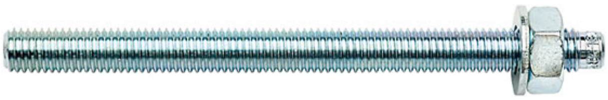
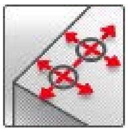
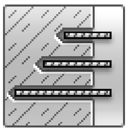
Hilti HIT-HY 150 with HIT-V / HAS

Injection mortar system	Benefits
 Hilti HIT-HY 150 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)  Static mixer  HAS rods HAS-R rods HAS-HCR rods  HAS-E rods HAS-E-R rods  HIT-V rods HIT-V-R rods HIT-V-HCR rods	- suitable for non-cracked concrete C 20/25 to C 50/60 - suitable for dry and water saturated concrete - high loading capacity - rapid curing - small edge distance and anchor spacing possible - large diameter applications - high corrosion resistant - in service temperature range up to 120°C short term/72°C long term - manual cleaning for anchor size M8 to M16 and embedment depth $h_{ef} \leq 10d$ - embedment depth range M8: 60 to 160 mm M30: 120 to 600 mm


Concrete


Small edge distance and spacing


Variable embedment depth


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 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range -5°C to +40°C

Embedment depth a) and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Typical embedment depth h_{ef} [mm]	80	90	110	125	170	210	240	270
Base material thickness h [mm]	110	120	140	165	220	270	300	340

a) The allowed range of embedment depth is shown in the setting details. The corresponding load values can be calculated according to the simplified design method.

Mean ultimate resistance: non-cracked concrete C 20/25 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Tensile $N_{Ru,m}$	HIT-V 5.8	[kN]	*18,9*	*30,5*	*44,1*	75,4	121,1	168,9	203,6	237,5
Shear $V_{Ru,m}$	HIT-V 5.8	[kN]	*9,5*	*15,8*	*22,1*	*41,0*	*64,1*	*92,4*	*120,8*	*147,0*

Characteristic resistance: non-cracked concrete C 20/25 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Tensile N_{Rk}	HIT-V 5.8	[kN]	*18,0*	*29,0*	*42,0*	56,5	90,8	126,7	152,7	178,1
Shear V_{Rk}	HIT-V 5.8	[kN]	*9,0*	*15,0*	*21,0*	*39,0*	*61,0*	*88,0*	*115,0*	*140,0*

Design resistance: non-cracked concrete C 20/25 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Tensile N_{Rd}	HIT-V 5.8	[kN]	12,0	17,3	25,3	26,9	43,2	60,3	72,7	84,8
Shear V_{Rd}	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0

Recommended loads a): non-cracked concrete C 20/25 , anchor HIT-V 5.8

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Tensile N_{rec}	HIT-V 5.8	[kN]	8,6	12,3	18,1	19,2	30,9	43,1	51,9	60,6
Shear V_{rec}	HIT-V 5.8	[kN]	5,1	8,6	12,0	22,3	34,9	50,3	65,7	80,0

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

Service temperature range

Hilti HIT-HY 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/mm²]	500	500	500	500	500	500	500	500
	HIT-V/HAS 8.8	[N/mm²]	800	800	800	800	800	800	800	800
	HIT-V/HAS -R	[N/mm²]	700	700	700	700	700	700	500	500
	HIT-V/HAS -HCR	[N/mm²]	800	800	800	800	800	700	700	700
Yield strength f_{yk}	HIT-V/HAS 5.8	[N/mm²]	400	400	400	400	400	400	400	400
	HIT-V/HAS 8.8	[N/mm²]	640	640	640	640	640	640	640	640
	HIT-V/HAS -R	[N/mm²]	450	450	450	450	450	450	210	210
	HIT-V/HAS -HCR	[N/mm²]	600	600	600	600	600	400	400	400
Stressed cross-section A_s	HAS	[mm²]	32,8	52,3	76,2	144	225	324	427	519
	HIT-V	[mm²]	36,6	58,0	84,3	157	245	353	459	561
Moment of resistance W	HAS	[mm³]	27,0	54,1	93,8	244	474	809	1274	1706
	HIT-V	[mm³]	31,2	62,3	109	277	541	935	1387	1874

Material quality

Part	Material
Threaded rod HIT-V(F), HAS 5.8: M8 – M24	Strength class 5.8, A_5 > 8% ductile steel galvanized ≥ 5 µm, (F) hot dipped galvanized ≥ 45 µm,
Threaded rod HIT-V(F), HAS 8.8: M27 – M30	Strength class 8.8, A_5 > 8% ductile steel galvanized ≥ 5 µm, (F) hot dipped galvanized ≥ 45 µm,
Threaded rod HIT-V-R, HAS-R	Stainless steel grade A4, A_5 > 8% ductile strength class 70 for ≤ M24 and class 50 for M27 to M30, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
Threaded rod HIT-V-HCR, HAS-HCR	High corrosion resistant steel, 1.4529; 1.4565 strength ≤ M20: R_m = 800 N/mm², $R_{p\,0.2}$ = 640 N/mm², A_5 > 8% ductile M24 to M30: R_m = 700 N/mm², $R_{p\,0.2}$ = 400 N/mm², A_5 > 8% ductile
Washer ISO 7089	Steel galvanized, hot dipped galvanized,
	Stainless steel, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
	High corrosion resistant steel, 1.4529; 1.4565
Nut EN ISO 4032	Strength class 8, steel galvanized ≥ 5 µm, hot dipped galvanized ≥ 45 µm
	Strength class 70, stainless steel grade A4, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
	Strength class 70, high corrosion resistant steel, 1.4529; 1.4565

Anchor dimensions

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Anchor rod HAS, HAS-R, HAS-HCR HAS-E, HAS-E-R	M8x80	M10x90	M12x110	M16x125	M20x170	M24x210	M27x240	M30x270
Embedment depth h_{ef} [mm]	80	90	110	125	170	210	240	270
Anchor rod HIT-V, HIT-V-R, HIT-V-HCR	Anchor rods HIT-V (-R / -HCR) are available in variable length							

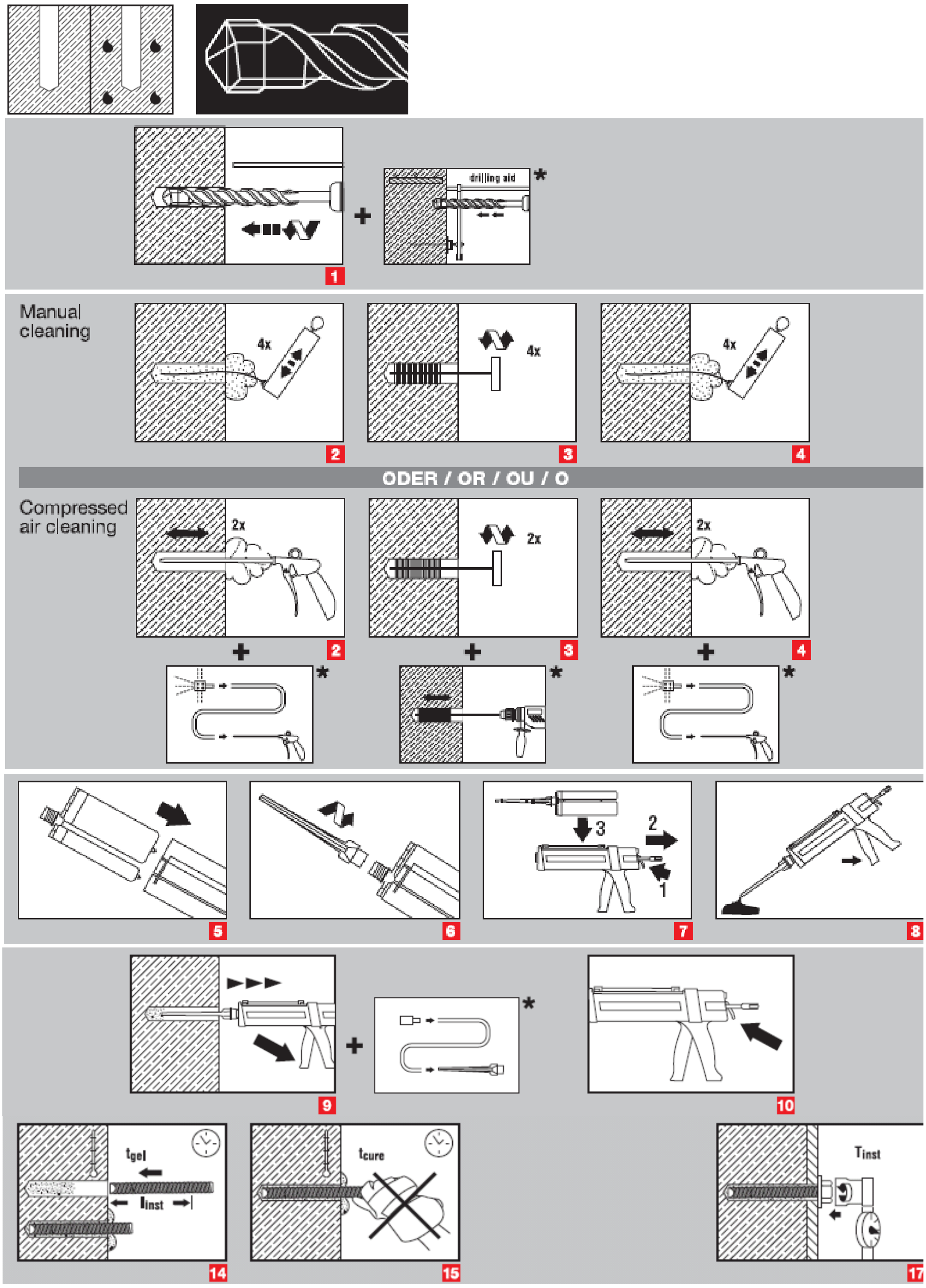
Setting

installation equipment

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Rotary hammer	TE 2 – TE 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 ≤ 16mm and embedment depth h_{ef} ≤ 10 d only!**
b) Note: **Extension and piston plug needed for overhead installation and/or embedment depth > 250mm!**

