Anchor Fastening Technology Manual

HIT-HY 170 mortar with rebar (as anchor)

Version 2016-10

Hilti HIT-HY 170 mortar with rebar (as anchor)

Injection mortar system	Benefits
 Hilti HIT-HY 170 500 ml foil pack (also available as 330 ml foil pack)  Static mixer  Rebar B500 B	- suitable for concrete C12/15 to C50/60 - suitable for dry and water saturated concrete - high loading capacity and fast cure - for rebar diameters up to 25 mm - in service temperature range up to 80°C short term/50°C long term - manual cleaning for drill hole sizes ≤ 18 mm and embedment depth h_{ef} ≤ 10d - Suitable for embedment depth up to 300 mm depending on the rebar diameter

Base material	Load conditions
 Concrete (non-cracked)	 Static/quasi-static
Installation conditions	**Other information**
 Hammer drilled holes  Dry concrete  Water saturated concrete	 CE conformity

Basic loading data (for a single anchor)

All data in this section applies to For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Base material thickness, as specified in the table
- One typical embedment depth, as specified in the table
- One anchor material, as specified in the tables
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range -5°C to +40°C

Embedment depth and base material thickness for the basic loading data

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø18	Ø20	Ø22	Ø24	Ø25
Typical embedment depth [mm]	80	90	110	125	145	155	170	185	200	210
Base material thickness [mm]	110	120	140	161	185	199	220	237	256	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.

For hammer drilled holes:
Mean ultimate resistance

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø18	Ø20	Ø22	Ø24	Ø25
Tensile $N_{Ru,m}$	BSt 500 S	[kN]	26,7	37,5	55,1	78,2	96,8	116,4	141,8	168,7	189,6	204,0
Shear $V_{Ru,m}$	BSt 500 S	[kN]	*14,7*	*23,1*	*32,6*	*44,1*	*57,8*	*73,5*	*90,3*	*109,2*	*130,2*	*141,8*

Characteristic resistance

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø18	Ø20	Ø22	Ø24	Ø25
Tensile N_{Rk}	BSt 500 S	[kN]	20,1	28,3	41,5	58,9	72,9	87,7	106,8	127,1	142,8	153,7
Shear V_{Rk}	BSt 500 S	[kN]	*14,0*	*22,0*	*31,0*	*42,0*	*55,0*	*70,0*	*86,0*	*104,0*	*124,0*	*135,0*

Design resistance

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø18	Ø20	Ø22	Ø24	Ø25
Tensile N_{Rd}	BSt 500 S	[kN]	13,4	18,8	27,6	39,3	48,6	58,4	71,2	84,7	95,2	102,5
Shear V_{Rd}	BSt 500 S	[kN]	*11,2*	*17,6*	*24,8*	*33,6*	*44,0*	*56,0*	*68,8*	*83,2*	*99,2*	*108,0*

Recommended loads

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø18	Ø20	Ø22	Ø24	Ø25
Tensile N_{rec}	BSt 500 S	[kN]	9,6	13,5	19,7	28,0	34,7	41,7	50,9	60,5	68,0	73,2
Shear V_{rec}	BSt 500 S	[kN]	8,0	12,6	17,7	24,0	31,4	40,0	49,1	59,4	70,9	77,1

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

Service temperature range

Hilti HIT-HY 170 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

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø18	Ø20	Ø22	Ø24	Ø25
Nominal tensile strength f_{uk}	BSt 500 S	[N/mm²]	550	550	550	550	550	550	550	550	550	550
Yield strength f_{yk}	BSt 500 S	[N/mm²]	500	500	500	500	500	500	500	500	500	500
Stressed cross-section A_s	BSt 500 S	[mm²]	50,3	78,5	113,1	153,9	201,1	254,0	314,2	380	452	490,9
Moment of resistance W	BSt 500 S	[mm³]	50,3	98,2	169,6	269,4	402,1	572,6	785,4	1045,3	1357,2	1534

Material quality

Designation	Material
Rebar EN 1992-1-1	Bars and de-coiled rods class B or C with f_{yk} and k according to NDP or NCL of EN 1992-1-1 $f_{uk} = f_{tk} = k \cdot f_{yk}$

