temperature  $-40^\circ\text{C}$ , max. long term/short term base material temperature:  $+24^\circ\text{C}/40^\circ\text{C}$ )
- Installation temperature range  $-5^\circ\text{C}$  to  $+40^\circ\text{C}$

### Embedment depth <sup>a)</sup> 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 <sup>a)</sup>: 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  $\gamma = 1,4$ . 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 150 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/mm <sup>2</sup> ]	500	500	500	500	500	500	500	500
	HIT-V/HAS 8.8	[N/mm <sup>2</sup> ]	800	800	800	800	800	800	800	800
	HIT-V/HAS -R	[N/mm <sup>2</sup> ]	700	700	700	700	700	700	500	500
	HIT-V/HAS -HCR	[N/mm <sup>2</sup> ]	800	800	800	800	800	700	700	700
Yield strength $f_{yk}$	HIT-V/HAS 5.8	[N/mm <sup>2</sup> ]	400	400	400	400	400	400	400	400
	HIT-V/HAS 8.8	[N/mm <sup>2</sup> ]	640	640	640	640	640	640	640	640
	HIT-V/HAS -R	[N/mm <sup>2</sup> ]	450	450	450	450	450	450	210	210
	HIT-V/HAS -HCR	[N/mm <sup>2</sup> ]	600	600	600	600	600	400	400	400
Stressed cross-section $A_s$	HAS	[mm <sup>2</sup> ]	32,8	52,3	76,2	144	225	324	427	519
	HIT-V	[mm <sup>2</sup> ]	36,6	58,0	84,3	157	245	353	459	561
Moment of resistance $W$	HAS	[mm <sup>3</sup> ]	27,0	54,1	93,8	244	474	809	1274	1706
	HIT-V	[mm <sup>3</sup> ]	31,2	62,3	109	277	541	935	1387	1874

### Material quality

Part	Material
Threaded rod HIT-V(F), HAS 5.8: M8 – M24	Strength class 5.8, A <sub>5</sub> > 8% ductile steel galvanized ≥ 5 μm, (F) hot dipped galvanized ≥ 45 μm,
Threaded rod HIT-V(F), HAS 8.8: M27 – M30	Strength class 8.8, A <sub>5</sub> > 8% ductile steel galvanized ≥ 5 μm, (F) hot dipped galvanized ≥ 45 μm,
Threaded rod HIT-V-R, HAS-R	Stainless steel grade A4, A <sub>5</sub> > 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 <sub>m</sub> = 800 N/mm <sup>2</sup> , R <sub>p0.2</sub> = 640 N/mm <sup>2</sup> , A <sub>5</sub> > 8% ductile M24 to M30: R <sub>m</sub> = 700 N/mm <sup>2</sup> , R <sub>p0.2</sub> = 400 N/mm <sup>2</sup> , A <sub>5</sub> > 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-R, HAS-HCR HAS-E, HAS-E-R	M8x80	M10x90	M12x110	M16x125	M20x170	M24x210	M27x240	M30x270
Embedment depth h <sub>ef</sub> [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

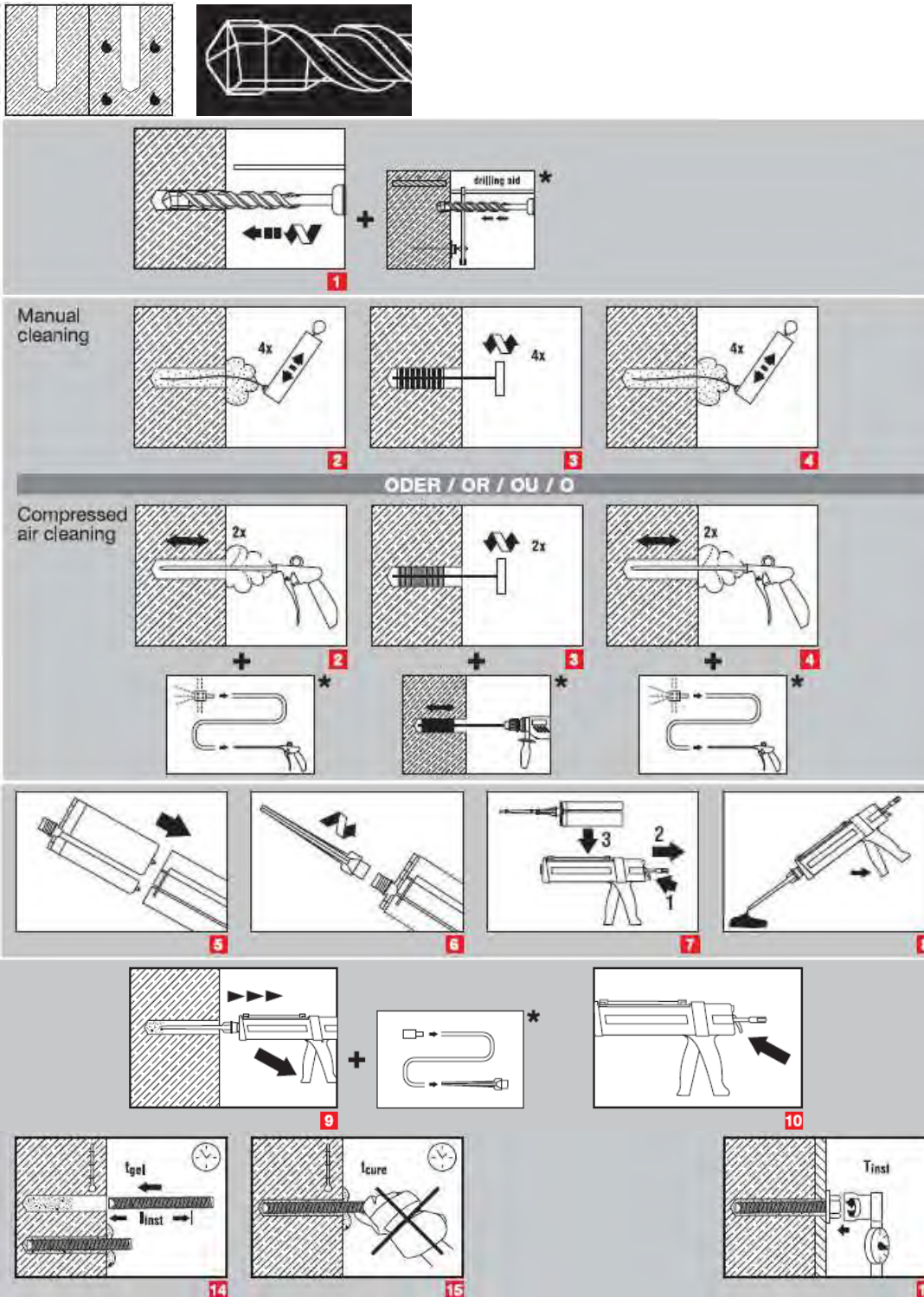
#### installation equipment

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Rotary hammer	TE 2 – TE 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)

b)

**a) Note:** Manual cleaning for element sizes  $d \leq 16\text{mm}$  and embedment depth  $h_{ef} \leq 10 d$  only!

**b) Note:** Extension and piston plug needed for overhead installation and/or embedment depth  $> 250\text{mm}$ !

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

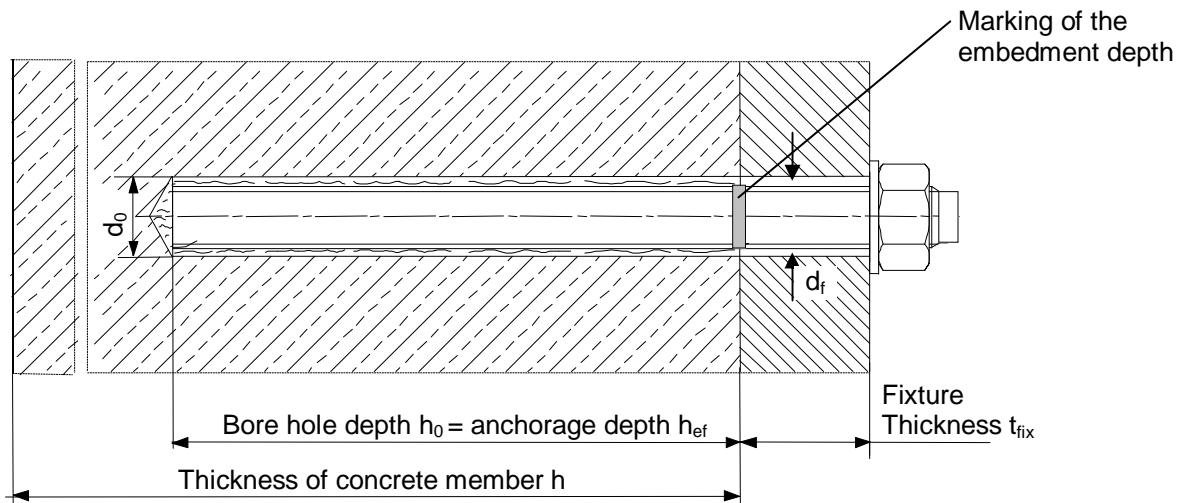


## Working time, Curing time

Temperature of the base material $T_{BM}$	Working time $t_{gel}$	Curing time $t_{cure}^{a)}$
$-5\text{ °C} \leq T_{BM} < 0\text{ °C}$	90 min	9 h
$0\text{ °C} \leq T_{BM} < 5\text{ °C}$	45 min	4,5 h
$5\text{ °C} \leq T_{BM} < 10\text{ °C}$	20 min	2 h
$10\text{ °C} \leq T_{BM} < 20\text{ °C}$	6 min	90 min
$20\text{ °C} \leq T_{BM} < 30\text{ °C}$	4 min	50 min
$30\text{ °C} \leq T_{BM} \leq 40\text{ °C}$	2 min	40 min

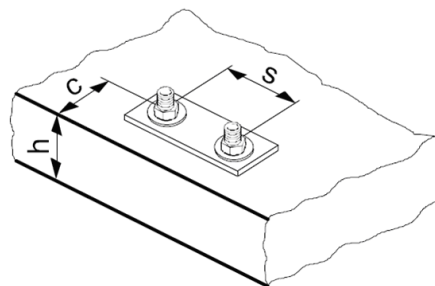
a) The curing time data are valid for dry anchorage base only. For water saturated anchorage bases the curing times must be doubled.

## 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	24	28	30	35
Effective embedment and drill hole depth range <sup>a)</sup> <b>for HIT-V</b>	$h_{ef,min}$	[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 <b>for HAS</b>	$h_{ef}$	[mm]	80	90	110	125	170	210	240	270
Minimum base material thickness	$h_{min}$	[mm]	$h_{ef} + 30 \text{ mm}$ $\geq 100 \text{ mm}$			$h_{ef} + 2 d_0$				
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 <sup>c)</sup>	$c_{cr,sp}$	[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 <sup>d)</sup>	$c_{cr,N}$	[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.

- 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 safe 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)

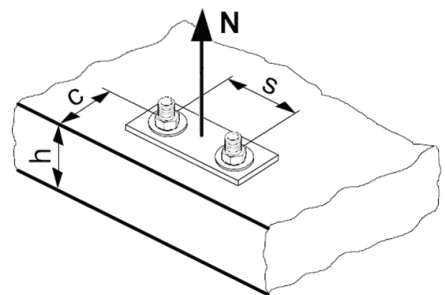
The values are valid for one anchor.

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



### 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

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

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
$N_{Rd,p}^0$	Temperature range I [kN]	14,7	17,3	25,3	26,9	43,2	60,3	72,7	84,8
$N_{Rd,p}^0$	Temperature range II [kN]	10,1	11,8	17,3	18,0	28,0	37,7	48,5	60,6
$N_{Rd,p}^0$	Temperature range III [kN]	8,7	10,2	15,0	15,0	25,4	33,9	38,8	48,5

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

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

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
$N_{Rd,c}^0$	[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)

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

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)

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

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

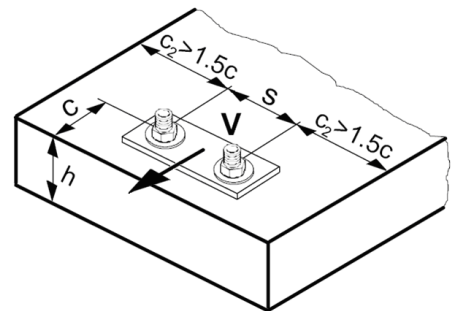
$h_{ef}$ [mm]	40	50	60	70	80	90	$\geq 100$
$f_{re,N} = 0,5 + h_{ef}/200\text{mm} \leq 1$	0,7 <sup>a)</sup>	0,75 <sup>a)</sup>	0,8 <sup>a)</sup>	0,85 <sup>a)</sup>	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



### Basic design shear resistance

#### Design steel resistance $V_{Rd,s}$

Anchor size		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 $V_{Rd,cp} = \text{lower value}^a)$ of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

$$k = 2 \text{ for } h_{ef} \geq 60 \text{ mm}$$

- a)  $N_{Rd,p}$ : Design combined pull-out and concrete cone resistance  
 $N_{Rd,c}$ : Design concrete cone resistance

#### Design concrete edge resistance $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete									
$V_{Rd,c}^0$	[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 $\beta$	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 <sup>a)</sup> for concrete edge resistance: $f_4$

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sup>a)</sup>

$c/d$	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".

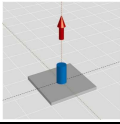
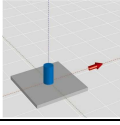
## Precalculated values – design resistance values

All data applies to:

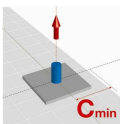
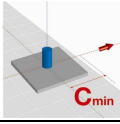
- non-cracked concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$
- temperature range I (see Service temperature range)
- minimum thickness of base material
- no effects of dense reinforcement

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

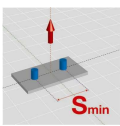
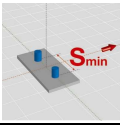
**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - minimum embedment depth**

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
 <b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>								
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
 <b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>								
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - minimum embedment depth**

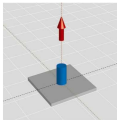
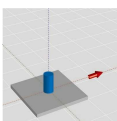
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth $h_{ef} = h_{ef,min}$ [mm]	60	60	70	80	90	100	110	120
Base material thickness $h = h_{min}$ [mm]	100	100	100	116	138	156	170	190
Edge distance $c = c_{min}$ [mm]	40	50	60	80	100	120	135	150
 <b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>								
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
 <b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>								
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - minimum embedment depth  
(load values are valid for single anchor)**

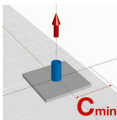
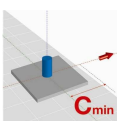
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth $h_{ef} = h_{ef,min}$ [mm]	60	60	70	80	90	100	110	120
Base material thickness $h = h_{min}$ [mm]	100	100	100	116	138	156	170	190
Spacing $s = s_{min}$ [mm]	40	50	60	80	100	120	135	150
 <b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>								
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
 <b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>								
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



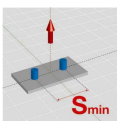
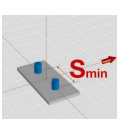
**esign resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - typical embedment depth**

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	
	<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>									
	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	
	<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>									
	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	

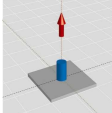
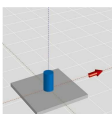
**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - typical embedment depth**

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	
	<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>									
	HIT-V 5.8 [kN]	8,6	10,1	14,7	16,4	26,7	37,8	46,3	55,0	
	HIT-V 8.8 [kN]									
	HIT-V-R [kN]									
	HIT-V-HCR [kN]									
	<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>									
	HIT-V 5.8 [kN]	3,7	5,3	7,3	11,5	17,2	23,6	29,0	34,8	
	HIT-V 8.8 [kN]									
	HIT-V-R [kN]									
	HIT-V-HCR [kN]									

**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - typical embedment depth  
(load values are valid for single anchor)**

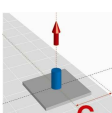
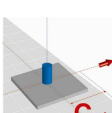
Anchor size		M8	M10	M12	M16	M20	M24	M27	M30	
Embedment depth $h_{ef} = h_{ef,typ}$ [mm]		80	90	110	125	170	210	240	270	
Base material thickness $h = h_{min}$ [mm]		110	120	140	161	218	266	300	340	
Spacing $s$ [mm]		40	50	60	80	100	120	135	150	
	<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>									
	HIT-V 5.8 [kN]	9,9	11,3	16,3	17,5	28,2	39,4	47,9	56,5	
	HIT-V 8.8 [kN]									
	HIT-V-R [kN]									
	HIT-V-HCR [kN]									
	<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>									
	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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - embedment depth = 12 d<sup>a)</sup>

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
 <b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>								
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
 <b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>								
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

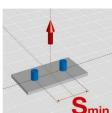
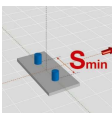
a) d = element diameter

Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - embedment depth = 12 d<sup>a)</sup>

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
 <b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>								
HIT-V 5.8 [kN]								
HIT-V 8.8 [kN]	10,3	13,4	19,3	25,2	37,7	51,9	62,6	73,4
HIT-V-R [kN]								
HIT-V-HCR [kN]								
 <b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>								
HIT-V 5.8 [kN]								
HIT-V 8.8 [kN]	3,9	5,7	7,8	12,9	18,9	25,9	31,8	38,1
HIT-V-R [kN]								
HIT-V-HCR [kN]								

a) d = element diameter




Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$  - embedment depth = 12 d<sup>a)</sup>  
(load values are valid for single anchor)

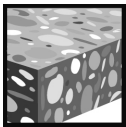
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth $h_{ef} = 12 d^a)$ [mm]	96	120	144	192	240	288	324	360
Base material thickness $h = h_{min}$ [mm]	126	150	174	228	288	344	384	430
Spacing $s = s_{min}$ [mm]	40	50	60	80	100	120	135	150
 <b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>								
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 [kN]								
HIT-V-R [kN]	12,1	15,5	22,0	28,0	41,2	55,8	66,6	77,3
HIT-V-HCR [kN]								
 <b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>								
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 150 with HIS-(R)N

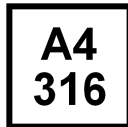
Injection mortar system		Benefits
	Hilti HIT-HY 150 330 ml foil pack  (also available as 500 ml and 1400 ml foil pack)	<ul style="list-style-type: none"> <li>- suitable for non-cracked concrete C 20/25 to C 50/60</li> <li>- suitable for dry and water saturated concrete</li> <li>- high loading capacity</li> <li>- rapid curing</li> <li>- small edge distance and anchor spacing possible</li> <li>- corrosion resistant</li> <li>- in service temperature range up to 120°C short term/72°C long term</li> <li>- manual cleaning for anchor size M8 and M10</li> </ul>
	Static mixer	
	Internal threaded sleeve HIS-N HIS-RN	



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

- 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- 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

For details see Simplified design method

### 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 <sup>a)</sup>: 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  $\gamma = 1,4$ . 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 150 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/mm <sup>2</sup> ]	490	490	460	460	460
	Screw 8.8	[N/mm <sup>2</sup> ]	800	800	800	800	800
	HIS-RN	[N/mm <sup>2</sup> ]	700	700	700	700	700
	Screw A4-70	[N/mm <sup>2</sup> ]	700	700	700	700	700
Yield strength $f_{yk}$	HIS-N	[N/mm <sup>2</sup> ]	410	410	375	375	375
	Screw 8.8	[N/mm <sup>2</sup> ]	640	640	640	640	640
	HIS-RN	[N/mm <sup>2</sup> ]	350	350	350	350	350
	Screw A4-70	[N/mm <sup>2</sup> ]	450	450	450	450	450
Stressed cross-section $A_s$	HIS-(R)N	[mm <sup>2</sup> ]	51,5	108,0	169,1	256,1	237,6
	Screw	[mm <sup>2</sup> ]	36,6	58	84,3	157	245
Moment of resistance $W$	HIS-(R)N	[mm <sup>3</sup> ]	145	430	840	1595	1543
	Screw	[mm <sup>3</sup> ]	31,2	62,3	109	277	541

### Material quality

Part	Material
Internal threaded sleeve <sup>a)</sup> HIS-N	C-steel 1.0718, Steel galvanized $\geq 5\mu\text{m}$
Internal threaded sleeve <sup>a)</sup> HIS-RN	Stainless steel 1.4401 and 1.4571

- a) related fastening screw: strength class 8.8, A5 > 8% Ductile  
steel galvanized  $\geq 5\mu\text{m}$
- 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			M8x90	M10x110	M12x125	M16x170	M20x205
Internal threaded sleeve HIS-N / HIS-RN							
Embedment depth	$h_{ef}$	[mm]	80	90	110	125	170

## Setting

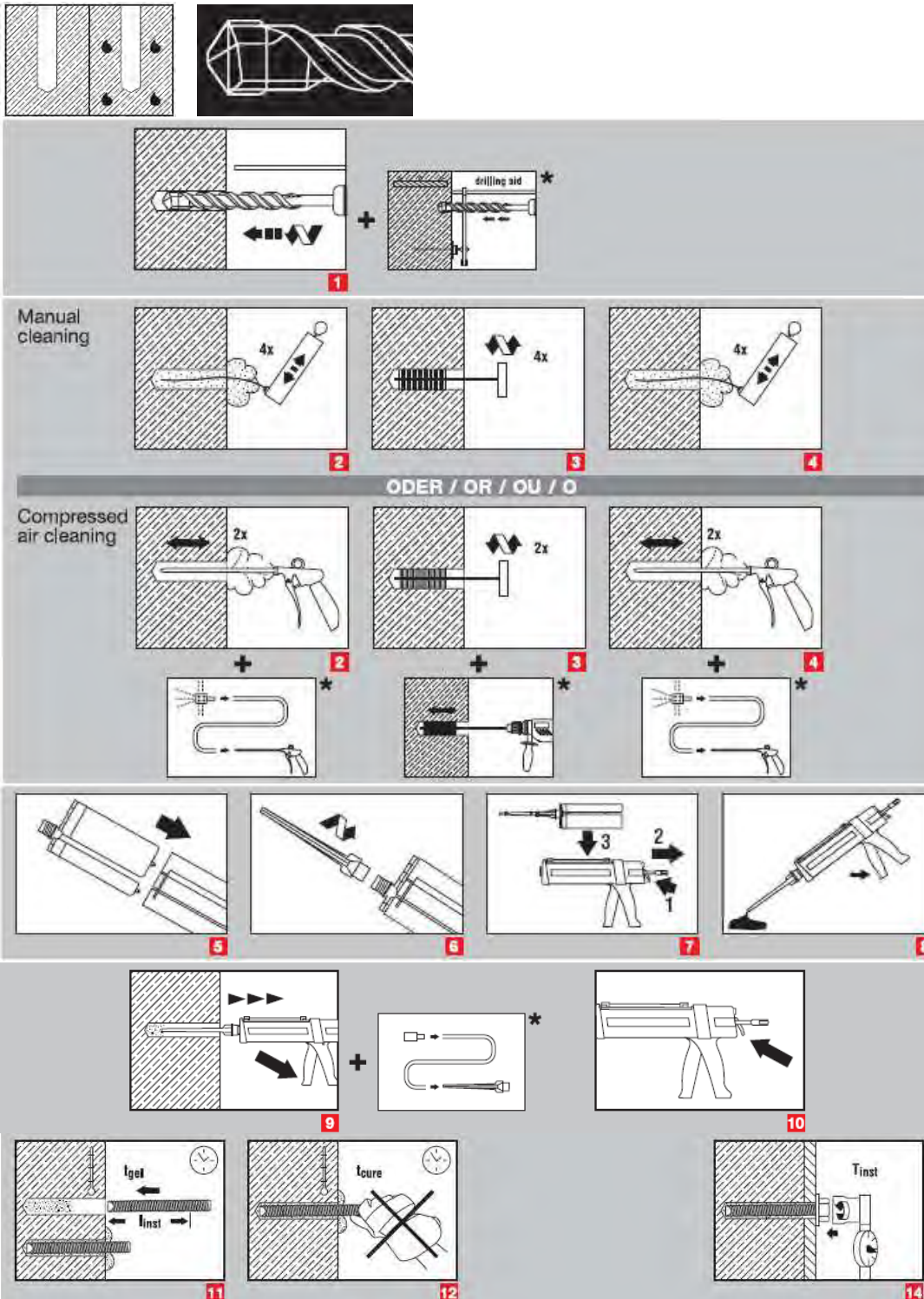
### installation equipment

Anchor size	M8x90	M10x110	M12x125	M16x170	M20x205
Rotary hammer	TE 2 – TE 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)

b)

**a) Note:** Manual cleaning for HIS-(R)N M8 and HIS-(R)N M10 only!

**b) Note:** Extension and piston plug needed for overhead installation!

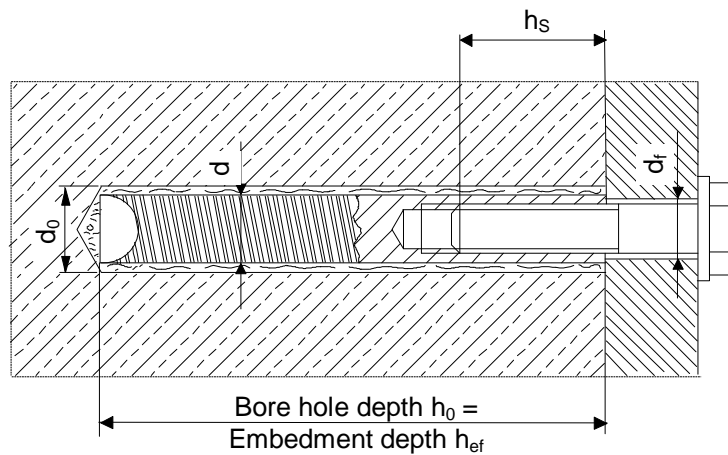
For detailed information on installation see instruction for use given with the package of the product.

### Working time, Curing time

Temperature of the base material $T_{BM}$	Working time $t_{gel}$	Curing time $t_{cure}^{a)}$
$-5\text{ °C} \leq T_{BM} < 0\text{ °C}$	90 min	9 h
$0\text{ °C} \leq T_{BM} < 5\text{ °C}$	45 min	4,5 h
$5\text{ °C} \leq T_{BM} < 10\text{ °C}$	20 min	2 h
$10\text{ °C} \leq T_{BM} < 20\text{ °C}$	6 min	90 min
$20\text{ °C} \leq T_{BM} < 30\text{ °C}$	4 min	50 min
$30\text{ °C} \leq T_{BM} \leq 40\text{ °C}$	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 <sup>a)</sup>	$T_{max}$	[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 <sup>b)</sup>	$c_{cr,sp}$	[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 <sup>c)</sup>	$c_{cr,N}$	[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.

- 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)

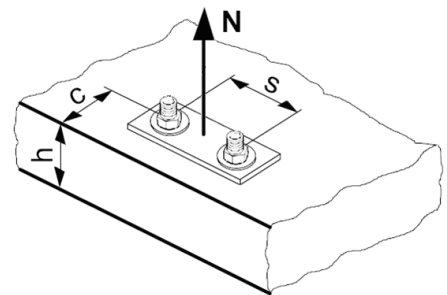
The values are valid for one anchor.

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



## 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

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

Anchor size		M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth	$h_{ef}$ [mm]	90	110	125	170	205
$N_{Rd,p}^0$	Temperature range I [kN]	23,3	26,7	40,0	63,9	77,8
$N_{Rd,p}^0$	Temperature range II [kN]	13,3	20,0	26,7	41,7	52,8
$N_{Rd,p}^0$	Temperature range III [kN]	10,7	13,3	20,0	27,8	33,3

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

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

Anchor size		M8	M10	M12	M16	M20
$N_{Rd,c}^0$	[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
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,15}$ <sup>a)</sup>	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
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ <sup>a)</sup>	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 <sup>a)</sup>

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

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 <sup>a)</sup>

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

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

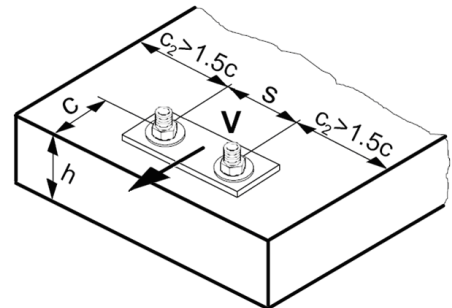
$h_{ef}$ [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,7 <sup>a)</sup>	0,75 <sup>a)</sup>	0,8 <sup>a)</sup>	0,85 <sup>a)</sup>	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



## Basic design shear resistance

### Design steel resistance $V_{Rd,s}$

Anchor size		M8x90	M10x110	M12x125	M16x170	M20x205
$V_{Rd,s}$	HIS-N [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<sup>a)</sup> of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

$$k = 2 \text{ for } h_{ef} \geq 60 \text{ mm}$$

- a)  $N_{Rd,p}$ : Design combined pull-out and concrete cone resistance  
 $N_{Rd,c}$ : Design concrete cone resistance

### Design concrete edge resistance $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		M8	M10	M12	M16	M20
Non-cracked concrete						
$V_{Rd,c}^0$ [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 $\beta$	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 <sup>a)</sup> for concrete edge resistance:  $f_4$

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sup>a)</sup>

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".

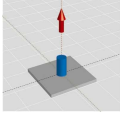
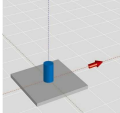
### Precalculated values – design resistance values

All data applies to:

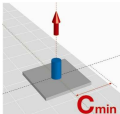
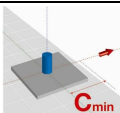
- non-cracked concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$
- temperature range I (see Service temperature range)
- minimum thickness of base material
- no effects of dense reinforcement

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

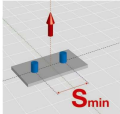
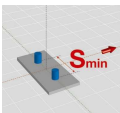
**Design resistance: non-cracked- concrete C 20/25**

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
	<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>					
	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
	<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>					
	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
	<b>Tensile <math>N_{Rd}</math>: single single anchor, min. edge distance (<math>c = c_{min}</math>)</b>					
	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
	<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>					
	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

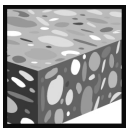
**Design resistance: non-cracked- concrete C 20/25**

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
	<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>					
	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
	<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>					
	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 150 with rebar

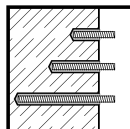
Injection mortar system		Benefits
	<p>Hilti HIT-HY 150 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)</p> <p>Static mixer</p> <p>rebar BSt 500 S</p>	<ul style="list-style-type: none"> <li>- suitable for non-cracked concrete C 20/25 to C 50/60</li> <li>- suitable for dry and water saturated concrete</li> <li>- high loading capacity</li> <li>- rapid curing</li> <li>- small edge distance and anchor spacing possible</li> <li>- large diameter applications</li> <li>- in service temperature range up to 120°C short term/72°C long term</li> <li>- manual cleaning for anchor size <math>\varnothing 8</math> to <math>\varnothing 14</math> and embedment depth <math>h_{ef} \leq 10d</math></li> <li>- embedment depth range                             <ul style="list-style-type: none"> <li><math>\varnothing 8</math>: 60 to 160 mm</li> <li><math>\varnothing 25</math>: 120 to 500 mm</li> </ul> </li> </ul>



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

- 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- 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

For details see Simplified design method



**Embedment depth <sup>a)</sup> 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 $h_{ef} = h_{ef,typ}$ <sup>b)</sup> [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 <sup>a)</sup>: 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  $\gamma = 1,4$ . 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 150 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/mm <sup>2</sup> ]	550						
Yield strength $f_{yk}$	BSt 500 S	[N/mm <sup>2</sup> ]	500						
Stressed cross-section $A_s$	BSt 500 S	[mm <sup>2</sup> ]	50,3	78,5	113,1	153,9	201,1	314,2	490,9
Moment of resistance $W$	BSt 500 S	[mm <sup>3</sup> ]	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						

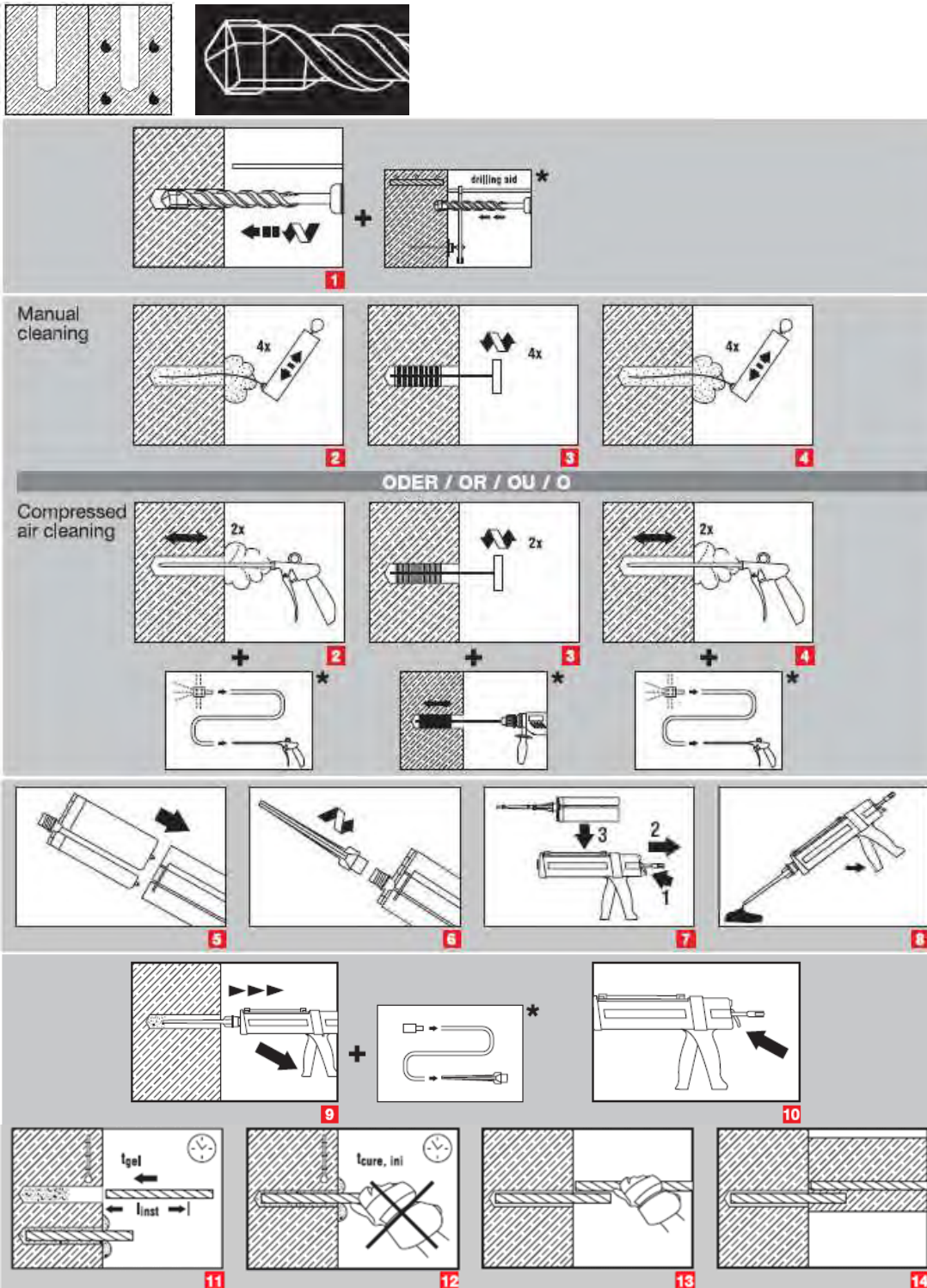
## Setting

### installation equipment

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Rotary hammer	TE 2 – TE 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)

b)

**a) Note:** Manual cleaning for element sizes  $d \leq 14\text{mm}$  and embedment depth  $h_{ef} \leq 10 d$  only!

**b) Note:** Extension and piston plug needed for overhead installation and/or embedment depth  $> 250\text{mm}$ !

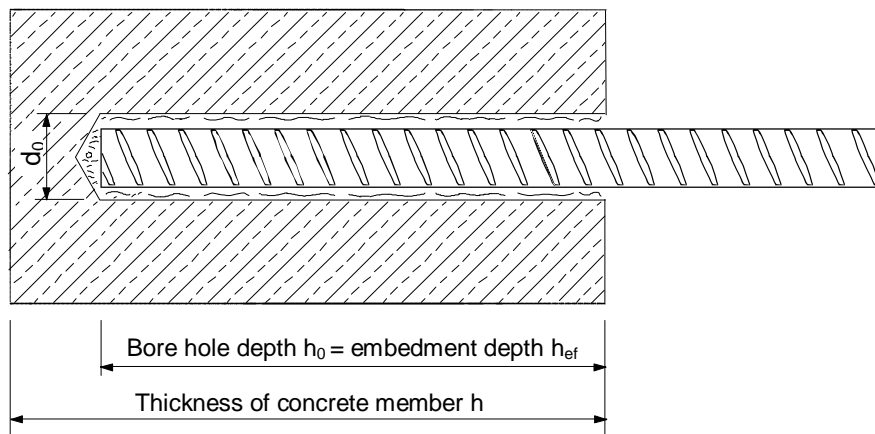
For detailed information on installation see instruction for use given with the package of the product.