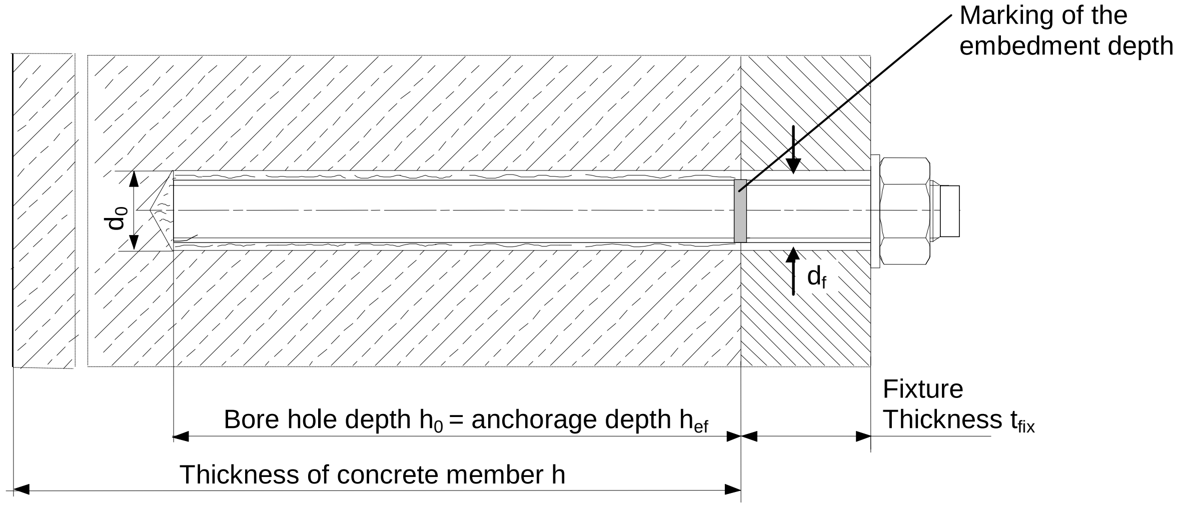
For detailed information on installation see instruction for use given with the package of the product.

Working time, Curing time

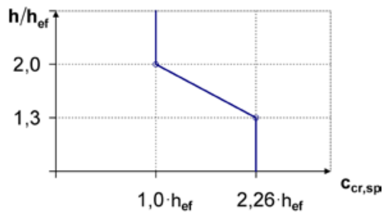
Temperature of the base material T_{BM}	Working time t_{gel}	Curing time t_{cure} a)
-5 °C ≤ T_{BM} < 0 °C	90 min	9 h
0 °C ≤ T_{BM} < 5 °C	45 min	4,5 h
5 °C ≤ T_{BM} < 10 °C	20 min	2 h
10 °C ≤ T_{BM} < 20 °C	6 min	90 min
20 °C ≤ T_{BM} < 30 °C	4 min	50 min
30 °C ≤ T_{BM} ≤ 40 °C	2 min	40 min

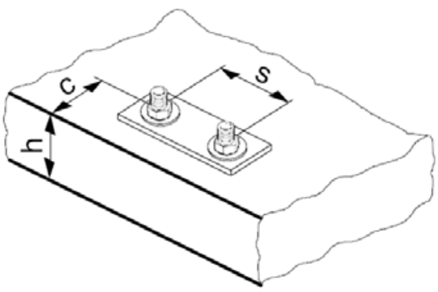
a) The curing time data are valid for dry anchorage base only. For water saturated anchorage bases the curing times must be doubled.

Setting details



Setting details

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Nominal diameter of drill bit	d_0	[mm]	10	12	14	18	24	28	30	35
Effective embedment and drill hole depth range a) **for HIT-V**	$h_{ef,min}$	[mm]	60	60	70	80	90	100	110	120
	$h_{ef,max}$	[mm]	160	200	240	320	400	480	540	600
Effective anchorage and drill hole depth **for HAS**	h_{ef}	[mm]	80	90	110	125	170	210	240	270
Minimum base material thickness	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm			$h_{ef} + 2\ d_0$				
Diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22	26	30	33
Torque moment	T_{max} b)	[Nm]	10	20	40	80	150	200	270	300
Minimum spacing	s_{min}	[mm]	40	50	60	80	100	120	135	150
Minimum edge distance	c_{min}	[mm]	40	50	60	80	100	120	135	150
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$							
Critical edge distance for splitting failure c)	$c_{cr,sp}$	[mm]	**$1{,}0 \cdot h_{ef}$**	for $h / h_{ef} \geq 2{,}0$						
			$4{,}6\ h_{ef} - 1{,}8\ h$	for $2{,}0 > h / h_{ef} > 1{,}3$						
			$2{,}26\ h_{ef}$	for $h / h_{ef} \leq 1{,}3$						
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	$2\ c_{cr,N}$							
Critical edge distance for concrete cone failure d)	$c_{cr,N}$	[mm]	$1{,}5\ h_{ef}$							



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

a) Embedment depth range: $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$

b) Maximum recommended torque moment to avoid splitting failure during installation with minimum spacing and/or edge distance.

c) h: base material thickness ($h \geq h_{min}$), h_{ef}: embedment depth

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

Simplified design method

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

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, TR 029. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

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

The values are valid for one anchor.

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

Tension loading

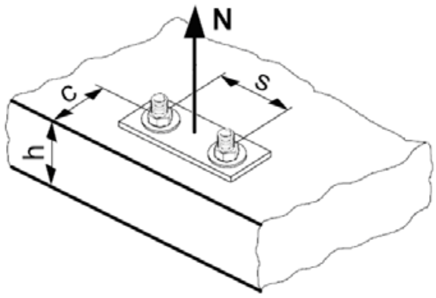
The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Combined pull-out and concrete cone resistance:

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

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

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



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
$N_{Rd,s}$	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

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

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Typical embedment depth $h_{ef} = h_{ef,typ}$		[mm]	80	90	110	125	170	210	240	270
$N^0_{Rd,p}$	Temperature range I	[kN]	14,7	17,3	25,3	26,9	43,2	60,3	72,7	84,8
$N^0_{Rd,p}$	Temperature range II	[kN]	10,1	11,8	17,3	18,0	28,0	37,7	48,5	60,6
$N^0_{Rd,p}$	Temperature range III	[kN]	8,7	10,2	15,0	15,0	25,4	33,9	38,8	48,5

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

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
$N^0_{Rd,c}$	[kN]	24,1	24,0	32,4	33,6	53,3	73,2	89,4	106,7

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,15}$ a)	1,00	1,03	1,06	1,09	1,11	1,13	1,14

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

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

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

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

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

Influence of edge distance a)

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

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

Influence of anchor spacing a)

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

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

Influence of embedment depth on concrete cone resistance

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

Influence of reinforcement

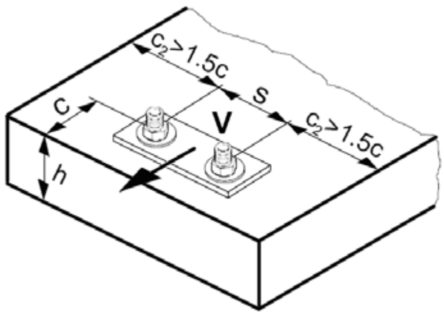
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N}$ = 0,5 + h_{ef}/200mm ≤ 1	0,7 [a)]	0,75 [a)]	0,8 [a)]	0,85 [a)]	0,9 [a)]	0,95 [a)]	1

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

Shear loading

The design shear resistance is the lower value of

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



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
$V_{Rd,s}$	HAS 5.8	[kN]	6,8	10,4	15,2	28,8	44,8	64,0	-	-
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	HAS 8.8	[kN]	-	-	-	-	-	-	139,2	168,8
	HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
	HAS (-E)-R	[kN]	7,7	12,2	17,3	32,7	50,6	71,8	45,8	55,5
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
	HAS (-E)-HCR	[kN]	10,4	16,8	24,8	46,4	72,0	64,0	86,9	105,7
	HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0

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

k = 2 for h_{ef} ≥ 60 mm

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

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

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete									
$V^0_{Rd,c}$	[kN]	5,9	8,6	11,6	18,7	27,0	36,6	44,5	53,0

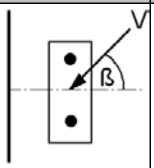
Influencing factors

Influence of concrete strength

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

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

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

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

Influence of base material thickness

h/c	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2	1,35	≥ 1,5
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \le 1$	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

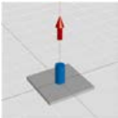
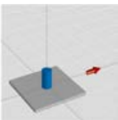
For combined tension and shear loading see section “Anchor Design”.