Setting

Installation equipment

Anchor size	8-16	18-25
Rotary hammer	TE 2 (-A) – TE 30 (-A)	TE 40 – TE 70
Other tools	Blow out hand pump $h_{ef} \leq 10.d$	
	Compressed air gun	
	Set of cleaning brushes, dispenser, piston plug	

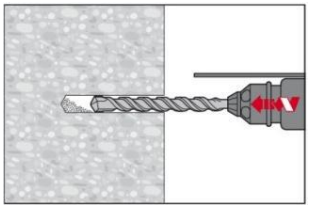
Drilling and cleaning

Rebar	Hammer drilling (HD)	Brush HIT-RB	Piston plug HIT-SZ
			
Diameter [mm]	**Drill bit diameter [mm]**	**Size**	
8	10	10	-
	12	12	12
10	12	12	12
	14	14	14
12	14	14	14
	16	16	16
14	18	18	18
16	20	20	20
18	22	22	22
20	25	25	25
22	28	28	28
24	32	32	32
25	32	32	32

Setting instruction

Bore hole drilling

Hammer drilling



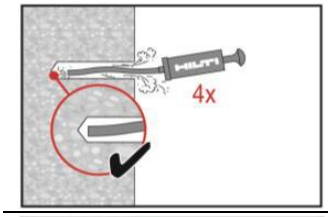
Drill Hole to the required embedment depth with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit.

Bore hole cleaning

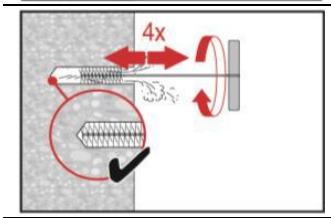
Just before setting an anchor, the bore hole must be free of dust and debris. Inadequate hole cleaning = poor load values.

Manual Cleaning (MC)

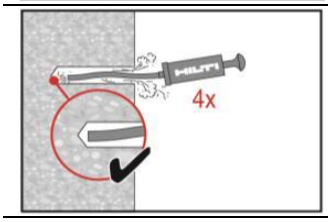
Non-cracked concrete only.
For bore hole diameters $d_0 \leq 18$ mm and bore hole depth $h_0 \leq 10d$.



The Hilti manual pump may be used for blowing out bore holes up to diameters $d_0 \leq 18$ mm and embedment depths up to $h_{ef} \leq 10d$.
Blow out at least 4 times from the back of the bore hole until return air stream is free of noticeable dust



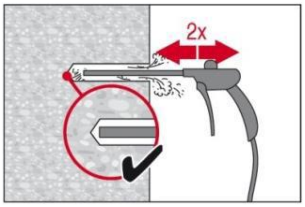
Brush 4 times with the specified brush size (brush diameter ≥ bore hole) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the bore hole - if not the brush is too small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



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

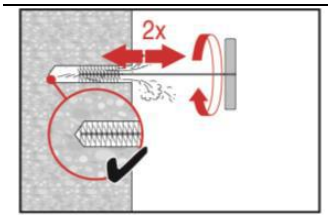
Compressed air cleaning (CAC)

For all bore hole diameters d_0 and all bore hole depth h_0

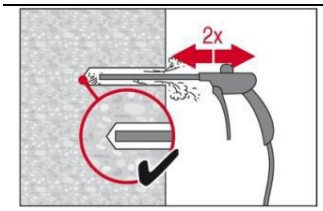


Blow 2 times from the back of the hole (if needed with nozzle extension) over the hole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust.

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

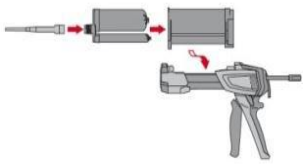


Brush 2 times with the specified brush size by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the bore hole - if not the brush is too small and must be replaced with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

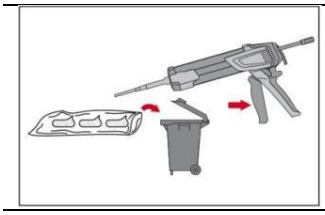


Blow again with compressed air 2 times until return air stream is free of noticeable dust.