### Working time, Curing time

Temperature of the base material $T_{BM}$	Working time $t_{gel}$	Curing time $t_{cure}^{a)}$
$-5\text{ °C} \leq T_{BM} < 0\text{ °C}$	90 min	9 h
$0\text{ °C} \leq T_{BM} < 5\text{ °C}$	45 min	4,5 h
$5\text{ °C} \leq T_{BM} < 10\text{ °C}$	20 min	2 h
$10\text{ °C} \leq T_{BM} < 20\text{ °C}$	6 min	90 min
$20\text{ °C} \leq T_{BM} < 30\text{ °C}$	4 min	50 min
$30\text{ °C} \leq T_{BM} \leq 40\text{ °C}$	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 <sup>a)</sup> <b>for rebar BSt 500 S</b>	$h_{ef,min}$	[mm]	60	60	70	75	80	90	100
	$h_{ef,max}$	[mm]	160	200	240	280	320	400	500
Minimum base material thickness	$h_{min}$	[mm]	$h_{ef} + 30 \text{ mm}$ $\geq 100 \text{ mm}$		$h_{ef} + 2 d_0$				
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 <sup>b)</sup>	$c_{cr,sp}$	[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 <sup>c)</sup>	$c_{cr,N}$	[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.

- Embedment depth range:  $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$
- $h$ : base material thickness ( $h \geq h_{min}$ ),  $h_{ef}$ : embedment depth
- 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.

- 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)

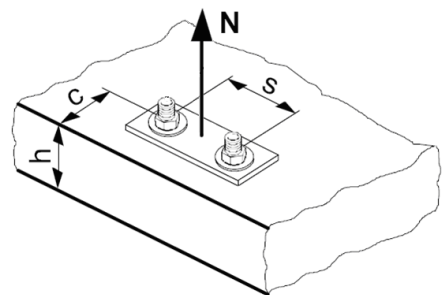
The values are valid for one anchor.

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



## 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

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

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
$N_{Rd,p}^0$ Temperature range I	[kN]	11,4	13,4	19,6	19,6	26,0	38,1	58,9
$N_{Rd,p}^0$ Temperature range II	[kN]	8,0	9,4	13,8	13,1	17,4	25,4	39,3
$N_{Rd,p}^0$ Temperature range III	[kN]	6,7	7,9	11,5	11,8	15,6	22,9	35,3

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

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

Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
$N_{Rd,c}^0$	[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
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,15}$ <sup>a)</sup>	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
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ <sup>a)</sup>	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 <sup>a)</sup>

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

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 <sup>a)</sup>

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

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 <sup>a)</sup>	0,75 <sup>a)</sup>	0,8 <sup>a)</sup>	0,85 <sup>a)</sup>	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

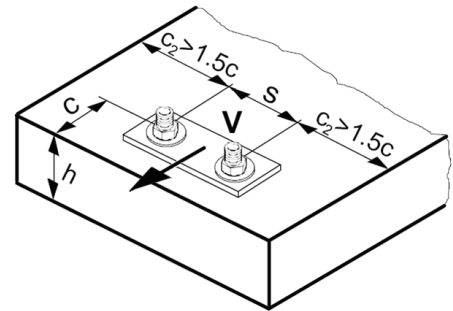
a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  mm, then a factor  $f_{re,N} = 1$  may be applied.



## Shear loading

The design shear resistance is the lower value of

- Steel resistance:  $V_{Rd,s}$
- Concrete pryout resistance:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_\beta \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



## Basic design shear resistance

### Design steel resistance $V_{Rd,s}$

Anchor size	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 $V_{Rd,cp} = \text{lower value}^a)$ of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

$$k = 2 \text{ for } h_{ef} \geq 60 \text{ mm}$$

- a)  $N_{Rd,p}$ : Design combined pull-out and concrete cone resistance  
 $N_{Rd,c}$ : Design concrete cone resistance

### Design concrete edge resistance $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_\beta \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Non-cracked concrete							
$V_{Rd,c}^0$ [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 $\beta$	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 <sup>a)</sup> for concrete edge resistance: $f_4$

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sub>ef</sub> /d	4	4,5	5	6	7	8	9	10	11
f <sub>hef</sub> = 0,05 · (h <sub>ef</sub> / d) <sup>1,68</sup>	0,51	0,63	0,75	1,01	1,31	1,64	2,00	2,39	2,81
h <sub>ef</sub> /d	12	13	14	15	16	17	18	19	20
f <sub>hef</sub> = 0,05 · (h <sub>ef</sub> / d) <sup>1,68</sup>	3,25	3,72	4,21	4,73	5,27	5,84	6,42	7,04	7,67

### Influence of edge distance <sup>a)</sup>

c/d	4	6	8	10	15	20	30	40
f <sub>c</sub> = (d / c) <sup>0,19</sup>	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".

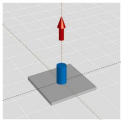
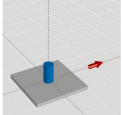
### Precalculated values – design resistance values

All data applies to:

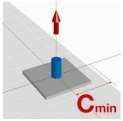
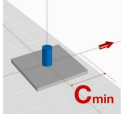
- non-cracked concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$
- temperature range I (see Service temperature range)
- minimum thickness of base material
- no effects of dense reinforcement

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

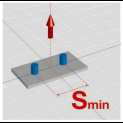
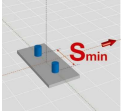
**Design resistance: non- cracked concrete C 20/25 - minimum embedment depth**

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
	<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>							
BSt 500 S [kN]		8,5	8,9	12,5	12,6	16,2	22,4	27,7
	<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>							
BSt 500 S [kN]		9,3	14,7	20,7	25,1	32,3	44,9	55,5

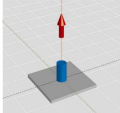
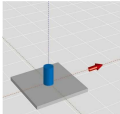
**Design resistance: non- cracked concrete C 20/25 - minimum embedment depth**

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
	<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>							
BSt 500 S [kN]		5,3	6,0	8,5	9,4	13,0	17,4	21,5
	<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>							
BSt 500 S [kN]		3,5	4,9	6,6	10,0	13,2	17,4	21,8

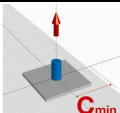
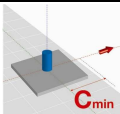
**Design resistance: non- cracked concrete C 20/25 - minimum embedment depth  
(load values are valid for single anchor)**

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
	<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>							
BSt 500 S [kN]		5,9	6,2	8,5	8,7	11,1	15,2	19,3
	<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>							
BSt 500 S [kN]		9,3	11,4	16,0	16,2	20,9	29,9	40,4

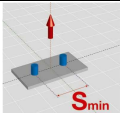
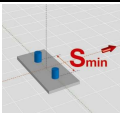
### Design resistance: non- cracked concrete C 20/25 - typical embedment depth

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
	<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>							
BSt 500 S [kN]		11,4	13,4	19,6	19,6	26,0	38,1	58,9
	<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>							
BSt 500 S [kN]		9,3	14,7	20,7	28,0	36,7	57,3	90,0

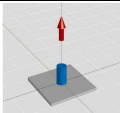
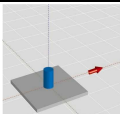
### Design resistance: non- cracked concrete C 20/25 - typical embedment depth

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
	<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>							
BSt 500 S [kN]		7,0	8,3	12,1	13,4	18,8	26,9	37,0
	<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>							
BSt 500 S [kN]		3,7	5,3	7,3	11,2	15,8	21,5	27,5

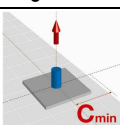
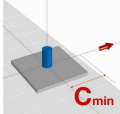
### Design resistance: non- cracked concrete C 20/25 - typical embedment depth (load values are valid for single anchor)

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
	<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>							
BSt 500 S [kN]		8,0	9,3	13,4	13,7	18,0	25,8	40,2
	<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>							
BSt 500 S [kN]		9,3	14,7	20,7	23,3	30,8	45,6	72,9

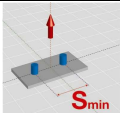
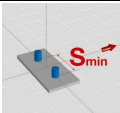
**Design resistance: non- cracked concrete C 20/25 - embedment depth = 12 d<sup>a)</sup>**

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
	<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>							
BSt 500 S [kN]		13,7	17,8	25,6	26,4	34,5	53,9	84,1
	<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>							
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<sup>a)</sup>**

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
	<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>							
BSt 500 S [kN]		8,4	11,0	15,8	18,1	24,9	37,9	55,9
	<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>							
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<sup>a)</sup>**  
(load values are valid for single anchor)

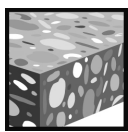
Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth $h_{ef} = 12 d^{a)}$ [mm]		96	120	144	168	192	240	300
Base material thickness $h = h_{min}$ [mm]		126	150	176	204	232	290	364
Spacing $s = s_{min}$ [mm]		40	50	60	80	100	120	135
	<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>							
BSt 500 S [kN]		9,7	12,5	17,9	18,7	24,2	37,3	59,2
	<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>							
BSt 500 S [kN]		9,3	14,7	20,7	28,0	36,7	57,3	90,0

a) d = element diameter



## Hilti HIT-ICE with HIT-V / HAS

Injection mortar system		Benefits
	Hilti HIT-ICE 296 ml cartridge	<ul style="list-style-type: none"> <li>- suitable for non-cracked concrete C 20/25 to C 50/60</li> <li>- high loading capacity</li> <li>- suitable for dry and water saturated concrete</li> <li>- high corrosion resistant</li> <li>- odourless resin</li> <li>- low installation temperature (range -23 °C to +32 °C)</li> </ul>
	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

- 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- Installation temperature range -18°C to +32°C

For details see Simplified design method

**Embedment depth <sup>a)</sup> 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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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 <sup>a)</sup>: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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  $\gamma = 1,4$ . 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

Anchor size			Hilti technical data					
			M8	M10	M12	M16	M20	M24
Nominal tensile strength $f_{uk}$	HIT-V/HAS 5.8	[N/mm <sup>2</sup> ]	500	500	500	500	500	500
	HIT-V 8.8	[N/mm <sup>2</sup> ]	800	800	800	800	800	800
	HIT-V/HAS -R	[N/mm <sup>2</sup> ]	700	700	700	700	700	700
	HIT-V/HAS -HCR	[N/mm <sup>2</sup> ]	800	800	800	800	800	700
Yield strength $f_{yk}$	HIT-V/HAS 5.8	[N/mm <sup>2</sup> ]	400	400	400	400	400	400
	HIT-V 8.8	[N/mm <sup>2</sup> ]	640	640	640	640	640	640
	HIT-V/HAS -R	[N/mm <sup>2</sup> ]	450	450	450	450	450	450
	HIT-V/HAS -HCR	[N/mm <sup>2</sup> ]	600	600	600	600	600	400
Stressed cross-section $A_s$	HAS	[mm <sup>2</sup> ]	32,8	52,3	76,2	144	225	324
	HIT-V	[mm <sup>2</sup> ]	36,6	58,0	84,3	157	245	353
Moment of resistance $W$	HAS	[mm <sup>3</sup> ]	27,0	54,1	93,8	244	474	809
	HIT-V	[mm <sup>3</sup> ]	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 $\geq 5 \mu\text{m}$ , (F) hot dipped galvanized $\geq 45 \mu\text{m}$ ,
Threaded rod HIT-V(F) 8.8	Strength class 8.8, $A_5 > 8\%$ ductile steel galvanized $\geq 5 \mu\text{m}$ , (F) hot dipped galvanized $\geq 45 \mu\text{m}$ ,
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 $\leq$ M20: $R_m = 800 \text{ N/mm}^2$ , $R_{p0.2} = 640 \text{ N/mm}^2$ , $A_5 > 8\%$ ductile M24: $R_m = 700 \text{ N/mm}^2$ , $R_{p0.2} = 400 \text{ N/mm}^2$ , $A_5 > 8\%$ 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 $\geq 5 \mu\text{m}$ , hot dipped galvanized $\geq 45 \mu\text{m}$ ,
	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					

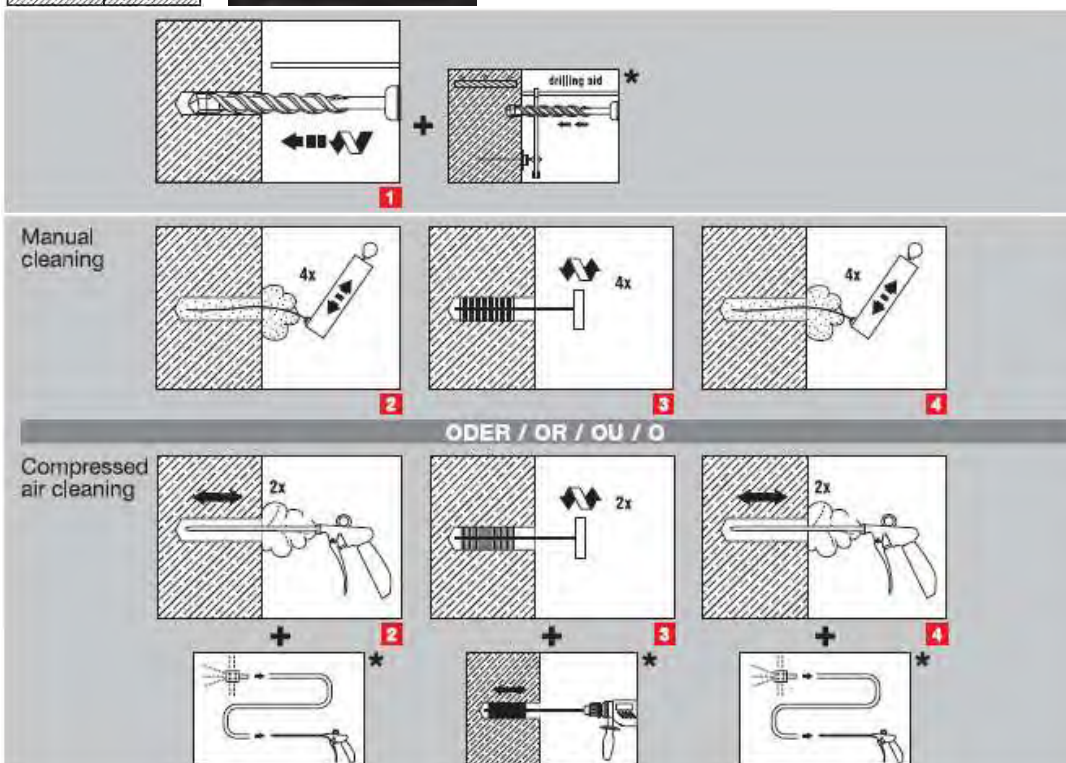
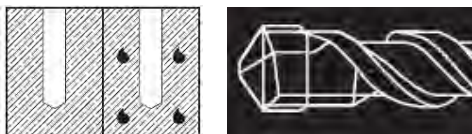
## Setting

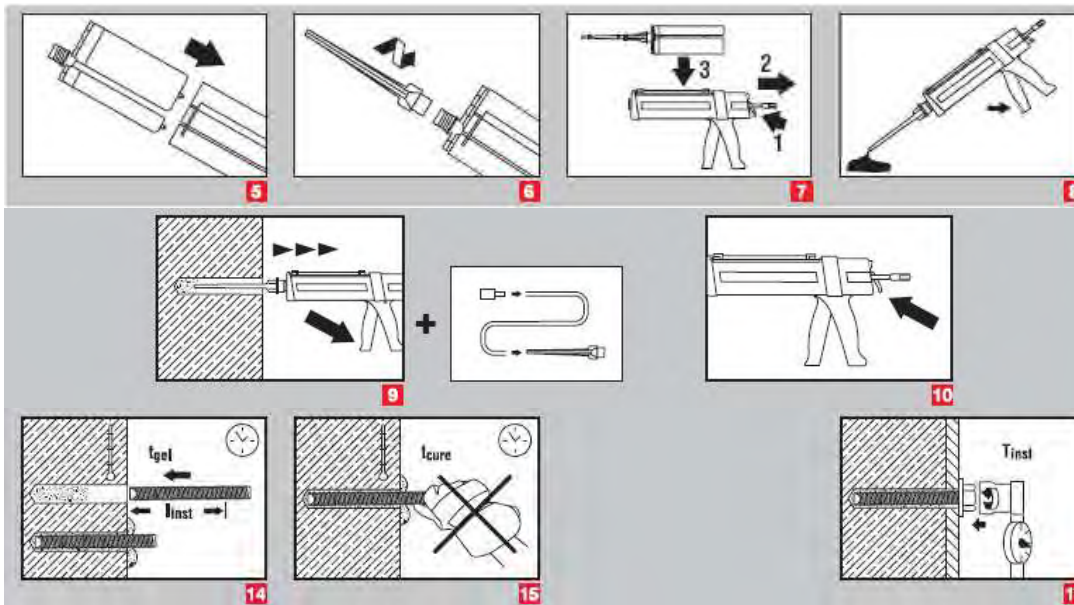
### installation equipment

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) Note:** Manual cleaning for element sizes  $d \leq 16\text{mm}$  and embedment depth  $h_{ef} \leq 10 d$  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 <sup>b)</sup>	$h_{min}$	[mm]	$h_{ef} + 30 \text{ mm}$ $\geq 100 \text{ mm}$			$h_{ef} + 2 d_0$		
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 <sup>c)</sup>	$c_{cr,sp}$	[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 <sup>b)</sup>	$c_{cr,N}$		$1.5 h_{ef}$					
Torque moment <sup>c)</sup>	$T_{inst}$	[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.

- $h$ : base material thickness ( $h \geq h_{min}$ )
- 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.
- 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)

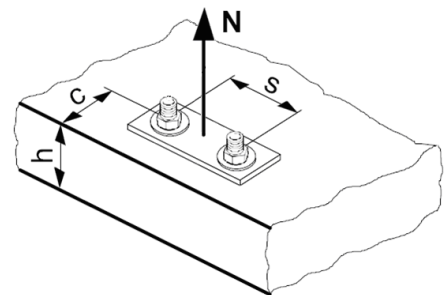
The values are valid for one anchor.

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



## 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

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

		Hilti technical data					
Anchor size		M8	M10	M12	M16	M20	M24
Typical embedment depth $h_{ef,typ}$ [mm]		80	90	110	125	170	210
$N_{Rd,p}^0$	Temperature range I [kN]	8,4	11,2	16,8	21,4	36,4	45,4

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

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

Anchor size	Hilti technical data					
	M8	M10	M12	M16	M20	M24
$N_{Rd,c}^0$ [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

$f_{h,p} = 1$
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### 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)

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

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 smaller than the critical 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
$s/s_{cr,sp}$										
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1
$f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp})$										

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

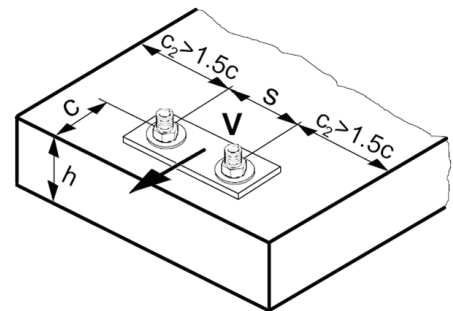
$h_{ef}$ [mm]	80	90	$\geq 100$
$f_{re,N} = 0,5 + h_{ef}/200\text{mm} \leq 1$	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{h'} \cdot f_4 \cdot f_{hef} \cdot f_c$



### Basic design shear resistance

#### Design steel resistance $V_{Rd,s}$

Anchor size		Hilti technical data					
		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 $V_{Rd,cp} = \text{lower value}^a)$ 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 $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{h'} \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		M8	M10	M12	M16	M20	M24
Non-cracked concrete							
$V_{Rd,c}^0$ [kN]		5,9	8,6	11,6	18,7	27,0	36,6

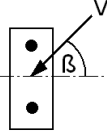
### Influencing factors

#### 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 $\beta$	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 <sup>a)</sup> for concrete edge resistance: $f_4$

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sup>a)</sup>

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

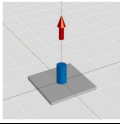
For combined tension and shear loading see section "Anchor Design".

### Precalculated values

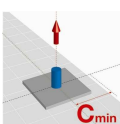
Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action  $\gamma = 1,4$ . The partial safety factors for action depend on the type of loading and shall be taken from national regulations.



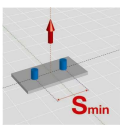
Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$

		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	
<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>								
 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	
	<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>							
	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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$

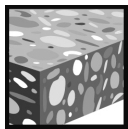
		Hilti technical data						
Anchor size		M8	M10	M12	M16	M20	M24	
Embedment depth $h_{ef,typ} =$ [mm]		80	90	110	125	170	210	
Base material thickness $h_{min} =$ [mm]		110	120	140	161	218	266	
Edge distance $c = c_{min} =$ [mm]		40	50	60	80	100	120	
<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>								
 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	
	<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>							
	HIT-V 5.8	[kN]	3,7	5,3	7,3	11,5	17,2	23,6
	HIT-V 8.8	[kN]	3,7	5,3	7,3	11,5	17,2	23,6
HIT-V-R	[kN]	3,7	5,3	7,3	11,5	17,2	23,6	
HIT-V-HCR	[kN]	3,7	5,3	7,3	11,5	17,2	23,6	

Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$   
(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	
<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>								
 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	
	<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>							
	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 with HIS-(R)N

Injection mortar system		Benefits
	Hilti HIT-ICE 296 ml cartridge	<ul style="list-style-type: none"> <li>- suitable for non-cracked concrete C 20/25 to C 50/60</li> <li>- high loading capacity</li> <li>- suitable for dry and water saturated concrete</li> <li>- odourless resin</li> <li>- low installation temperature (range -23 °C to +32 °C)</li> </ul>
	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

- 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- Installation temperature range -18°C to +32°C

For details see Simplified design method

**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 <sup>a)</sup>: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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 <sup>a)</sup>: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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  $\gamma = 1,4$ . 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

Anchor size			Hilti technical data				
			M8	M10	M12	M16	M20
Nominal tensile strength $f_{uk}$	HIS-N	[N/mm <sup>2</sup> ]	490	490	460	460	460
	Screw 8.8	[N/mm <sup>2</sup> ]	800	800	800	800	800
	HIS-RN	[N/mm <sup>2</sup> ]	700	700	700	700	700
	Screw A4-70	[N/mm <sup>2</sup> ]	700	700	700	700	700
Yield strength $f_{yk}$	HIS-N	[N/mm <sup>2</sup> ]	410	410	375	375	375
	Screw 8.8	[N/mm <sup>2</sup> ]	640	640	640	640	640
	HIS-RN	[N/mm <sup>2</sup> ]	350	350	350	350	350
	Screw A4-70	[N/mm <sup>2</sup> ]	450	450	450	450	450
Stressed cross-section $A_s$	HIS-(R)N	[mm <sup>2</sup> ]	51,5	108,0	169,1	256,1	237,6
	Screw	[mm <sup>2</sup> ]	36,6	58	84,3	157	245
Moment of resistance $W$	HIS-(R)N	[mm <sup>3</sup> ]	145	430	840	1595	1543
	Screw	[mm <sup>3</sup> ]	31,2	62,3	109	277	541

### Material quality

Part	Material
internally threaded sleeves <sup>a)</sup> HIS-N	C-steel 1.0718, steel galvanized $\geq 5\mu\text{m}$
internally threaded sleeves <sup>b)</sup> HIS-RN	stainless steel 1.4401 and 1.4571

a) related fastening screw: strength class 8.8, A5 > 8% Ductile steel galvanized  $\geq 5\mu\text{m}$

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

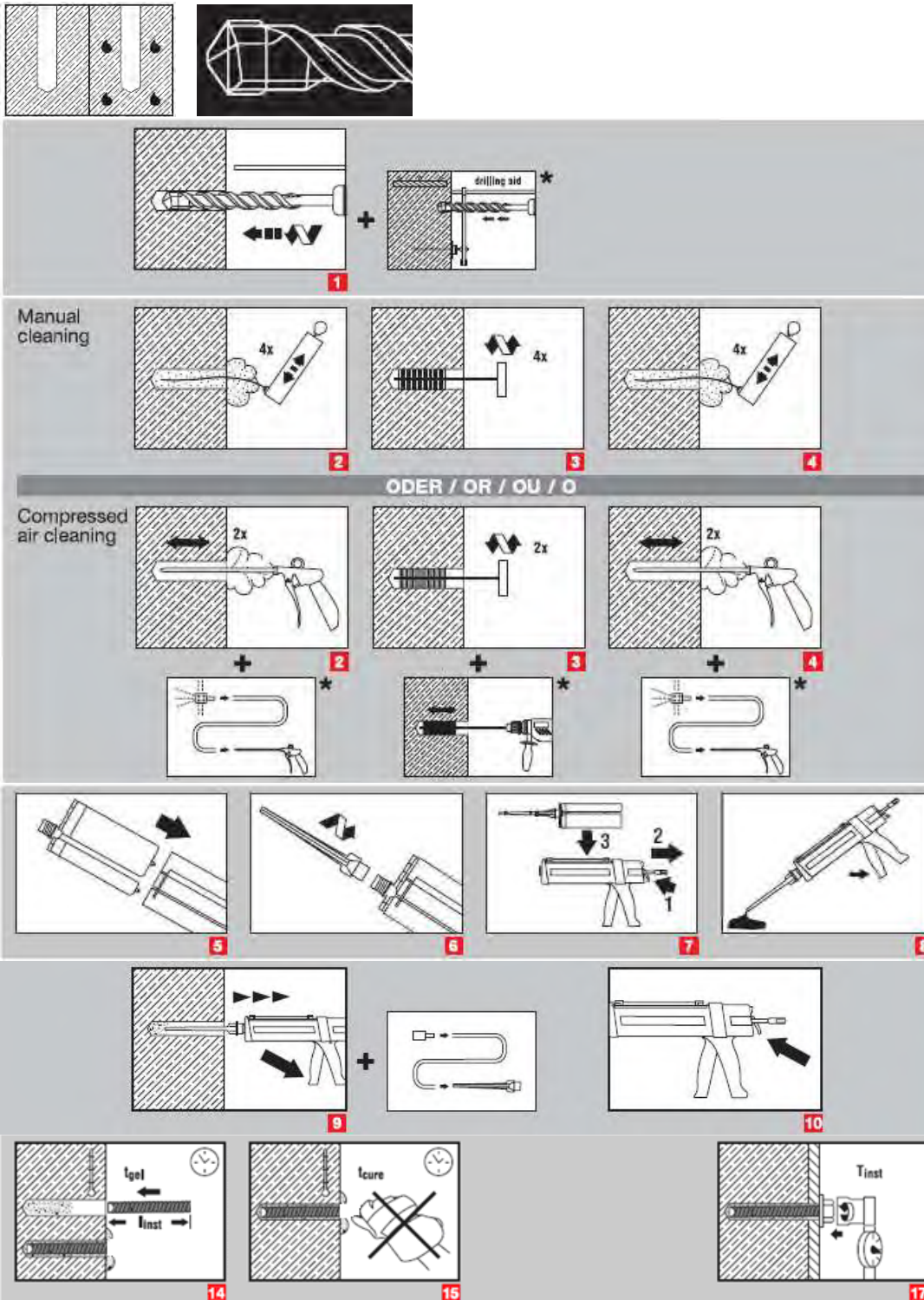
## Setting

### 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) Note: 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 <sup>a)</sup>	$h_{min}$	[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 <sup>a)</sup>	$c_{cr,sp}$	[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	$c_{cr,N}$	<sup>b)</sup>	$1.5 h_{ef}$				
Torque moment <sup>c)</sup>	$T_{inst}$	[Nm]	10	20	40	80	150

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

- $h$ : base material thickness ( $h \geq h_{min}$ )
- 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.
- 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)

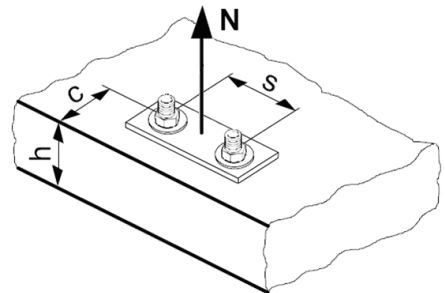
The values are valid for one anchor.

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



## 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

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

		Hilti technical data				
Anchor size		M8	M10	M12	M16	M20
Embedment depth $h_{ef}$ [mm]		90	110	125	170	205
$N_{Rd,p}^0$	Temperature range I [kN]	11,5	17,2	21,8	37,7	45,1



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

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

		Hilti technical data				
Anchor size		M8	M10	M12	M16	M20
$N_{Rd,c}^0$	[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)

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

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 smaller than the critical 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
$s/s_{cr,sp}$										
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1
$f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp})$										

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

$f_{h,N} = 1$
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### Influence of reinforcement

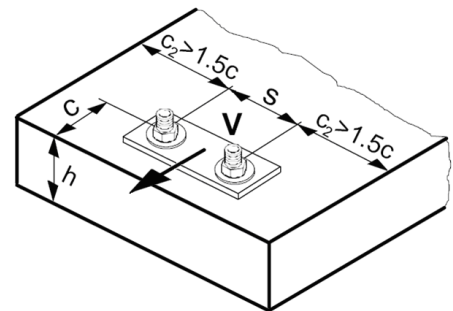
$h_{ef}$ [mm]	80	90	$\geq 100$
$f_{re,N} = 0.5 + h_{ef}/200\text{mm} \leq 1$	0.9 <sup>a)</sup>	0.95 <sup>a)</sup>	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



### 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 $V_{Rd,cp} = \text{lower value}^a)$ of $k \cdot N_{Rd,p}$ and $k \cdot N_{Rd,c}$

$$k = 1 \text{ for } h_{ef} < 60 \text{ mm}$$

$$k = 2 \text{ for } h_{ef} \geq 60 \text{ mm}$$

- a)  $N_{Rd,p}$ : Design combined pull-out and concrete cone resistance  
 $N_{Rd,c}$ : Design concrete cone resistance

#### Design concrete edge resistance $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		M8	M10	M12	M16	M20
Non-cracked concrete						
$V_{Rd,c}^0$ [kN]		12,4	19,6	28,2	40,2	46,2

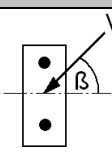
### Influencing factors

#### 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
$f_B = (f_{ck,cube}/25\text{N/mm}^2)^{1/2}$ 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 $\beta$	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 <sup>a)</sup> for concrete edge resistance: $f_4$

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

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sup>a)</sup>

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  $c_{min}$ .

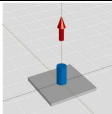
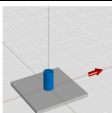
## Combined tension and shear loading

For combined tension and shear loading see section "Anchor Design".

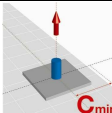
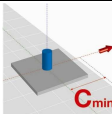
### Precalculated values

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.