Precalculated values – design resistance values

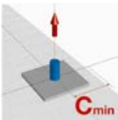
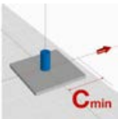
All data applies to:
- non-cracked concrete C 20/25 – $f_{ck,cube}$ =25 N/mm²
- temperature range I (see Service temperature range)
- minimum thickness of base material
- no effects of dense reinforcement

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

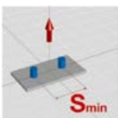
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - minimum embedment depth

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	$h_{ef} = h_{ef,min}$	[mm]	60	60	70	80	90	100	110	120
Base material thickness	$h = h_{min}$	[mm]	100	100	100	116	138	156	170	190
	**Tensile N_{Rd}: single anchor, no edge effects**									
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	11,1	11,5	16,1	17,2	20,5	24,0	27,7	31,6
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**									
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	67,3	77,7	88,5
	HIT-V 8.8	[kN]	12,0	18,4	27,2	48,2	57,5	67,3	77,7	88,5
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	67,3	48,3	58,8
	HIT-V-HCR	[kN]	12,0	18,4	27,2	48,2	57,5	67,3	77,7	88,5

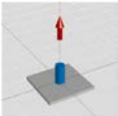
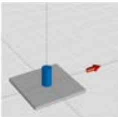
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - minimum embedment depth

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	$h_{ef} = h_{ef,min}$	[mm]	60	60	70	80	90	100	110	120
Base material thickness	$h = h_{min}$	[mm]	100	100	100	116	138	156	170	190
Edge distance	$c = c_{min}$	[mm]	40	50	60	80	100	120	135	150
	**Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**									
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	6,7	7,8	9,7	11,0	14,5	18,1	21,0	24,8
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm**									
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	3,5	4,9	6,6	10,2	14,1	18,3	21,8	25,9

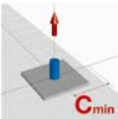
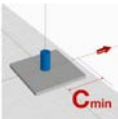
**Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - minimum embedment depth
(load values are valid for single anchor)**

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	$h_{ef} = h_{ef,min}$	[mm]	60	60	70	80	90	100	110	120
Base material thickness	$h = h_{min}$	[mm]	100	100	100	116	138	156	170	190
Spacing	$s = s_{min}$	[mm]	40	50	60	80	100	120	135	150
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**									
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	7,4	7,6	10,0	10,8	13,4	16,0	18,6	21,5
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm**									
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	39,4	47,1	54,7	62,7
	HIT-V 8.8	[kN]	12,0	17,7	24,9	32,1	39,4	47,1	54,7	62,7
	HIT-V-R	[kN]	8,3	12,8	19,2	32,1	39,4	47,1	48,3	58,8
	HIT-V-HCR	[kN]	12,0	17,7	24,9	32,1	39,4	47,1	54,7	62,7

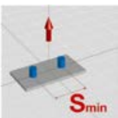
esign resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - typical embedment depth

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	$h_{ef} = h_{ef,typ}$	[mm]	80	90	110	125	170	210	240	270
Base material thickness	$h = h_{min}$	[mm]	110	120	140	161	218	266	300	340
	Tensile N_{Rd}: single anchor, no edge effects									
	HIT-V 5.8	[kN]	12,0	17,3	25,3	26,9	43,2	60,3	72,7	84,8
	HIT-V 8.8	[kN]	14,7	17,3	25,3	26,9	43,2	60,3	72,7	84,8
	HIT-V-R	[kN]	13,9	17,3	25,3	26,9	43,2	60,3	72,7	84,8
	HIT-V-HCR	[kN]	14,7	17,3	25,3	26,9	43,2	60,3	72,7	84,8
	Shear V_{Rd}: single anchor, no edge effects, without lever arm									
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
	HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0

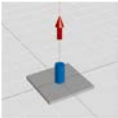
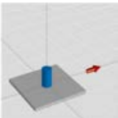
Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - typical embedment depth

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	$h_{ef} = h_{ef,typ}$	[mm]	80	90	110	125	170	210	240	270
Base material thickness	$h = h_{min}$	[mm]	110	120	140	161	218	266	300	340
Edge distance	$c = c_{min}$	[mm]	40	50	60	80	100	120	135	150
	Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)									
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	8,6	10,1	14,7	16,4	26,7	37,8	46,3	55,0
	Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$) , without lever arm									
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	3,7	5,3	7,3	11,5	17,2	23,6	29,0	34,8

**Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - typical embedment depth
(load values are valid for single anchor)**

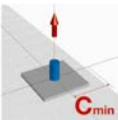
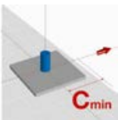
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	$h_{ef} = h_{ef,typ}$	[mm]	80	90	110	125	170	210	240	270
Base material thickness	$h = h_{min}$	[mm]	110	120	140	161	218	266	300	340
Spacing	s	[mm]	40	50	60	80	100	120	135	150
	Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)									
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	9,9	11,3	16,3	17,5	28,2	39,4	47,9	56,5
	Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm									
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	HIT-V 8.8	[kN]	12,0	18,4	27,2	45,7	72,4	100,5	120,9	140,7
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
	HIT-V-HCR	[kN]	12,0	18,4	27,2	45,7	72,4	70,9	92,0	112,0

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - embedment depth = 12 d [a)]

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	h_{ef} = 12 d [a)]	[mm]	96	120	144	192	240	288	324	360
Base material thickness	h = h_{min}	[mm]	126	150	174	228	288	344	384	430
	**Tensile N_{Rd}: single anchor, no edge effects**									
	HIT-V 5.8	[kN]	12,0	19,3	28,0	41,4	61,0	82,7	98,2	113,1
	HIT-V 8.8	[kN]	17,7	23,0	33,2	41,4	61,0	82,7	98,2	113,1
	HIT-V-R	[kN]	13,9	21,9	31,6	41,4	61,0	82,7	80,4	98,3
	HIT-V-HCR	[kN]	17,7	23,0	33,2	41,4	61,0	82,7	98,2	113,1
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**									
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
	HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0

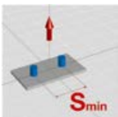
a) d = element diameter

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - embedment depth = 12 d [a)]

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	h_{ef} = 12 d [a)]	[mm]	96	120	144	192	240	288	324	360
Base material thickness	h = h_{min}	[mm]	126	150	174	228	288	344	384	430
Edge distance	c = c_{min}	[mm]	40	50	60	80	100	120	135	150
	**Tensile N_{Rd}: single anchor, min. edge distance (c = c_{min})**									
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	10,3	13,4	19,3	25,2	37,7	51,9	62,6	73,4
	**Shear V_{Rd}: single anchor, min. edge distance (c = c_{min}) , without lever arm**									
	HIT-V 5.8 HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	3,9	5,7	7,8	12,9	18,9	25,9	31,8	38,1

a) d = element diameter

Design resistance: concrete C 20/25 – $f_{ck,cube}$ = 25 N/mm² - embedment depth = 12 d [a)]
(load values are valid for single anchor)

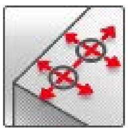
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Embedment depth	h_{ef} = 12 d [a)]	[mm]	96	120	144	192	240	288	324	360
Base material thickness	h = h_{min}	[mm]	126	150	174	228	288	344	384	430
Spacing	s=s_{min}	[mm]	40	50	60	80	100	120	135	150
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min})**									
	HIT-V 5.8	[kN]	12,0	15,5	22,0	28,0	41,2	55,8	66,6	77,3
	HIT-V 8.8 HIT-V-R HIT-V-HCR	[kN]	12,1	15,5	22,0	28,0	41,2	55,8	66,6	77,3
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min}) , without lever arm**									
	HIT-V 5.8	[kN]	7,2	12,0	16,8	31,2	48,8	70,4	92,0	112,0
	HIT-V 8.8	[kN]	12,0	18,4	27,2	50,4	78,4	112,8	147,2	179,2
	HIT-V-R	[kN]	8,3	12,8	19,2	35,3	55,1	79,5	48,3	58,8
	HIT-V-HCR	[kN]	12,0	18,4	27,2	50,4	78,4	70,9	92,0	112,0

a) d = element diameter

Hilti HIT-HY 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)	- suitable for non-cracked concrete C 20/25 to C 50/60 - suitable for dry and water saturated concrete - high loading capacity - rapid curing - small edge distance and anchor spacing possible - corrosion resistant - in service temperature range up to 120°C short term/72°C long term - manual cleaning for anchor size M8 and M10
	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

For details see Simplified design method

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

**Embedment depth and base material thickness for the basic loading data.
Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.**

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth	h_{ef}	[mm]	90	110	125	170	205
Base material thickness	h	[mm]	120	150	170	230	270

Mean ultimate resistance: non-cracked concrete C 20/25 , anchor HIS-N

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Tensile $N_{Ru,m}$	HIS-N	[kN]	*26,3*	*48,3*	*70,4*	*123,9*	*114,5*
Shear $V_{Ru,m}$	HIS-N	[kN]	*13,7*	*24,2*	*41,0*	*62,0*	*57,8*

Characteristic resistance: non-cracked concrete C 20/25 , anchor HIS-N

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Tensile N_{Rk}	HIS-N	[kN]	*25,0*	40,0	60,0	111,9	*109,0*
Shear V_{Rk}	HIS-N	[kN]	*13,0*	*23,0*	*39,0*	*59,0*	*55,0*

Design resistance: non-cracked concrete C 20/25 , anchor HIS-N

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Tensile N_{Rd}	HIS-N	[kN]	17,5	26,7	40,0	62,2	74,1
Shear V_{Rd}	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7

Recommended loads [a)]: non-cracked concrete C 20/25 , anchor HIS-N

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Tensile N_{rec}	HIS-N	[kN]	12,5	19,0	28,6	44,4	53,0
Shear V_{rec}	HIS-N	[kN]	7,4	13,1	18,6	28,1	26,2

