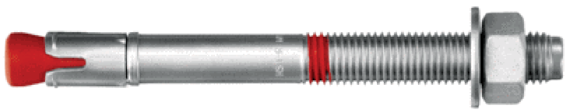
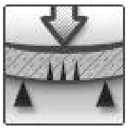
HST Stud anchor

Anchor version		Benefits
	HST Carbon steel	- suitable for non-cracked and cracked concrete C 20/25 to C 50/60 - highly reliable and safe anchor for structural seismic design with ETA C1/C2 approval - quick and simple setting operation - safety wedge for certain follow up expansion
	HST-R Stainless steel HST-HCR High corrosion resistance steel	


Concrete


Tensile zone


Seismic ETA-C1/C2


Shock


Fire resistance

A4 316
Corrosion resistance

HCR highMo
High corrosion resistance

European Technical Approval

CE conformity

PROFIS Anchor design software

Approvals / certificates

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

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

Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

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

Mean ultimate resistance

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

Characteristic resistance

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

Design resistance

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

Recommended loads

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

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

Materials

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

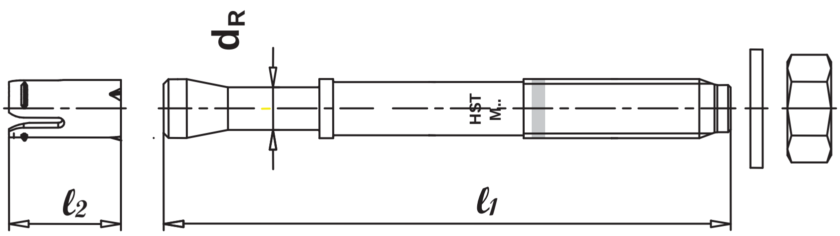
Anchor size		M8	M10	M12	M16	M20	M24
Nominal tensile strength f_{uk}	HST [N/mm²]	800	800	800	720	700	530
	HST-R [N/mm²]	720	700	700	650	650	650
	HST-HCR [N/mm²]	800	800	800	800	-	-
Yield strength f_{yk}	HST [N/mm²]	640	640	640	580	560	451
	HST-R [N/mm²]	575	560	560	500	450	450
	HST-HCR [N/mm²]	640	640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

Material quality

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

Anchor dimensions

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

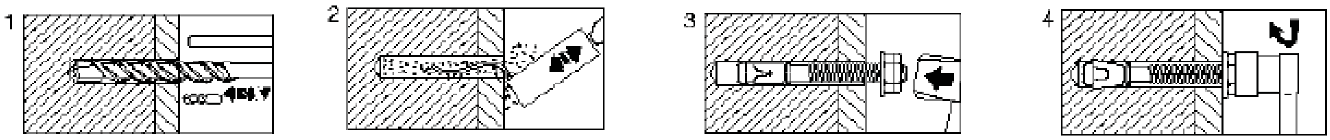


Setting

Installation equipment

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

Setting instruction

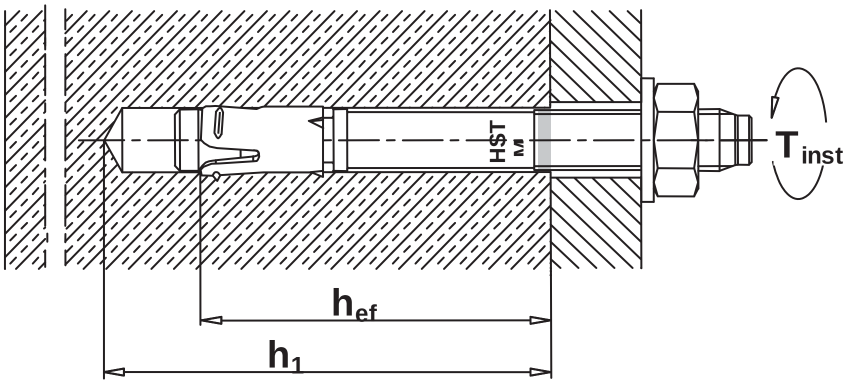


Drill hole with drill bit. Blow out dust and fragments. Install anchor. Apply tightening torque.