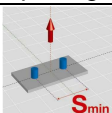
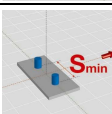
**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$**

		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
	<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>					
HIS-(R)N	[kN]	11,5	17,2	21,8	37,7	45,1
	<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>					
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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$**



		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
	<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>					
HIS-(R)N	[kN]	6,1	8,8	11,3	19,1	25,5
	<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>					
HIS-(R)N	[kN]	4,2	5,5	7,6	10,8	17,2

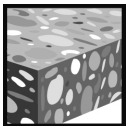
**Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$**   
(load values are valid for single anchor)

		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
	<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>					
HIS-(R)N	[kN]	7,7	11,2	14,1	23,8	29,9
	<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>					
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 with rebar

Injection mortar system		Benefits
	Hilti HIT-ICE 296 ml cartridge	<ul style="list-style-type: none"> <li>- suitable for non-cracked concrete C 20/25 to C 50/60</li> <li>- high loading capacity</li> <li>- suitable for dry and water saturated concrete</li> <li>- high corrosion resistant</li> <li>- odourless resin</li> <li>- low installation temperature (range -23 °C – 32 °C)</li> </ul>
	Statik mixer	
	rebar BSt 500 S	



Concrete



Small edge distance and spacing



PROFIS Anchor design software

### 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
- 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,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- Installation temperature range -18°C to +32°C

For details see Simplified design method

**Embedment depth <sup>a)</sup> and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.**

Anchor size	Hilti technical data						
	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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor rebar BSt 500S**

Anchor size	Hilti technical data						
	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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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 <sup>a)</sup>: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , 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  $\gamma = 1,4$ . 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

Anchor size			Hilti technical data						
			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Nominal tensile strength $f_{uk}$	BSt 500 S	[N/mm <sup>2</sup> ]	550	550	550	550	550	550	550
Yield strength $f_{yk}$		[N/mm <sup>2</sup> ]	500	500	500	500	500	500	500
Stressed cross-section $A_s$	BSt 500 S	[mm <sup>2</sup> ]	50,3	78,5	113,1	153,9	201,1	314,2	490,9
Moment of resistance $W$	BSt 500 S	[mm <sup>3</sup> ]	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						

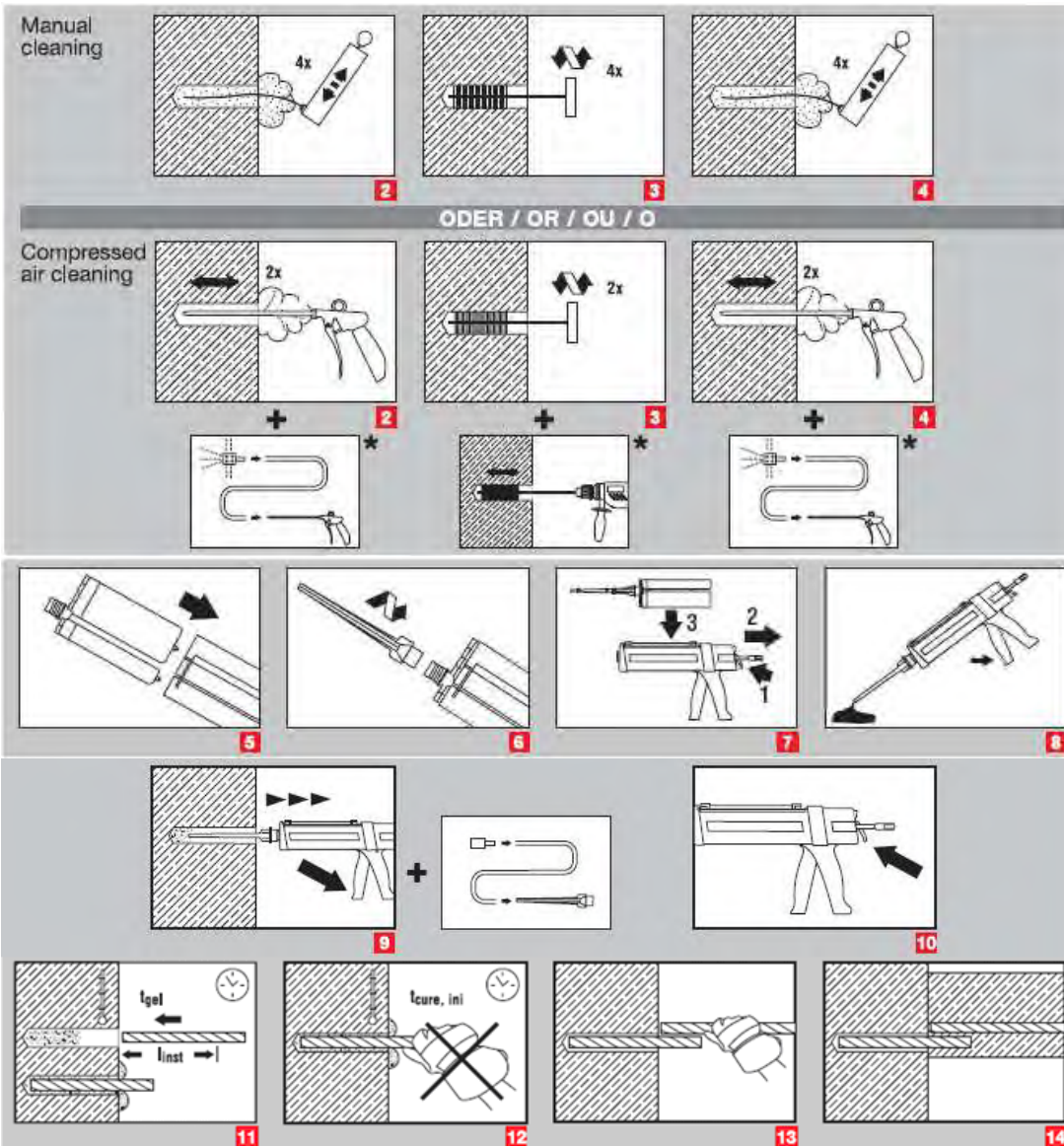
### Setting instruction

#### Dry and water-saturated concrete, hammer drilling





a)



**a) Note:** Manual cleaning for element sizes  $d \leq 16\text{mm}$  and embedment depth  $h_{ef} \leq 10 d$  only!

Brush bore hole with required steel brush HIT-RB

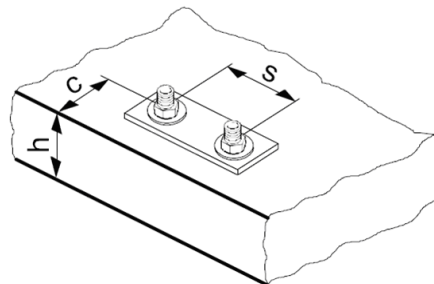
For detailed information on installation see instruction for use given with the package of the product.

## 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 <sup>a)</sup>	$h_{min}$	[mm]	$h_{ef} + 30 \text{ mm}$ $\geq 100 \text{ mm}$			$h_{ef} + 2 d_0$			
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 <sup>b)</sup>	$c_{cr,sp}$	[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 <sup>c)</sup>	$c_{cr,N}$		$1.5 h_{ef}$						



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 safe 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 safe 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)

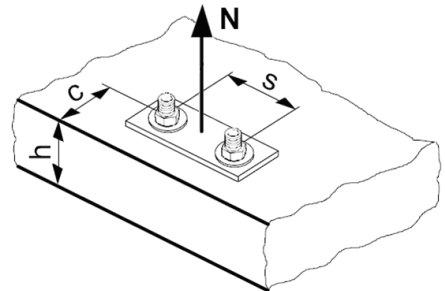
The values are valid for one anchor.

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



## 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

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

		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
$N_{Rd,p}^0$	Temperature range I [kN]	7,2	10,1	14,3	18,5	22,7	30,2	37,8

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

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

		Hilti technical data						
Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
$N_{Rd,c}^0$	[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)

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

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 smaller than the critical 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
$s/s_{cr,sp}$										
$f_{3,N} = 0,5 \cdot (1 + s/s_{cr,N})$	0,55	0,60	0,65	0,70	0,75	0,80	0,85	0,90	0,95	1
$f_{3,sp} = 0,5 \cdot (1 + s/s_{cr,sp})$										

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

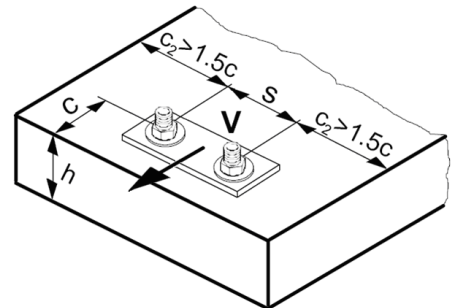
$h_{ef}$ [mm]	80	90	$\geq 100$
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,9 a)	0,95 a)	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  mm (any diameter) or with a diameter  $\leq 10$  mm and a spacing  $\geq 100$  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:  $V_{Rd,cp} = k \cdot \text{lower value of } N_{Rd,p} \text{ and } N_{Rd,c}$
- Concrete edge resistance:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



### Basic design shear resistance

#### Design steel resistance $V_{Rd,s}$

		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 $V_{Rd,cp} = \text{lower value}^a$ 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 $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{\beta} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$

Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Non-cracked concrete								
$V_{Rd,c}^0$	[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 $\beta$	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 <sup>a)</sup> for concrete edge resistance:  $f_4$   
 $f_4 = (c/h_{ef})^{1,5} \cdot (1 + s / [3 \cdot c]) \cdot 0,5$

c/h <sub>ef</sub>	Single anchor	Group of two anchors s/h <sub>ef</sub>														
		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 <sup>a)</sup>

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  $c_{min}$ .

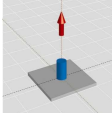
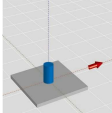
## Combined tension and shear loading

For combined tension and shear loading see section "Anchor Design".

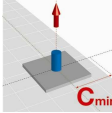
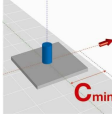
### Precalculated values

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.

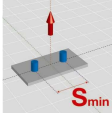
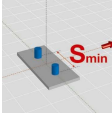
Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$

		Hilti technical data						
Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth	$h_{ef,typ} = [\text{mm}]$	80	90	110	125	125	170	210
Base material thickness	$h_{min} = [\text{mm}]$	110	120	142	161	165	220	274
	<b>Tensile <math>N_{Rd}</math>: single anchor, no edge effects</b>							
BSt 500 S	[kN]	7,2	10,1	14,3	18,5	22,7	30,2	37,8
	<b>Shear <math>V_{Rd}</math>: single anchor, no edge effects, without lever arm</b>							
BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0

Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$







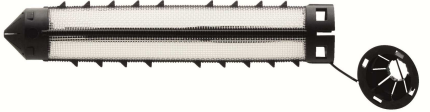
		Hilti technical data						
Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth	$h_{ef,typ} = [\text{mm}]$	80	90	110	125	125	170	210
Base material thickness	$h_{min} = [\text{mm}]$	110	120	142	161	165	220	274
Edge distance	$c = c_{min} = [\text{mm}]$	40	50	60	70	80	100	125
	<b>Tensile <math>N_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>)</b>							
BSt 500 S	[kN]	4,6	6,4	9,2	12,0	14,4	20,5	27,2
	<b>Shear <math>V_{Rd}</math>: single anchor, min. edge distance (<math>c = c_{min}</math>), without lever arm</b>							
BSt 500 S	[kN]	3,7	5,3	7,3	9,5	11,5	17,2	25,0

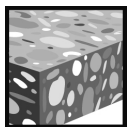
Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$   
(load values are valid for single anchor)

		Hilti technical data						
Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth	$h_{ef,typ} = [\text{mm}]$	80	90	110	125	125	170	210
Base material thickness	$h_{min} = [\text{mm}]$	110	120	142	161	165	220	274
Spacing	$s = s_{min} = [\text{mm}]$	40	50	60	70	80	100	125
	<b>Tensile <math>N_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>)</b>							
BSt 500 S	[kN]	5,2	7,2	10,1	13,0	15,5	21,5	27,6
	<b>Shear <math>V_{Rd}</math>: double anchor, no edge effects, min. spacing (<math>s = s_{min}</math>), without lever arm</b>							
BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	50,6	63,4

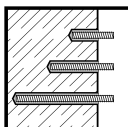


## Hilti HIT-HY 70 injection mortar for masonry

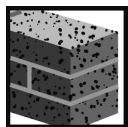
Injection mortar system		Benefits
      	<p>Hilti HIT-HY 70 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)</p> <p>Mixer</p> <p>HIT-V rod</p> <p>HAS, HAS-E rod</p> <p>HIT-IC internal threaded sleeve</p> <p>HIS-RN sleeve</p> <p>HIT-SC composite sleeve</p>	<ul style="list-style-type: none"> <li>- chemical injection fastening for all type of base materials:</li> <li>- hollow and solid</li> <li>- clay bricks, sand-lime bricks, normal and light weight concrete blocks, aerated light weight concrete, natural stones</li> <li>- two-component hybrid mortar</li> <li>- rapid curing</li> <li>- versatile and convenient handling</li> <li>- flexible setting depth and fastening thickness</li> <li>- small edge distance and anchor spacing</li> <li>- mortar filling control with HIT-SC sleeves</li> <li>- suitable for overhead fastenings</li> <li>- in-service temperatures: short term: max.80°C long term: max 50°C</li> </ul>



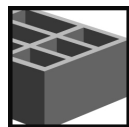
Concrete



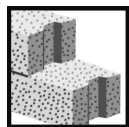
Variable embedment depth



Solid brick



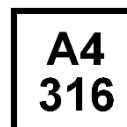
Hollow brick



Autoclaved aerated concrete



Fire resistance



Corrosion resistance



High corrosion resistant



PROFIS Anchor design software

### Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Allgemeine bauaufsichtliche Zulassung (national German approval)	DIBt, Berlin	Z-21.3-1830 / 2011-12-01
Fiche technique SOCOTEC <sup>a)</sup>	SOCOTEC, Paris	YX 0047 08.2006
Fire test report	MFPA, Leipzig	PB III/B-07-157 / 2012-03-03
Assessment report (fire)	warringtonfire	WF 166402 / 2007-10-26

### 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 <sup>a)</sup> $F_{rec}$ for brick breakout and pull out in [kN] Solid masonry: HIT-HY 70 with HIT-V, HAS, HAS-E and HIT-IC

Anchor size			HIT-V, HAS, HAS-E				HIT-IC		
Base material	Setting depth [mm]		M6	M8	M10	M12	M8	M10	M12
Solid clay brick Mz12/2,0 DIN 105/ EN 771-1 $f_b^{b)} \geq 12 \text{ N/mm}^2$  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 <sup>c)</sup>	3,0 <sup>c)</sup>	3,0 <sup>c)</sup>	3,0 <sup>c)</sup>	3,0 <sup>c)</sup>	3,0 <sup>c)</sup>
		$V_{rec}$ [kN]	-	3,0 <sup>c)</sup>	3,0 <sup>c)</sup>	3,0 <sup>c)</sup>	3,0 <sup>c)</sup>	3,0 <sup>c)</sup>	3,0 <sup>c)</sup>
Solid sand-lime brick KS 12/2,0 DIN 106/ EN 771-2 $f_b^{b)} \geq 12 \text{ N/mm}^2$  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 <sup>d)</sup>	3,0 <sup>d)</sup>	3,0 <sup>d)</sup>	3,0 <sup>d)</sup>	3,0 <sup>d)</sup>	3,0 <sup>d)</sup>
		$V_{rec}$ [kN]	-	3,0 <sup>d)</sup>	3,0 <sup>d)</sup>	3,0 <sup>d)</sup>	3,0 <sup>d)</sup>	3,0 <sup>d)</sup>	3,0 <sup>d)</sup>


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  $\geq 29 \text{ N/mm}^2$ , density  $2,0 \text{ kg/dm}^3$ , 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  $\geq 23 \text{ N/mm}^2$ , density  $2,0 \text{ kg/dm}^3$ , 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 <sup>a)</sup>  $F_{rec}$  for brick breakout and pull out in [kN]  
 Solid masonry: HIT-HY 70 with HIT-V, HAS, HAS-E and HIT-IC

Anchor size			HIT-V, HAS, HAS-E				HIT-IC		
Base material	Setting depth [mm]		M6	M8	M10	M12	M8	M10	M12
Aerated concrete PPW 2-0,4 DIN 4165/ EN 771-4 $f_b^{b)} \geq 2 \text{ N/mm}^2$  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 (haufwerksporiger 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 <sup>a)</sup> F<sub>rec</sub> 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**

Anchor size			HIT-V, HAS, HAS-E				HIT-IC				
Base material	Setting depth [mm]		M6	M8	M10	M12	M8	M10	M12		
			HIT-SC 12x...	HIT-SC 16x...	HIT-SC 16x...	HIT-SC 18x...	HIT-SC 16x...	HIT-SC 18x...	HIT-SC 22x...	HIT-SC 22x...	
<b>HizB 6</b> DIN 105/ EN 771-1 f <sub>b</sub> <sup>b)</sup> ≥ 6 N/mm <sup>2</sup>  Germany, Austria, Switzerland	50	N <sub>rec</sub> [kN]	0,3	0,4	0,4	0,8	-	-	-	-	
		V <sub>rec</sub> [kN]	0,3	0,4	0,4	0,4	-	-	-	-	
	80	N <sub>rec</sub> [kN]	-	0,8	0,8	0,8	0,8	0,8	0,8	0,8	
		V <sub>rec</sub> [kN]	-	0,8	0,8	0,8	0,8	0,8	0,8	0,8	
	100	N <sub>rec</sub> [kN]	-	0,8	0,8	0,8	-	-	-	-	
		V <sub>rec</sub> [kN]	-	0,8	0,8	0,8	-	-	-	-	
	130	N <sub>rec</sub> [kN]	-	0,84	0,84	0,8	-	-	-	-	
		V <sub>rec</sub> [kN]	-	0,8	0,8	0,8	-	-	-	-	
	160	N <sub>rec</sub> [kN]	-	0,91	0,91	0,8	-	-	-	-	
		V <sub>rec</sub> [kN]	-	0,8	0,8	0,8	-	-	-	-	
	<b>Hiz 12</b> DIN 105/ EN 771-1 f <sub>b</sub> <sup>b)</sup> ≥ 12 N/mm <sup>2</sup>  Germany, Austria, Switzerland	50	N <sub>rec</sub> [kN]	0,6	0,8	0,8	0,8	-	-	-	-
			V <sub>rec</sub> [kN]	0,6	0,8	0,8	0,8	-	-	-	-
80		N <sub>rec</sub> [kN]	-	1,0	1,0	1,0	1,0	1,0	1,0	1,0	
		V <sub>rec</sub> [kN]	-	1,0	1,0	1,0	1,0	1,0	1,0	1,0	
100		N <sub>rec</sub> [kN]	-	1,54	1,54	1,54	-	-	-	-	
		V <sub>rec</sub> [kN]	-	1,4	1,4	1,4	-	-	-	-	
130		N <sub>rec</sub> [kN]	-	1,68	1,68	1,54	-	-	-	-	
		V <sub>rec</sub> [kN]	-	1,4	1,4	1,4	-	-	-	-	
160		N <sub>rec</sub> [kN]	-	1,82	1,82	1,54	-	-	-	-	
		V <sub>rec</sub> [kN]	-	1,4	1,4	1,4	-	-	-	-	

a) Recommended load values for German base materials are based on national regulations.

b) f<sub>b</sub> = brick strength




Recommended loads <sup>a)</sup>  $F_{rec}$  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

Anchor size			HIT-V, HAS, HAS-E				HIT-IC			
			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...
		<b>KSL 12</b> DIN 106/ EN 771-2 $f_b^{b)} \geq 12 \text{ N/mm}^2$  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 <sup>a)</sup> F<sub>rec</sub> 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**

Anchor size			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...	
<b>Hbl 2</b> DIN 18 151/ EN 771-3 $f_b^{b)} \geq 2 \text{ N/mm}^2$  Germany, Austria, Switzerland	50	N <sub>rec</sub> [kN]	0,3	0,5	0,5	0,5	-	-	-	-	
		V <sub>rec</sub> [kN]	0,3	0,5	0,5	0,5	-	-	-	-	
	80	N <sub>rec</sub> [kN]	-	0,5	0,5	0,5	0,5	0,5	0,5	0,5	
		V <sub>rec</sub> [kN]	-	0,5	0,5	0,5	0,5	0,5	0,5	0,5	
	100	N <sub>rec</sub> [kN]	-	0,7	0,7	0,7	-	-	-	-	
		V <sub>rec</sub> [kN]	-	0,6	0,6	0,6	-	-	-	-	
	130	N <sub>rec</sub> [kN]	-	0,72	0,72	0,7	-	-	-	-	
		V <sub>rec</sub> [kN]	-	0,6	0,6	0,6	-	-	-	-	
	160	N <sub>rec</sub> [kN]	-	0,78	0,78	0,7	-	-	-	-	
		V <sub>rec</sub> [kN]	-	0,6	0,6	0,6	-	-	-	-	
	<b>Hbl 4</b> DIN 18 151/ EN 771-3 $f_b^{b)} \geq 4 \text{ N/mm}^2$  Germany, Austria, Switzerland	50	N <sub>rec</sub> [kN]	0,4	0,6	0,6	0,6	-	-	-	-
			V <sub>rec</sub> [kN]	0,4	0,6	0,6	0,6	-	-	-	-
80		N <sub>rec</sub> [kN]	-	0,8	0,8	0,8	0,8	0,8	0,8	0,8	
		V <sub>rec</sub> [kN]	-	0,8	0,8	0,8	0,8	0,8	0,8	0,8	
<b>Hbn 4</b> DIN 18 153/ EN 771-3 $f_b^{b)} \geq 4 \text{ N/mm}^2$  Germany, Austria, Switzerland	50	N <sub>rec</sub> [kN]	0,4	0,6	0,6	0,6	-	-	-	-	
		V <sub>rec</sub> [kN]	0,4	0,6	0,6	0,6	-	-	-	-	
	80	N <sub>rec</sub> [kN]	-	0,8	0,8	0,8	0,8	0,8	0,8	0,8	
		V <sub>rec</sub> [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 <sup>a)</sup>  $F_{rec}$  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

Anchor size			HIT-V, HAS, HAS-E				HIT-IC				
			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...	
			<b>Brique creuse C40</b> NF-P 13-301/ EN 771-1 $f_b \geq 4 \text{ N/mm}^2$  France	80	$N_{rec}$ [kN]	-	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	-	-	-	-	
<b>Parpaing creux B40</b> NF-P 14-301/ EN 771-3 $f_b \geq 4 \text{ N/mm}^2$  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]:

Anchor size		HIT-V, HAS, HAS-E				HIT-IC					
Base material	Setting depth [mm]	M6	M8	M10	M12	M8	M10	M12			
		HIT-SC 12x...	HIT-SC 16x...	HIT-SC 16x...	HIT-SC 18x...	HIT-SC 16x...	HIT-SC 18x...	HIT-SC 22x...			
<b>Mattone Alveolater 50</b> EN 771-1 $f_b^{b)} \geq 16 \text{ N/mm}^2$  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	-	-	-	-	
	<b>Doppio uni</b> EN 771-1 $f_b^{b)} \geq 27 \text{ N/mm}^2$  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	-	-	-	-	
<b>Foratino 4 Fori</b> EN 771-1 $f_b^{b)} \geq 7 \text{ N/mm}^2$  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  $\gamma_{global} = 3,0$ :  $F_{rec} = F_{Rk} / \gamma_{global}$   
 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]:**

Anchor size			HIT-V, HAS, HAS-E				HIT-IC			
Base material	Setting depth [mm]		M6	M8	M10	M12	M8	M10		M12
			HIT-SC 12x...	HIT-SC 16x...	HIT-SC 16x...	HIT-SC 18x...	HIT-SC 16x...	HIT-SC 18x...	HIT-SC 22x...	HIT-SC 22x...
<b>Mattone rosso</b> EN 771-1 $f_b^{b)} \geq 26 \text{ N/mm}^2$  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]	-	-	-	-	-	-	-	-
<b>Blocchi cem 2 Fori</b> EN 771-3 $f_b^{b)} \geq 8 \text{ N/mm}^2$  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  $\gamma_{global} = 3,0$ :  $F_{rec} = F_{Rk} / \gamma_{global}$

b)  $f_b$  = brick strength

**Recommended loads  $F_{rec}$  for brick breakout and pull out in [kN]**  
**Solid masonry: HIT-HY 70 with HIT-V, HAS, HAS-E and HIT-IC**

Anchor size			HIT-V, HAS, HAS-E or Rebar <sup>c)</sup>				
Base material	Setting depth [mm]		Rod M8 or Rebar $\varnothing 8^{d)}$	Rod M10 or Rebar $\varnothing 10^{d)}$	Rod M12 or Rebar $\varnothing 12^{d)}$	Rod M14 or Rebar $\varnothing 14^{d)}$	Rod M16 or Rebar $\varnothing 16^{d)}$
			<b>Volcanic rock (Tufo)</b> EN 771-3 $f_b^{b)} \geq 4,3 \text{ N/mm}^2$  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  $\gamma_{global} = 3,0$ :  $F_{rec} = F_{Rk} / \gamma_{global}$

b)  $f_b$  = brick strength




c) Minimum base material thickness  $h$  = setting depth + 50mm.

d) Drill bit diameters for rebars BSt 500S:

$\varnothing 8$ :  $d_0=12\text{mm}$ ;  $\varnothing 10$ :  $d_0=14\text{mm}$ ;  $\varnothing 12$ :  $d_0=16\text{mm}$ ;  $\varnothing 14$ :  $d_0=18\text{mm}$ ;  $\varnothing 16$ :  $d_0=20\text{mm}$ ;






**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]:**

Anchor size			HIT-V, HAS, HAS-E				HIT-IC			
Base material	Setting depth [mm]		M6	M8	M10	M12	M8	M10	M12	
			HIT-SC 12x...	HIT-SC 16x...	HIT-SC 16x...	HIT-SC 18x...	HIT-SC 16x...	HIT-SC 18x...	HIT-SC 22x...	HIT-SC 22x...
<b>Hueco doble</b> EN 771-1 $f_b^{b)} \geq 4 \text{ N/mm}^2$  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
<b>Termoarcilla</b> EN 771-1 $f_b^{b)} \geq 22 \text{ N/mm}^2$  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
<b>Ladrillo cara vista</b> EN 771-1 $f_b^{b)} \geq 42 \text{ N/mm}^2$  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
<b>Clinker mediterraneo</b> EN 771-1 $f_b^{b)} \geq 78 \text{ N/mm}^2$  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  $\gamma_{global} = 3,0$ :  $F_{rec} = F_{Rk} / \gamma_{global}$

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**

Anchor size			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...
<b>Concrete Block</b> EN 771-3 $f_b^{b)} \geq 7,0 \text{ N/mm}^2$ 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	-	-	-	-
<b>Concrete Block</b> EN 771-3 $f_b^{b)} \geq 7 \text{ N/mm}^2$ 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	-	-	-	-
<b>Concrete Block</b> EN 771-3 $f_b^{b)} \geq 7 \text{ N/mm}^2$ 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  $\gamma_{global} = 3,0$ :  $F_{rec} = F_{RK} / \gamma_{global}$


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**

Anchor size			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...
<b>Dense Concrete</b> EN 771-3 $f_b^{b)} \geq 14 \text{ N/mm}^2$ 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	-	-	-	-
<b>Dense Concrete</b> EN 771-3 $f_b^{b)} \geq 14 \text{ N/mm}^2$ 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
<b>Thermalite/Celcon</b> EN 771-3 $f_b^{b)} \geq 6 \text{ N/mm}^2$ 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
<b>Nostell Red Multi</b> EN 771-3 $f_b^{b)} \geq 70 \text{ N/mm}^2$ 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  $\gamma_{global} = 3,0$ :  $F_{rec} = F_{Rk} / \gamma_{global}$   
 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**

Anchor size			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...
<b>London yellow Multi Stock</b> EN 771-3 $f_b^{b)} \geq 16 \text{ N/mm}^2$ L x H x B [mm] 215 x 100 x 65  Great Britain	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
		$V_{rec}$ [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  $\gamma_{global} = 3,0$ :  $F_{rec} = F_{Rk} / \gamma_{global}$

b)  $f_b$  = brick strength

**Recommended loads  $F_{rec}$  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**




Anchor size			HIT-V, HAS, HAS-E				HIT-IC		
Base material	Setting depth [mm]	Base material	M6	M8	M10	M12	M8	M10	M12
<b>Dense Concrete</b> EN 771-3 $f_b^{b)} \geq 14 \text{ N/mm}^2$ 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	-	-	-
<b>Dense Concrete</b> EN 771-3 $f_b^{b)} \geq 14 \text{ N/mm}^2$ L x H x B [mm] 440 x 215 x 140  Great Britain	80	$N_{rec}$ [kN]	-	3,5 <sup>c)</sup>	4,0 <sup>c)</sup>	4,5 <sup>c)</sup>	-	-	-
		$V_{rec}$ [kN]	-	2,5	2,5	3,0	-	-	-

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


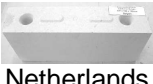

c) The minimum value of brick break out and/or pull out given in the table and of pull out of one brick is decisive.

**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**

Anchor size			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...
<b>Fire light brick Scoria Blend</b> $f_b^{b)} \geq 16 \text{ N/mm}^2$ 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
<b>Hollow Block</b> $f_b^{b)} \geq 15 \text{ N/mm}^2$ 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
<b>Clay common (Standard)</b> $f_b^{b)} \geq 84 \text{ N/mm}^2$ 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 <sup>a)</sup>  $F_{rec}$  for brick breakout and pull out in [kN]  
 Solid masonry: HIT-HY 70 with HIT-V, HAS, HAS-E and HIT-IC




Anchor size			HIT-V, HAS, HAS-E				HIT-IC		
Base material	Setting depth [mm]		M6	M8	M10	M12	M8	M10	M12
<b>Clay common (Dry pressed)</b> $f_b^{b)} \geq 25 \text{ N/mm}^2$ 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
<b>Calduran</b> Solid sand-lime brick $f_b^{b)} \geq 22 \text{ N/mm}^2$ L x H x B [mm] 437x198x100  Netherlands	80	$N_{rec}$ [kN]	-	-	2,5 <sup>c)</sup>	3,0 <sup>c)</sup>	3,0 <sup>c)</sup>	3,0 <sup>c)</sup>	4,0 <sup>c)</sup>
		$V_{rec}$ [kN]	-	-	3,0	4,0	3,0	3,0	4,0
<b>Calduran</b> Solid sand-lime brick $f_b^{b)} \geq 22 \text{ N/mm}^2$ L x H x B [mm] 437x298x215  Netherlands	80	$N_{rec}$ [kN]	-	-	2,5 <sup>c)</sup>	3,0 <sup>c)</sup>	3,0 <sup>c)</sup>	3,0 <sup>c)</sup>	4,0 <sup>c)</sup>
		$V_{rec}$ [kN]	-	-	3,0	4,0	3,0	3,0	4,0

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



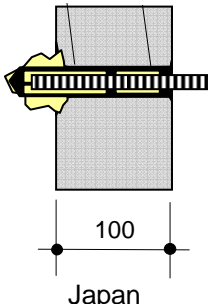
c) The minimum value of brick break out and/or pull out given in the table and of pull out of one brick is decisive.

**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**

Anchor size			HIT-V, HAS, HAS-E				HIT-IC			
			M6	M8	M10	M12	M8	M10	M12	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...
<b>Wienerberger Powerbrick</b> $f_b^{b)} \geq 41 \text{ N/mm}^2$ 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
<b>Wienerberger Thermobrick</b> $f_b^{b)} \geq 21 \text{ N/mm}^2$ 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
<b>Concrete hollow brick</b> $f_b^{b)} \geq 6 \text{ N/mm}^2$ 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
<b>Leca typ 3</b> EN 771-3 $f_b \geq 3,0 \text{ N/mm}^2$  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  $\gamma_{global} = 3,0$ :  $F_{rec} = F_{Rk} / \gamma_{global}$   
 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]:

Anchor size			HIT-V, HAS, HAS-E				HIT-IC			
Base material	Setting depth [mm]		M6	M8	M10	M12	M8	M10		M12
			HIT-SC 12x...	HIT-SC 16x...	HIT-SC 16x...	HIT-SC 18x...	HIT-SC 16x...	HIT-SC 18x...	HIT-SC 22x...	HIT-SC 22x...
<b>Concrete block</b> $f_b^{b)} \geq 23 \text{ N/mm}^2$ 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 (11,4)	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)
<b>Spancrete (Hollow Core Slab)</b> $f_b^{b)} \geq 83 \text{ N/mm}^2$ L x H x B [mm] 1000 x 1000 x 125  (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)	-
<b>Aerated concrete block</b> $f_b^{b)} \geq 6 \text{ N/mm}^2$ L x H x B [mm] 1900 x 600 x 100  Special application: through fastening HIT-SC HIT-SC ...x85 ...x50  100 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  $\gamma_{global} = 3,0$ :  $F_{rec} = F_{RK} / \gamma_{global}$   
 b)  $f_b$  = brick strength



**Recommended loads <sup>a)</sup>  $F_{rec}$  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]:**

Anchor size			HIT-V, HAS, HAS-E				HIT-IC		
Base material	Setting depth [mm]		M6	M8	M10	M12	M8	M10	M12
<b>Aerated concrete block</b> $f_b^{b)} \geq 6 \text{ N/mm}^2$ 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  $\gamma_{global} = 3,0$ :  $F_{rec} = F_{Rk} / \gamma_{global}$

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  $\alpha_j = 0.75$ .

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  $\alpha_j = 0.75$ .

**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:

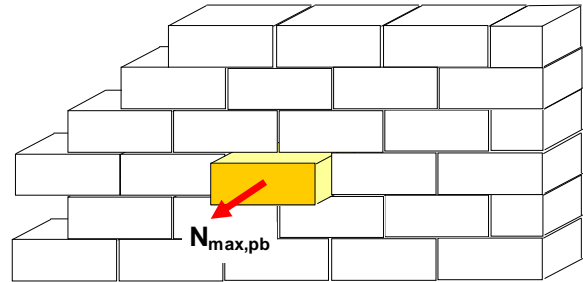
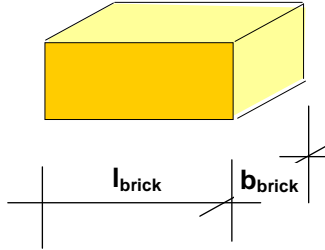
### Clay bricks:

$N_{max,pb}$ [kN]	brick breadth $b_{brick}$ [mm]	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]	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 <sub>5</sub> > 8% ductile steel galvanized ≥ 5 μm
Threaded rod HAS-(E)R	Stainless steel grade A4, A <sub>5</sub> > 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

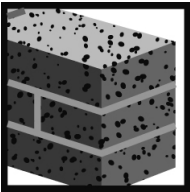
Part	Material
HIT-IG sleeve	Carbon steel 1.0718; galvanized to min. 5 μm
HIT-IC sleeve	Carbon steel; galvanized to min. 5 μm
HIT-SC sleeve	PA/PP

### Setting

#### Installation equipment

Anchor size	M6	M8	M10	M12
Rotary hammer	TE2 – TE16			
Other tools	blow out pump, set of cleaning brushes, dispenser			

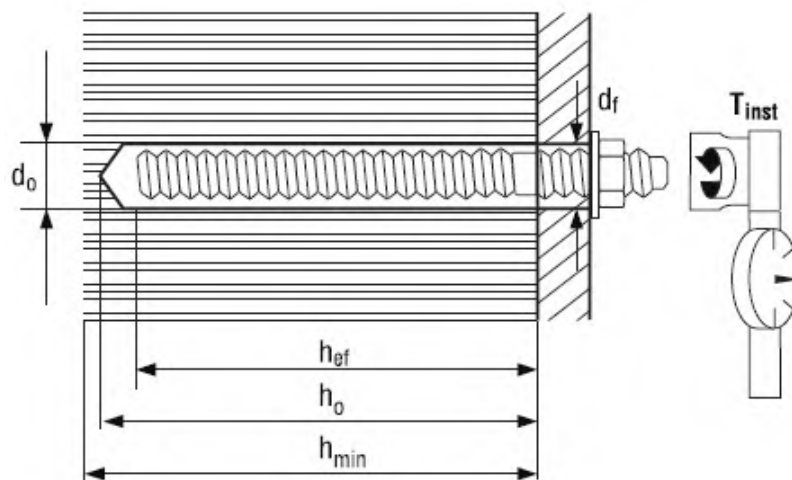
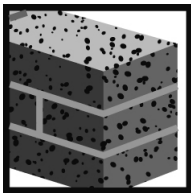
#### Setting instruction in solid base materials



15	°F	°C	t <sub>gel</sub>
	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 <sub>cure</sub>
	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

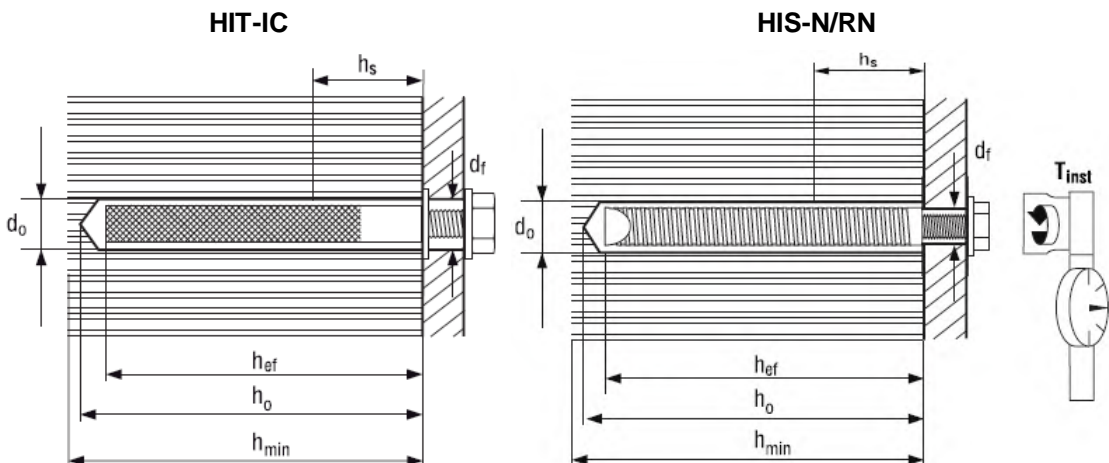
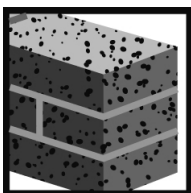


Setting details HIT-AC, HIT-V, HIT-V, HAS, HAS-E, HAS-R

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 <sup>a)</sup>	$s_{min}$	[mm]	100	100	100	100	100	100	100
Minimum edge distance <sup>a)</sup>	$c_{min}$	[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.