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

Service temperature range

Hilti HIT-HY 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/mm²]	490	490	460	460	460
	Screw 8.8	[N/mm²]	800	800	800	800	800
	HIS-RN	[N/mm²]	700	700	700	700	700
	Screw A4-70	[N/mm²]	700	700	700	700	700
Yield strength f_{yk}	HIS-N	[N/mm²]	410	410	375	375	375
	Screw 8.8	[N/mm²]	640	640	640	640	640
	HIS-RN	[N/mm²]	350	350	350	350	350
	Screw A4-70	[N/mm²]	450	450	450	450	450
Stressed cross-section A_s	HIS-(R)N	[mm²]	51,5	108,0	169,1	256,1	237,6
	Screw	[mm²]	36,6	58	84,3	157	245
Moment of resistance W	HIS-(R)N	[mm³]	145	430	840	1595	1543
	Screw	[mm³]	31,2	62,3	109	277	541

Material quality

Part	Material
Internal threaded sleeve [a)] HIS-N	C-steel 1.0718, Steel galvanized ≥ 5μm
Internal threaded sleeve [a)] HIS-RN	Stainless steel 1.4401 and 1.4571

a) related fastening screw: strength class 8.8, A5 > 8% Ductile steel galvanized ≥ 5μm

b) related fastening screw: strength class 70, A5 > 8% Ductile stainless steel 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362

Anchor dimensions

Anchor size Internal threaded sleeve HIS-N / HIS-RN			M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth	h_{ef}	[mm]	80	90	110	125	170

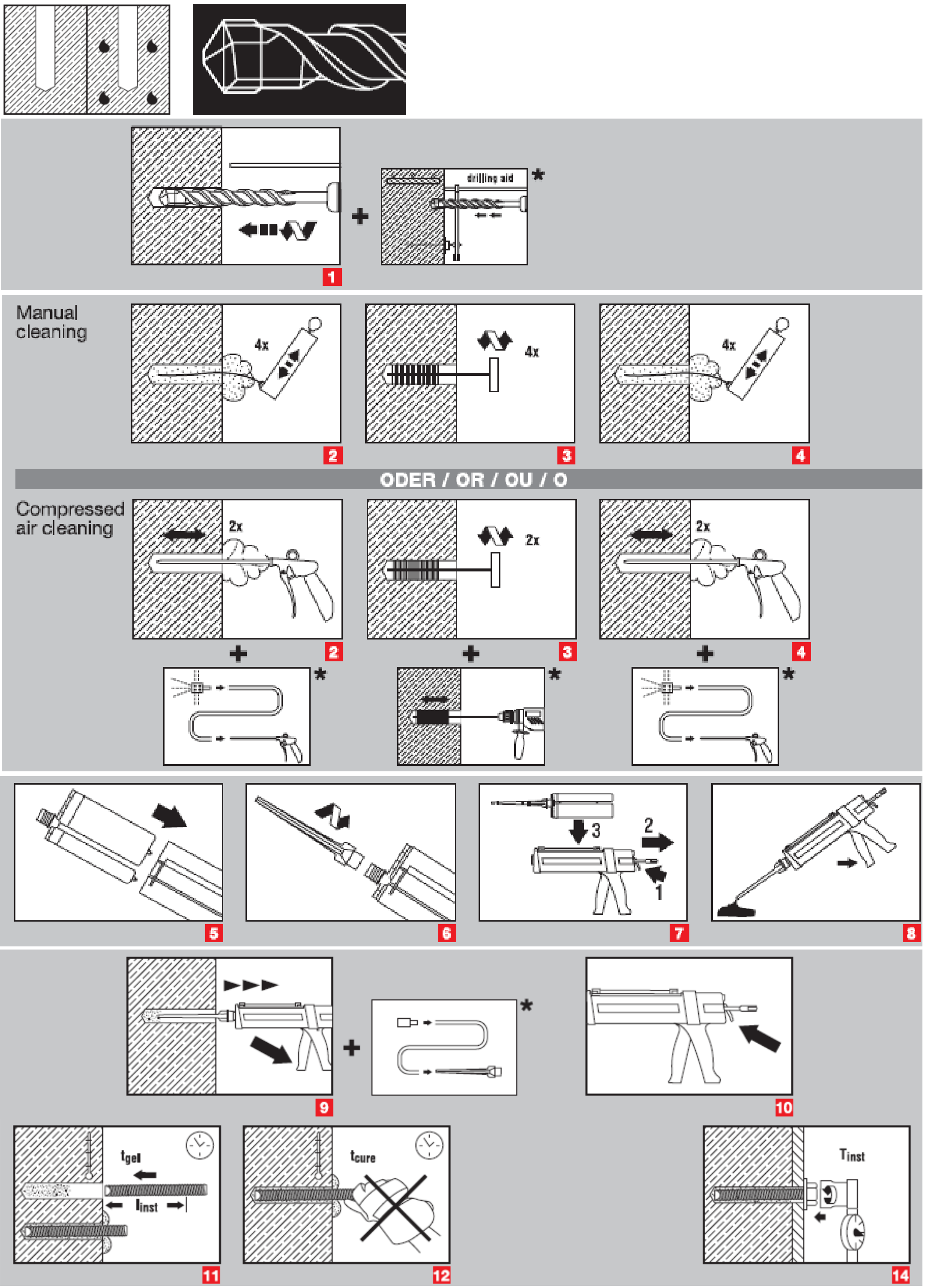
Setting

installation equipment

Anchor size	M8x90	M10x110	M12x125	M16x170	M20x205
Rotary hammer	TE 2 – TE 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)

<u>a) Note:</u> Manual cleaning for HIS-(R)N M8 and HIS-(R)N M10 only!
<u>b) Note:</u> Extension and piston plug needed for overhead installation!

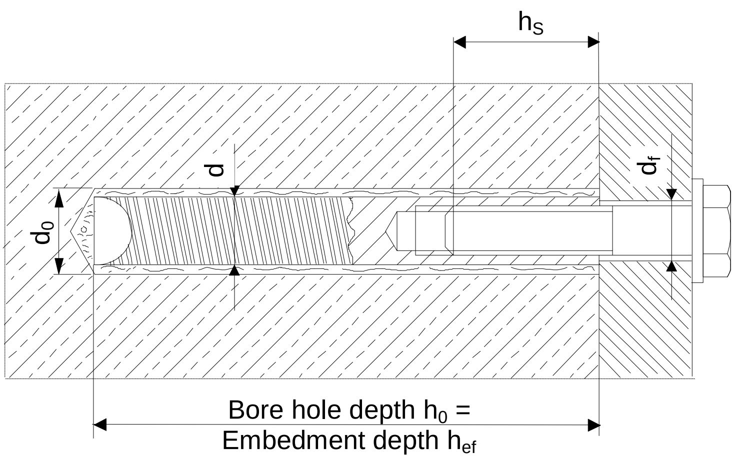
For detailed information on installation see instruction for use given with the package of the product.

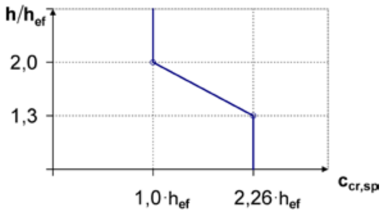
Working time, Curing time

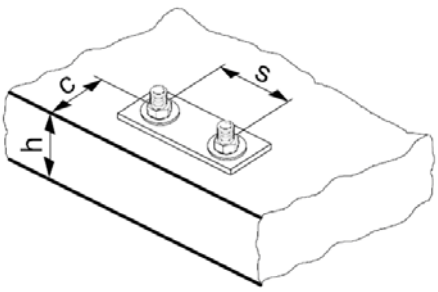
Temperature of the base material T_{BM}	Working time t_{gel}	Curing time t_{cure} a)
-5 °C ≤ T_{BM} < 0 °C	90 min	9 h
0 °C ≤ T_{BM} < 5 °C	45 min	4,5 h
5 °C ≤ T_{BM} < 10 °C	20 min	2 h
10 °C ≤ T_{BM} < 20 °C	6 min	90 min
20 °C ≤ T_{BM} < 30 °C	4 min	50 min
30 °C ≤ T_{BM} ≤ 40 °C	2 min	40 min

a) The curing time data are valid for dry anchorage base only. For water saturated anchorage bases the curing times must be doubled.

Setting details



Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Nominal diameter of drill bit	d_0	[mm]	14	18	22	28	32
Diameter of element	d	[mm]	12,5	16,5	20,5	25,4	27,6
Effective anchorage and drill hole depth	h_{ef}	[mm]	90	110	125	170	205
Minimum base material thickness	h_{min}	[mm]	120	150	170	230	270
Diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22
Thread engagement length; min - max	h_s	[mm]	8-20	10-25	12-30	16-40	20-50
Torque moment [a)]	T_{max}	[Nm]	10	20	40	80	150
Minimum spacing	s_{min}	[mm]	40	45	55	65	90
Minimum edge distance	c_{min}	[mm]	40	45	55	65	90
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$				
Critical edge distance for splitting failure [b)]	$c_{cr,sp}$	[mm]	**$1{,}0 \cdot h_{ef}$** for $h / h_{ef} \geq 2{,}0$ **$4{,}6\ h_{ef} - 1{,}8\ h$** for $2{,}0 > h / h_{ef} > 1{,}3$ **$2{,}26\ h_{ef}$** for $h / h_{ef} \leq 1{,}3$				
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	$2\ c_{cr,N}$				
Critical edge distance for concrete cone failure [c)]	$c_{cr,N}$	[mm]	$1{,}5\ h_{ef}$				



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

a) Maximum recommended torque moment to avoid splitting failure during installation with minimum spacing and/or edge distance.

b) h: base material thickness ($h \geq h_{min}$), h_{ef}: embedment depth

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

Simplified design method

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

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, TR 029. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

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

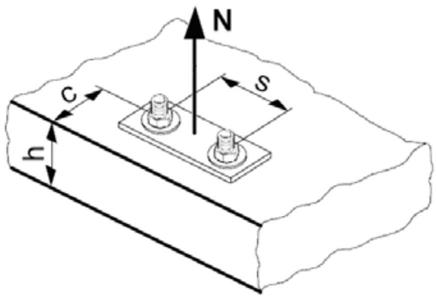
The values are valid for one anchor.