Injection preparation



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

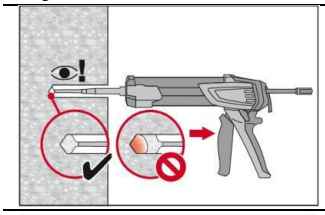


The foil pack opens automatically as dispensing is initiated. Discard initial adhesive. Depending on the size of the foil pack an initial amount of adhesive has to be discarded.
Discard quantities are:

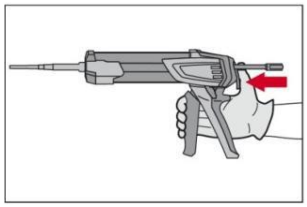
- 2 strokes for 330 ml foil pack,
- 3 strokes for 500 ml foil pack

Inject adhesive

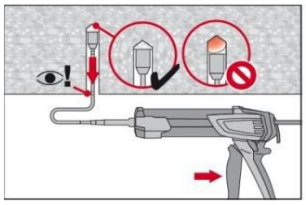
From the back of the drill hole without forming air voids



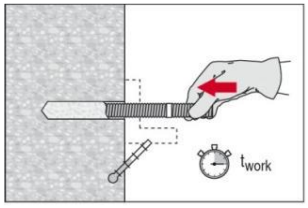
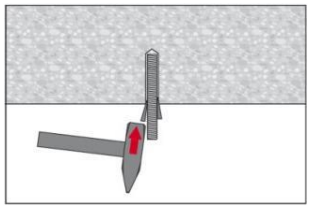
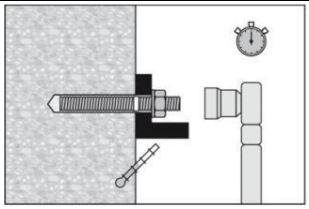
Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull.
Fill holes approximately 2/3 full. It is required that the annular gap between the anchor and the concrete is completely filled with adhesive along the embedment length.



After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further adhesive discharge from the mixer.



Overhead installation and/or installation with embedment depth h_{ef} > 250mm.
For overhead installation the injection is only possible with the aid of extensions and piston plugs. Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug HIT-SZ. Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded out of the bore hole by the adhesive pressure.

Setting the element	Just before setting the element, the drill hole must be free of dust and debris.
	Before use, verify that the element is dry and free of oil and other contaminants. Mark and set element to the required embedment depth untill working time t_{work} has elapsed.
	For overhead installation use piston plugs and fix embedded parts with e.g. wedges HIT-OHW.
	Loading the anchor: after required curing time t_{cure} the anchor can be loaded. The applied installation torque shall not exceed $T_{max.}$

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

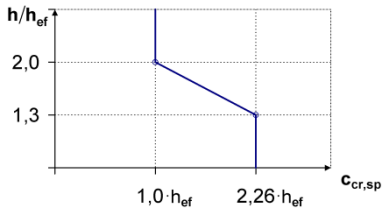
Working time and curing time

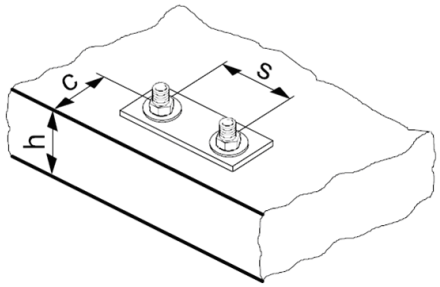
Temperature of the base material T_{BM}	Maximum working time t_{work}	Minimum curing time t_{cure} a)
-5˚C ≤ T_{BM} ≤ 0˚C	10 min	12 h
0˚C < T_{BM} ≤ 5˚C	10 min	5 h
5˚C < T_{BM} ≤ 10˚C	8 min	2,5 h
10˚C < T_{BM} ≤ 20˚C	5 min	1,5 h
20˚C < T_{BM} ≤ 30˚C	3 min	45 min
30˚C < T_{BM} ≤ 40˚C	2 min	30 min