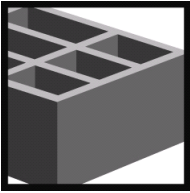
### Setting details HIT-IC

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 <sup>a)</sup>	$s_{min}$	[mm]	100	100	100	100	100	100
Minimum edge distance <sup>a)</sup>	$c_{min}$	[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.

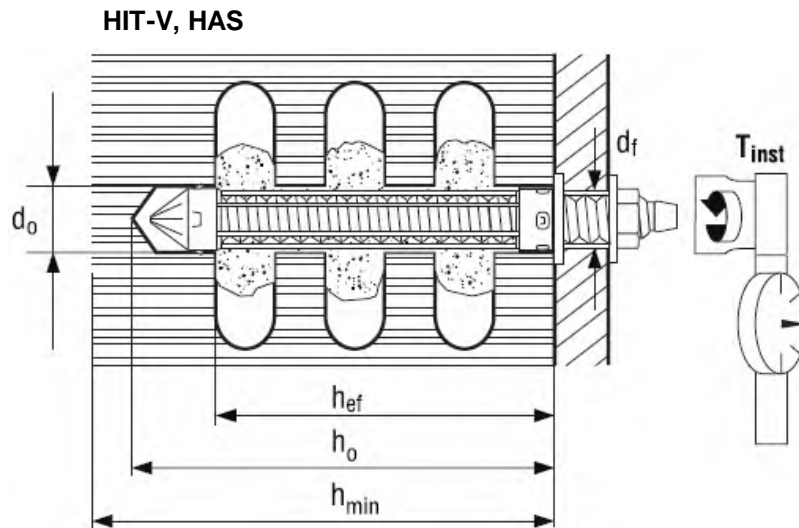
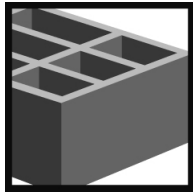
Setting instruction in hollow base material – using 330 ml foil pack



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



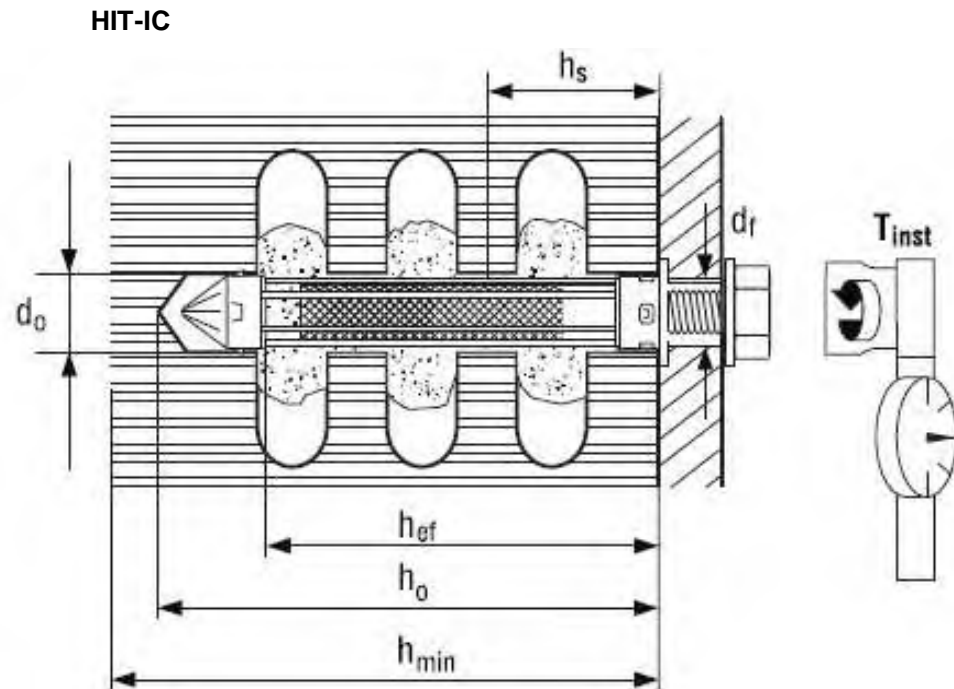
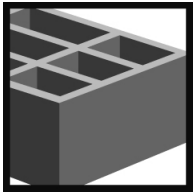
### Setting details HIT-V / HAS with sieve sleeve

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 <sup>a)</sup>	$s_{min}$	[mm]	100	100	100	100	100	100	100	100	100	100
Minimum edge distance <sup>a)</sup>	$c_{min}$	[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



### 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 <sup>a)</sup>	$s_{min}$ [mm]	100	100	100
Minimum edge distance <sup>a)</sup>	$c_{min}$ [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.





## HRT-WH Rail anchor with Hilti HVU or Hilti HIT-RE 500

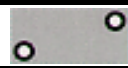
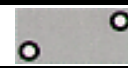
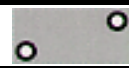
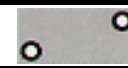
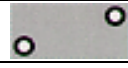
Fastening system		Benefits
 <p>Hilti HRT-WH</p>		<ul style="list-style-type: none"> <li>- for fastening rails to concrete slab track</li> <li>- for bottom-up (post-installed) construction method</li> <li>- verified for axle loads up to 250 kN</li> <li>- high electrical insulation values concerning stray current</li> <li>- corrosion resistance</li> <li>-- additional sizes and accessories available</li> <li>- chisel point</li> <li>- setting through rib plate possible</li> <li>- different support stiffness</li> <li>- complete installation and system portfolio</li> <li>- 2 and 4 anchor configuration</li> </ul>
 <p>Hilti HIT-RE 500 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)</p>		
 <p>Hilti HVU foil capsule</p>		


### 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 <sub>max</sub>	60 km/h	80 km/h	120 km/h	≥ 250 km/h
	R <sub>min</sub> (V <sub>max</sub> )***	70m (25 km/h)	200m (60 km/h)	350m (80 km/h)	3000m
	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<sub>max</sub> 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 to 19 °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 resistivity:  $1.2 \times 10^{12} \Omega \text{ cm}$

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)**



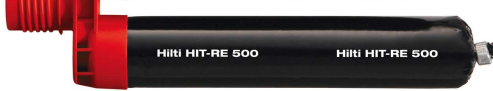
To provide adequate bonding with foil capsule HVU or HIT-RE 500 mortar and transfer tension loading to the lower part of the concrete slab

#### **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
 <p>Hilti HRT</p>	 <p>Hilti HIT-RE 500 330 ml foil pack</p>	<ul style="list-style-type: none"> <li>- for fastening rails to concrete slab track</li> <li>- for bottom-up (post-installed) construction method</li> <li>- verified for axle loads up to 170 kN</li> <li>- high electrical insulation values concerning stray current</li> <li>- corrosion resistance</li> <li>- for diamond core drilled holes with roughening</li> <li>- additional sizes and accessories available</li> <li>- setting through rib plate possible</li> <li>- different support stiffness</li> <li>- complete installation and system portfolio</li> <li>- 2 and 4 anchor configuration</li> </ul>
 <p>(also available as 500 ml and 1400 ml foil pack)</p>		


### 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	$\geq 250$ 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	
	<b>Anchor size</b>	<b>M22</b>
	<b>Hilti mortar type</b>	<b>HIT-RE 500</b>
	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 to 19 °C	24h
10 °C to 14 °C	48h
5 °C to 9 °C	72h




## Specification

Hilti HRT Rail Anchor	
	<p><b>Stopnut (M22-SW32)</b> 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</p> <p><b>Spring 35mm</b> Wire grade: C7 (DIN 2076), yellow zinc plated: Fe/Zn 7C (DIN 50961) Spring rate: 373 N/mm Deformation: 8mm → 3.0 kN compression</p> <p><b>Collar Bush (Sealing Lip)</b> Material: Plastic, int. Ø= 22 mm, ext. Ø= 36 mm Volume resistivity: <math>1.2 \times 10^{12} \Omega \text{ cm}</math> Flexible lower portion of collar bush to prevent any excess injection mortar from restricting managed system compression</p> <p><b>Anchor Body (Ø 22 mm)</b> 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</p> <p><b>Knurling</b> To provide adequate bonding with HIT-RE 500 mortar and transfer tension and torsion loadings to the lower part of the concrete slab</p> <p><b>Centering Bush</b> To centrally locate the anchor within the cored hole to provide an uniform wrapping of the anchor rod with the injection mortar. To avoid the contact between the concrete slab reinforcement and the anchor body</p>





## HRC / HRC-DB Rail anchor with Hilti HIT-RE 500

Fastening system		Benefits
	Hilti HRC	<ul style="list-style-type: none"> <li>- for fastening rails to concrete slab track</li> <li>- for bottom-up (post-installed) construction method</li> <li>- verified for axle loads up to 250 kN</li> <li>- high electrical insulation values concerning stray current</li> <li>- corrosion resistance</li> <li>- additional sizes and accessories available</li> <li>- horizontal adjustment when used with ex-center collar bush</li> <li>- different support stiffness</li> <li>- complete installation and system portfolio</li> <li>- 2 and 4 anchor configuration</li> </ul>
	Hilti HRC-DB	
	Hilti HIT-RE 500 330 ml foil pack  (also available as 500 ml and 1400 ml foil pack)	

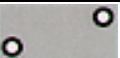
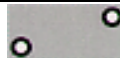
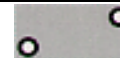
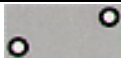
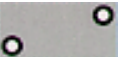
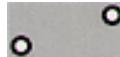
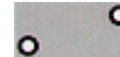
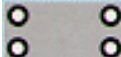
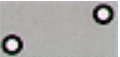
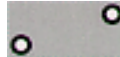
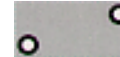
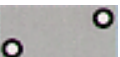
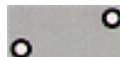
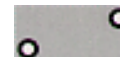
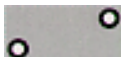
### Approvals / certificates


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 <sup>a)</sup>	German Federal Railway Office	21.62 lozb (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	$\geq 250$ 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		
	<b>Anchor</b>	<b>HRC M22</b>	<b>HRC-DB M22</b>
	<b>Hilti mortar type</b>	<b>HIT-RE 500</b>	
	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 to 19 °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 Resistivity:  $1.2 \times 10^{12} \Omega \text{ cm}$

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 uniform 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

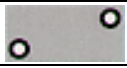
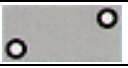
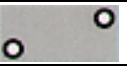
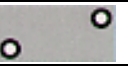
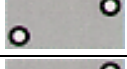
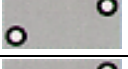
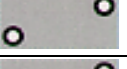
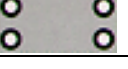
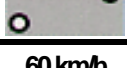
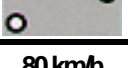
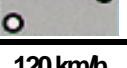
Fastening system	Benefits
 <p>Hilti HRA, type a</p>	<ul style="list-style-type: none"> <li>- for fastening rails to concrete slab track</li> <li>- for bottom-up (post-installed) construction method</li> <li>- verified for axle loads up to 250 kN</li> <li>- high electrical insulation values concerning stray current</li> <li>- corrosion resistance</li> <li>-- with spring or double coil spring</li> <li>- additional sizes and accessories available</li> <li>- different support stiffness</li> <li>- complete installation and system portfolio</li> <li>- 2 and 4 anchor configuration</li> </ul>
 <p>Hilti HRA, type b</p>	
 <p>Hilti HIT-RE 500 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)</p>	
 <p>Hilti HVU-G/EA glass capsule</p>	


### 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	$\geq 250$ 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				
	<b>Anchor</b>	<b>HRA M22</b>			
		<b>220a</b>	<b>220b</b>	<b>270</b>	<b>310</b>
	<b>Hilti mortar type</b>	<b>HIT-RE 500 HVU-G/EA glass capsule</b>			
	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 to 19 °C	1,5 h
-5 °C to 9 °C	6 h

The curing time data for water saturated 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 to 19 °C	24h
10 °C to 14 °C	48h
5 °C to 9 °C	72h

**Specification**

<b>Hilti HRA Rail Anchor, type a</b>	
	<p><b>Stopnut (M22-SW38)</b> Material; 5S (DIN 982), Zinc plated Fe/Zn 7C (DIN 50961)</p>
	<p><b>Spring (35mm/55mm)</b> Wire Grade: C7 (DIN 2076), yellow zinc plated: Fe/Zn 7C (DIN 50961) Spring Rate: 373 N/mm</p>
	<p><b>Washer (W 24 x39 x 3 mm)</b> Zinc plated Fe/ZN 5B (DIN 50961)</p>
	<p><b>Collar Bush</b> Material; Plastic, int Ø= 28 mm, ext Ø= 35.5 mm Electrical Insulation; <math>3.5 \times 10^{12} \Omega</math></p>
	<p><b>Plastic Wrapping</b> Designed to eliminate stray current loss. Ext Ø= 32 mm</p>
	<p><b>Anchor Body</b> High grade carbon steel. Designed to withstand high dynamic loads resulting from train axle loads up to 250 kN</p>
	<p><b>Bonding Ribs</b> To provide adequate bonding with injection mortar HIT-RE 500 mortar and HVU-G/EA capsule</p>
<p><b>Chisel Point</b> To provide torsional resistance and ensure mixing of HVU-G/EA capsule</p>	



## 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 Ø= 24mm, Ext Ø= 44 mm, Original Height: 22mm  
Compressed Height: 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;  $3.5 \times 10^{12} \Omega$

### 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

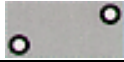
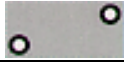
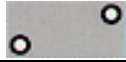
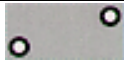
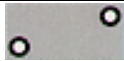
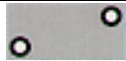
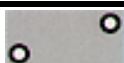
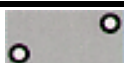
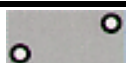
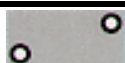
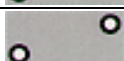
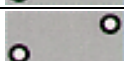
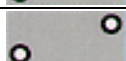
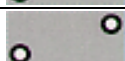
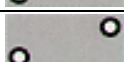
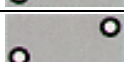
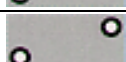
Fastening system		Benefits
	Hilti HRT-I (rigid)	<ul style="list-style-type: none"> <li>- for fastening rails to concrete slab track</li> <li>- for bottom-up (post-installed) construction method</li> <li>- verified for axle loads up to 250 kN</li> <li>- high electrical insulation values concerning stray current</li> <li>- corrosion resistance</li> <li>- with spring (elastic) or spring washer (rigid)</li> <li>- additional sizes and accessories available</li> <li>- bolt removable</li> <li>- different support stiffness</li> <li>- complete installation and system portfolio</li> <li>- 2 and 4 anchor configuration</li> </ul>
	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

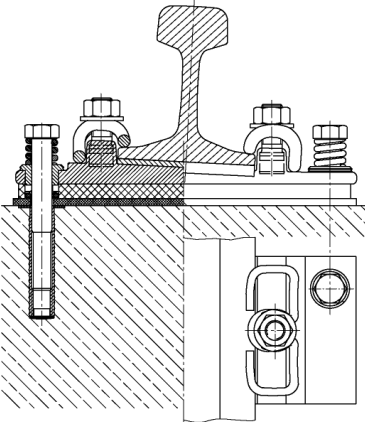
Selection of Hilti rail anchors for fastening rails to concrete track slab, based on axle load (A), stiffness (c) and thickness (t) of elastic pad

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	$\geq 250$ 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 to 19 °C	24h
10 °C to 14 °C	48h
5 °C to 9 °C	72h

Specification

Hilti HRT-I (elastic) Rail Anchor		
	<p><b>Bolt (M22, SW32)</b> Material: 10.9 (DIN 931, EN ISO 4014), hot dipped galvanized Head: Hexagonal</p>	<p><b>Bolt (M27, SW41)</b> Material: 8.8 (DIN 931, EN ISO 4014), blue zinc plated: Fe/Zn 10B (DIN 50961) Head: Hexagonal</p>
	<p><b>Spring (35 mm)</b> Wire Grade: C7 (DIN 2076), Yellow Zinc Plated: Fe/Zn 7C (DIN 50961), spring Rate: 373 N/mm, deformation: 8mm</p>	<p><b>Spring (40 mm)</b> Wire Grade: C7 (DIN 2076), yellow zinc plated: Fe/Zn 7C (DIN 50961), spring Rate: 300 N/mm, deformation: 10mm → 3.0 kN compression</p>
	<p><b>Collar Bush (Sealing Lip)</b> Material: Plastic, Int. Ø= 23 mm, Ext. Ø= 36 mm Volume resistivity: <math>1.2 \times 10^{12} \Omega \text{ cm}</math> Flexible lower portion of collar bush to prevent any excess injection mortar HIT-RE on the anchor shaft</p>	<p><b>Collar Bush (Sealing Lip)</b> Material: Plastic, int. Ø= 28 mm, ext. Ø= 36 mm Volume Resistivity: <math>1.2 \times 10^{12} \Omega \text{ cm}</math> Flexible lower portion of collar bush to prevent any excess injection mortar HIT-RE on the anchor shaft</p>
	<p><b>Sealingwasher (22.0/36.0/5.0)</b> To prevent any excess injection mortar HIT-RE on the anchor shaft.</p>	<p><b>Sealingwasher (27.0/36.0/5.0)</b> To prevent any excess injection mortar HIT-RE on the anchor shaft.</p>
	<p><b>Insert Body Ø 28 mm</b> Material: carbon steel (DIN/ISO 898/1), blue zinc plated: Fe/Zn 10B (DIN 50961), designed for an embedment of 120 mm</p>	<p><b>Insert Body Ø 33 mm</b> Material: carbon steel (DIN/ISO 898/1), blue zinc plated: Fe/Zn 10B (DIN 50961), designed for an embedment of 150 mm</p>

### Hilti HRT-I (rigid) Rail Anchor

#### Bolt (M22, SW32)

Material: 10.9 (DIN 931, EN ISO 4014), hot dipped galvanized  
Head: Hexagonal

#### 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: Hexagonal

#### 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)	<ul style="list-style-type: none"> <li>- for fastening rails to concrete slab track</li> <li>- for top-down (cast-in) construction method</li> <li>- verified for axle loads up to 250 kN</li> <li>- high electrical insulation values concerning stray current</li> <li>- corrosion resistance</li> <li>- with spring (elastic) or spring washer (rigid)</li> <li>- additional accessories available different support stiffness</li> <li>- fixing plate to support assembling</li> <li>- bolt removable</li> <li>- identical system for post-installed/bottom up construction method available (HRT-I) → Rehabilitation</li> <li>- 2 and 4 anchor configuration</li> </ul>
	Hilti HRT-IP (rigid)	

### 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	$\geq 250$ 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		
	<p><b>Bolt (M22, SW32)</b> Material: 10.9 (DIN 931, EN ISO 4014.), hot dipped galvanized Head: Hexagonal</p>	<p><b>Bolt (M27, SW41)</b> Material: 8.8 (DIN 931, EN ISO 4014), Blue Zinc Plated: Fe/Zn 10B (DIN 50961) Head: Hexagonal</p>
	<p><b>Spring (35 mm)</b> Wire Grade: C7 (DIN 2076), yellow zinc plated: Fe/Zn 7C (DIN 50961), Spring rate: 373 N/mm, deformation: 8mm</p>	<p><b>Spring (40 mm)</b> Wire Grade: C7 (DIN 2076), Yellow Zinc Plated: Fe/Zn 7C (DIN 50961), spring Rate: 300 N/mm, deformation: 10mm → 3.0 kN compression</p>
	<p><b>Collar Bush</b> Material: Plastic, int. Ø= 27 mm, ext. Ø= 36 mm Volume resistivity: <math>1.2 \times 10^{12} \Omega \text{ cm}</math></p>	<p><b>Collar Bush</b> Material: Plastic, int. Ø= 28 mm, ext. Ø= 36 mm Volume resistivity: <math>1.2 \times 10^{12} \Omega \text{ cm}</math></p>
	<p><b>Sealingwasher (22.0/36.0/5.0)</b> To prevent any excess concrete on the anchor shaft</p>	<p><b>Sealingwasher (27.0/36.0/5.0)</b> To prevent any excess concrete on the anchor shaft</p>
	<p><b>Fixing plate (26.2/50.0/2.0)</b> To fix the rigid pad (HDPE) and elastic pad to the support assembling during concrete slab pouring.</p>	<p><b>Fixing plate (31.2/50.0/2.0)</b> To fix the rigid pad (HDPE) and elastic pad to the support assembling during concrete slab pouring.</p>
	<p><b>Insert Body (Ø 28 mm)</b> Material: carbon steel (DIN/ISO 898/1), blue zinc plated: Fe/Zn 10B (DIN 50961), designed for an embedment of 120 mm</p>	<p><b>Insert Body (Ø 33 mm)</b> Material: Carbon steel (DIN/ISO 898/1), blue zinc plated: Fe/Zn 10B (DIN 50961), designed for an embedment of 150 mm</p>



## Hilti HRT-IP (rigid) Rail Anchor

### Bolt (M22, SW32)

Material: 10.9 (DIN 931, EN ISO 4014), hot dipped galvanized  
Head: Hexagonal

### 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: Hexagonal

### 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)

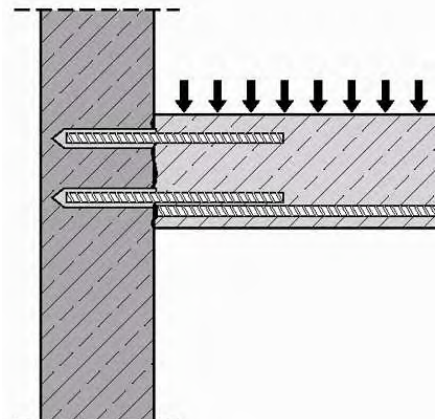
Material: carbon steel (DIN/ISO 898/1), blue zinc plated: Fe/Zn 10B (DIN 50961), designed for an embedment of 150 mm





## Post-installed rebar connections

Basics, design and installation  
Injection mortar systems for post-installed rebars



# Basics, design and installation of post installed rebar

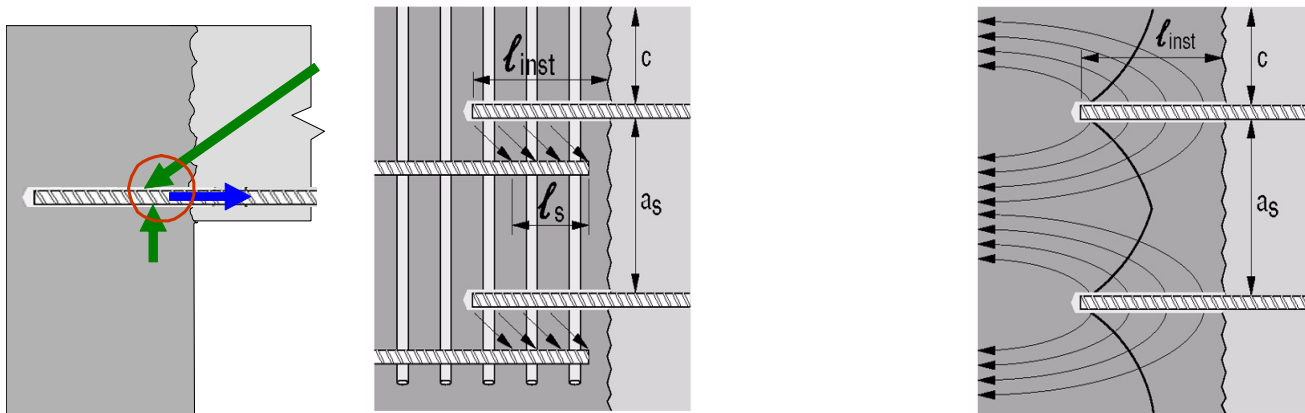
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## 1 Basics of post installed rebar connections

### 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  $w_k \sim 0.3\text{mm}$ . This is an important factor when considering resistance to the environment, mainly corrosion of the reinforcement.

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

### 1.2 Advantages of post-installed rebar connections

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

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

### 1.3 Application examples

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

Post-installed rebar connections in new construction projects

#### Diaphragm walls



#### Slab connections



#### Misplaced bars



#### Vertical/horizontal connections



Post-installed rebar connections in structure upgrades

#### Wall strengthening



#### New slab constructions





**Joint strengthening**



**Cantilevers/balconies**



Post-installed rebar connections in infrastructure requalifications  
**Slab widening**



**Structural upgrade**



**Slab strengthening**

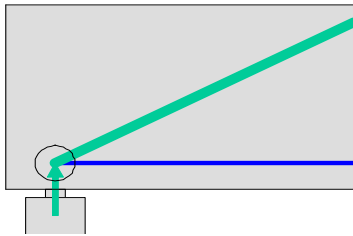


**Sidewalk upgrade**



## 1.4 Anchorage and Splice

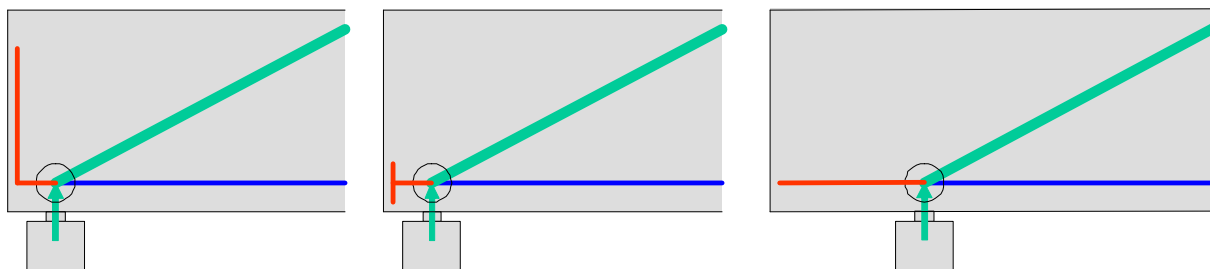
### Development Length



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



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.

Overlap splices

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°.

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:

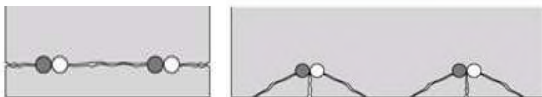
#### Bond Failure

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.

#### Splitting failure:

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

#### Influence of spacing and cover on splitting and spalling of concrete



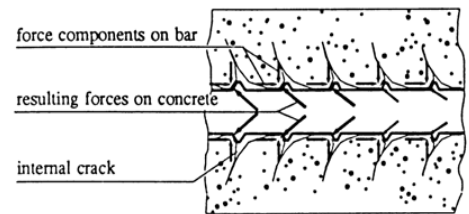
In most cases the reinforcement bars are placed close to the surface of the concrete member to achieve good crack distribution and economical bending capacity. For splices at wide spacing (normally in slabs, left part of figure left), the bearing capacity of the concrete depends only on the thickness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

#### Load Transfer in Overlap Splices

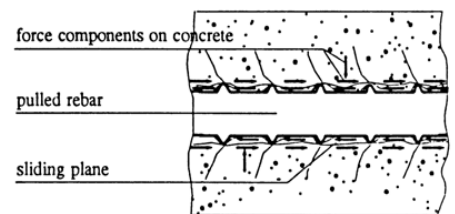


Load transfer at lap splices

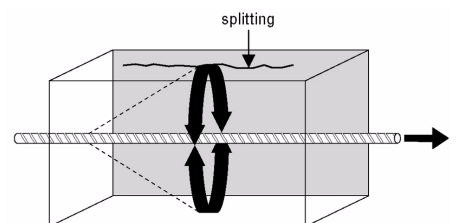
The load transfer between bars is performed by means of compressive struts in the concrete, see figure left. A 45° truss model is assumed. The resulting perpendicular forces act as splitting forces. The splitting forces are normally taken up by the transverse reinforcement. Small splitting forces are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



Load transfer from ribbed bars into



Bond failure of ribbed bars



Splitting

## 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 ( $w=0.3\text{mm}$ ) is similar, then the minimum anchorage length  $\ell_{b,min}$  and the minimum overlap length  $\ell_{o,min}$  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

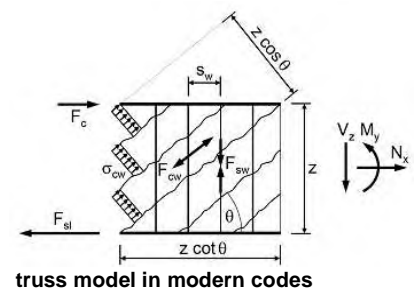
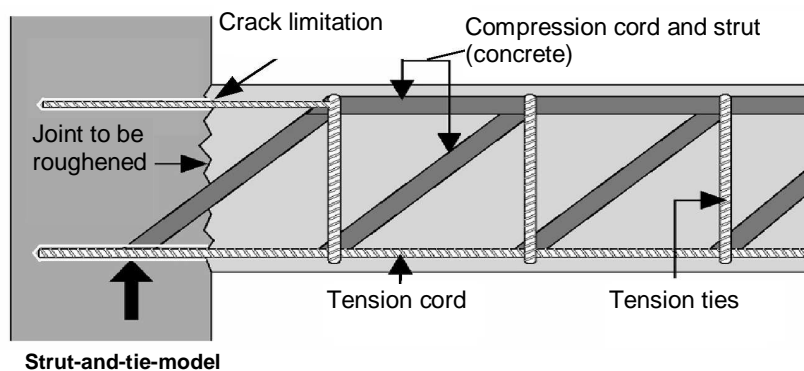
Strut-and-tie models are used to calculate the load path in reinforced concrete members. Where a non-linear strain distribution exists (e.g. supports) strut-and-tie models may be used {Clause 6.5.1(1), EC2: EN 1992-1-1:2011}.