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

Tension loading

The design tensile resistance is the lower value of

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



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
$N_{Rd,s}$	HIS-N	[kN]	17,5	30,7	44,7	80,3	74,1
	HIS-RN	[kN]	13,9	21,9	31,6	58,8	69,2

Design combined pull-out and concrete cone resistance

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

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth	h_{ef}	[mm]	90	110	125	170	205
$N^0_{Rd,p}$	Temperature range I	[kN]	23,3	26,7	40,0	63,9	77,8
$N^0_{Rd,p}$	Temperature range II	[kN]	13,3	20,0	26,7	41,7	52,8
$N^0_{Rd,p}$	Temperature range III	[kN]	10,7	13,3	20,0	27,8	33,3

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

Anchor size		M8	M10	M12	M16	M20
$N^0_{Rd,c}$	[kN]	28,7	38,8	47,1	62,2	82,3

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,15}$ a)	1,00	1,03	1,06	1,09	1,11	1,13	1,14

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

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

$$f_{h,p} = 1$$

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

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

Influence of edge distance a)

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

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

Influence of anchor spacing a)

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

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

Influence of embedment depth on concrete cone resistance

$$f_{h,N} = 1$$

Influence of reinforcement

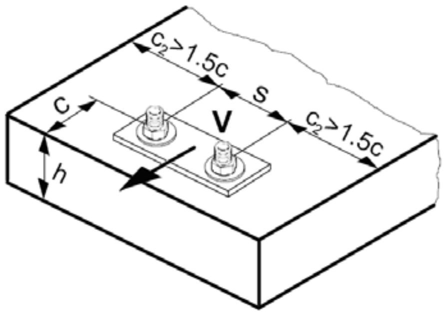
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,7 a)	0,75 a)	0,8 a)	0,85 a)	0,9 a)	0,95 a)	1

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

Shear loading

The design shear resistance is the lower value of

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



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
$V_{Rd,s}$	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7
	HIS-RN	[kN]	8,3	12,8	19,2	35,3	41,5

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

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

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

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

Anchor size		M8	M10	M12	M16	M20
Non-cracked concrete						
$V^0_{Rd,c}$	[kN]	12,4	19,6	28,2	40,2	46,2

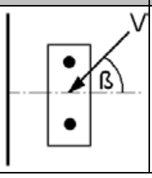
Influencing factors

Influence of concrete strength

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

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

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

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

Influence of base material thickness

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

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

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

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

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

Influence of embedment depth

Anchor size	M8	M10	M12	M16	M20
f_{hef} =	1,38	1,21	1,04	1,22	1,45

Influence of edge distance a)

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

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

Combined tension and shear loading

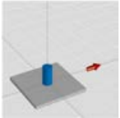
For combined tension and shear loading see section “Anchor Design”.

Precalculated values – design resistance values

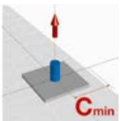
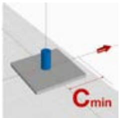
All data applies to:
- non-cracked concrete C 20/25 – $f_{ck,cube}$ =25 N/mm²
- temperature range I (see Service temperature range)
- minimum thickness of base material
- no effects of dense reinforcement

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

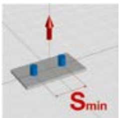
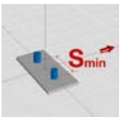
Design resistance: non-cracked- concrete C 20/25

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth	h_{ef}	[mm]	90	110	125	170	205
Base material thickness	$h = h_{min}$	[mm]	120	150	170	230	270
	**Tensile N_{Rd}: single anchor, no edge effects**						
	HIS-N	[kN]	17,5	26,7	40,0	62,2	74,1
	HIS-RN	[kN]	13,9	21,9	31,6	58,8	69,2
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**						
	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7
	HIS-RN	[kN]	8,3	12,8	19,2	35,3	41,5

Design resistance: non-cracked- concrete C 20/25

Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth	h_{ef}	[mm]	90	110	125	170	205
Base material thickness	$h = h_{min}$	[mm]	120	150	170	230	270
Edge distance	$c = c_{min}$	[mm]	40	45	55	65	90
	**Tensile N_{Rd}: single single anchor, min. edge distance ($c = c_{min}$)**						
	HIS-N	[kN]	11,9	13,4	20,4	27,5	37,4
	HIS-RN	[kN]	11,9	13,4	20,4	27,5	37,4
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm**						
	HIS-N	[kN]	4,2	5,5	7,6	10,8	17,2
	HIS-RN	[kN]	4,2	5,5	7,6	10,8	17,2

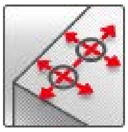
Design resistance: non-cracked- concrete C 20/25

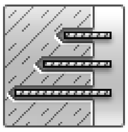
Anchor size			M8x90	M10x110	M12x125	M16x170	M20x205
Embedment depth	h_{ef}	[mm]	90	110	125	170	205
Base material thickness	$h = h_{min}$	[mm]	120	150	170	230	270
Spacing	$s = s_{min}$	[mm]	40	45	55	65	90
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**						
	HIS-N	[kN]	14,3	16,9	24,2	33,8	45,2
	HIS-RN	[kN]	13,9	16,9	24,2	33,8	45,2
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm**						
	HIS-N	[kN]	10,4	18,4	26,0	39,3	36,7
	HIS-RN	[kN]	8,3	12,8	19,2	35,3	41,5

Hilti HIT-HY 150 with rebar

Injection mortar system		Benefits
	Hilti HIT-HY 150 330 ml foil pack (also available as 500 ml and 1400 ml foil pack)	- suitable for non-cracked concrete C 20/25 to C 50/60 - suitable for dry and water saturated concrete - high loading capacity - rapid curing - small edge distance and anchor spacing possible - large diameter applications - in service temperature range up to 120°C short term/72°C long term - manual cleaning for anchor size Ø8 to Ø14 and embedment depth $h_{ef} \leq 10d$ - embedment depth range Ø8: 60 to 160 mm Ø25: 120 to 500 mm
	Static mixer	
	rebar BSt 500 S	


Concrete


Small edge distance and spacing


Variable embedment depth


PROFIS Anchor design software

Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- *Steel* failure
- Base material thickness, as specified in the table
- One typical embedment depth, as specified in the table
- Anchor material: rebar BSt 500 S
- Concrete C 20/25, $f_{ck,cube}$ = 25 N/mm²
- Temperate range I
  (min. base material temperature -40°C, max. long term/short term base material temperature: +24°C/40°C)
- Installation temperature range -5°C to +40°C

Embedment depth [a] and base material thickness for the basic loading data. Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth $h_{ef} = h_{ef,typ}$ [b] [mm]	80	90	110	125	170	210	240
Base material thickness h [mm]	110	120	140	165	220	270	300

a) The allowed range of embedment depth is shown in the setting details. The corresponding load values can be calculated according to the simplified design method.
b) $h_{ef,typ}$: Typical embedment depth

Mean ultimate resistance: non-cracked concrete C 20/25 , anchor BSt 500 S

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Tensile $N_{Ru,m}$	BST 500 S	[kN]	22,8	32,0	47,0	55,0	72,9	106,8	164,9
Shear $V_{Ru,m}$	BST 500 S	[kN]	*14,7*	*23,1*	*32,6*	*44,1*	*57,8*	*90,3*	*141,8*

Characteristic resistance: non-cracked concrete C 20/25 , anchor BSt 500 S

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Tensile N_{Rk}	BST 500 S	[kN]	17,1	24,0	35,2	41,2	54,7	80,1	123,7
Shear V_{Rk}	BST 500 S	[kN]	*14,0*	*22,0*	*31,0*	*42,0*	*55,0*	*86,0*	*135,0*

Design resistance: non-cracked concrete C 20/25 , anchor BSt 500 S

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Tensile N_{Rd}	BST 500 S	[kN]	11,4	13,4	19,6	19,6	26,0	38,1	58,9
Shear V_{Rd}	BST 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0

Recommended loads [a]: non-cracked concrete C 20/25 , anchor BSt 500 S

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Tensile N_{rec}	BST 500 S	[kN]	8,1	9,5	14,0	14,0	18,6	27,2	42,1
Shear V_{rec}	BST 500 S	[kN]	6,7	10,5	14,8	20,0	26,2	41,0	64,3

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

Service temperature range

Hilti HIT-HY 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/mm²]	550						
Yield strength f_{yk}	BSt 500 S	[N/mm²]	500						
Stressed cross-section A_s	BSt 500 S	[mm²]	50,3	78,5	113,1	153,9	201,1	314,2	490,9
Moment of resistance W	BSt 500 S	[mm³]	50,3	98,2	169,6	269,4	402,1	785,4	1534