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

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

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

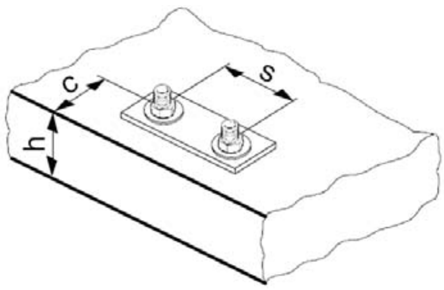


Setting details HST, HST-R, HST-HCR

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

Setting parameters

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



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

Simplified design method

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

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

The design method is based on the following simplification:

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

The values are valid for one anchor.

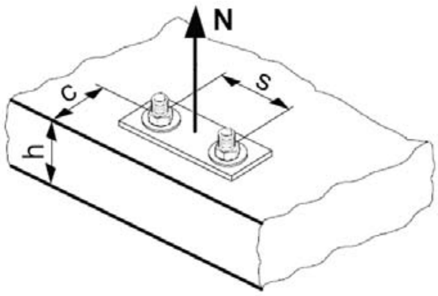
For more complex fastening applications please use the anchor design software PROFIS Anchor.

Tension loading

The design tensile resistance is the lower value of

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

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



Basic design tensile resistance

Design steel resistance $N_{Rd,s}$

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

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

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

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

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

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

Influencing factors

Influence of concrete strength

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

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

Influence of edge distance [a]

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

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

Influence of anchor spacing [a]

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

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

Influence of base material thickness

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

Influence of reinforcement

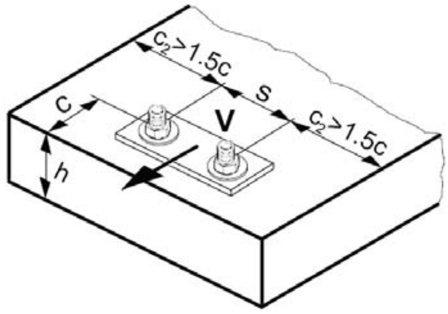
Anchor size	M8	M10	M12	M16	M20	M24
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,74 a)	0,8 a)	0,85 a)	0,91 a)	1	1

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

Shear loading

The design shear resistance is the lower value of

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



Basic design shear resistance

Design steel resistance $V_{Rd,s}$

Anchor size			M8	M10	M12	M16	M20	M24
$V_{Rd,s}$	HST	[kN]	11,2	18,8	28,0	44,0	67,2	62,7
	HST-R	[kN]	10,4	16,0	24,0	38,5	55,6	79,9
	HST-HCR	[kN]	10,4	16,0	24,0	44,0	-	-

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

Anchor size	M8	M10	M12	M16	M20	M24
k	2	2	2,2	2,5	2,5	2,5

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

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

		Non-cracked concrete						Cracked concrete					
Anchor size		M8	M10	M12	M16	M20	M24	M8	M10	M12	M16	M20	M24
$V^0_{Rd,c}$	[kN]	5,9	8,6	11,7	18,9	27,3	37,1	4,2	6,1	8,3	13,4	19,3	26,3

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

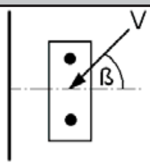
Influencing factors

Influence of concrete strength

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

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

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

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

Influence of base material thickness

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

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

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

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

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

Influence of embedment depth

Anchor size	M8	M10	M12	M16	M20	M24
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	0,98	1,01	0,97	0,78	0,76	0,80

Influence of edge distance [a)]

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

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

Combined tension and shear loading

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

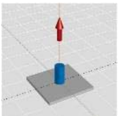
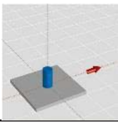
Precalculated values

Design resistance calculated according ETAG 001, Annex C and data given in ETA-98/0001, issue 2013-05-08.
All data applies to concrete C 20/25 – $f_{ck,cube}$ =25 N/mm².

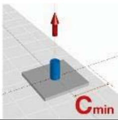
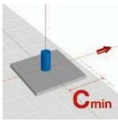
Recommended loads can be calculated by dividing the design resistance by an overall partial safety factor for action γ = 1,4. The partial safety factors for action depend on the type of loading and shall be taken from national regulations.