Strut-and-tie 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  $\theta$  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:

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



## 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]:

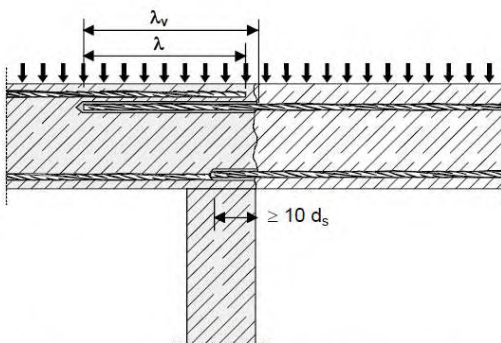


Figure 1.1: Overlap joint for rebar connections of slabs and beams

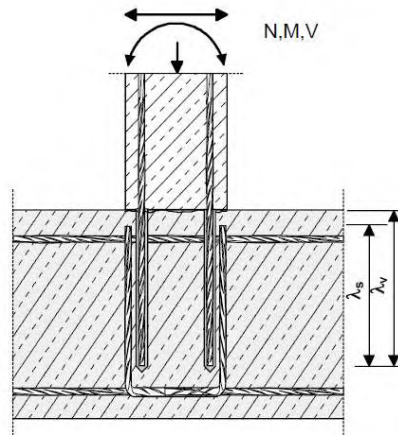


Figure 1.2: Overlap joint at a foundation of a column or wall where the rebars are stressed in tension

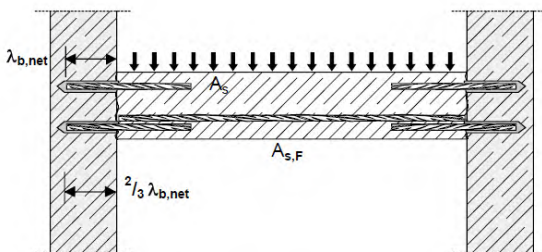


Figure 1.3: End anchoring of slabs or beams, designed as simply supported

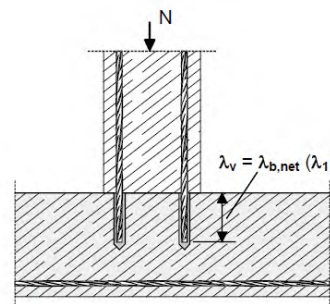


Figure 1.4: Rebar connection for components stressed primarily in compression. The rebars are stressed in compression

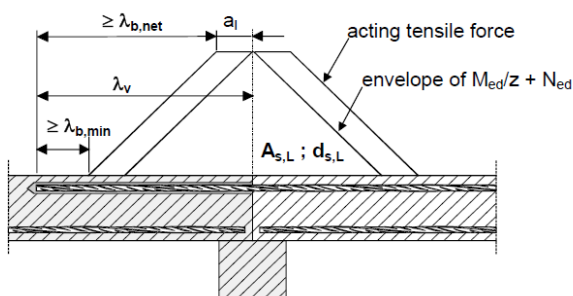


Figure 1.5: Anchoring of reinforcement to cover the line of acting tensile force

#### 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

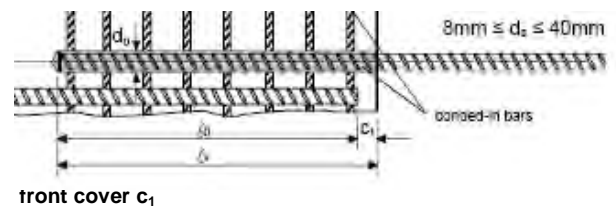
The following reflect the design relevant sections from EOTA TR023, chapter 4 “Assumptions under which the fitness of use is to be assessed” and from the specific European Technical Approvals:

#### 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:

$$l_v \geq l_0 + c_1$$

with:  $l_0$  = required lap length  
 $c_1$  = concrete cover at end-face of bonded-in rebar



- 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:

$$c_{\min} = 30 + 0,06 l_v \geq 2d_s \text{ (mm) for hammer drilled holes}$$

$$c_{\min} = 50 + 0,08 l_v \geq 2d_s \text{ (mm) for compressed air drilled holes}$$

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  $a = 40 \text{ mm} \geq 4d_s$

- 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

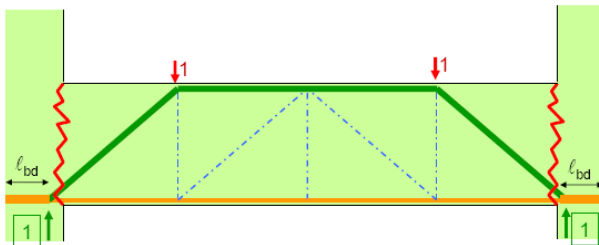
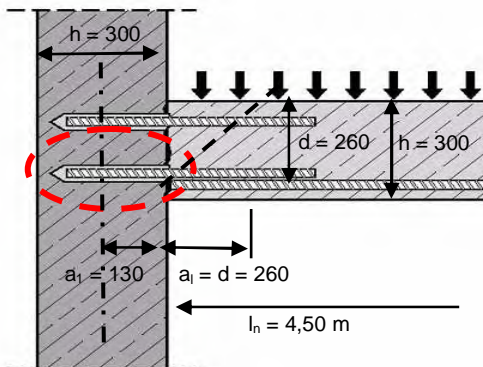
- The surface of the joint between new and existing concrete should be prepared (roughing, keying) according to the envisaged intended use according to EC2.
- In case of a connection being made between new and existing concrete where the surface layer of the existing concrete is carbonated, the layer should be removed in the area of the new reinforcing bar (with a diameter  $d_s+60\text{mm}$ ) 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:  $l_n = 4,50\text{ m}$ ,  $Q_k = 20\text{ kN/m}^2$ ,  $h = 300\text{ mm}$ ,  $d = 260\text{ mm}$

Wall:  $h = 300\text{ mm}$

Concrete strength class: C20/25, dry concrete

Reinforcement:  $f_{yk} = 500\text{ N/mm}^2$ ,  $\gamma_s = 1,15$

Loads:  $G_k = 25\text{ kN/m}^3 \cdot h = 7,5\text{ kN/m}^2$   
 $S_d = (1,50 \cdot Q_d + 1,35 \cdot G_k) = 40,1\text{ kN/m}^2$

Structural analysis (design forces):

$$M_{Ed} = S_d \cdot l_n^2 / 8 = 102\text{ kNm/m}$$

$$V_{Ed} = S_d \cdot l_n / 2 = 90,3\text{ kN/m}$$

Bottom reinforcement required at mid span:

$$A_{s,rqd,m} = (M_{sd} \cdot \gamma_s) / (0,9 \cdot d \cdot f_{yk}) = 998\text{ mm}^2/\text{m}$$

Reinforcement provided at mid span:  $\varnothing 16$ ,  $s = 200\text{ mm}$

$$A_{s,prov,m} = 1005\text{ mm}^2/\text{m}$$

Bottom reinforcement at support:

Tension force to be anchored:  $F_E = |V_{Ed}| \cdot a_1 / (0,9d) = 100\text{ kN/m}$  {Clause 9.2.1.4(2), EC2: EN 1992-1-1:2004}

Steel area required:  $A_{s,rqd} = F_E \cdot \gamma_s / f_{yk} = 231\text{ mm}^2/\text{m}$

Minimum reinforcement to be anchored at support:

$A_{s,min} = k_c \cdot k \cdot f_{ct,eff} \cdot A_s / \sigma_s = 0,4 \cdot 1 \cdot 2,2 \cdot 150 \cdot 1000 / 500 = 264\text{ mm}^2/\text{m}$  {Clause 7.3.2(2), EC2: EN 1992-1-1:2011}

$A_{s,min} = 0,50 \cdot 988 = 499\text{ mm}^2/\text{m}$  {Clause 9.3.1.2(1), EC2: EN 1992-1-1:2011}

$A_{s,min} = 0,25 \cdot 1010 = 251\text{ mm}^2/\text{m}$  {Clause 9.2.1.4(1), EC2: EN 1992-1-1:2011}

Decisive is  $499\text{ mm}^2/\text{m} \Rightarrow$  reinforcement provided:  $\varnothing 12$ ,  $s = 200\text{ mm} \Rightarrow A_{s,prov} = 565\text{ mm}^2/\text{m}$ ;

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}:

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

with:  $d_s =$  diameter of the rebar = 12 mm

$\sigma_{sd} =$  calculated design stress of the rebar =  $(A_{s,rqd} / A_{s,prov}) \cdot (f_{yk} / \gamma_s) = (231 / 565) \cdot (500 / 1,15) = 177\text{ N/mm}^2$

$f_{bd} =$  design value of bond strength according to corresponding ETA (= 2,3 N/mm<sup>2</sup>)

$$l_{b,rqd} = (12 / 4) \times (177 / 2,3) = 231\text{ mm}$$

Design anchorage length {EC2: EN 1992-1-1:2011, section 8.4.4}:

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

with:  $l_{b,rqd}$  as above

$\alpha_1 = 1,0$  for straight bars

$\alpha_2 = 1 - 0,15(c_d - \varnothing) / \varnothing$  ( $0,7 \leq \alpha_2 \leq 1,0$ )

$\alpha_2$  is for the effect of concrete cover, in this case half the clear spacing:  $c_d = (200 - 12) / 2 = 94\text{ mm}$

$\alpha_2 = 0,7$

Straight bars,  $c_d = \min(a/2, c_1, c)$

$\alpha_3 = 1,0$  because of no transverse reinforcement

$\alpha_4 = 1,0$  because of no welded transverse reinforcement

$\alpha_5 = 1,0$  influence of transverse pressure is neglected in this example

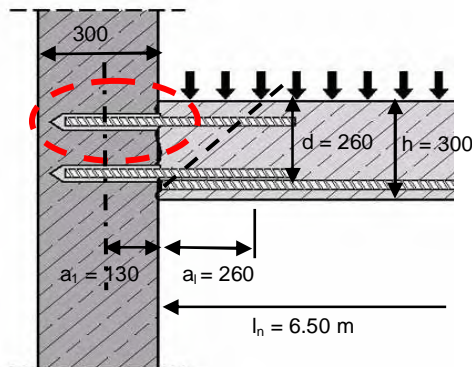
$$l_{bd} = 0,7 \cdot 231 = 162\text{ mm}$$

minimum anchorage length {Clause 8.4.4(1), EC2: EN 1992-1-1:2011}:

$$\ell_{b,\min} = \max \{0,3\ell_{b,\text{reqd}}; 10\phi; 100\text{mm}\} = 120 \text{ mm}$$

$\ell_{bd}$  controls  $\rightarrow$  drill hole length  $l_{ef} = 162 \text{ mm}$

Top reinforcement at support:



Minimum reinforcement:

25% of bottom steel required at mid-span  
{Clause 9.3.1.2(2), EC2: EN 1992-1-1:2004}

$$A_{s,\text{req}} = 0,25 \times 988 = 247 \text{ mm}^2/\text{m}$$

$$A_{s,\text{min}} = 0,4 \times 1 \times 2,2 \times 150 \times 1000 / 500 = 264 \text{ mm}^2/\text{m}$$

{Clause 7.3.2(2), EC2: EN 1992-1-1:2004}

Decisive is 264 mm<sup>2</sup>/m

$\Rightarrow$  reinforcement provided:  $\phi 12$ ,  $s = 333 \text{ mm}$ ;  $A_{s,\text{prov}} = 339 \text{ mm}^2/\text{m}$

As the design stress is 0, the minimum anchorage length applies for the upper reinforcement. As in the above calculation for bottom reinforcement:

$$\ell_{b,\min} = \max \{0,3\ell_{b,\text{reqd}}; 10\phi; 100\text{mm}\} = 120 \text{ mm}$$

Therefore, drill hole length  $l_{ef} = 120\text{mm}$

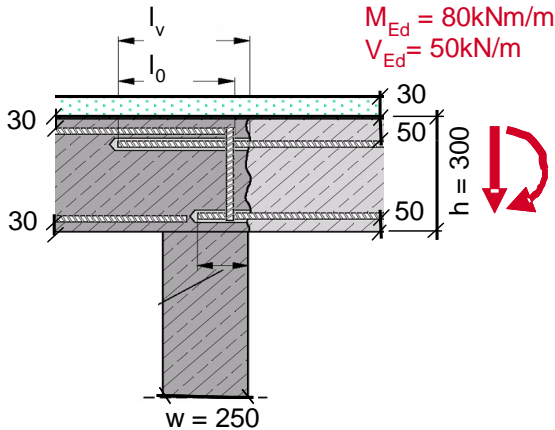
If wet diamond core drilling is used {Clause 8.4.4(1), EC2: EN 1992-1-1:2011}:

$$\ell_{b,\min} = \max \{0,3\ell_{b,\text{reqd}}; 10\phi; 100\text{mm}\} \cdot 1,5 = 180 \text{ mm} \quad (\text{as wet diamond core drilling is used, the minimum values according do EC2 have to be multiplied by 1,5, see tech data})$$

$\rightarrow$  in this case the minimum length will control, drill hole length  $l_{ef} = 180\text{mm}$  for upper and lower layers

## 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:  $c_n = 50$ mm  $h = 300$  mm;
- Top reinforcement (new and existing):  $\phi 16$ ,  $s = 200$  mm;  $A_{s,prov} = 1005$  mm<sup>2</sup>/m; cover to face  $c_1 = 30$  mm
- Bottom reinforcement:  $\phi 10$ ,  $s=200$  mm;  $A_{s,prov}=393$  mm<sup>2</sup>/m
- Concrete strength class: C25/30
- Properties of reinforcement:  $f_{yk} = 500$  N/mm<sup>2</sup>
- 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<sup>2</sup>
- Hilti HIT-RE 500

### Cast-in reinforcement top

$$l_{0,ci} = \alpha_1 \alpha_2 \alpha_3 \alpha_5 \alpha_6 l_{b,rqd,ci} \geq l_{0,min}$$

$\eta_1 = (d - \phi/2 > 250\text{mm})$	0.7	poor bond condition
$Z_{ci} =$	239 mm	(from static calculation)
$A_{s,req} = (M_{Ed}/z) \cdot (\gamma_s/f_{yk}) = (80/0.239) \cdot (1.15/0.5) =$	770 mm <sup>2</sup> /m	
$\sigma_{sd} = (A_{s,rqd} / A_{s,prov}) \cdot (f_{yk}/\gamma_s) = (770 / 1005) \cdot (500 / 1.15) =$	333 N/mm <sup>2</sup>	
$f_{bd} = 2.25 \cdot \eta_1 \cdot 0.7 \cdot 0.3 \cdot f_{ck}^{2/3} / \gamma_c = 2.25 \cdot 0.7 \cdot 0.7 \cdot 0.3 \cdot 25^{2/3} / 1.5 =$	1.89 N/mm <sup>2</sup>	(ETA-08/0105)

$$l_{b,rqd,pi} = (\phi / 4) \cdot (\sigma_{sd} / f_{bd}) = (16 / 4) \cdot (333 / 1,89) = 705 \text{ mm}$$

$\alpha_1 =$	0,7	hooked end of cast-in bars
$\alpha_2 = (1 - 0,15(c_d - \phi)/\phi \geq 0.7) = 1 - 0,15(30 - 16)/16 =$	0,87	
$\alpha_3 =$	1,0	no transverse reinforcement
$\alpha_5 =$	1,0	no transverse pressure
$\alpha_6 =$	1,5	splice factor

$$l_{0,min} = \max\{0,3 \cdot 1,5 \cdot 705; 15 \cdot 16; 200\} = 317 \text{ mm}$$

$$l_{0,ci} = 0,70 \cdot 0,87 \cdot 1,5 \cdot 705 = 643 \text{ mm}$$

### 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:

$$l_{0,pi} = \alpha_1 \alpha_2 \alpha_3 \alpha_5 \alpha_6 l_{b,rqd,pi} \geq l_{0,min}$$

$d = h - c_n - \phi/2 = 300 - 50 - 16/2 =$	242 mm	
$\eta_1 = (d - \phi/2 < 250\text{mm})$	1,0	good bond condition
$Z =$	228 mm	(from static calculation)
$A_{s,req} = (M_{Ed}/z) \cdot (\gamma_s/f_{yk}) = (80/0.228) \cdot (1,15/0,5) =$	807 mm <sup>2</sup> /m	
$\sigma_{sd} = (A_{s,rqd} / A_{s,prov}) \cdot (f_{yk}/\gamma_s) = (807 / 1005) \cdot (500 / 1,15) =$	349 N/mm <sup>2</sup>	
$f_{bd} =$ design value of bond strength according to 2.2.3 =	2,7 N/mm <sup>2</sup>	(ETA-08/0105)

$$l_{b,rqd,pi} = (\phi / 4) \cdot (\sigma_{sd} / f_{bd}) = (16 / 4) \cdot (349 / 2,7) = 516 \text{ mm}$$



$\alpha_1 =$	1,0	for straight bars
$\alpha_2 = (1 - 0,15(c_d - \emptyset)/\emptyset \geq 0,7) = 1 - 0,15(50 - 16)/16 =$	0,7	
$\alpha_3 =$	1,0	no transverse reinforcement
$\alpha_5 =$	1,0	no transverse pressure
$\alpha_6 =$	1,5	splice factor
$l_{0,min} = \max\{0,3 \cdot 1,5 \cdot 515; 15 \cdot 16; 200\} =$	240 mm	
$l_{0,pi} = 0,7 \cdot 1,5 \cdot 530 =$	542 mm	

### Fire resistance post-installed reinforcement top:

$\gamma_L =$	1,4	assumed safety factor loads
$\sigma_{sd,fi} = \sigma_{sd}/\gamma_L = 358/1,4 =$	249 N/mm <sup>2</sup>	$< \sigma_{Rd,fi} \rightarrow ok$
$c_{fi} = c_n + t_p = 30 + 50 =$	80 mm	cover effective against fire
$f_{bd,fi} = (\text{sect. 2.4.1, table fire parallel})$	1,4 N/mm <sup>2</sup>	(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:

$e = [(s/2)^2 + (c_n - c_c)^2]^{0,5} - \phi = [100^2 + (50 - 30)^2]^{0,5} - 16 =$	86 mm	clear spacing between spliced bars
$\Delta l_0 = e - 4\phi = 86 - 4 \cdot 16 =$	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	
$l_v = l_0 + \max(w/2; c_f) = 733 + 125 =$	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)
$l_{b,min} = f_{min} \cdot \max(10\phi; 100\text{mm}) = 1,0 \cdot \max(10 \cdot 10; 100) =$	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

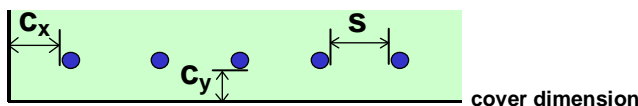
The factor  $\alpha_2$  of Eurocode 2 [1] gives an explicit consideration for splitting and spalling as a function of concrete cover and bar spacing. European Technical Approvals recommend the same procedure for post-installed rebar connections:

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

$f_{bd}$  according to technical data (ETA's for post – installed anchors)

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

$$c_d = \min(c_x; c_y; s/2)$$
(1)



This function is adapted and extended for post-installed reinforcement for the HIT-Rebar design concept: Eurocode 2 limits the  $\alpha_2$  value to  $\alpha_2 \geq 0.7$ . This can be interpreted as follows: as long as  $\alpha_2$  exceeds 0.7, spalling of the concrete cover or splitting between bars will be the controlling mode of failure. If  $\alpha_2$  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  $\alpha_2$  and the bond stress, at which splitting occurs can be expressed as:

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

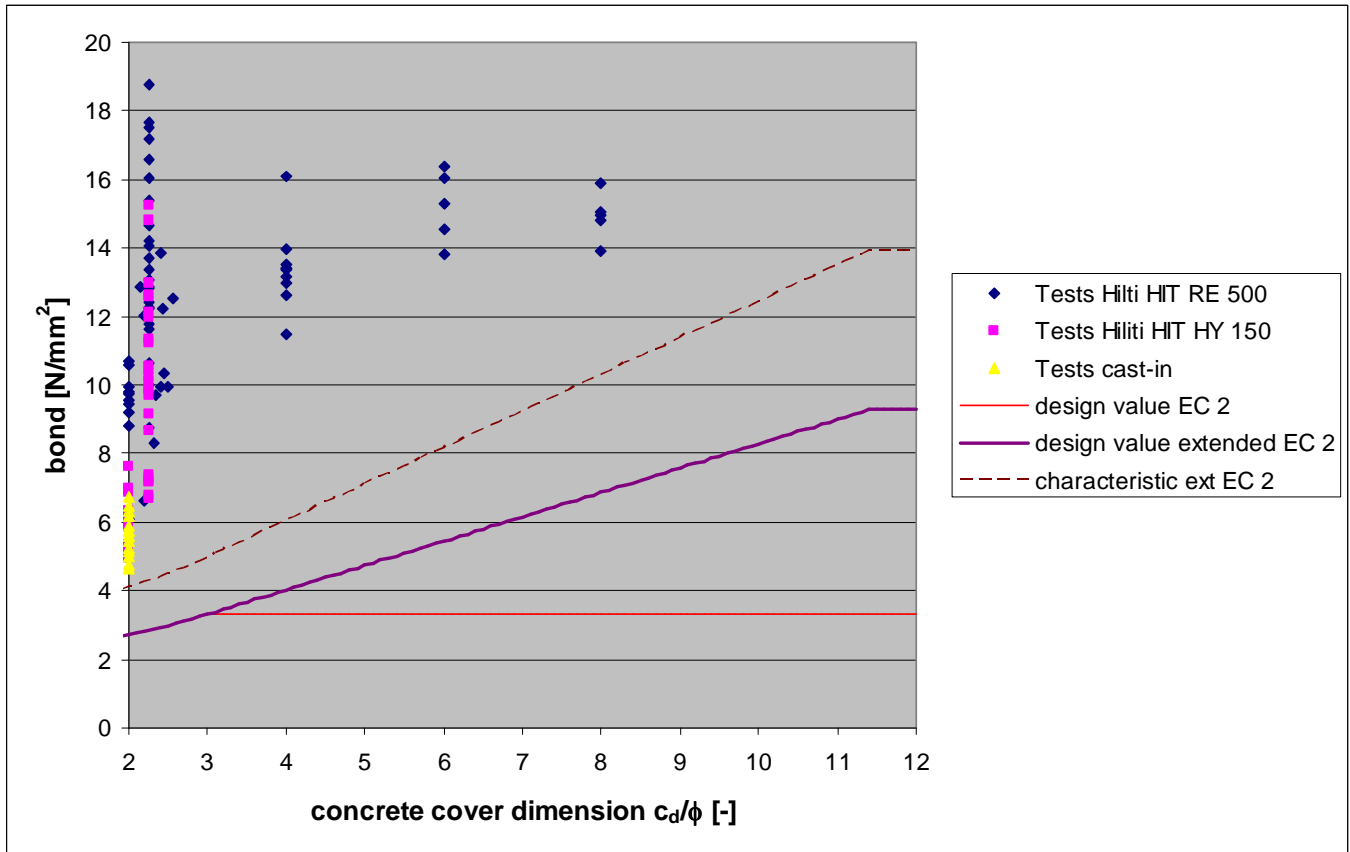
For cover dimensions exceeding the range of Eurocode 2, i.e. for  $c_d/\phi > 3$  (bonded-in bars only), an adapted factor  $\alpha_2'$  is used to create a linear extension of the bond strength function:

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

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

where  $\delta$  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  $\alpha_2'$ , its value is limited to  $\alpha_2' \geq 0.25$

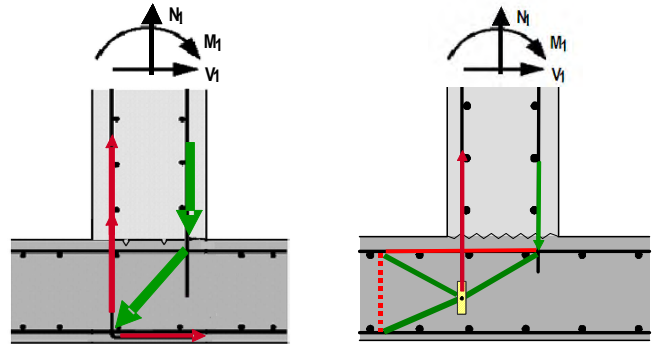
Below is a typical design bond stress  $f_{bd}$  curve as a function of the minimum edge distance/spacing distance,  $c_d$  is shown for a concrete class C20/25 and for a rebar with a diameter of not more than 32mm. In this figure the equivalent design bond stresses according to EC 2 and resulting from the above described definition of  $\alpha_2$  and  $\alpha_2'$  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  $\gamma_c=1,5$ ).



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.

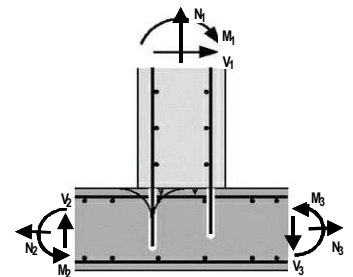
### 2.3.2 Strut and Tie Model for Frame Nodes

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

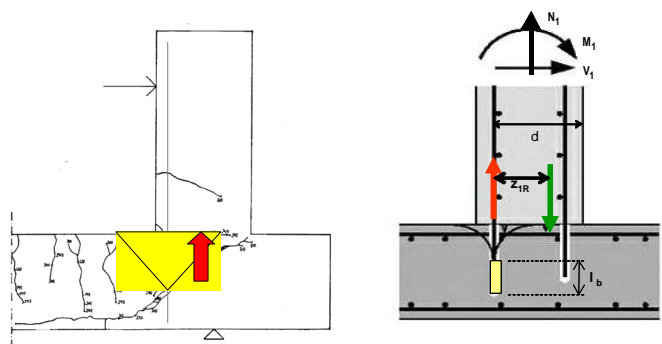
In order to check the struts and ties inside the node, the reactions  $N_2$ ,  $V_2$ ,  $M_2$ ,  $N_3$ ,  $V_3$ ,  $M_3$  at the other ends of the node need to be defined. Normally, they result from the structural analysis outside the node region and will be determined by the designer in charge.



Global equilibrium of the node

#### Tension in connecting bars

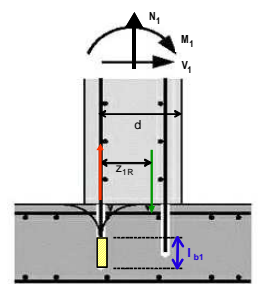
The loading of the wall in the figures results in a tensile force in the reinforcement on the left hand side and in a compression force on the right hand side. Initial tests and computer simulations led to the consideration that the straight bar has a tendency to push a concrete cone against the interface with the wall. Thus the compressive stress in the interface is 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.

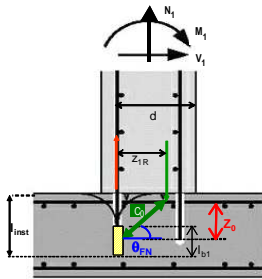
As bending cracks are expected to occur along the bar from the top of the base concrete, the anchorage zone is developing from the lower end of the bar and its length  $l_b$  is that required to develop the steel stress calculated from the section forces  $M_1$ ,  $N_1$  and  $V_1$ .



$$\ell_b = \frac{\sigma_{sd} \cdot \phi}{4 \cdot f_{bd}}$$

with  $\sigma_{sd}$  design steel stress in the connection bars [MPa]  
 $\phi$  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  $\theta$  between the inclined compression strut  $C_0$  and the horizontal direction is  $30^\circ$  to  $60^\circ$ . For low drill hole lengths the resulting strut angle will be less than  $30^\circ$ . 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  $\theta_{FN}$ .

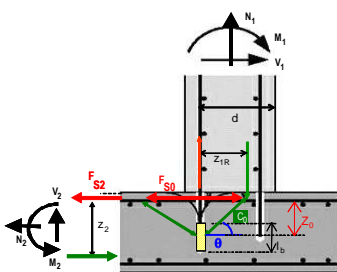
Note that PROFIS Rebar will preferably propose the installation length such that the strut angle  $\theta_{FN}$  is  $60^\circ$ . In cases where the existing section is too thin for this, it will propose the maximum possible embedment depth which is defined for bonded anchors in ETAG 001,

part 5, section 2.2.2 as

$$\ell_{inst,max} = h_{member} - \max(2 \cdot d_0; 30\text{mm})$$

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  $\ell_b$  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:

$$z_0 = \ell_{inst} - \frac{\ell_b}{2} - c_s$$

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:

$$F_{s2} = M_2/z_2 + N_2/2 \quad (\text{tension in existing reinforcement outside node area})$$

$$H_{s2} = \left( M_1 + (V_2 + V_3) \cdot \frac{z_1}{2} \right) \cdot \left( \frac{1}{z_0} - \frac{1}{z_2} \right) + V_1 \cdot \left( \frac{z_1}{z_0} - 1 \right) \quad (\text{additional tension in node due to reduced lever arm})$$

$$F_{s0} = F_{s2} + H_{s2} \quad (\text{steel tension in node area})$$

$$A_{s0,rqd} = F_{s0}/(f_{yk}/\gamma_s) \quad (\text{steel area required in existing part for forces from new part})$$

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  $\ell_b$ .

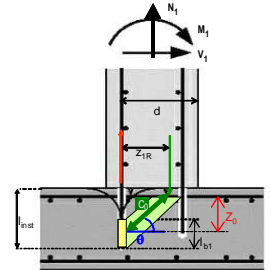
$$F_{c0} = \frac{M_1 + (V_2 + V_3) \cdot z_1 / 2}{z_0} \quad (\text{horizontal component of concrete strut force})$$

$$D_0 = F_{c0} / \cos \theta_{FN} \quad (\text{concrete force in direction of strut})$$

$$\sigma_{Rd,max} = v' \cdot k_2 \cdot \alpha_{cc} \cdot f_{ck} / \gamma_c \quad (\text{reduced concrete strength in tension-compression node according to ENV1992-1-1, 4.5.4(4b). Standard parameters: } v'=1 \cdot f_{ck}/250; k_2=0.85; \alpha_{cc}=1.0; \gamma_c=1.5, \text{ subject to variations in National Application Documents})$$

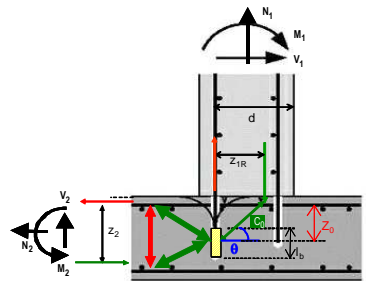
$$D_{0,R} = \sigma_{Rd,max} \cdot \ell_b \cdot w \cdot \cos \theta_{FN} \quad (\text{resistance of concrete in strut direction, } w=\text{width of section})$$

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 right 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



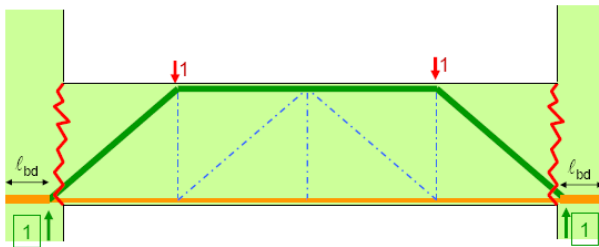
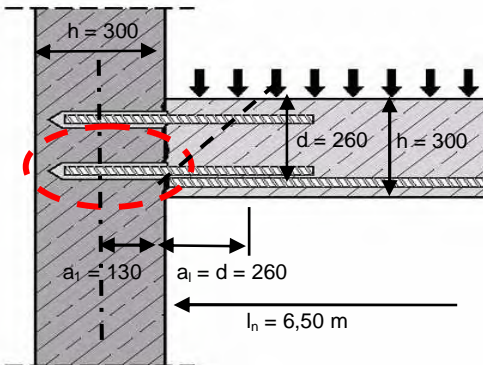
$$\max \sigma_{sp} = \left( M_1 + \frac{(V_2 + V_3) \cdot z_1}{2} \right) \cdot \left( 1 - \frac{z_0}{z_2} \right) \cdot \left( 1 - \frac{\ell_b}{2 \cdot z_2} \right) \cdot \left( \frac{2.42}{b \cdot z_2^2} \right) \leq f_{ct}$$

- with:  $M_1, V_2, V_3$ : external forces on node according to figure 5
- $z_2$ : inner lever arm of wall 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:  $\alpha_{ct}=1.0$ , 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:  $l_n = 4,50\text{m}$ ,  $Q_k = 20\text{ kN/m}^2$ ,  $h = 300\text{ mm}$ ,  $d = 260\text{ mm}$

Wall:  $h = 300\text{ mm}$

Concrete strength class: C20/25, dry concrete

Reinforcement:  $f_{yk} = 500\text{ N/mm}^2$ ,  $\gamma_s = 1,15$

Loads:  $G_k = 25\text{ kN/m}^3 \cdot h = 7,5\text{ kN/m}^2$ ;  
 $S_d = (1,50 \cdot Q_d + 1,35 \cdot G_k) = 40,1\text{ kN/m}^2$

Structural analysis (design forces):

$$M_{Ed} = S_d \cdot l_n^2 / 8 = 102\text{ kNm/m}$$

$$V_{Ed} = S_d \cdot l_n / 2 = 90,3\text{ kN/m}$$

Bottom reinforcement required at mid span:

$$A_{s,rqd,m} = (M_{sd} \cdot \gamma_s) / (0,9 \cdot d \cdot f_{yk}) = 998\text{ mm}^2/\text{m}$$

Reinforcement provided at mid span:  $\varnothing 16$ ,  $s = 200\text{ mm}$

$$A_{s,prov,m} = 1005\text{ mm}^2/\text{m}$$

#### Bottom reinforcement at support:

Tension force to be anchored:  $F_{Ed} = |V_{Ed}| \cdot a_1 / (0,9d) = 100\text{ kN/m}$  (Clause 9.2.1.4(2), EC2: EN 1992-1-1:2004)

Steel area required:  $A_{s,rqd} = F_{Ed} \cdot \gamma_s / f_{yk} = 231\text{ mm}^2/\text{m}$

#### Minimum reinforcement to be anchored at support:

$A_{s,min} = k_c \cdot k_{ct,eff} \cdot A_s / \sigma_s = 0,4 \cdot 1 \cdot 2,2 \cdot 150 \cdot 1000 / 500 = 264\text{ mm}^2/\text{m}$  (Clause 7.3.2(2), EC2: EN 1992-1-1:2011)

$A_{s,min} = 0,5 \cdot A_{s,rqd,m} = 0,50 \cdot 988 = 499\text{ mm}^2/\text{m}$  (Clause 9.3.1.2(1), EC2: EN 1992-1-1:2011)

$A_{s,min} = 0,25 \cdot A_{s,prov,m} = 0,25 \cdot 1010 = 251\text{ mm}^2/\text{m}$  (Clause 9.2.1.4(1), EC2: EN 1992-1-1:2011)

Decisive is  $499\text{ mm}^2/\text{m} \Rightarrow$  reinforcement provided:  $\varnothing 12$ ,  $s = 200\text{ mm} \Rightarrow A_{s,prov} = 565\text{ mm}^2/\text{m}$ ;

Installation by hammer drilling; Hilti HIT-RE 500

#### Minimum anchorage length

$\sigma_{sd} = (A_{s,rqd} / A_{s,prov}) \cdot (f_{yk} / \gamma_s) = (23 / 565) \cdot (500 / 1,15) = 177\text{ N/mm}^2$

$f_{bd,EC2} = 2,3\text{ N/mm}^2$  (EC 2 for minimum length. see tech. data)

$\ell_{b,rqd} = (\phi / 4) \times (\sigma_{sd} / f_{bd}) = (12 / 4) \times (177 / 2,3) = 231\text{ mm}$

$\ell_{b,min} = \max \{0,3\ell_{b,rqd}; 10\phi; 100\text{mm}\} = 120\text{ mm}$  (Clause 8.4.4(1), EC2: EN 1992-1-1:2011)

#### Development length:

Cover dimension:  $c_d = (s - \phi) / 2 = 94\text{ mm}$

Confinement  $c_d / \phi = 94 / 12 = 7,8$

Splitting bond strength for  $c_d/\phi > 3$ :

$$\alpha_2' = \frac{1}{\frac{1}{0.7} + \delta \cdot \frac{c_d - 3\phi}{\phi}} = \frac{1}{\frac{1}{0.7} + 0.306 \cdot \frac{94 - 3 \cdot 12}{12}} = 0.344$$

$$f_{bd,spl,2} = \frac{f_{bd,EC2}}{\max(\alpha_2'; 0.25)} = \frac{2.3}{0.344} = 6.7 \text{ N/mm}^2$$

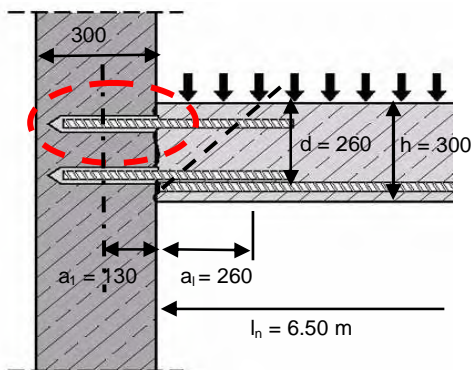
Pullout bond strength:  $f_{bd,p} = 8.6 \text{ N/mm}^2$  (see tech. data)

Applicable design bond strength:  $f_{bd} = \min(f_{bd,spl}; f_{bd,p}) = 6.7 \text{ N/mm}^2$

Design development length:  $l_{bd} = (\phi/4) \cdot (\sigma_{sd}/f_{bd}) = 80 \text{ mm}$

Minimum length controls → drill hole length  $l_{ef} = 120 \text{ mm}$

Top reinforcement at support:



Minimum reinforcement:

$$A_{s,req} = 0.25 \cdot A_{s,rqd,m} = 0.25 \cdot 988 = 247 \text{ mm}^2/\text{m}$$