Material quality

Part	Material
rebar BSt 500 S	Mechanical properties according to DIN 488-1:1984 Geometry according to DIN 488-21:1986

Anchor dimensions

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
rebar BSt 500 S	rebar are available in variable length						

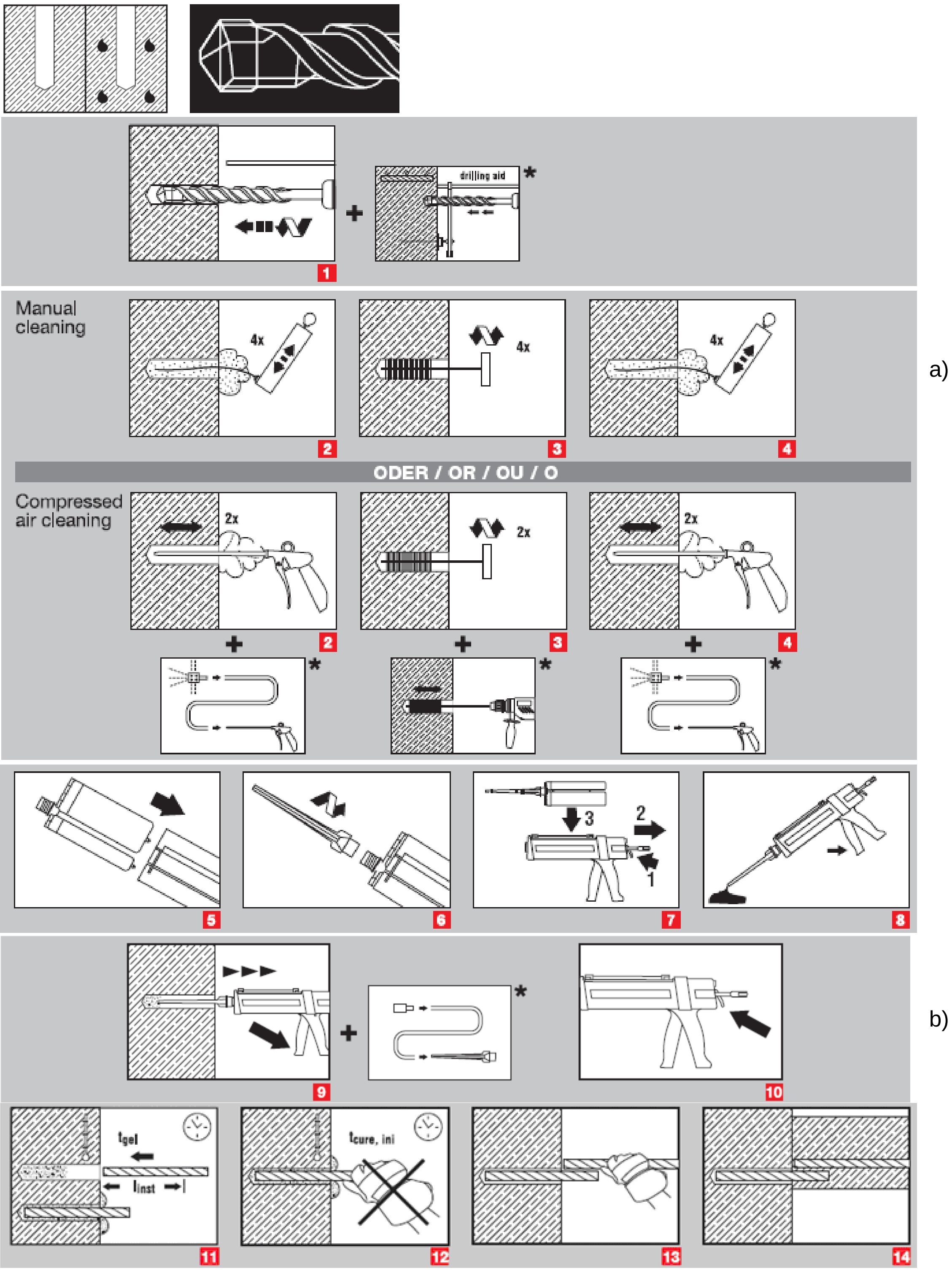
Setting

installation equipment

Anchor size	Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Rotary hammer	TE 2 – TE 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



<u>a) Note:</u> **Manual cleaning for element sizes d ≤ 14mm and embedment depth h_{ef} ≤ 10 d only!**
<u>b) Note:</u> **Extension and piston plug needed for overhead installation and/or embedment depth > 250mm!**

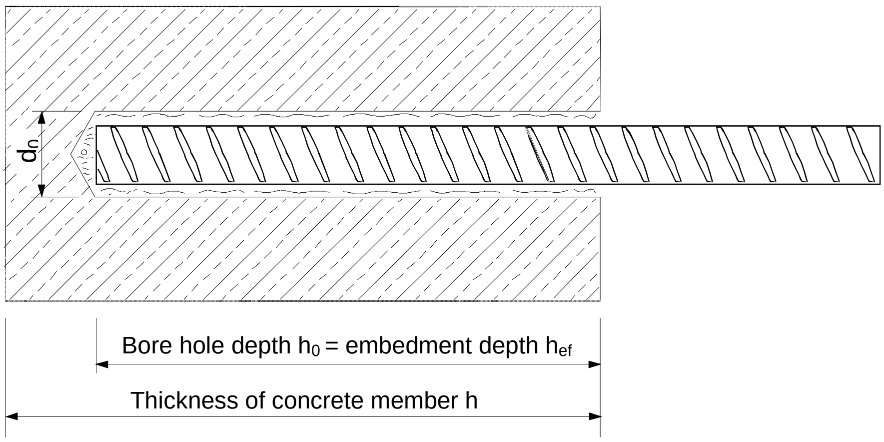
For detailed information on installation see instruction for use given with the package of the product.

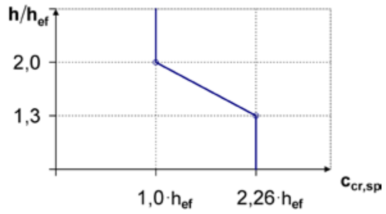
Working time, Curing time

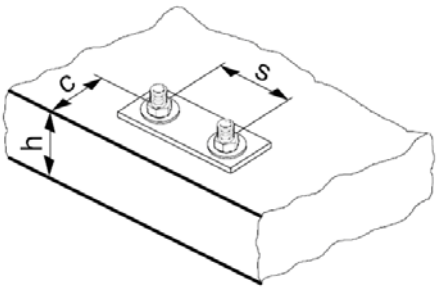
Temperature of the base material T_{BM}	Working time t_{gel}	Curing time t_{cure} a)
-5 °C ≤ T_{BM} < 0 °C	90 min	9 h
0 °C ≤ T_{BM} < 5 °C	45 min	4,5 h
5 °C ≤ T_{BM} < 10 °C	20 min	2 h
10 °C ≤ T_{BM} < 20 °C	6 min	90 min
20 °C ≤ T_{BM} < 30 °C	4 min	50 min
30 °C ≤ T_{BM} ≤ 40 °C	2 min	40 min

a) The curing time data are valid for dry anchorage base only. For water saturated anchorage bases the curing times must be doubled.

Setting details



Anchor size			ø8	ø10	ø12	ø14	ø16	ø20	ø25
Nominal diameter of drill bit	d_0	[mm]	12	14	16	18	20	25	32
Effective embedment and drill hole depth range [a)]	$h_{ef,min}$	[mm]	60	60	70	75	80	90	100
for rebar BSt 500 S	$h_{ef,max}$	[mm]	160	200	240	280	320	400	500
Minimum base material thickness	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm		$h_{ef} + 2\ d_0$				
Minimum spacing	s_{min}	[mm]	40	50	60	70	80	100	150
Minimum edge distance	c_{min}	[mm]	40	50	60	80	100	120	150
Critical spacing for splitting failure	$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$						
Critical edge distance for splitting failure [b)]	$c_{cr,sp}$	[mm]	**$1{,}0 \cdot h_{ef}$**	for $h / h_{ef} \geq 2{,}0$					
			$4{,}6\ h_{ef} - 1{,}8\ h$	for $2{,}0 > h / h_{ef} > 1{,}3$					
			$2{,}26\ h_{ef}$	for $h / h_{ef} \leq 1{,}3$					
Critical spacing for concrete cone failure	$s_{cr,N}$	[mm]	$2\ c_{cr,N}$						
Critical edge distance for concrete cone failure [c)]	$c_{cr,N}$	[mm]	$1{,}5\ h_{ef}$						



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

a) Embedment depth range: $h_{ef,min} \leq h_{ef} \leq h_{ef,max}$

b) h: base material thickness ($h \geq h_{min}$), h_{ef}: embedment depth

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

Simplified design method

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

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors. (The method may also be applied for anchor groups with more than two anchors or more than one edge distance. The influencing factors must then be considered for each edge distance and spacing. The calculated design loads are then on the save side: They will be lower than the exact values according ETAG 001, TR 029. To avoid this, it is recommended to use the anchor design software PROFIS anchor)

The design method is based on the following simplification:

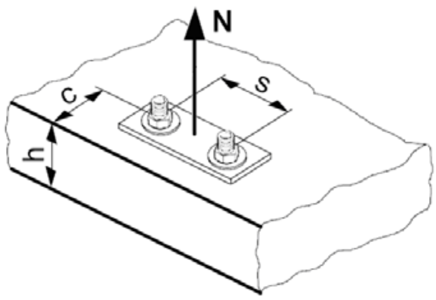
- No different loads are acting on individual anchors (no eccentricity)

The values are valid for one anchor.