Design resistance

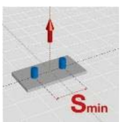
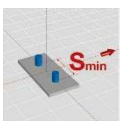
Single anchor, no edge effects

			Non-cracked concrete						Cracked concrete					
Anchor size			M8	M10	M12	M16	M20	M24	M8	M10	M12	M16	M20	M24
Min. base material thickness h_{min} [mm]			100	120	140	160	200	250	100	120	140	160	200	250
	Tensile N_{Rd}													
	HST	[kN]	5,0	10,7	13,3	23,3	33,3	40,0	2,8	6,0	8,0	13,3	20,0	26,7
	HST-R	[kN]	6,0	10,7	13,3	23,3	33,3	40,0	3,3	6,0	8,0	16,7	20,0	26,7
	HST-HCR	[kN]	6,0	10,7	13,3	23,3	-	-	3,3	6,0	8,0	16,7	-	-
	Shear V_{Rd}, without lever arm													
	HST	[kN]	11,2	18,8	28,0	44,0	67,2	62,7	11,2	18,8	28,0	44,0	60,9	62,7
	HST-R	[kN]	10,4	16,0	24,0	38,5	55,6	79,9	10,4	16,0	24,0	38,5	55,6	79,9
	HST-HCR	[kN]	10,4	16,0	24,0	44,0	-	-	10,4	16,0	24,0	44,0	-	-

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

			Non-cracked concrete						Cracked concrete					
Anchor size			M8	M10	M12	M16	M20	M24	M8	M10	M12	M16	M20	M24
Min. base material thickness h_{min} [mm]			100	120	140	160	200	250	100	120	140	160	200	250
Min. edge distance c_{min}	HST	[mm]	50	55	55	85	140	170	45	55	55	70	100	125
	HST-R	[mm]	60	50	55	70	140	150	45	50	55	60	100	125
	HST-HCR	[mm]	60	55	55	70	-	-	45	50	55	60	-	-
	Tensile N_{Rd}													
	HST	[kN]	5,0	10,7	12,9	19,1	32,1	40,0	2,8	6,0	8,0	12,2	18,2	25,2
	HST-R	[kN]	6,0	10,5	12,9	17,0	32,1	39,7	3,3	6,0	8,0	11,2	18,2	25,2
	HST-HCR	[kN]	6,0	10,7	12,9	17,0	-	-	3,3	6,0	8,0	11,2	-	-
	Shear V_{Rd}, without lever arm													
	HST	[kN]	4,5	5,6	5,9	11,3	22,8	32,0	2,8	3,9	4,2	6,2	10,7	15,4
	HST-R	[kN]	5,8	4,9	5,9	8,8	22,8	27,5	2,8	3,5	4,2	5,1	10,7	15,4
	HST-HCR	[kN]	5,8	5,6	5,9	8,8	-	-	2,8	3,5	4,2	5,1	-	-

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

			Non-cracked concrete						Cracked concrete					
Anchor size			M8	M10	M12	M16	M20	M24	M8	M10	M12	M16	M20	M24
Min. base material thickness h_{min} [mm]			100	120	140	160	200	250	100	120	140	160	200	250
Min. spacing s_{min} [mm]			60	55	60	70	100	125	40	55	60	70	100	125
	Tensile N_{Rd}													
	HST	[kN]	5,0	10,2	12,7	16,0	22,7	31,3	2,8	6,0	8,0	11,4	16,2	22,4
	HST-R	[kN]	6,0	10,2	12,7	16,0	22,7	31,3	3,3	6,0	8,0	11,4	16,2	22,4
	HST-HCR	[kN]	6,0	10,2	12,7	16,0	-	-	3,3	6,0	8,0	11,4	-	-
	Shear V_{Rd}, without lever arm													
	HST	[kN]	11,2	18,8	27,8	40,1	56,7	62,7	8,3	14,6	19,9	22,9	40,5	55,9
	HST-R	[kN]	10,4	16,0	24,0	38,5	55,6	78,4	9,9	14,6	19,9	28,6	40,5	55,9
	HST-HCR	[kN]	10,4	16,0	24,0	40,1	-	-	9,9	14,6	19,9	28,6	-	-

Seismic design C1 and C2

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

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

The following technical data are based on: ETA-98/0001 issue 2013-05-08

Anchorage depth range

Anchor size			M8	M10	M12	M16	M20	M24
Nominal anchorage depth range	h_{nom}	[mm]	55	69	80	95	117	143