(Clause 9.3.1.2(2), EC2: EN 1992-1-1:2011)

$$A_{s,min} = 0.4 \cdot 1 \cdot 2.2 \cdot 150 \cdot 1000 / 500 = 264 \text{ mm}^2/\text{m}$$

(Clause 7.3.2(2), EC2: EN 1992-1-1:2011)

Decisive is 264 mm<sup>2</sup>/m

⇒ reinforcement provided:  $\phi 12, s = 333 \text{ mm}; A_{s,prov} = 339 \text{ mm}^2/\text{m}$

As the design stress is 0, the minimum anchorage length applies for the upper reinforcement. As in the above calculation for bottom reinforcement:

$$l_{b,min} = \max \{0.3l_{b,rqd}; 10\phi; 100\text{mm}\} = 120 \text{ mm}$$

Therefore, drill hole length  $l_{ef} = 120 \text{ mm}$

If wet diamond core drilling is used:

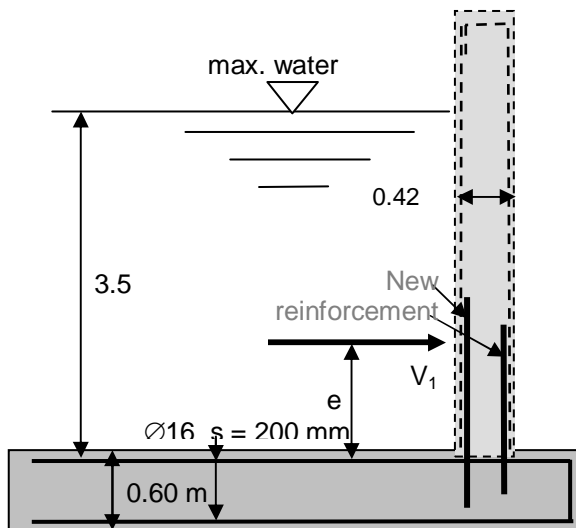
$$l_{b,min} = \max \{0.3l_{b,rqd}; 10\phi; 100\text{mm}\} \cdot 1.5 = 180 \text{ mm}$$

(as wet diamond core drilling is used, the minimum values according to EC2 have to be multiplied by 1.5, see tech data)

-> in this case the minimum length will control, drill hole length  $l_{ef} = 180 \text{ mm}$  for upper and lower layers



## b) Wall bending connection



Note: transverse reinforcement not

### Geometry:

$$h_1 = 420 \text{ mm}; h_2 = h_3 = 600 \text{ mm};$$

$$d_1 = 380 \text{ mm}; d_2 = d_3 = 560 \text{ mm};$$

$$z_1 = 360 \text{ mm}; z_2 = z_3 = 520 \text{ mm}$$

$$A_{s0} = A_{s2} = A_{s3} = 1005 \text{ mm}^2/\text{m} (\text{Ø}16 \text{ } s = 200 \text{ mm})$$

$$c_s = h_2 - d_2 = 40 \text{ mm}$$

### Material:

Concrete: C20/25 (new and existing parts),  $\gamma_c = 1,5$

Steel grade: 500 N/mm<sup>2</sup>,  $\gamma_s = 1,15$

Safety factor for variable load:  $\gamma_Q = 1,5$

HIT-RE 500-SD (temperature range I)

### Acting loads:

$$V_{1d} = \gamma_Q \cdot p \cdot h^2 / 2 = 1,4 \cdot 10 \cdot 3,5^2 / 2 = 92 \text{ kN/m}$$

$$e = h / 3 = 3,5 / 3 = 1,17 \text{ m}$$

$$M_{1d} = V_{1d} \cdot e = 92 \cdot 1,17 = 107 \text{ kNm/m}$$

### Force in post-installed reinforcement

$$z_{1r} = 0,85 \cdot z_1 = 0,85 \cdot 360 = 306 \text{ mm} \quad (\text{opening moment} \rightarrow \text{reduced inner lever arm})$$

$$F_{s1d} = M_{1d} / z_{1r} = 107 / 0,306 = 350 \text{ kN/m}$$

$$A_{s1,rqd} = F_{s1d} / (f_{yk} / \gamma_{Ms}) = 350 \cdot 1000 / (500 / 1,15) = 805 \text{ mm}^2/\text{m}$$

$$\text{Select } \phi 12 \text{ mm, spacing } s_1 = 125 \text{ mm} \rightarrow A_{s1,prov} = 905 \text{ mm}^2$$

$$\rightarrow \text{drilled hole diameter: } d_0 = 16 \text{ mm}$$

$$\text{Stress in bar: } \sigma_{sd} = F_{s1d} / A_{s1,prov} = 386 \text{ N/mm}^2$$

### anchorage length

$$f_{bd,EC2} = 2,3 \text{ N/mm}^2 \quad (\text{EC 2 for minimum length})$$

$$\ell_{b,rqd,EC2} = (\phi/4) \cdot (\sigma_{sd} / f_{bd,EC2}) = 504 \text{ mm}$$

$$\ell_{b,min} = \max \{0,3 \ell_{b,rqd,EC2}; 10\phi; 100 \text{ mm}\} = 151 \text{ mm}$$

$$f_{bd,b} = 8,3 \text{ N/mm}^2 \quad (\text{see tech. data})$$

$$c_d = s_1 / 2 - \phi / 2 = 56,5 \text{ mm} > 3\phi$$

$$\alpha_2' = \frac{1}{\max \left[ \frac{1}{0,7} + \delta \cdot \frac{c_d - 3\phi}{\phi}; 0,25 \right]} = 0,512$$

$$f_{bd,spl2} = \frac{f_{bd}}{\max [\alpha_2'; 0,25]} = 4,5 \text{ N/mm}^2$$

$$f_{bd} = \min \{f_{bd,b}; f_{bd,spl}\} = 4,5 \text{ N/mm}^2$$

$$\ell_{b1} = \max \{(\phi/4) \cdot (\sigma_{sd} / f_{bd}); \ell_{b,min}\} = 258 \text{ mm}$$

Drilled hole length

$$\ell_{inst,max} = h_2 - \max\{2d_0; 30\text{mm}\} = 568 \text{ mm} \quad (\text{maximum possible hole length})$$

$$\ell_{inst,60} = c_s + z_{1R} \cdot \tan 60^\circ + \ell_{b1} / 2 = 672 \text{ mm} \quad (\text{hole length corresponding to } \theta=60^\circ)$$

$$\ell_{inst,60} > \ell_{inst,max} \rightarrow \text{select hole length } \ell_{inst} = \ell_{inst,max} = 568 \text{ mm}$$

$$\text{Strut angle with } \ell_{inst,max}: \tan \theta = (\ell_{inst,max} - c_s - \ell_{b1}/2) / z_{1R} \rightarrow \theta_{FN} = 53^\circ$$

$$\text{check: } \theta > 30^\circ \rightarrow \text{ok}$$

Reaction in Foundation:

$$-M_{2d} = M_{1d} + V_{1d} \cdot z_2 / 2 = 107 + 0.25 \cdot 92 = 131 \text{ kNm/m}$$

$$N_{2d} = -V_{1d} = -92 \text{ kN/m}$$

$$M_{s3} = 0; V_{2d} = V_{3d} = 0; N_1 = N_3 = 0$$

Check of foundation reinforcement

$$F_{s2d} = M_{2d} / z_2 + N_{2d} / 2 = 298 \text{ kNm/m} \quad (\text{tension outside node area})$$

$$z_0 = \ell_{inst} - c_s - \ell_{b1} / 2 = 568 - 40 - 258/2 = 399 \text{ mm} \quad (\text{lever arm in node area})$$

$$H_{s2d} = M_{1d} \cdot (1/z_0 - 1/z_2) + V_{1d} \cdot (z_1/z_0 - 1) = 53 \text{ kNm/m} \quad (\text{additional force in node area})$$

$$F_{s2d,node} = F_{s2d} + H_{s2d} = 351 \text{ kNm/m} \quad (\text{tension in node area})$$

$$A_{s2,rqd} = F_{s2d,node} / (f_{yk} / \gamma_{Ms}) = 351'000 / (500 / 1.15) = 808 \text{ mm}^2/\text{m}$$

$$A_{s2} > A_{s2,rqd} \rightarrow \text{ok} \quad (A_{s2} \text{ is given})$$

Check concrete compressive strut

$$F_{c0d} = M_{1d} / z_0 = 268 \text{ kN/m}$$

$$D_{0d} = F_{c0d} / \cos \theta_{FN} = 441 \text{ kN/m}$$

$$\alpha_{ct} = 1.0 \quad (\text{EC2: EN 1992-1-1:2004, 3.1.6(1)})$$

$$v' = 1 - f_{ck} / 250 = 0.92 \quad (\text{EC2: EN 1992-1-1:2004, 6.5.2(2)})$$

$$k_2 = 0.85 \quad (\text{EC2: EN 1992-1-1:2004, 6.5.4(4b)})$$

$$D_{0Rd} = \alpha_{ct} \cdot v' \cdot k_2 \cdot f_{ck} / \gamma_c \cdot \ell_{b1} \cdot \cos \theta_{FN} = 1639 \text{ kN/m}$$

$$D_{0Rd} > D_{0d} \rightarrow \text{ok}$$

Check concrete splitting in plane of foundation

$$\alpha_{ct} = 1.0 \quad (\text{EC2: EN 1992-1-1:2004, 3.1.6(2)})$$

$$f_{ctk,0.05} = \alpha_{ct} \cdot 0.7 \cdot 0.3 \cdot f_{ck}^{2/3} / \gamma_c = 1.03 \text{ N/mm}^2 \quad (\text{table 3.1, EC2: EN 1992-1-1:2004})$$

$$M_{sp,d} = F_{c0d} \cdot z_0 \cdot (1 - z_0/z_2) \cdot (1 - \ell_{b1}/(2z_2)) = 1.87 \cdot 10^7 \text{ Nmm/m}$$

$$W_{sp} = 1000\text{mm} \cdot z_2^2 / 2.41 = 1.12 \cdot 10^8 \text{ mm}^3/\text{m}$$

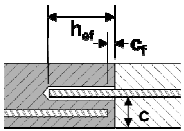
$$\max \sigma_{sp} = M_{sp,d} / W_{sp} = 0.17 \text{ N/mm}^2$$

$$f_{ctk,0.05} > \max \sigma_{sp} \rightarrow \text{ok}$$

## 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 Brunswick, 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 ctim 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.



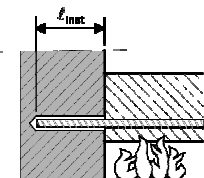
Clear concrete cover c [mm]	Max. bond stress, $\tau_c$ [N/mm <sup>2</sup> ]			
	F30	F60	F90	F120
10	0	0	0	0
20	0,494	0	0	0
30	0,665	0	0	0
40	0,897	0,481	0	0
50	1,200	0,623	0	0
60	1,630	0,806	0,513	0
70	2,197	1,043	0,655	0,487
80	2,962	1,351	0,835	0,614
90	3,992	1,748	1,065	0,775
100	5,382	2,263	1,358	0,977
110	7,255	2,930	1,733	1,233
120	9,780	3,792	2,210	1,556
130		4,909	2,818	1,963
140		6,355	3,594	2,477
150		8,226	4,584	3,125

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 bond strength in case of fire

$\tau_{Rd,fi}$

$$F_{fire} = f_{bd,fi} \cdot \phi \cdot \pi \cdot h_{ef}$$

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

Bar $\varnothing$ [mm]	Drill hole $\varnothing$ [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
			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
			320			
120	180	28,15	120	12,32	4,35	2,16
			180	28,15	17,56	11,59

$f_{yk,fi}=322N/mm^2$  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.

$$R_{fire} = \phi \cdot \pi \cdot \sum_{i=1}^n \tau_{crit,\alpha} \cdot l_i$$

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:

$$F_{Sd,fat} \leq N_{Rd} \cdot f_{fat}$$

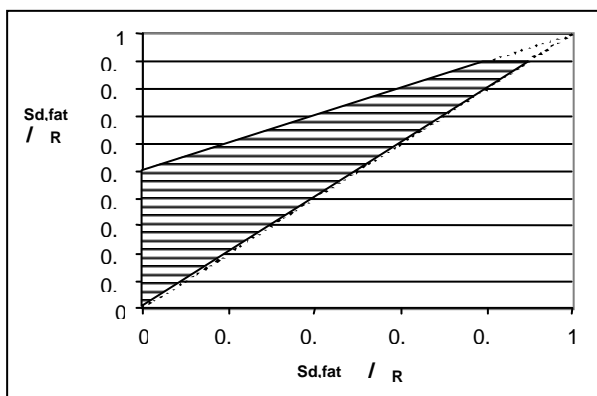
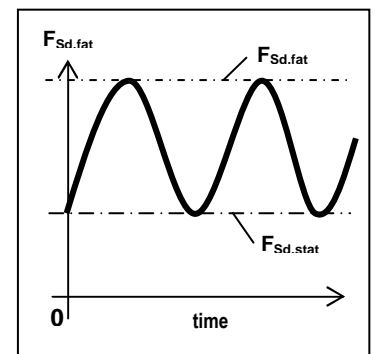
where:

$F_{Sd,fat}$  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

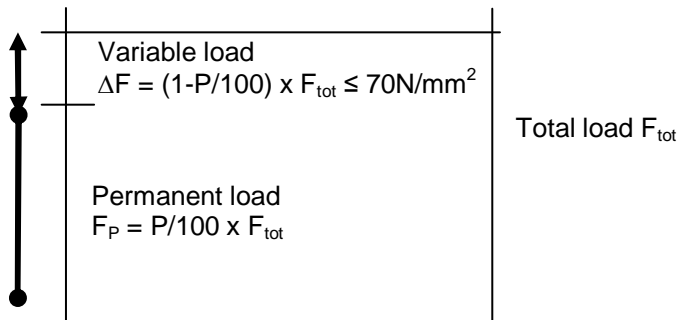
#### Steel resistance:

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).

$\Delta\sigma_{s,max}$  = ... 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:  $0 \leq P \leq 100$



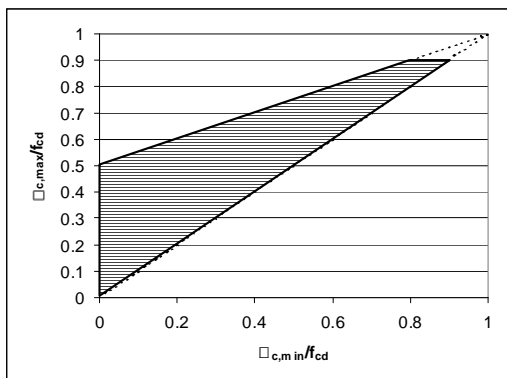
The reduction factor on steel resistance due to dynamic loading is then:

$$f_{red,s,dyn} = \frac{\min(f_{yk}; \frac{70}{1-P/100})}{f_{yk}}$$

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):

$$f_{red,c,dyn} = 0.5 + 0.45 \cdot \frac{P}{100} \leq 0.9$$

For  $P = 100$  (only permanent loads),  $f_{red,c,dyn}$  is, of course 1.0, but as soon as  $P < 100$ ,  $f_{red,c,dyn} \leq 0.9$ .

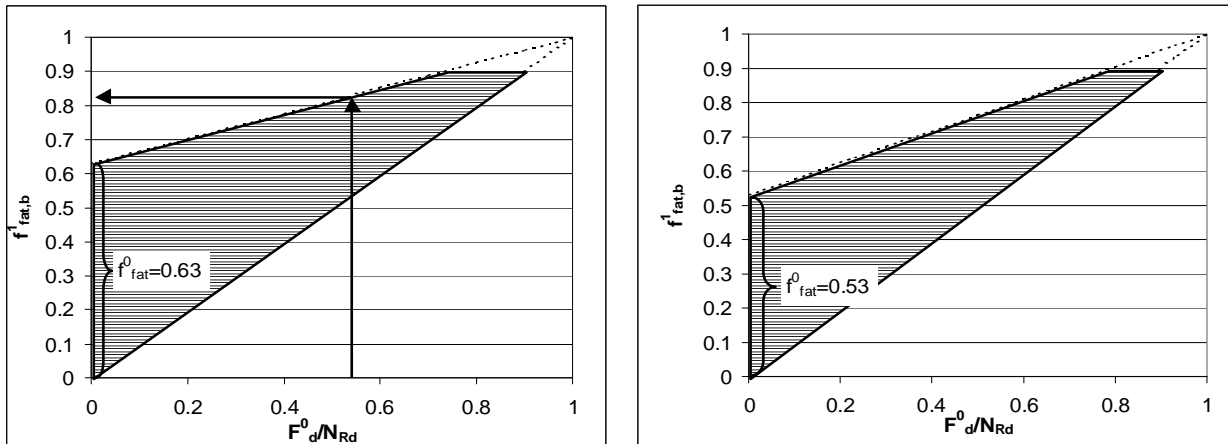
## Bond Resistance

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:  $f_{red,b,dyn} = 0.63 + 0.37 \cdot \frac{P}{100} \leq 0.9$

b) HIT-RE 500 in diamond drilled, water saturated hole:  $f_{red,b,dyn} = 0.53 + 0.47 \cdot \frac{P}{100} \leq 0.9$

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]:

- $\max f_{yk} = 500 \text{ N/mm}^2$
- 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 150, Hilti HIT-HY 150 MAX 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 150 + Hilti HIT-HY 150 MAX

- The Hilti HIT-HY 150 and Hilti HIT-HY 150 MAX 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.

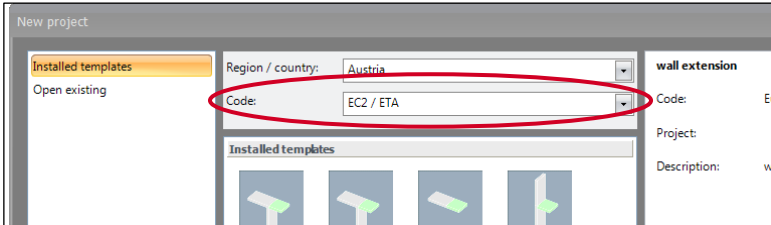
### Hilti HIT-RE 500

- 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

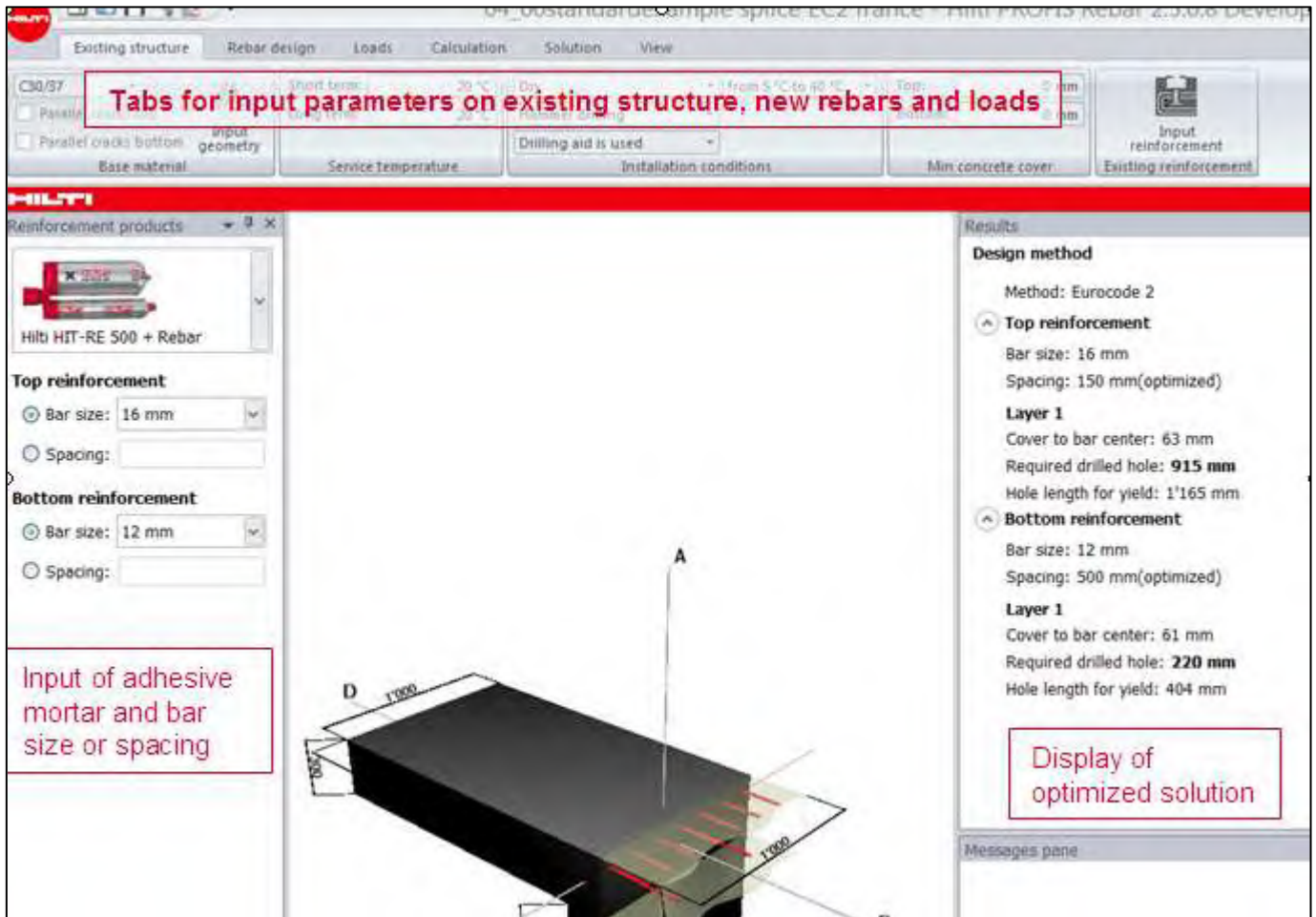
The PROFIS Rebar™ design programme allows rapid and safe design of post-installed reinforcement connections.



When a new project is opened, the user selects between the design methods “EC2 / ETA” and “Hit Rebar design”. After this, the necessary data concerning existing structure, new rebars and loads have to be defined.

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.

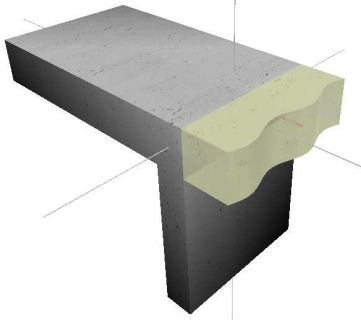
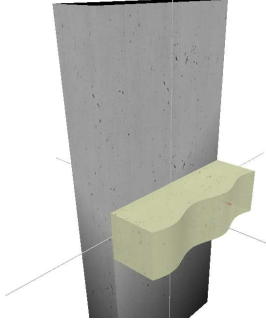

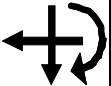



Under the “calculation” tab, the user can get all possible solutions and select the appropriate one from a table.

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

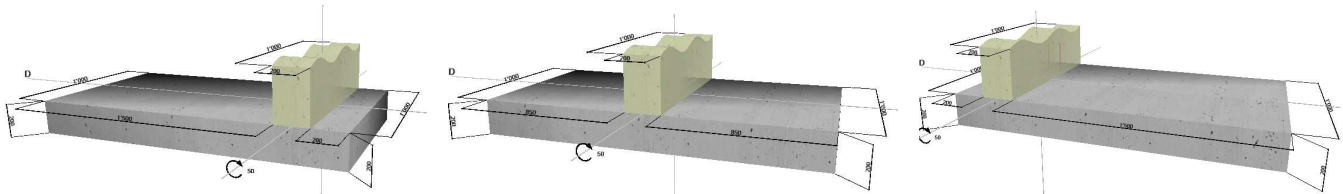


The applications are shown in the following table. For each case the table shows if there is a solution and if yes, which cast-in reinforcement must be defined in order to obtain a solution:

	New and existing members parallel	New and existing members perpendicular		
	 <p><b>design method:</b></p> <p><b>EC2 / ETA</b>   <b>Hit Rebar</b></p>	 <p><b>design method:</b></p> <p><b>EC2 / ETA</b>   <b>Hit Rebar</b></p>		
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		<i>No solution, concrete in tension</i> → 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		<i>No solution, concrete in tension</i> → 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:



$$M_2 = -M_1 + V_1 \cdot \frac{z_2}{2} + N_1 \cdot \frac{z_1}{2}$$

$$M_3 = 0$$

$$V_2 = N_1; \quad V_3 = 0$$

$$N_2 = V_1; \quad N_3 = 0$$

$$M_2 = 0$$

$$M_3 = -M_1 + V_1 \cdot \frac{z_2}{2} + N_1 \cdot \frac{z_1}{2}$$

$$V_2 = 0; \quad V_3 = N_1$$

$$N_2 = 0; \quad N_3 = V_1$$

$$M_2 = 0.5 \cdot \left( -M_1 + V_1 \cdot \frac{z_2}{2} + N_1 \cdot \frac{z_1}{2} \right)$$

$$M_3 = 0.5 \cdot \left( -M_1 + V_1 \cdot \frac{z_2}{2} + N_1 \cdot \frac{z_1}{2} \right)$$

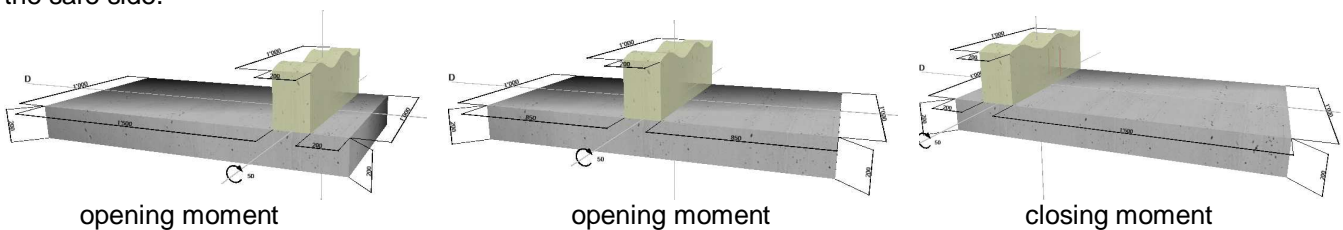
$$V_2 = V_3 = N_1 / 2;$$

$$N_2 = N_3 = V_1 / 2$$

Global equilibrium of the node as assumed in PROFIS Rebar

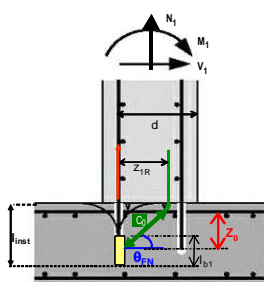
It is important to realize that the checks made by PROFIS Rebar are ONLY for the efforts introduced by the loading of the new concrete part. If the existing part is already loaded by other efforts, the total loading needs to be considered separately by the designer.

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.



**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  $\theta_{FN} > 60^\circ$ , the drill hole length will be selected such that  $\theta_{FN} = 60^\circ$
- If  $h_{ef,max}$  results in a strut angle  $30^\circ \leq \theta_{FN} \leq 60^\circ$ , the drill hole length will be  $h_{ef,max}$
- If  $h_{ef,max}$  results in a strut angle  $\theta_{FN} < 30^\circ$ , 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
- [3] EOTA: Technical Report TR 029, Design of Anchors, Edition Sept. 2010
- [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.
- [7] Kupfer, H., Münger, F., Kunz, J., Jähring, A.: Nachträglich verankerte gerade Bewehrungsstäbe bei Rahmenknoten. Bauingenieur: Sonderdruck, Springer Verlag,
- [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 Vallée (France), June 2010.
- [11] 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 ( $R_t > 3 \text{ mm}$ ), 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:

$$c_{\min} = 50 + 0,08 l_v \geq 2\phi \text{ [mm]} \text{ for compressed air drilled holes}$$

$$c_{\min} = 30 + 0,06 l_v \geq 2\phi \text{ [mm]} \text{ for hammer drilled holes}$$

$$c_{\min} = 30 + 0,02 l_v \geq 2\phi \text{ [mm]} \text{ if a drilling aid is used}$$

## 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.



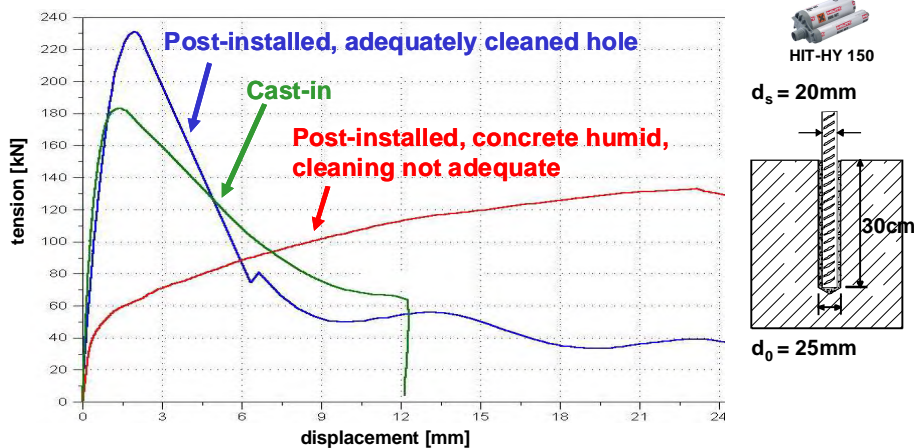
Deeper holes than 250mm should as well be brushed by machine brushing using steel brushes and brush extensions:



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.

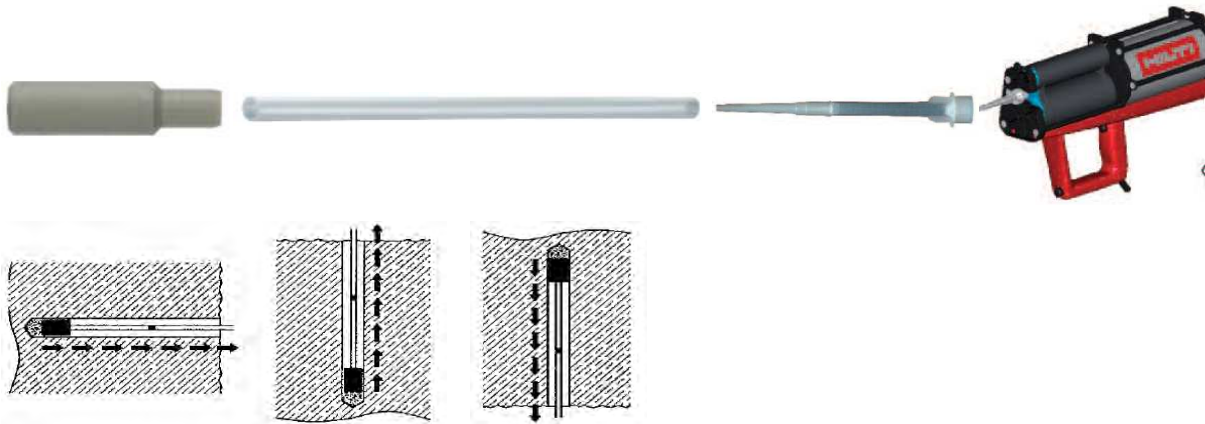
The following figure underlines the importance of adequate hole cleaning: For drilled holes cleaned according to the instruction, the post-installed bar (blue line) shows higher stiffness and higher resistance than the equivalent cast-in bar. With substandard cleaning (red line), however, stiffness and 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 supplies 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 requiring a depth of at least 10 drilling diameters.



### Mortar consumption estimation for post-installed rebars (in ml)

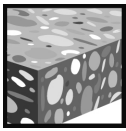
Rebar $\varnothing$ $d_s$ [mm]	8	10	12	14	16	18	20	22	24
Drill bit $\varnothing$ $d_o$ [mm]	12	14	16	18	20	22	25	28	32
Hole depth [mm]									
100	8,0	9,6	11,2	12,8	14,3	15,9	22,2	29,3	43,4
120	9,6	11,5	13,4	15,3	17,2	19,1	26,6	35,2	52,1
140	11,2	13,4	15,6	17,8	20,1	22,3	31,0	41,1	60,8
160	12,8	15,3	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 $\varnothing$ $d_s$ [mm]
32	35	35	37	40	45	45	55	Drill bit $\varnothing$ $d_0$ [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 post-installed rebars

Injection mortar system		Benefits
	Hilti HIT-RE 500-SD 330 ml foil pack  (also available as 500 ml and 1400 ml foil pack)	<ul style="list-style-type: none"> <li>- suitable for concrete C 12/15 to C 50/60</li> <li>- high loading capacity</li> <li>- suitable for dry and water saturated concrete</li> <li>- for rebar diameters up to 40 mm</li> <li>- non corrosive to rebar elements</li> <li>- long working time at elevated temperatures</li> <li>- odourless epoxy</li> <li>- suitable for embedment length till 3200 mm</li> </ul>
	Statik mixer	
	Rebar	



Concrete



Fire resistance



European Technical Approval



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 / 2009-09-14
Application document	CSTB, Marne la Vallée	DTA-3/10-649 / 2010-06-17
European technical approval	DIBt, Berlin	ETA-07/0260 / 2009-01-12
Assessment	MFGPA Leipzig GmbH	GS 3.2/09-122 / 2010-05-26

<sup>a)</sup> All data given in this section according to the approvals mentioned above.