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

Tension loading

The design tensile resistance is the lower value of



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

Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

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

Design combined pull-out and concrete cone resistance
$N_{Rd,p} = N^0_{Rd,p} \cdot f_{B,p} \cdot f_{1,N} \cdot f_{2,N} \cdot f_{3,N} \cdot f_{h,p} \cdot f_{re,N}$

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth h_{ef} = Typical embedment depth $h_{ef,typ}$		[mm]	80	90	110	125	145	170	210
$N^0_{Rd,p}$	Temperature range I	[kN]	11,4	13,4	19,6	19,6	26,0	38,1	58,9
$N^0_{Rd,p}$	Temperature range II	[kN]	8,0	9,4	13,8	13,1	17,4	25,4	39,3
$N^0_{Rd,p}$	Temperature range III	[kN]	6,7	7,9	11,5	11,8	15,6	22,9	35,3

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

Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
$N^0_{Rd,c}$	[kN]	24,1	24,0	32,4	33,6	42,0	53,3	73,2

Influencing factors

Influence of concrete strength on combined pull-out and concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,15}$ a)	1,00	1,03	1,06	1,09	1,11	1,13	1,14

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

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

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

Influence of concrete strength on concrete cone resistance

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_B = (f_{ck,cube}/25N/mm^2)^{0,5}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

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

Influence of edge distance a)

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

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

Influence of anchor spacing a)

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

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

Influence of embedment depth on concrete cone resistance

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

Influence of reinforcement

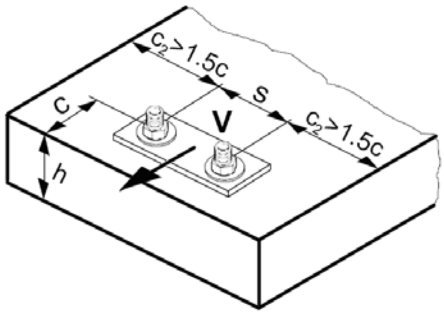
h_{ef} [mm]	40	50	60	70	80	90	≥ 100
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,7 a)	0,75 a)	0,8 a)	0,85 a)	0,9 a)	0,95 a)	1

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

Shear loading

The design shear resistance is the lower value of

- Steel resistance: $V_{Rd,s}$
- Concrete pryout resistance: $V_{Rd,cp} = k \cdot$ 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	Ø20	Ø25
$V_{Rd,s}$	Rebar BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0

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

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

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

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

Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Non-cracked concrete								
$V^0_{Rd,c}$	[kN]	5,9	8,6	11,6	15,0	18,7	27,0	39,2

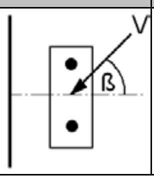
Influencing factors

Influence of concrete strength

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

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

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

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

Influence of base material thickness

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

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

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

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

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

Influence of embedment depth

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

Influence of edge distance [a]

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

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

Combined tension and shear loading

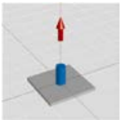
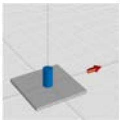
For combined tension and shear loading see section “Anchor Design”.

Precalculated values – design resistance values

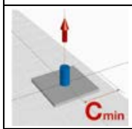
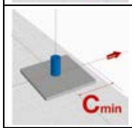
All data applies to:
- non-cracked concrete C 20/25 – $f_{ck,cube}$ =25 N/mm²
- temperature range I (see Service temperature range)
- minimum thickness of base material
- no effects of dense reinforcement

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

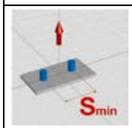
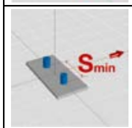
Design resistance: non- cracked concrete C 20/25 - minimum embedment depth

Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth $h_{ef} = h_{ef,min}$ [mm]		60	60	70	80	90	100	110
Base material thickness $h = h_{min}$ [mm]		100	100	102	116	130	150	174
	**Tensile N_{Rd}: single anchor, no edge effects**							
	BSt 500 S [kN]	8,5	8,9	12,5	12,6	16,2	22,4	27,7
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**							
	BSt 500 S [kN]	9,3	14,7	20,7	25,1	32,3	44,9	55,5

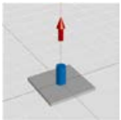
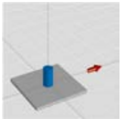
Design resistance: non- cracked concrete C 20/25 - minimum embedment depth

Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth $h_{ef} = h_{ef,min}$ [mm]		60	60	70	80	90	100	110
Base material thickness $h = h_{min}$ [mm]		100	100	102	116	130	150	174
Edge distance $c = c_{min}$ [mm]		40	50	60	80	100	120	135
	**Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**							
	BSt 500 S [kN]	5,3	6,0	8,5	9,4	13,0	17,4	21,5
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm**							
	BSt 500 S [kN]	3,5	4,9	6,6	10,0	13,2	17,4	21,8

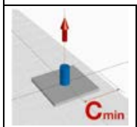
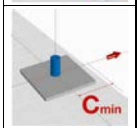
Design resistance: non- cracked concrete C 20/25 - minimum embedment depth
(load values are valid for single anchor)

Anchor size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth $h_{ef} = h_{ef,min}$ [mm]		60	60	70	80	90	100	110
Base material thickness $h = h_{min}$ [mm]		100	100	100	116	138	156	170
Spacing $s = s_{min}$ [mm]		40	50	60	80	100	120	135
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**							
	BSt 500 S [kN]	5,9	6,2	8,5	8,7	11,1	15,2	19,3
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm**							
	BSt 500 S [kN]	9,3	11,4	16,0	16,2	20,9	29,9	40,4

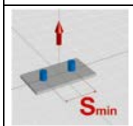
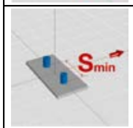
Design resistance: non- cracked concrete C 20/25 - typical embedment depth

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth	$h_{ef} = h_{ef,typ}$	[mm]	80	90	110	125	145	170	210
Base material thickness	$h = h_{min}$	[mm]	110	120	142	161	185	220	274
	**Tensile N_{Rd}: single anchor, no edge effects**								
	BSt 500 S	[kN]	11,4	13,4	19,6	19,6	26,0	38,1	58,9
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**								
	BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0

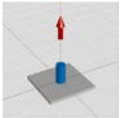
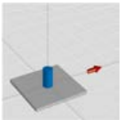
Design resistance: non- cracked concrete C 20/25 - typical embedment depth

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth	$h_{ef} = h_{ef,typ}$	[mm]	80	90	110	125	145	170	210
Base material thickness	$h = h_{min}$	[mm]	110	120	142	161	185	220	274
Edge distance	$c = c_{min}$	[mm]	40	50	60	80	100	120	135
	**Tensile N_{Rd}: single anchor, min. edge distance ($c = c_{min}$)**								
	BSt 500 S	[kN]	7,0	8,3	12,1	13,4	18,8	26,9	37,0
	**Shear V_{Rd}: single anchor, min. edge distance ($c = c_{min}$), without lever arm**								
	BSt 500 S	[kN]	3,7	5,3	7,3	11,2	15,8	21,5	27,5

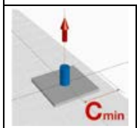
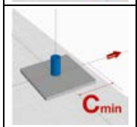
Design resistance: non- cracked concrete C 20/25 - typical embedment depth
(load values are valid for single anchor)

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth	$h_{ef} = h_{ef,typ}$	[mm]	80	90	110	125	145	170	210
Base material thickness	$h = h_{min}$	[mm]	110	120	142	161	185	220	274
Spacing	$s = s_{min}$	[mm]	40	50	60	80	100	120	135
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$)**								
	BSt 500 S	[kN]	8,0	9,3	13,4	13,7	18,0	25,8	40,2
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing ($s = s_{min}$), without lever arm**								
	BSt 500 S	[kN]	9,3	14,7	20,7	23,3	30,8	45,6	72,9

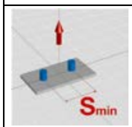
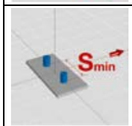
Design resistance: non- cracked concrete C 20/25 - embedment depth = 12 d [a)]

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth	h_{ef} = 12 d [a)]	[mm]	96	120	144	168	192	240	300
Base material thickness	h = h_{min}	[mm]	126	150	176	204	232	290	364
	**Tensile N_{Rd}: single anchor, no edge effects**								
	BSt 500 S	[kN]	13,7	17,8	25,6	26,4	34,5	53,9	84,1
	**Shear V_{Rd}: single anchor, no edge effects, without lever arm**								
	BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0

Design resistance: non- cracked concrete C 20/25 - embedment depth = 12 d [a)]

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth	h_{ef} = 12 d [a)]	[mm]	96	120	144	168	192	240	300
Base material thickness	h = h_{min}	[mm]	126	150	176	204	232	290	364
Edge distance	c = c_{min}	[mm]	40	50	60	80	100	120	135
	**Tensile N_{Rd}: single anchor, min. edge distance (c = c_{min})**								
	BSt 500 S	[kN]	8,4	11,0	15,8	18,1	24,9	37,9	55,9
	**Shear V_{Rd}: single anchor, min. edge distance (c = c_{min}), without lever arm**								
	BSt 500 S	[kN]	3,9	5,7	7,8	12,0	16,9	23,6	30,5

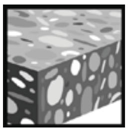
Design resistance: non- cracked concrete C 20/25 - embedment depth = 12 d [a)]
(load values are valid for single anchor)

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25
Embedment depth	h_{ef} = 12 d [a)]	[mm]	96	120	144	168	192	240	300
Base material thickness	h = h_{min}	[mm]	126	150	176	204	232	290	364
Spacing	s = s_{min}	[mm]	40	50	60	80	100	120	135
	**Tensile N_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min})**								
	BSt 500 S	[kN]	9,7	12,5	17,9	18,7	24,2	37,3	59,2
	**Shear V_{Rd}: double anchor, no edge effects, min. spacing (s = s_{min}), without lever arm**								
	BSt 500 S	[kN]	9,3	14,7	20,7	28,0	36,7	57,3	90,0

a) d = element diameter

Hilti HIT-HY 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)	- suitable for concrete C 12/15 to C 50/60 - high loading capacity and fast cure - suitable for dry and water saturated concrete - for rebar diameters up to 25 mm - non corrosive to rebar elements - good load capacity at elevated temperatures - hybrid chemistry - suitable for embedment length till 2000 mm - suitable for applications down to - 5 °C
	Statik mixer	
	Rebar	



Concrete

Drinking water appoved

Corossion 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

Reinforcmenent bars according to EC2 Annex C Table C.1 and C.2N.

