





## 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>- Approved automatic cleaning with the use of the hollow drill-bit</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



Approved automatic cleaning while drilling



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

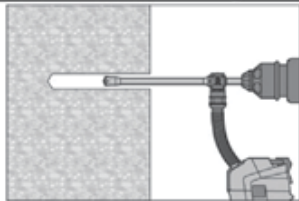
## Setting

### Installation equipment

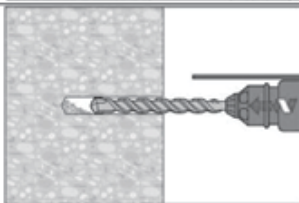
Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Rotary hammer	TE 2 – TE 16					TE 40 – TE 70			
Other tools	compressed air gun or blow out pump, set of cleaning brushes, dispenser								

### 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.

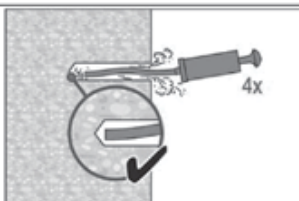


Drill Hole to the required embedment depth with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit.

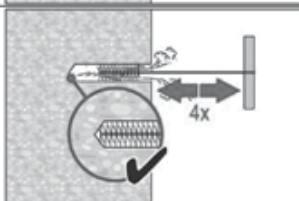
**Bore hole cleaning** Just before setting an anchor, the bore hole must be free of dust and debris.

#### a) Manual Cleaning (MC) non-cracked concrete only

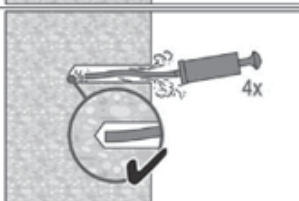
for bore hole diameters  $d_0 \leq 20\text{mm}$  and bore hole depth  $h_0 \leq 10d$



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



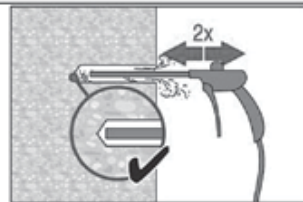
Brush 4 times with the specified brush size by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it. The brush must produce natural resistance as it enters the bore hole -- if not the brush is too small and must be replaced with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



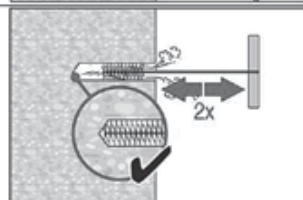
Blow out again with manual pump at least 4 times until return air stream is free of noticeable dust.

**b) Compressed air cleaning (CAC)**

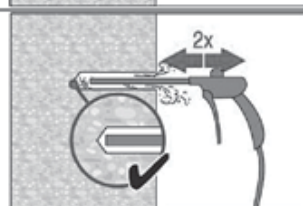
for all bore hole diameters  $d_o$  and all bore hole depth  $h_o$



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  $\geq 32$  mm the compressor must supply a minimum air flow of 140 m<sup>3</sup>/hour.

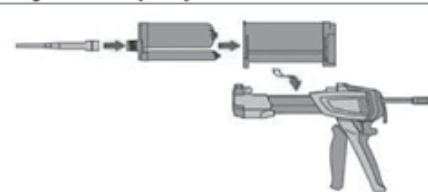


Brush 2 times with the specified brush size by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it. The brush must produce natural resistance as it enters the bore hole -- if not the brush is too small and must be replaced with the proper brush diameter.

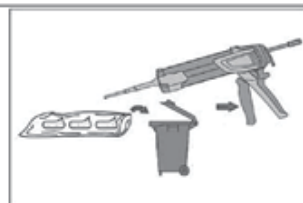


Blow again with compressed air 2 times until return air stream is free of noticeable dust.

**Injection preparation**



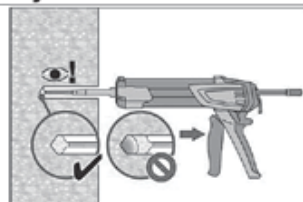
Tightly attach new Hilti mixing nozzle HIT-RE-M to foil pack manifold (snug fit). Do not modify the mixing nozzle. Observe the instruction for use of the dispenser. Check foil pack holder for proper function. Do not use damaged foil packs / holders. Swing foil pack holder with foil pack into HIT-dispenser.



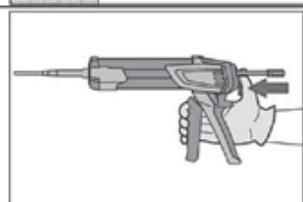
Discard initial adhesive. The foil pack opens automatically as dispensing is initiated. Depending on the size of the foil pack an initial amount of adhesive has to be discarded.

Discard quantities are  
 2 strokes for 330 ml foil pack,  
 3 strokes for 500 ml foil pack,  
 4 strokes for 500 ml foil pack  $\leq 5^\circ\text{C}$ .