### 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 $k = (f_t/f_y)_k$		$\geq 1,08$	$\geq 1,15$ < 1,35
Characteristic strain at maximum force, $\epsilon_{uk}$ (%)		$\geq 5,0$	$\geq 7,5$
Bendability		Bend / Rebend test	
Maximum deviation from nominal mass (individual bar) (%)	Nominal bar size (mm) $\leq 8$	$\pm 6,0$	
	$> 8$	$\pm 4,5$	
Bond: Minimum relative rib area, $f_{R,min}$	Nominal bar size (mm) 8 to 12	0,040	
	$> 12$	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

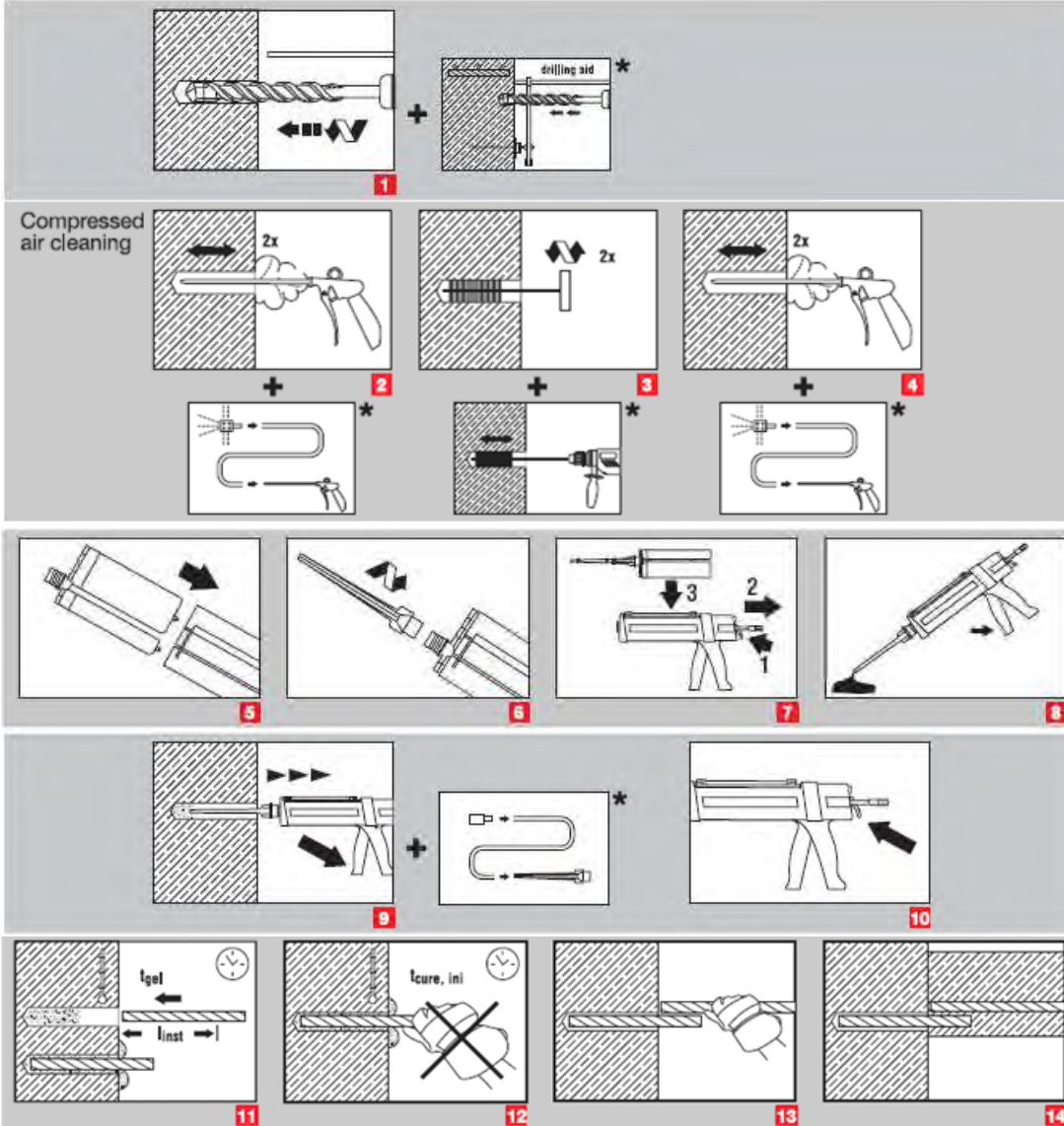
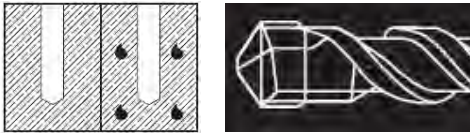
Data according ETA-09/0295, issue 2009-09-14			
Temperature of the base material	Working time in which rebar can be inserted and adjusted $t_{gel}$	Initial curing time $t_{cure,ini}$	Curing time before rebar can be fully loaded $t_{cure}$
$5\text{ °C} \leq T_{BM} < 10\text{ °C}$	2 h	18 h	72 h
$10\text{ °C} \leq T_{BM} < 15\text{ °C}$	90 min	12 h	48 h
$15\text{ °C} \leq T_{BM} < 20\text{ °C}$	30 min	9 h	24 h
$20\text{ °C} \leq T_{BM} < 25\text{ °C}$	20 min	6 h	12 h
$25\text{ °C} \leq T_{BM} < 30\text{ °C}$	20 min	5 h	12 h
$30\text{ °C} \leq T_{BM} < 40\text{ °C}$	12 min	4 h	8 h
$T_{BM} = 40\text{ °C}$	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
$T_{BM} = -5\text{ °C}$	4 h	36 h	72 h	0,6
$T_{BM} = 0\text{ °C}$	3 h	25 h	50 h	0,7
$T_{BM} = 5\text{ °C}$	2 ½ h	18 h	36 h	1
$T_{BM} = 10\text{ °C}$	2 h	12 h	24 h	1
$T_{BM} = 15\text{ °C}$	1 ½ h	9 h	18 h	1
$T_{BM} = 20\text{ °C}$	30 min	6 h	12 h	1
$T_{BM} = 30\text{ °C}$	20 min	4 h	8 h	1
$T_{BM} = 40\text{ °C}$	12 min	2 h	4 h	1

Dry and water-saturated concrete, hammer drilling



**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  $66 \cdot 10^{12} \Omega \cdot m$  (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)
<b>8</b>	12 (10 <sup>a)</sup> )	-
<b>10</b>	14 (12 <sup>a)</sup> )	-
<b>12</b>	16 (14 <sup>a)</sup> )	17
<b>14</b>	18	17
<b>16</b>	20	20
<b>18</b>	22	22
<b>20</b>	25	26
<b>22</b>	28	28
<b>24</b>	32	32
<b>25</b>	32	32
<b>26</b>	35	35
<b>28</b>	35	35
<b>30</b>	37	35
<b>32</b>	40	40
<b>34</b>	45	42
<b>36</b>	45	45
<b>40</b>	55	57

a) Max. installation length  $l = 250$  mm.

### Basic design data for rebar design according to rebar ETA

**Bond strength in N/mm<sup>2</sup> 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
<b>8 - 32</b>	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3
<b>34</b>	1,6	2,0	2,3	2,6	2,9	3,3	3,6	3,9	4,2
<b>36</b>	1,5	1,9	2,2	2,6	2,9	3,3	3,6	3,8	4,1
<b>40</b>	1,5	1,8	2,1	2,5	2,8	3,1	3,4	3,7	4,0

### Pullout design bond strength for Hit Rebar design

**Bond strength in N/mm<sup>2</sup> according to ETA 07/0260 (values in tables are design values,  $f_{bd,po} = \tau_{RK}/\gamma_{Mp}$ )**

Hammer, compressed air or dry diamond core drilling.  
Dry or water saturated hole.  
Uncracked concrete C20/25.

temperature range	Bar diameter												
	8	10	12	14	16	20	22	24	25	26	28	30	32
I: 40°C/24°C	8,3			7,8	6,7			6,2					
II: 58°C/35°C	6,7				5,2						4,8		
III: 70°C/43°C	3,9			3,3	3,1				2,9				

Hammer, compressed air or dry diamond core drilling.  
Dry or water saturated hole.  
Cracked concrete C20/25.

temperature range	Bar diameter												
	8	10	12	14	16	20	22	24	25	26	28	30	32
I: 40°C/24°C	4,4	4,2	3,9	3,3				3,1		2,9			
II: 58°C/35°C	3,6		3,3		2,9	2,6				2,4			
III: 70°C/43°C	2,2	1,9			1,7	1,4							

Increasing factor in non-cracked concrete:  $f_{B,p} = (f_{cck}/25)^{0,1}$  ( $f_{cck}$ : characteristic compressive strength on cube)

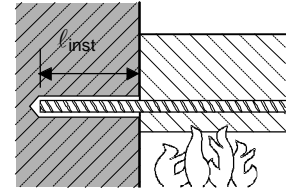
#### Additional Hilti Technical Data:

Reduction factor for splitting with large concrete cover:  $\delta = 0,306$  (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  $f_{yk} = 500 \text{ N/mm}^2$ ) according EC2<sup>a)</sup>.

Bar $\varnothing$ [mm]	Drill hole $\varnothing$ [mm]	Max. $F_{s,T}$ [kN]	$l_{inst}$ [mm]	Fire resistance of bar in [kN]					
				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 $\varnothing$ [mm]	Drill hole $\varnothing$ [mm]	Max. $F_{s,T}$ [kN]	$\ell_{inst}$ [mm]	Fire resistance of bar in [kN]					
				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,  $\tau_T$ , 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.

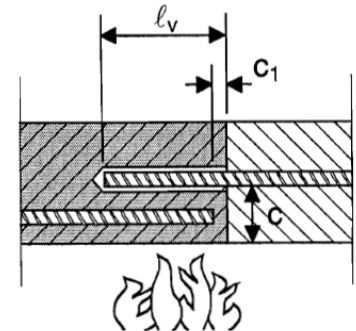
$$F_{s,T} \leq (l_{inst} - c_f) \cdot \phi \cdot \pi \cdot \tau_T \quad \text{where: } (l_{inst} - c_f) \geq l_s;$$

$l_s$  = lap length

$\phi$  = nominal diameter of bar

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

$\tau_T$  = bond stress when exposed to fire



**Critical temperature-dependent bond stress,  $\tau_c$ , concerning “overlap joint” for Hilti HIT-RE 500-SD injection adhesive in relation to fire resistance class and required minimum concrete coverage c.**

Clear concrete cover c [mm]	Max. bond stress, $\tau_c$ [N/mm <sup>2</sup> ]					
	R30	R60	R90	R120	R180	R240
10	0	0	0	0	0	0
20	0,49					
30	0,66					
40	0,89					
50	1,21					
60	1,63	0,48	0,51	0,49	0	
70	2,19	1,04	0,65			
80	2,96	1,35	0,83	0,61	0,45	
90	3,99	1,75	1,06	0,77		
100	5,38	2,26	1,36	0,97	0,55	
110	7,25	2,93	1,73	1,23	0,67	0,47
120	9,78	3,79	2,21	1,55	0,81	0,55
130	11,00	4,91	2,81	1,96	0,98	0,64
140		6,35	3,59	2,47	1,18	0,76
150		8,22	4,58	3,12	1,43	0,89
160		10,65	5,84	3,94	1,73	1,04
170		11,00	7,45	4,97	2,10	1,23
180			9,51	6,27	2,54	1,44
190			7,91	3,07	1,69	
200			9,99	3,71	1,99	
210			4,49	2,34		
220		5,44	2,75			
230	6,58	3,22				
240	7,96	3,79				
250	9,64	4,45				
260	11,00	11,00	11,00	11,00	11,00	5,23
270						6,14
280						7,21
290						8,47
300						9,95
310						11,00

## Basic design data for seismic rebar design

**Bond strength  $f_{bd,seism}$  in N/mm<sup>2</sup> 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
<b>8</b>	2,3	2,7	3,0	3,4	3,7	4,0
<b>10</b>	2,3	2,7	3,0	3,4	3,7	4,0
<b>12</b>	2,3	2,7	3,0	3,4	3,7	3,7
<b>14</b>	2,3	2,7	3,0	3,4	3,7	3,7
<b>16</b>	2,3	2,7	3,0	3,4	3,7	3,7
<b>18</b>	2,3	2,7	3,0	3,4	3,7	3,7
<b>20</b>	2,3	2,7	3,0	3,4	3,7	3,7
<b>22</b>	2,3	2,7	3,0	3,0	3,4	3,4
<b>24</b>	2,3	2,7	3,0	3,0	3,4	3,4
<b>25</b>	2,3	2,7	3,0	3,0	3,4	3,4
<b>26</b>	2,3	2,7	3,0	3,0	3,0	3,0
<b>28</b>	2,3	2,7	3,0	3,0	3,0	3,0
<b>30</b>	2,3	2,7	3,0	3,0	3,0	3,0
<b>32</b>	2,3	2,7	3,0	3,0	3,0	3,0
<b>34</b>	2,3	2,6	2,9	2,7	2,7	2,7
<b>36</b>	2,2	2,6	2,9	2,7	2,7	2,7
<b>40</b>	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)

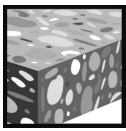
Rebar		Hammer drilling, Compressed air drilling, Dry diamond coring drilling		Wet diamond coring drilling		
Diameter $d_s$ [mm]	$f_{y,k}$ [N/mm <sup>2</sup> ]	$l_{b,min}^*$ [mm]	$l_{0,min}^*$ [mm]	$l_{b,min}^*$ [mm]	$l_{0,min}^*$ [mm]	$l_{max}$ [mm]
8	500	113	200	170	300	1000
10	500	142	200	213	300	1000
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  $f_{yk} = 500 \text{ N/mm}^2$  and  $\alpha_6 = 1,0$



## Hilti HIT-RE 500 post-installed rebars

Injection mortar system		Benefits
	Hilti HIT-RE 500 330 ml foil pack  (also available as 500 ml and 1400 ml foil pack)	<ul style="list-style-type: none"> <li>- suitable for non-cracked concrete C 20/25 to C 50/60</li> <li>- high loading capacity</li> <li>- suitable for dry and water saturated concrete</li> <li>- under water application</li> <li>- large diameter applications</li> <li>- high corrosion resistant</li> <li>- long working time at elevated temperatures</li> <li>- odourless epoxy</li> </ul>
	Static mixer	
	Rebar	



Concrete



Fire  
resistance



European  
Technical  
Approval



DIBt approval



Drinking  
water  
approved



Corosion  
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 / 2008-07-30
European technical approval	DIBt, Berlin	ETA-04/0027 / 2009-05-20
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 166402 / 2007-10-26

## 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 $k = (f_t/f_y)_k$		$\geq 1,08$	$\geq 1,15$ < 1,35
Characteristic strain at maximum force, $\epsilon_{uk}$ (%)		$\geq 5,0$	$\geq 7,5$
Bendability		Bend / Rebend test	
Maximum deviation from nominal mass (individual bar) (%)	Nominal bar size (mm) $\leq 8$	$\pm 6,0$	
	$> 8$	$\pm 4,5$	
Bond: Minimum relative rib area, $f_{R,min}$	Nominal bar size (mm) 8 to 12	0,040	
	$> 12$	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

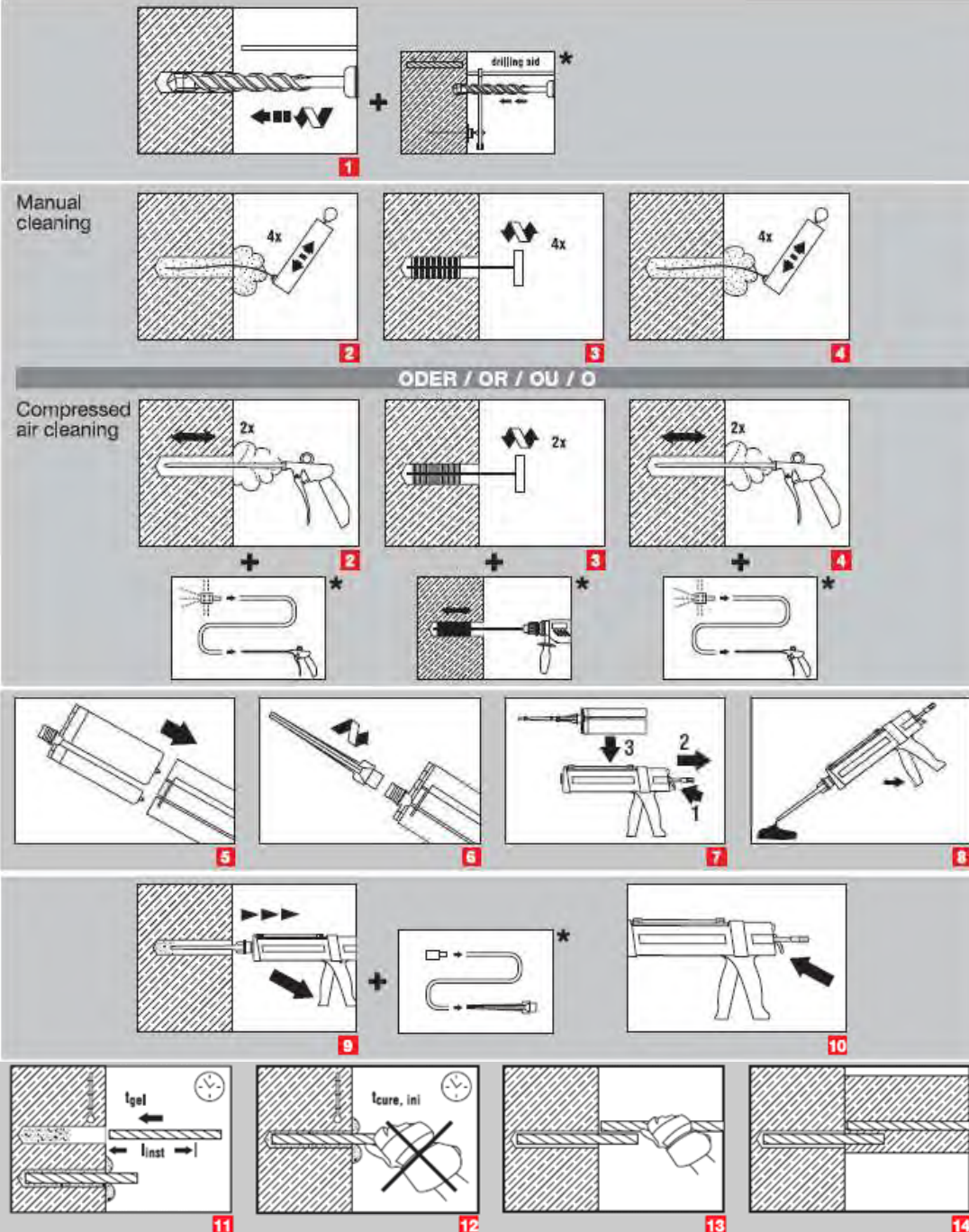
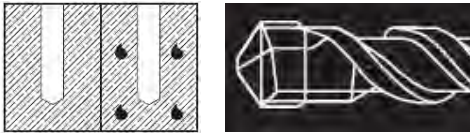
Data according ETA-08/0105, issue 2008-06-30			
Temperature of the base material	Working time in which rebar can be inserted and adjusted $t_{gel}$	Initial curing time $t_{cure,ini}$	Curing time before rebar can be fully loaded $t_{cure}$
$5\text{ °C} \leq T_{BM} < 10\text{ °C}$	2 h	18 h	72 h
$10\text{ °C} \leq T_{BM} < 15\text{ °C}$	90 min	12 h	48 h
$15\text{ °C} \leq T_{BM} < 20\text{ °C}$	30 min	9 h	24 h
$20\text{ °C} \leq T_{BM} < 25\text{ °C}$	20 min	6 h	12 h
$25\text{ °C} \leq T_{BM} < 30\text{ °C}$	20 min	5 h	12 h
$30\text{ °C} \leq T_{BM} < 40\text{ °C}$	12 min	4 h	8 h
$T_{BM} = 40\text{ °C}$	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
$T_{BM} = -5\text{ °C}$	4 h	36 h	72 h	0,6
$T_{BM} = 0\text{ °C}$	3 h	25 h	50 h	0,7
$T_{BM} = 5\text{ °C}$	2 ½ h	18 h	36 h	1
$T_{BM} = 10\text{ °C}$	2 h	12 h	24 h	1
$T_{BM} = 15\text{ °C}$	1 ½ h	9 h	18 h	1
$T_{BM} = 20\text{ °C}$	30 min	6 h	12 h	1
$T_{BM} = 30\text{ °C}$	20 min	4 h	8 h	1
$T_{BM} = 40\text{ °C}$	12 min	2 h	4 h	1

Dry and water-saturated concrete, hammer drilling

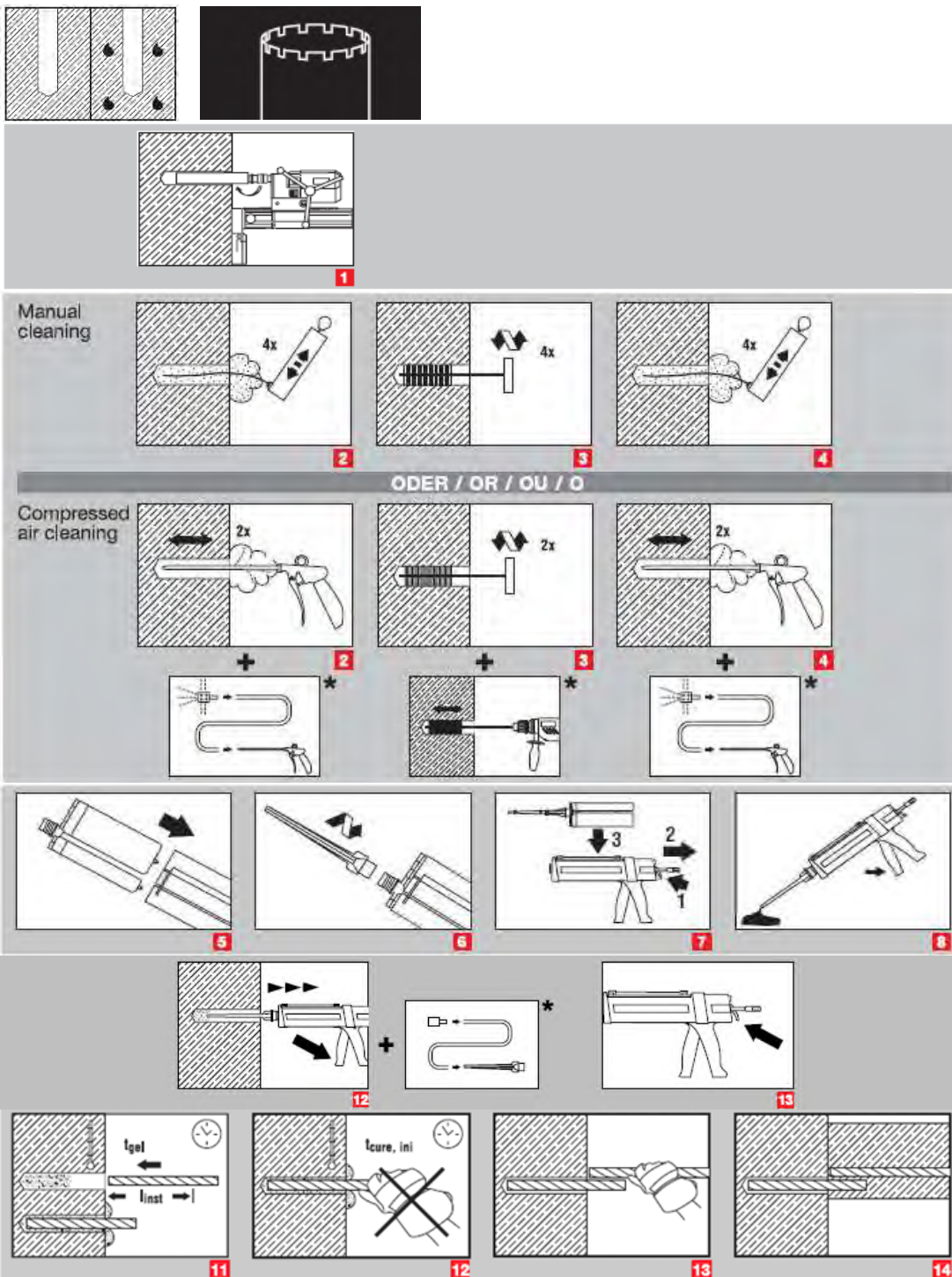


a)

**a) Note:** Manual cleaning for element sizes  $d \leq 16\text{mm}$  and embedment depth  $h_{ef} \leq 20 d$  only!



### Dry and water-saturated concrete, diamond coring drilling; Hilti technical information only



a) **Note:** Manual cleaning for element sizes  $d \leq 16\text{mm}$  and embedment depth  $h_{ef} \leq 20 d$  only!

### 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 environment 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  $66 \cdot 10^{12} \Omega \cdot m$  (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)	Diamond coring	
			Wet (DD)	Dry (PCC)
<b>8</b>	12 (10 <sup>a)</sup> )	-	12 (10 <sup>a)</sup> )	-
<b>10</b>	14 (12 <sup>a)</sup> )	-	14 (12 <sup>a)</sup> )	-
<b>12</b>	16 (14 <sup>a)</sup> )	17	16 (14 <sup>a)</sup> )	-
<b>14</b>	18	17	18	-
<b>16</b>	20	20	20	-
<b>18</b>	22	22	22	-
<b>20</b>	25	26	25	-
<b>22</b>	28	28	28	-
<b>24</b>	32	32	32	35
<b>25</b>	32	32	32	35
<b>26</b>	35	35	35	35
<b>28</b>	35	35	35	35
<b>30</b>	37	35	37	35
<b>32</b>	40	40	40	47
<b>34</b>	45	42	42	47
<b>36</b>	45	45	47	47
<b>40</b>	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/mm<sup>2</sup> 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
<b>8 - 32</b>	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3
<b>34</b>	1,6	2,0	2,3	2,6	2,9	3,3	3,6	3,9	4,2
<b>36</b>	1,5	1,9	2,2	2,6	2,9	3,3	3,6	3,8	4,1
<b>40</b>	1,5	1,8	2,1	2,5	2,8	3,1	3,4	3,7	4,0

**Bond strength in N/mm<sup>2</sup> 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
<b>8 - 25</b>	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3
<b>26 - 32</b>	1,6	2,0	2,3	2,7	2,7	2,7	2,7	2,7	2,7
<b>34</b>	1,6	2,0	2,3	2,6	2,6	2,6	2,6	2,6	2,6
<b>36</b>	1,5	1,9	2,2	2,6	2,6	2,6	2,6	2,6	2,6
<b>40</b>	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/mm<sup>2</sup> according to ETA 04/0027 (values in table are design values,  $f_{B,p0} = \tau_{RK}/\gamma_{Mp}$ )**

Hammer or compressed air drilling.  
Water saturated, water filled or submerged hole.  
Uncracked concrete C20/25.

temperature range	Bar diameter														
	Data according to ETA 04/0027													Hilti tech data	
	8	10	12	14	16	20	22	24	25	26	28	30	32	36	40
I: 40°C/24°C	7,1			6,7			6,2						5,2	4,8	
II: 58°C/35°C	5,7				5,2					4,8			4,3	3,8	
III: 70°C/43°C	3,3					3,1				2,9			2,4		

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:

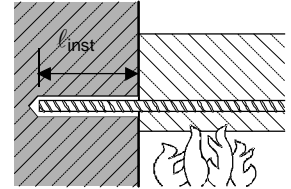
If the concrete is dry (not in contact with water before/during installation and curing), the pullout design bond strength may be increased by 20%.

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:  $\delta = 0,306$  (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  $f_{yk} = 500 \text{ N/mm}^2$ ) according EC2<sup>a)</sup>.

Bar $\varnothing$ [mm]	Drill hole $\varnothing$ [mm]	Max. $F_{s,T}$ [kN]	$l_{inst}$ [mm]	Fire resistance of bar in [kN]				
				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 $\varnothing$ [mm]	Drill hole $\varnothing$ [mm]	Max. $F_{s,T}$ [kN]	$l_{inst}$					
			[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

<sup>a)</sup> For tables according the standards to DIN 1045-1988, NF-ENV 1991-2-2(CE2), 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,  $\tau_T$ , 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.

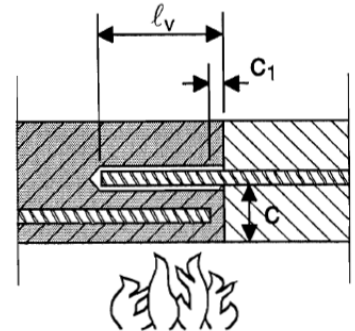
$$F_{s,T} \leq (l_{inst} - c_f) \cdot \phi \cdot \pi \cdot \tau_T \quad \text{where: } (l_{inst} - c_f) \geq l_s;$$

$l_s$  = lap length

$\phi$  = nominal diameter of bar

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

$\tau_T$  = bond stress when exposed to fire



**Critical temperature-dependent bond stress,  $\tau_c$ , concerning “overlap joint” for Hilti HIT-RE 500 injection adhesive in relation to fire resistance class and required minimum concrete coverage c.**

Clear concrete cover c [mm]	Max. bond stress, $\tau_c$ [N/mm <sup>2</sup> ]							
	R30	R60	R90	R120	R180			
30	0,7	0	0	0	0			
35	0,8	0,4						
40	0,9	0,5						
45	1,0	0,5						
50	1,2	0,6						
55	1,4	0,7	0,5					
60	1,6	0,8	0,5					
65	1,9	0,9	0,6	0,4				
70	2,2	1,0	0,7	0,5				
75		1,2	0,7	0,5				
80		1,4	0,8	0,6				
85		1,5	0,9	0,7				
90		1,7	1,1	0,8	0,5			
95		2,0	1,2	0,9	0,5			
100		2,2	2,2	1,4	1,0	0,6		
105				1,6	1,1	0,6		
110				1,7	1,2	0,7		
115				2,0	1,4	0,7		
120	2,2			2,2	1,6	0,8		
125					1,7	0,9		
130					2,0	1,0		
135					2,2	2,2	2,2	1,1
140								1,2
145								1,3
150		1,4						
155		1,6						
160		1,7						
165		1,9						
170	2,1							
175	2,2							

## Minimum anchorage length

According to ETA-08/0105, issue 2008-06-30, 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/mm <sup>2</sup> ]	$l_{b,min}^*$ [mm]	$l_{o,min}^*$ [mm]	$l_{b,min}^*$ [mm]	$l_{o,min}^*$ [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

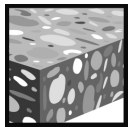
\*  $l_{b,min}$  (8.6) and  $l_{o,min}$  (8.11) are calculated for good bond conditions with maximum utilisation of rebar yield strength  $f_{yk} = 500$  N/mm<sup>2</sup> and  $\alpha_6 = 1,0$





## Hilti HIT-HY 200 post-installed rebars

Injection mortar system		Benefits
    	<p>Hilti HIT-HY 200-R 330 ml foil pack (also available as 500 ml foil pack)</p> <p>Hilti HIT-HY 200-A 330 ml foil pack (also available as 500 ml foil pack)</p> <p>Static mixer</p> <p>Rebar</p>	<ul style="list-style-type: none"> <li>- HY 200-R version is formulated for best handling and cure time specifically for rebar applications</li> <li>- Suitable for concrete C 12/15 to C 50/60</li> <li>- Suitable for dry and water saturated concrete</li> <li>- For rebar diameters up to 32 mm</li> <li>- Non corrosive to rebar elements</li> <li>- Good load capacity at elevated temperatures</li> <li>- Suitable for embedment length up to 1000 mm</li> <li>- Suitable for applications down to -10 °C</li> <li>- Two mortar (A and R) versions available with different curing times and same performance</li> </ul>



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 <sup>a)</sup>	DIBt, Berlin	ETA-12/0083 / 2012-08-08 (HIT-HY 200-R) ETA-11/0492 / 2012-08-08 (HIT-HY 200-A)
Fire test report	CSTB, Paris	26033756

a) All data given in this section according ETA-12/0083, issued 2012-08-08 and ETA-11/0492, issued 2012-08-08.

### 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 $k = (f_t/f_y)_k$		$\geq 1,08$	$\geq 1,15$ < 1,35
Characteristic strain at maximum force, $\epsilon_{uk}$ (%)		$\geq 5,0$	$\geq 7,5$
Bendability		Bend / Rebend test	
Maximum deviation from nominal mass (individual bar) (%)	Nominal bar size (mm)		
	$\leq 8$	$\pm 6,0$	
	$> 8$	$\pm 4,5$	
Bond: Minimum relative rib area, $f_{R,min}$	Nominal bar size (mm)		
	8 to 12	0,040	
	$> 12$	0,056	

### Setting details

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

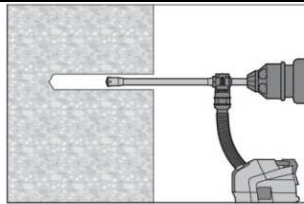
#### Working time, curing time<sup>a)</sup>

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

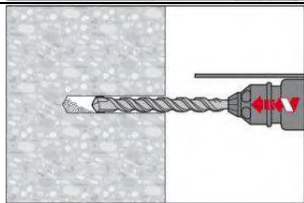
Temperature of the base material	HIT-HY 200-A	
	Working time in which anchor can be inserted and adjusted $t_{work}$	Curing time before anchor can be fully loaded $t_{cure}$
-10 °C to -5 °C	1,5 hour	7 hour
-4 °C to 0 °C	50 min	4 hour
1 °C to 5 °C	25 min	2 hour
6 °C to 10 °C	15 min	1 hour
11 °C to 20 °C	7 min	30 min
21 °C to 30 °C	4 min	30 min
31 °C to 40 °C	3 min	30 min

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.

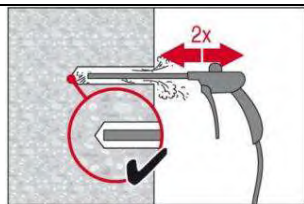


Drill hole to the required embedment depth using a hammer-drill with carbide drill bit set in rotation hammer mode, a Hilti hollow drill bit or a compressed air drill.

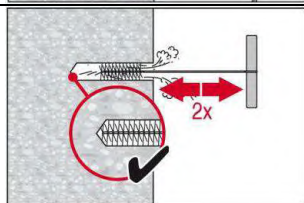
**Bore hole cleaning** Just before setting an anchor, the bore hole must be free of dust and debris by one of two cleaning methods described below

**b) Compressed air cleaning (CAC)**

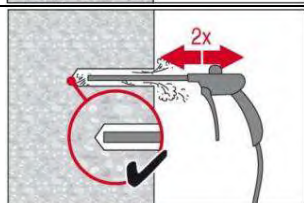
For all bore hole diameters  $d_0$  and all bore hole depth  $h_0$



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  $\geq 32$  mm the compressor must supply a minimum air flow of 140 m<sup>3</sup>/hour. If required use additional accessories and extensions for air nozzle and brush to reach back of hole.



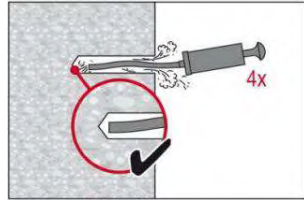
Brushing 2 times with the specified brush size (brush  $\varnothing \geq$  borehole  $\varnothing$ ) by inserting the round steel brush to the back of the hole in a twisting motion. The brush shall produce natural resistance as it enters the anchor hole. If this is not the case, please use a new brush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



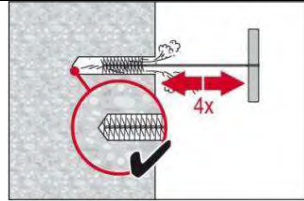
Blowing 2 times again with compressed air until return air stream is free of noticeable dust.

### a) Manual Cleaning (MC)

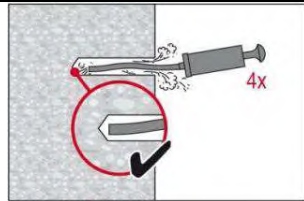
As an alternative to compressed air cleaning, a manual cleaning is permitted for hammer drilled boreholes up to hole diameters  $d_0 \leq 20\text{mm}$  and depths  $l_v$  resp.  $l_{e,ges.} \leq 160\text{mm}$  or  $10 * d$ . The borehole must be free of dust, debris, water, ice, oil, grease and other 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.