Properties of reinforcement

Product form		**Bars and de-coiled rods**	
Class		B	C
Characteristic yield strength f_{yk} or $f_{0,2k}$ (MPa)		400 to 600	
Minimum value of $k = (f_t/f_y)_k$		≥ 1,08	≥ 1,15 < 1,35
Characteristic strain at maximum force, ε_{uk} (%)		≥ 5,0	≥ 7,5
Bendability		Bend / Rebend test	
Maximum deviation from nominal mass (individual bar) (%)	Nominal bar size (mm) ≤ 8 > 8	 ± 6,0 ± 4,5	
Bond: Minimum relative rib area, $f_{R,min}$	Nominal bar size (mm) 8 to 12 > 12	 0,040 0,056	

Setting details

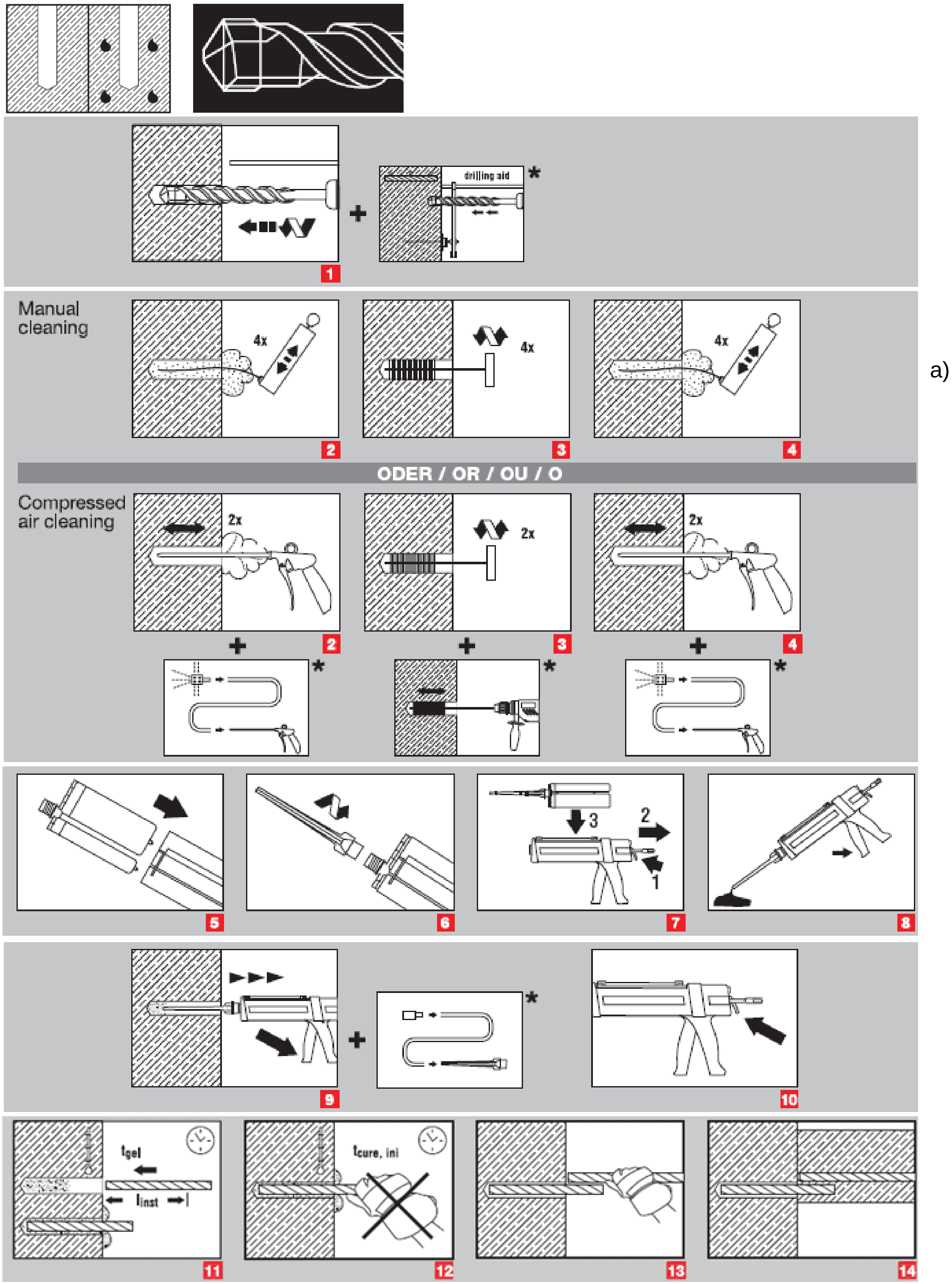
For detailed information on installation see instruction for use given with the package of the product.

Working time, Curing time

Temperature of the base material T_{BM}	**Working time t_{gel}**	**Curing time t_{cure} ***
-5 °C ≤ T_{BM} < 0 °C	90 min	9 h
0 °C ≤ T_{BM} < 5 °C	45 min	4,5 h
5 °C ≤ T_{BM} < 10 °C	20 min	2 h
10 °C ≤ T_{BM} < 20 °C	6 min	90 min
20 °C ≤ T_{BM} < 30 °C	4 min	50 min
30 °C ≤ T_{BM} ≤ 40 °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) Note: **Manual cleaning for element sizes d ≤ 16mm and embedment depth h_{ef} ≤ 10 d only!**

Fitness for use

Creep behaviour

Creep tests have been conducted in accordance with national standards in different conditions:

- in wet environnement at 23 °C during 90 days
- in dry environnement at 43 °C during 90 days.

These tests show an excellent behaviour of the post-installed connection made with HIT-HY 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 2.10^{11} Ω.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/mm² for good bond conditions for all drilling methods

Rebar (mm)	Concrete class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 - 25	1,6	2,0	2,3	2,7	3,0	3,0	3,0	3,0	3,0

Pullout design bond strength for Hit Rebar design

Design bond strength in N/mm², 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					

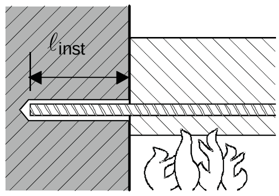
Increasing factor for other concrete class: $f_{B,p}=(f_{cck}/25)^{0,15}$ (f_{cck}: characteristic compressive strength on cube)

Additional Hilti Technical Data

Reduction factor for splitting with large concrete cover: δ = 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 N/mm²) according EC2[a)].

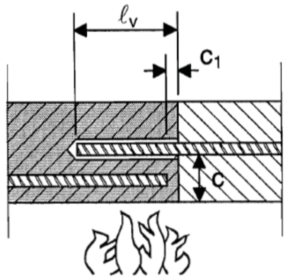
Bar ∅	Drill hole ∅	Max. $F_{s,T}$	ℓ_{inst}	R30	R60	R90	R120	R180
[mm]	[mm]	[kN]	[mm]	[kN]	[kN]	[kN]	[kN]	[kN]
8	**12**	**16,2**	80	3,5	1,5	0,6	0,3	0,0
			120	10,6	5,0	2,8	1,9	0,7
			160	16,2	11,9	7,9	5,2	2,7
			190		16,2	13,2	10,4	4,7
			210			16,2	13,9	6,4
			230				16,2	8,5
			280					16,2
10	**14**	**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 ∅ [mm]	Drill hole ∅ [mm]	Max. $F_{s,T}$ [kN]	ℓ_{inst} [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, τ_T , depending on actual clear concrete cover for classifying the fire resistance.

It must be verified that the actual force in the bar during a fire, $F_{s,T}$, can be taken up by the bar connection of the selected length, ℓ_{inst}. Note: Cold design for ULS is mandatory.



$F_{s,T} \leq (\ell_{inst} - c_f) \cdot \varnothing \cdot \pi \cdot \tau_T$ where: $(\ell_{inst} - c_f) \geq \ell_s$;

ℓ_s = lap length

∅ = nominal diameter of bar

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

τ_T = bond stress when exposed to fire

Critical temperature-dependent bond stress, τ_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, τ_c [N/mm²] 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		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			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			1,7	0,6
100				1,9	0,7
105		2,2			0,9
110					1,2
115					1,4
120			2,2		1,6
125				2,2	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/mm²]	$l_{b,min}$* [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_{yk} = 500 N/mm² and α_6 = 1,0