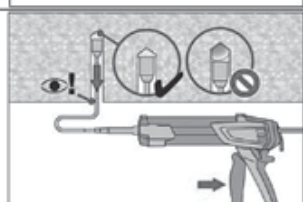
**Inject adhesive** from the back of the borehole without forming air voids



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 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	
	<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>For overhead installation use piston plugs and fix embedded parts with e.g. wedges</p>
	<p>Loading the anchor: After required curing time <math>t_{cure}</math> the anchor can be loaded.</p>

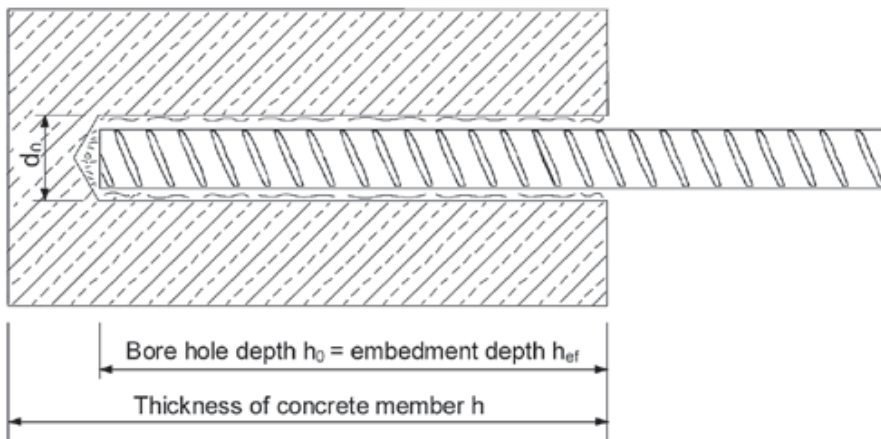
For detailed information on installation see instruction for use given with the package of the product.

### 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

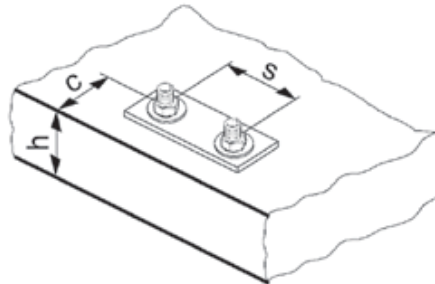
Temperature of the base material	Hilti HIT-HY 200-A	
	Working time in which anchor can be inserted and adjusted $t_{work}$	Curing time before anchor can be loaded $t_{cure}$
-10 °C to -5 °C	1,5 hour	7 hour
-4 °C to 0 °C	50 min	4 hour
1 °C to 5 °C	25 min	2 hour
6 °C to 10 °C	15 min	1 hour
11 °C to 20 °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]	$h_{ef} + 30 \text{ mm}$				$h_{ef} + 2 d_0$				
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>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.

- a) both given values for drill bit diameter can be used
- b)  $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$  ( $h_{ef}$ : embedment depth)
- c)  $h$ : base material thickness ( $h \geq h_{min}$ )
- d) The critical edge distance for concrete cone failure depends on the embedment depth  $h_{ef}$  and the design bond resistance. The simplified formula given in this table is on the 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)

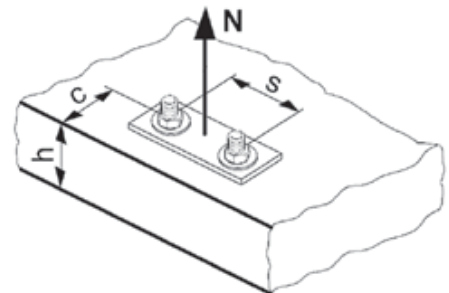
The values are valid for one anchor.

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
$N_{Rd,s}$	BS1 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

## 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-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
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,1}$ <sup>a)</sup>	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
$f_B = (f_{ck,cube}/25N/mm^2)^{1/2}$ <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

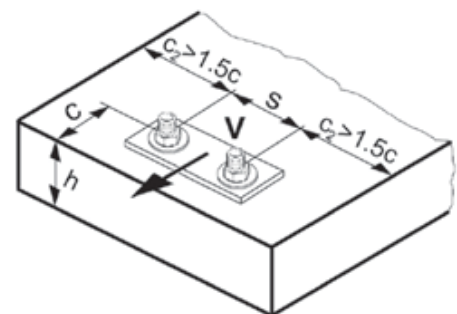
$h_{ef}$ [mm]	60	70	80	90	$\geq 100$
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,8 <sup>a)</sup>	0,85 <sup>a)</sup>	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

a) This factor applies only for dense reinforcement. If in the area of anchorage there is reinforcement with a spacing  $\geq 150$  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:  $V_{Rd,c} = V_{Rd,c}^0 \cdot f_B \cdot f_{B'} \cdot f_h \cdot f_4 \cdot f_{hef} \cdot f_c$



## 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  $V_{Rd,cp}$  = lower value<sup>a)</sup> 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

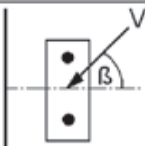
### Influencing factors

#### 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°
$f_{\beta} = \frac{1}{\sqrt{(\cos \alpha_V)^2 + \left(\frac{\sin \alpha_V}{2,5}\right)^2}}$ 	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".