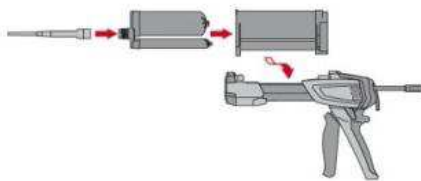


4 times with the specified brush size (brush  $\varnothing \geq$  borehole  $\varnothing$ ) by inserting the round steel wire brush to the back of the hole with a twisting motion

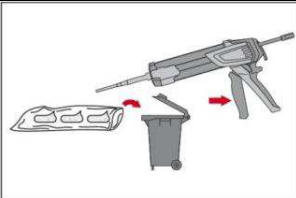


4 strokes with Hilti blow-out pump from the back of the hole until return air stream is free of noticeable dust.

### 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  $\leq 5^\circ\text{C}$ .

**Inject adhesive** from the back of the borehole without forming air voids

	<p><b>Injection method for borehole depth <math>\leq 250</math> mm:</b> 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. <b>Important! Use extensions for deep holes (<math>&gt; 250</math> mm).</b> 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.</p>
	<p>After injecting, depressurize the dispenser by pressing the release trigger (only for manual dispenser). This will prevent further mortar discharge from the mixing nozzle.</p>
	<p><b>Piston plug injection for borehole depth <math>&gt; 250</math> mm or overhead applications:</b> 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.</p>
	<p><b>HDM 330</b>      Manual dispenser (330 ml) <b>HDM 500</b>      Manual dispenser (330 / 500 ml) <b>HDE 500-A22</b>    Electric dispenser (330 / 500 ml)</p>

**Setting the element**

	<p>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 <math>t_{work}</math> has elapsed.</p>
	<p>After installing the rebar the annular gap must be completely filled with mortar. Proper installation can be verified when: Desired anchoring embedment is reached <math>\ell_v</math>: 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.</p>
	<p>Observe the working time "<math>t_{work}</math>", which varies according to temperature of base material. Minor adjustments to the rebar position may be performed during the working time. After <math>t_{cure}</math> preparation work may continue.</p>

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	-	Machinery 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  $15,5 \cdot 10^9 \Omega \cdot \text{cm}$  (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 <sup>a)</sup> )	-
10	14 (12 <sup>a)</sup> )	-
12	16 (14 <sup>a)</sup> )	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  $l = 250$  mm.

## Basic design data for rebar design according to ETA

### Bond strength

#### Bond strength in $N/mm^2$ 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

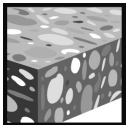
Minimum and maximum embedment depths and lap lengths for C20/25 according to ETA

Rebar		$l_{b,min}^*$ [mm]	$l_{o,min}^*$ [mm]	Concrete temp. $\geq -10^\circ\text{C}$	Concrete temp. $\geq 0^\circ\text{C}$
Diameter $d_s$ [mm]	$f_{y,k}$ [N/mm <sup>2</sup> ]			$l_{max}$ [mm]	$l_{max}$ [mm]
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  $l_{o,min}$  (8.11) are calculated for good bond conditions with maximum utilisation of rebar yield strength  $f_{yk} = 500 \text{ N/mm}^2$  and  $\alpha_6 = 1,0$

## Hilti HIT-HY 150 post-installed rebars

Injection mortar system		Benefits
	Hilti HIT-HY 150 330 ml foil pack  (also available as 500 ml and 1400 ml foil pack)	<ul style="list-style-type: none"> <li>- suitable for concrete C 12/15 to C 50/60</li> <li>- high loading capacity and fast cure</li> <li>- suitable for dry and water saturated concrete</li> <li>- for rebar diameters up to 25 mm</li> <li>- non corrosive to rebar elements</li> <li>- good load capacity at elevated temperatures</li> <li>- hybrid chemistry</li> <li>- suitable for embedment length till 2000 mm</li> <li>- suitable for applications down to -5 °C</li> </ul>
	Statik mixer	
	Rebar	



Concrete



Drinking water approved



Corrosion tested

### Service temperature range

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

### Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Fire test report	IBMB Braunschweig	3162/6989 / 1999-07-16
Assessment report (fire)	Warringtonfire	WF 166402 / 2007-10-26

### 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 $k = (f_t/f_y)_k$		$\geq 1,08$	$\geq 1,15$ < 1,35
Characteristic strain at maximum force, $\epsilon_{uk}$ (%)		$\geq 5,0$	$\geq 7,5$
Bendability		Bend / Rebend test	
Maximum deviation from nominal mass (individual bar) (%)	Nominal bar size (mm) $\leq 8$	$\pm 6,0$	
	$> 8$	$\pm 4,5$	
Bond: Minimum relative rib area, $f_{R,min}$	Nominal bar size (mm) 8 to 12	0,040	
	$> 12$	0,056	

### Setting details

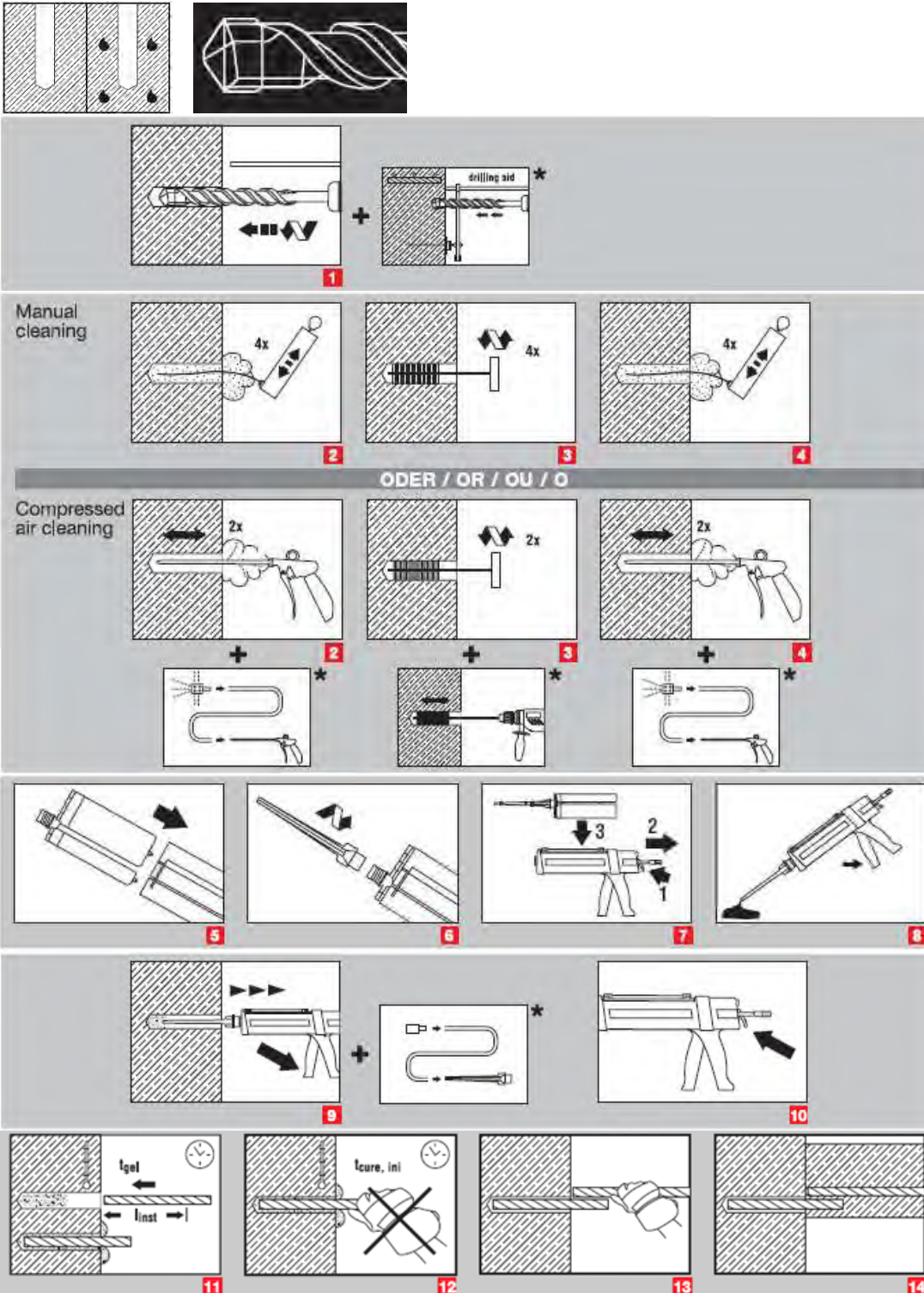
For detailed information on installation see instruction for use given with the package of the product.

### Working time, Curing time

Temperature of the base material $T_{BM}$	Working time $t_{gel}$	Curing time $t_{cure}^*$
$-5\text{ °C} \leq T_{BM} < 0\text{ °C}$	90 min	9 h
$0\text{ °C} \leq T_{BM} < 5\text{ °C}$	45 min	4,5 h
$5\text{ °C} \leq T_{BM} < 10\text{ °C}$	20 min	2 h
$10\text{ °C} \leq T_{BM} < 20\text{ °C}$	6 min	90 min
$20\text{ °C} \leq T_{BM} < 30\text{ °C}$	4 min	50 min
$30\text{ °C} \leq T_{BM} \leq 40\text{ °C}$	2 min	40 min

\* The curing time data are valid for dry anchorage base only. For water saturated anchorage bases the curing times must be doubled.

Dry and water-saturated concrete, hammer drilling



a)

a) **Note:** Manual cleaning for element sizes  $d \leq 16\text{mm}$  and embedment depth  $h_{ef} \leq 10 d$  only!

## Fitness for use

### Creep behaviour

Creep tests have been conducted in accordance with national standards in different conditions:

- in wet environment at 23 °C during 90 days
- in dry environment at 43 °C during 90 days.

These tests show an excellent behaviour of the post-installed connection made with HIT-HY 150: low displacements with long term stabilisation, failure load after exposure above reference load.

### Resistance to chemical products

HIT-HY 150 has been tested to its resistance to chemical products and the results are given in the table below:

Chemical product	Concentration (in % of weight)	First effects (in days)	Resistance
Acetic acid	Pure	6	o
	10 %		+
Hydrochloric Acid	20 %		+
Nitric Acid	40 %	< 1	-
Phosphoric Acid	40 %		+
Sulphuric acid	40 %		+
Ethyl acetate	Pure	8	-
Acetone	Pure	1	-
Ammoniac	5 %	21	-
Diesel	Pure		+
Gasoline	Pure		+
Ethanol	96 %	30	o
Machine oils	Pure		+
Methanol	Pure	2	-
Peroxide of hydrogen	30%	3	o
Solution of phenol	Saturated	< 1	-
Silicate of sodium	50% pH=14!		+
Solution of chlorine	saturated		+
Solution of hydrocarbons	60 % vol Toluene; 30 % vol Xylene 10 % vol Naphtalene of methyl		+
Salted solution (sodium chloride)	10 %		+
Suspension of cement	Saturated		+
Carbon tetrachloride	Pure		+
Xylene	Pure		+

We can retain that HIT-HY 150 behaves well as alkaline middle and that it is very resistant:

- in aqueous solutions in elevated pH (ex: silicate of sodium): no risk of saponification under weathering
- in salty solutions (ex: sea water)
- in solutions saturated in chlorine (ex: applications in swimming pool).

### Electrical conductivity

HIT-HY 150 in cured state shows **low electrical conductivity**. Its electric resistivity is  $2 \cdot 10^{11} \Omega \cdot m$  (DIN VDE 0303T3). It suits well electrically insulating anchoring (ex: railway applications, subway).

## Drilling diameters

Rebar (mm)	Drill bit diameters $d_0$ [mm]	
	Hammer drill (HD)	Compressed air drill (CA)
8	12	-
10	14	-
12	16	17
14	18	17
16	20	20
20	25	26
25	32	32

## Basic design data for rebar design

### Bond strength in N/mm<sup>2</sup> 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

## Pullout design bond strength for Hit Rebar design

### Design bond strength in N/mm<sup>2</sup>, values in table are design values, $f_{bd,po} = \tau_{RK}/\gamma_{Mp}$

Hammer or compressed air drilling. Uncracked concrete C20/25.									
temperature range	Bar diameter								
	8	10	12	14	16	20	22	24	25
I: 40°C/24°C	5,7	4,7		3,6					
II: 80°C/50°C	4,0	3,3		2,4					
III: 120°C/72°C	3,3	2,8		2,1					

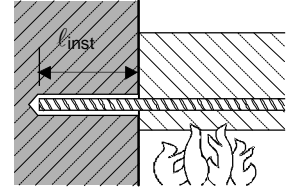
Increasing factor for other concrete class:  $f_{B,p} = (f_{ck}/25)^{0,15}$  ( $f_{ck}$ : characteristic compressive strength on cube)

### Additional Hilti Technical Data

Reduction factor for splitting with large concrete cover:  $\delta = 0,306$  (Hilti additional data)

### Fire Resistance

#### a) fire situation “anchorage”



Maximum force in rebar in conjunction with HIT-HY 150 as a function of embedment depth for the fire resistance classes F30 to F180 (yield strength  $f_{yk} = 500 \text{ N/mm}^2$ ) according EC2<sup>a)</sup>.

Bar Ø [mm]	Drill hole Ø [mm]	Max. $F_{s,T}$ [kN]	$l_{inst}$ [mm]	R30 [kN]	R60 [kN]	R90 [kN]	R120 [kN]	R180 [kN]
8	12	16,2	80	3,5	1,5	0,6	0,3	0,0
			120	10,6	5,0	2,8	1,9	0,7
			160	16,2	11,9	7,9	5,2	2,7
			190		16,2	13,2	10,4	4,7
			210			16,2	13,9	6,4
			230				16,2	8,5
			280					16,2
10	14	25,3	100	8,8	3,6	1,9	1,1	0,2
			150	19,8	12,7	7,7	5,1	2,6
			180	25,3	19,3	14,3	10,7	4,9
			210		25,3	20,6	17,3	7,6
			240			25,3	23,9	12,5
			250				25,3	14,4
			310					25,3
12	16	36,4	120	15,9	7,5	4,1	2,9	1,0
			180	31,7	23,1	17,1	12,9	5,9
			200	36,4	28,4	22,4	18,1	8,0
			240		36,4	32,9	28,7	14,4
			260			36,4	34,0	19,7
			270				36,4	22,3
			330					36,4
14	18	49,6	140	24,7	14,6	7,9	5,8	2,7
			210	44,0	36,2	29,2	24,2	10,6
			230	49,6	42,4	35,4	30,4	13,9
			260		49,6	44,0	39,6	23,0
			280			49,6	44,0	29,1
			300				49,6	32,2
			350					49,6
16	20	64,8	160	35,2	23,8	15,8	10,4	5,3
			240	57,5	51,9	43,9	38,3	19,2
			250	64,7	55,5	47,5	41,8	22,7
			280		64,7	57,5	52,3	33,2
			300			64,7	57,5	40,3
			320				64,7	47,3
			370					64,7
20	25	101,2	200	61,6	47,3	37,3	30,2	13,3
			290	101,2	86,9	76,9	69,8	45,9
			330		101,2	94,5	87,4	63,5
			350			101,2	96,2	72,3
			370				101,2	81,1
			420					101,2

Bar Ø [mm]	Drill hole Ø [mm]	Max. F <sub>s,T</sub> [kN]	l <sub>inst</sub> [mm]	R30 [kN]	R60 [kN]	R90 [kN]	R120 [kN]	R180 [kN]
25	32	158,1	250	104,5	86,6	74,1	65,3	35,4
			350	158,1	141,6	129,1	120,2	90,4
			380		158,1	145,6	136,7	106,9
			410			158,1	153,2	123,4
			420				158,1	128,9
			480					158,1

### b) Fire situation parallel

Max. bond stress,  $\tau_T$ , 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.

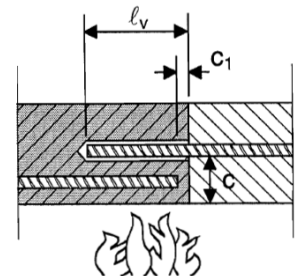
$$F_{s,T} \leq (l_{inst} - c_f) \cdot \varnothing \cdot \pi \cdot \tau_T \quad \text{where: } (l_{inst} - c_f) \geq l_s;$$

$l_s$  = lap length

$\varnothing$  = nominal diameter of bar

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

$\tau_T$  = bond stress when exposed to fire



**Critical temperature-dependent bond stress,  $\tau_c$ , concerning “overlap joint” for Hilti HIT-HY 150 injection adhesive in relation to fire resistance class and required minimum concrete coverage  $c$ .**

Clear concrete cover $c$ [mm]	Max. bond stress, $\tau_c$ [N/mm <sup>2</sup> ]					
	R30	R60	R90	R120	R180	
30	1,4	0,2	0	0	0	
35	1,7	0,4	0	0	0	
40	1,9	0,7	0	0	0	
45	2,2	1,0	0	0	0	
50		1,2	0,4	0	0	
55		1,4	0,5	0	0	
60		1,7	0,7	0,3	0	
65		1,9	0,9	0,5	0	
70		2,2	2,2	1,2	0,7	0
75				1,4	0,8	0
80				1,7	1,0	0,2
85				1,8	1,3	0,5
90				2,0	1,5	0,5
95	2,2	2,2	2,2	1,7	0,6	
100				1,9	0,7	
105					0,9	
110					1,2	
115					1,4	
120					1,6	
125					1,7	
130					1,9	
135					2,1	
140					2,2	



## Minimum anchorage length




The multiplication factor for minimum anchorage length shall be considered as 1,5 for all drilling methods.

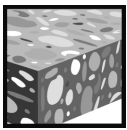
## Minimum anchorage and lap lengths for C20/25; maximum hole lengths

Rebar		Hammer drilling, Compressed air drilling		
Diameter $d_s$ [mm]	$f_{y,k}$ [N/mm <sup>2</sup> ]	$l_{b,min}^*$ [mm]	$l_{0,min}^*$ [mm]	$l_{max}$ [mm]
8	500	170	300	1000
10	500	213	300	1000
12	500	255	300	1000
14	500	298	315	1000
16	500	340	360	1500
20	500	425	450	2000
25	500	532	563	2000

\* $l_{b,min}$  (8.6) and  $l_{0,min}$  (8.11) are calculated for good bond conditions with maximum utilisation of rebar yield strength  $f_{y,k} = 500 \text{ N/mm}^2$  and  $\alpha_6 = 1,0$

## Hilti HIT-HY 150 MAX post-installed rebars

Injection mortar system		Benefits
	Hilti HIT-HY 150 MAX 330 ml foil pack  (also available as 500 ml and 1400 ml foil pack)	<ul style="list-style-type: none"> <li>- suitable for concrete C 12/15 to C 50/60</li> <li>- high loading capacity and fast cure</li> <li>- suitable for dry and water saturated concrete</li> <li>- for rebar diameters up to 25 mm</li> <li>- non corrosive to rebar elements</li> <li>- good load capacity at elevated temperatures</li> <li>- hybrid chemistry</li> <li>- multiplication factor for minimum anchoring and splice length 1.0</li> <li>- suitable for embedment length till 2000 mm</li> <li>- suitable for applications down to -10 °C</li> </ul>
	Static mixer	
	Rebar	



Concrete



Fire  
resistance



European  
Technical  
Approval



CE  
conformity



Drinking  
water  
approved



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 <sup>a)</sup>	CSTB, France	ETA-08/0202 / 2008-07-24
European technical approval <sup>a)</sup>	CSTB, France	ETA-08/0352 / 2009-12-18
National Approval	DIBt, Berlin	DIBt Z-21.8-1882 / 2010-08-13
Fire test report	DIBt, Berlin	DIBt Z-21.8-1882 / 2010-08-13
Assessment report (fire)	Warringtonfire	WF 166402 / 2007-10-26

<sup>a)</sup> All data given in this section according ETA-08/0202, issue 2008-07-24.

## 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 $k = (f_t/f_y)_k$		$\geq 1,08$	$\geq 1,15$ < 1,35
Characteristic strain at maximum force, $\epsilon_{uk}$ (%)		$\geq 5,0$	$\geq 7,5$
Bendability		Bend / Rebind test	
Maximum deviation from nominal mass (individual bar) (%)	Nominal bar size (mm) $\leq 8$	$\pm 6,0$ $\pm 4,5$	
	$> 8$		
Bond: Minimum relative rib area, $f_{R,min}$	Nominal bar size (mm) 8 to 12	$0,040$ $0,056$	
	$> 12$		

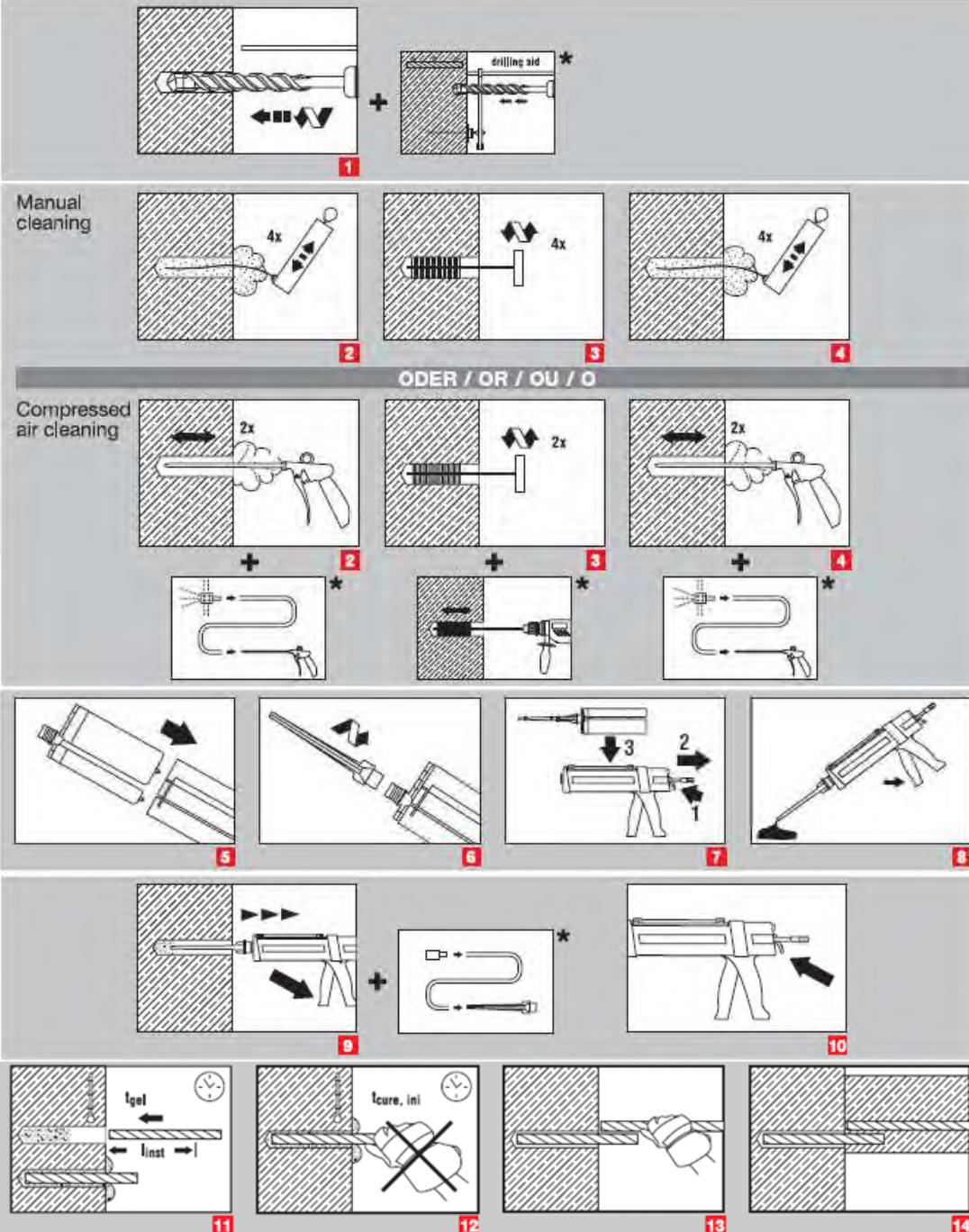
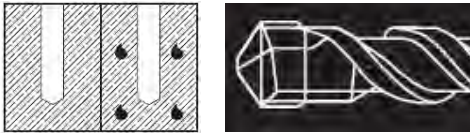
## Setting details

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 $t_{cure}$
$-10\text{ °C} \leq T_{BM} < -5\text{ °C}$	180 min	12 h
$-5\text{ °C} \leq T_{BM} < -0\text{ °C}$	90 min	9 h
$0\text{ °C} \leq T_{BM} < 5\text{ °C}$	45 min	4,5 h
$5\text{ °C} \leq T_{BM} < 10\text{ °C}$	20 min	2 h
$10\text{ °C} \leq T_{BM} < 15\text{ °C}$	7 min	50 min
$15\text{ °C} \leq T_{BM} < 20\text{ °C}$	6 min	40 min
$20\text{ °C} \leq T_{BM} < 25\text{ °C}$	5 min	30 min
$25\text{ °C} \leq T_{BM} < 30\text{ °C}$	3 min	30 min
$30\text{ °C} \leq T_{BM} \leq 40\text{ °C}$	2 min	30 min

Dry and water-saturated concrete, hammer drilling



a)

a) **Note:** Manual cleaning for element sizes  $d \leq 16\text{mm}$  and embedment depth  $h_{ef} \leq 10 d$  only!

## 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 environment at 50 °C during 90 days.

These tests show an excellent behaviour of the post-installed connection made with HIT-HY 150 MAX: low displacements with long term stability, failure load after exposure above reference load.

### Water behaviour

- **Water:** HIT-HY 150 MAX is water tight and water resistant, without any toxicity risk for the environment.
- **Drinking water:** HIT-HY 150 MAX is «NSF» certified, in accordance with NSF/ANSI St 61 «Drinking Water System Components - Health Effects». Tests are done at 60 °C, which corresponds to domestic hot water. The use of HIT-HY 150 MAX is possible for water tanks.

### 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	+

## Drilling diameters

Rebar (mm)	Drill bit diameters d <sub>0</sub> [mm]	
	Hammer drill (HD)	Compressed air drill (CA)
<b>8</b>	12 (10 <sup>a)</sup> )	-
<b>10</b>	14 (12 <sup>a)</sup> )	-
<b>12</b>	16 (14 <sup>a)</sup> )	17
<b>14</b>	18	17
<b>16</b>	20	20
<b>18</b>	22	22
<b>20</b>	25	26
<b>22</b>	28	28
<b>24</b>	32	32
<b>25</b>	32	32

a) Max. installation length l = 250 mm.

## Basic design data for rebar design according to rebar ETA

**Bond strength in N/mm<sup>2</sup> according to ETA 08/0202 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
<b>8 - 24</b>	1,6	2,0	2,3	2,7	3,0	3,4	3,4	3,4	3,7
<b>25</b>	1,6	2,0	2,3	2,7	3,0	3,4	3,7	3,7	3,7

## Pullout design bond strength for Hit Rebar design

**Design bond strength in N/mm<sup>2</sup> according to ETA 08/0352 (values in table are design values,  $f_{bd,po} = \tau_{Rk}/\gamma_{Mp}$ )**

Hammer or compressed air drilling. Uncracked concrete C20/25.

temperature range	Bar diameter								
	8	10	12	14	16	20	22	24	25
I: 40°C/24°C	5,3			6,3			5,3		
II: 80°C/50°C	4,4			5,3			4,4		
III: 120°C/72°C	2,8			3,3			2,8		

Hammer or compressed air drilling. Cracked concrete C20/25.

temperature range	Bar diameter								
	8	10	12	14	16	20	22	24	25
I: 40°C/24°C	-	3,7		4,0			3,3		
II: 80°C/50°C	-	3,0	3,3		3,7	4,0	3,3		
III: 120°C/72°C	-	2,0		2,3			2,2		

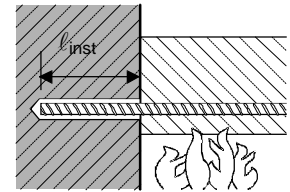
Increasing factor in non-cracked concrete:  $f_{B,p} = (f_{cck}/25)^{0,1}$  ( $f_{cck}$ : characteristic compressive strength on cube)

### Additional Hilti Technical Data

Reduction factor for splitting with large concrete cover:  $\delta = 0,306$

### Fire Resistance according to DIBt Z-21.8-1882

#### a) fire situation “anchorage”



Maximum force in rebar in conjunction with Hilti HIT-HY 150 Max as a function of embedment depth for the fire resistance classes F30 to F240 (yield strength  $f_{yk} = 500 \text{ N/mm}^2$ ) according EC2<sup>a)</sup>.

Bar $\varnothing$ [mm]	Drill hole $\varnothing$ [mm]	Max. $F_{s,T}$ [kN]	$l_{inst}$ [mm]	R30 [kN]	R60 [kN]	R90 [kN]	R120 [kN]	R180 [kN]
8	12	16,2	80	3,0	0,7	0,2	0	0
			120	7,0	2,2	1,3	0,7	0,2
			170	16,2	10,2	9,2	4,0	1,7
			210		16,2	16,2	11,0	7,5
			230				14,5	10,9
			250				16,2	14,4
			300					16,2
10	14	25,3	100	6,1	2,0	1,0	0,4	0
			150	19,3	9,3	7,1	2,2	1,0
			190	25,3	18,0	15,9	9,3	4,9
			230		25,3	24,7	18,1	13,7
			260			25,3	24,7	20,3
			280				25,3	24,7
			320					25,3
12	16	36,4	120	15,3	6,0	1,9	1,1	0,3
			180	31,0	19,0	17,8	8,5	7,0
			220	36,4	29,6	27,0	19,1	13,8
			260		36,4	36,4	29,7	24,4
			280				35,0	29,6
			300				36,4	34,9
			340					36,4
14	18	49,6	140	24,0	9,9	6,9	2,6	1,0
			210	45,0	31,4	28,5	25,7	13,0
			240	49,6	40,6	37,7	32,8	22,3
			280		49,6	49,6	40,7	34,6
			300				44,7	40,7
			330				49,6	49,6
16	20	64,8	160	34,5	18,4	14,9	4,4	2,3
			240	62,6	46,4	43,0	37,7	25,5
			260	64,8	53,5	50,0	44,7	32,5
			300		64,8	57,0	51,7	46,6
			330			64,8	61,3	57,2
			360				64,8	64,8
20	25	101,2	200	60,7	40,0	36,3	29,3	14,2
			250	78,3	62,5	58,3	51,3	36,3
			310	101,2	88,9	84,6	77,6	62,6
			350		101,2	101,2	94,2	80,2
			370				101,2	83,5
			390					97,8
			430					101,2

Bar Ø [mm]	Drill hole Ø [mm]	Max. F <sub>s,T</sub> [kN]	ℓ <sub>inst</sub> [mm]	R30 [kN]	R60 [kN]	R90 [kN]	R120 [kN]	R180 [kN]
25	32	158,1	250	97,9	78,1	72,9	64,7	45,3
			280	126,5	94,6	89,4	81,2	61,8
			370	158,1	144,0	127,9	119,7	111,2
			410		158,1	150,0	141,8	123,2
			430			158,1	150,0	144,2
			450				158,1	155,2
			500					158,1

a) For Hilti HIT-HY 150 MAX rebar only the standard acc. EC2 is available (Data also in Warringtonfire report WF 166402 or/and IBMB Braunschweig report No 3884/8246-CM).



### b) fire situation “anchorage”

Max. bond stress,  $\tau_T$ , 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.

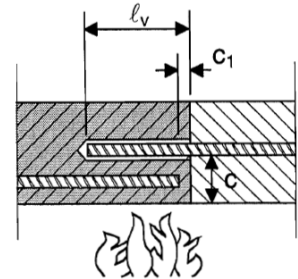
$$F_{s,T} \leq (l_{inst} - c_f) \cdot \varnothing \cdot \pi \cdot \tau_T \quad \text{where: } (l_{inst} - c_f) \geq l_s;$$

$l_s$  = lap length

$\varnothing$  = nominal diameter of bar

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

$\tau_T$  = bond stress when exposed to fire



**Critical temperature-dependent bond stress,  $\tau_c$ , concerning “overlap joint” for Hilti HIT-HY 150 MAX injection adhesive in relation to fire resistance class and required minimum concrete coverage c.**

Clear concrete cover c [mm]	Max. bond stress, $\tau_c$ [N/mm <sup>2</sup> ]				
	R30	R60	R90	R120	R180
30	0,6	0,3	0	0	0
35	0,7	0,3			
40	0,9	0,4	0,2		
45	1,0	0,4	0,2		
50	1,2	0,5	0,3		
55	1,5	0,6	0,3	0,2	
60	1,8	0,8	0,4	0,3	
65	2,2	0,9	0,5	0,3	
70	2,7	1,0	0,5	0,3	
75	3,4	1,2	0,6	0,4	
80	3,7	1,5	0,7	0,5	0,3
85		1,7	0,8	0,5	0,3
90		2,0	1,0	0,6	0,3
95		2,2	1,1	0,7	0,4
100		2,4	1,3	0,8	0,4
105		2,7	1,5	0,9	0,5
110		3,0	1,7	1,1	0,5
115		3,4	2,0	1,2	0,6
120		3,7	2,2	1,4	0,6
125			2,5	1,6	0,7
130	2,8		1,9	0,8	
135	3,0		2,1	0,9	
140	3,4		2,3	1,0	
145	3,7		3,7	2,6	1,1
150				2,9	1,2
155				3,1	1,3
160				3,4	1,4
165				3,5	1,5
170		3,7	3,7	1,6	
175				1,7	
180				1,8	
185				1,9	
190				2,1	
195	2,2				
200	2,3				

## Minimum anchorage length

According to ETA-08/0202, the multiplication factor for minimum anchorage length is 1,0 for all approved drilling methods.

## Minimum anchorage and lap lengths for C20/25; maximum hole lengths

Rebar		Hammer drilling, Compressed air drilling		
Diameter $d_s$ [mm]	$f_{y,k}$ [N/mm <sup>2</sup> ]	$l_{b,min}^*$ [mm]	$l_{0,min}^*$ [mm]	$l_{max}$ [mm]
8	500	113	200	1000
10	500	142	200	1000
12	500	170	200	1000
14	500	198	210	1000
16	500	227	240	1500
18	500	255	270	2000
20	500	284	300	2000
22	500	312	330	2000
24	500	340	360	2000
25	500	354	375	2000

\*  $l_{b,min}$  (8.6) and  $l_{0,min}$  (8.11) are calculated for good bond conditions with maximum utilisation of rebar yield strength  $f_{yk} = 500 \text{ N/mm}^2$  and  $\alpha_6 = 1,0$



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