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

Setting details

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø18	Ø20	Ø22	Ø24	Ø25
Nominal diameter of drill bit	d_0	[mm]	10[1] / 12	12[1] / 14	14[1] / 16	18	20	22	25	26	28	32
Effective anchorage and drill hole depth range [a]	$h_{ef,min}$	[mm]	60	60	70	75	80	85	90	95	100	100
	$h_{ef,max}$	[mm]	96	120	144	168	192	216	240	264	288	300
Minimum base material thickness	h_{min}	[mm]	h_{ef} +30 ≥ 100 mm			h_{ef} + 2 d_0						
Minimum spacing	s_{min}	[mm]	40	50	60	70	80	90	100	110	120	125
Minimum edge distance	c_{min}	[mm]	40	50	60	70	80	90	100	110	120	125
Critical spacing for splitting failure	$s_{cr,sp}$		2 $c_{cr,sp}$									
Critical edge distance for splitting failure [b]	$c_{cr,sp}$	[mm]	**1,0 · h_{ef}** for h / h_{ef} ≥ 2,0 **4,6 h_{ef} - 1,8 h** for 2,0 > h / h_{ef} > 1,3 **2,26 h_{ef}** for h / h_{ef} ≤ 1,3									
Critical spacing for concrete cone failure	$s_{cr,N}$		2 $c_{cr,N}$									
Critical edge distance for concrete cone failure [c]	$c_{cr,N}$		1,5 h_{ef}									





1) Values valid for maximum drilling depth of 250 mm.

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

a) $h_{ef,min} \le h_{ef} \le h_{ef,max}$ (h_{ef}: embedment depth)

b) h: base material thickness ($h \ge h_{min}$)

c) The critical edge distance for concrete cone failure depends on the embedment depth h_{ef} and the design bond resistance. The simplified formula given in this table is on the save side.

Simplified design method

Simplified version of the design method according ETAG 001, TR 029.

- 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:

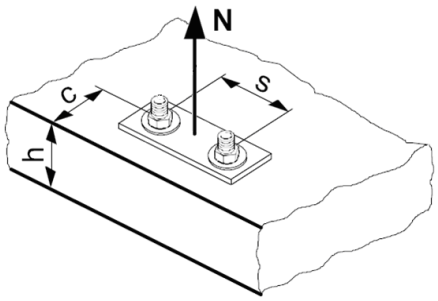
- No different loads are acting on individual anchors (no eccentricity)
- Values are valid for one anchor.

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

Tension loading

The design tensile resistance is the lower value of

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



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø18	Ø20	Ø22	Ø24	Ø25
$N_{Rd,s}$	BSt 500 S	[kN]	20,0	30,7	44,3	60,7	79,3	100,0	123,6	149,3	177,9	192,9

Design combined pull-out and concrete cone resistance

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

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø18	Ø20	Ø22	Ø24	Ø25
Embedment depth h_{ef}		[mm]	80	90	110	125	145	155	170	185	200	210
$N^0_{Rd,p}$	Temperature range I	[kN]	13,4	18,8	27,6	39,3	48,6	58,4	71,2	85,2	100,5	110,0
	Temperature range II	[kN]	9,4	13,2	19,4	25,7	34,0	40,9	49,8	59,7	70,4	77,0

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

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø18	Ø20	Ø22	Ø24	Ø25
$N^0_{Rd,c}$ [kN]	24,1	28,7	38,8	47,1	58,8	65,0	74,6	84,7	95,2	102,5

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
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,1}$ a)	1	1,02	1,04	1,06	1,07	1,08	1,09

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

Influence of embedment depth on combined pull-out and concrete cone resistance

$$f_{h,p} = h_{ef}/h_{ef,typ}$$

Influence of concrete strength on concrete cone resistance

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

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

Influence of edge distance a)

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

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

Influence of anchor spacing a)

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

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

Influence of embedment depth on concrete cone resistance

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

Influence of reinforcement

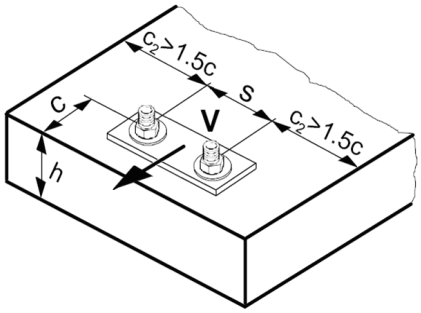
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,7 a)	0,75 a)	0,8 a)	0,85 a)	0,9 a)	0,95 a)	1

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

Shear loading

The design shear resistance is the lower value of

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



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø18	Ø20	Ø22	Ø24	Ø25
$V_{Rd,s}$ BSt 500 S	[kN]	11,2	17,6	24,8	33,6	44,0	56,0	68,8	83,2	99,2	108,0

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

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

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

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

Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø18	Ø20	Ø22	Ø24	Ø25
$V^0_{Rd,c}$	[kN]	3,7	5,3	7,3	9,5	11,9	14,4	17,2	20,1	23,3	25,0

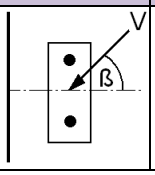
Influencing factors

Influence of concrete strength

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

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

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

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

Influence of base material thickness

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

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

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

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

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

Influence of embedment depth

h_{ef}/d	4	4,5	5	6	7	8	9	10	11
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	0,51	0,63	0,75	1,01	1,31	1,64	2,00	2,39	2,81
h_{ef}/d	12	13	14	15	16	17	18	19	20
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	3,25	3,72	4,21	4,73	5,27	5,84	6,42	7,04	7,67

Influence of edge distance [a)]

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

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

Combined tension and shear loading

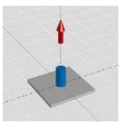
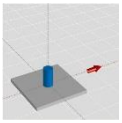
For combined tension and shear loading see section “Anchor Design”.

Precalculated values

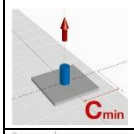
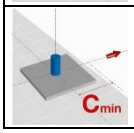
Design resistance calculated according to to ETAG 001, TR 029, Annex C.
All data apply to concrete C20/25 – $f_{ck,cube}$= 25 N/mm² and temperature range I.
Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Design resistance

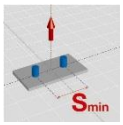
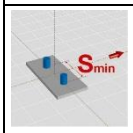
Single anchor, no edge effects

Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø18	Ø20	Ø22	Ø24	Ø25
Embedment depth	h_{ef} = [mm]	80	90	110	125	145	155	170	185	200	210
Base material thickness	h_{min}= [mm]	110	120	140	161	185	199	220	237	256	274
	**Tensile N_{Rd}**										
	BSt 500 S [kN]	13,4	18,8	27,6	39,3	48,6	58,4	71,2	84,7	95,2	102,5
	**Shear V_{Rd}**										
	BSt 500 S [kN]	11,2	17,6	24,8	33,6	44,0	56,0	68,8	83,2	99,2	108,0

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

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø18	Ø20	Ø22	Ø24	Ø25
Embedment depth	h_{ef} =	[mm]	80	90	110	125	145	155	170	185	200	210
Base material thickness	h_{min}=	[mm]	110	120	140	161	185	199	220	237	256	274
Edge distance	$c = c_{min}$=	[mm]	40	50	60	70	80	90	100	110	120	125
	**Tensile N_{Rd}**											
	BSt 500 S	[kN]	8,0	11,2	16,4	22,7	28,3	31,7	36,6	41,7	47,0	50,4
	**Shear V_{Rd}**											
	BSt 500 S	[kN]	3,7	5,3	7,3	9,5	11,9	14,4	17,2	20,1	23,3	25,0

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

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø18	Ø20	Ø22	Ø24	Ø25
Embedment depth	h_{ef} =	[mm]	80	90	110	125	145	155	170	185	200	210
Base material thickness	h_{min}=	[mm]	110	120	140	161	185	199	220	237	256	274
Spacing	$s = s_{min}$=	[mm]	40	50	60	70	80	90	100	110	120	125
	**Tensile N_{Rd}**											
	BSt 500 S	[kN]	8,2	11,5	16,8	23,9	29,6	35,5	42,2	47,9	53,9	58,0
	**Shear V_{Rd}**											
	BSt 500 S	[kN]	11,2	17,6	24,8	33,6	44,0	56,0	68,8	83,2	99,2	108,0