Tension resistance in case of seismic performance category C1

Anchor size			M10	M12	M16
Characteristic tension resistance to steel failure					
HST (steel galvanized)					
Characteristic resistance	$N_{Rk,s,seis}$	[kN]	32	45	76
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,5		
HST-R (stainless steel)					
Characteristic resistance	$N_{Rk,s,seis}$	[kN]	28	40	69
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,5		1,56
Pullout failure					
HST (steel galvanized) and **HST-R** (stainless steel)					
Characteristic resistance	$N_{Rk,p,seis}$	[kN]	8,0	10,7	18,0
Partial safety factor	$\gamma_{Mp,seis}$	[-]	1,5		
Concrete cone and splitting failure					
HST (steel galvanized) and **HST-R** (stainless steel)					
Partial safety factor	$\gamma_{Mc,seis} = \gamma_{Msp,seis}$	[-]	1,5		

Displacement under tension load in case of seismic performance category C1 1)

Anchor size			M10	M12	M16
Displacement HST and **HST-R**	$\delta_{N,seis}$	[mm]	1,1	0,8	1,0

1) Maximum displacement during cycling (seismic event).

Shear resistance in case of seismic performance category C1 [1)]

Anchor size			M10	M12	M16
Steel failure					
HST (steel galvanized)					
Characteristic resistance	$V_{Rk,s,seis}$	[kN]	16	27	41,3
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,25		
HST-R (stainless steel)					
Characteristic resistance	$V_{Rk,s,seis}$	[kN]	13,6	23,1	37,5
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,25		1,3
Concrete pryout and concrete edge failure					
HST (steel galvanized) and **HST-R** (stainless steel)					
Partial safety factor	$\gamma_{Mcp,seis} = \gamma_{Mc,seis}$	[-]	1,5		

1) Reduction factor α_{gap} = 1,0 when using the Hilti Dynamic Set

Displacement under shear load for seismic loading, performance category C1 [1)]

Anchor size			M10	M12	M16
Displacement HST and **HST-R**	$\delta_{V,seis}$	[mm]	6,2	7,3	6,2

1) Maximum displacement during cycling (seismic event).

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

Tension resistance in case of seismic performance category C2

Anchor size			M10	M12	M16
Characteristic tension resistance to steel failure					
HST (steel galvanized)					
Characteristic resistance	$N_{Rk,s,seis}$	[kN]	32	45	76
Partial safety factor	$\gamma_{Ms,seis}$	[-]		1,5	
HST-R (stainless steel)					
Characteristic resistance	$N_{Rk,s,seis}$	[kN]	28	40	69
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,5		1,56
Pullout failure					
HST (steel galvanized) and **HST-R** (stainless steel)					
Characteristic resistance	$N_{Rk,p,seis}$	[kN]	3,3	10,0	12,8
Partial safety factor	$\gamma_{Ms,seis}$	[-]		1,5	
Concrete cone and splitting failure					
HST (steel galvanized) and **HST-R** (stainless steel)					
Partial safety factor	$\gamma_{Mc,seis} = \gamma_{Msp,seis}$	[-]		1,5	

Displacement under tension load in case of seismic performance category C2

Anchor size			M10	M12	M16
HST and **HST-R**					
Displacement DLS	$\delta_{N,seis(DLS)}$	[mm]	1,4	6,7	4,0
Displacement ULS	$\delta_{N,seis(ULS)}$	[mm]	8,6	15,9	13,3

Shear resistance in case of seismic performance category C2 1)

Anchor size			M10	M12	M16
Steel failure					
HST (steel galvanized)					
Characteristic resistance	$V_{Rk,s,seis}$	[kN]	14,3	21	41,3
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,25		
HST-R (stainless steel)					
Characteristic resistance	$V_{Rk,s,seis}$	[kN]	12	18	37,5
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,25		1,3
Concrete pryout and concrete edge failure					
HST (steel galvanized) and **HST-R** (stainless steel)					
Partial safety factor	$\gamma_{Mcp,seis} = \gamma_{Mc,seis}$	[-]	1,5		

1) Reduction factor α_{gap} = 1,0 when using the Hilti Dynamic Set

Displacement under shear load in case of seismic performance category C2

Anchor size			M10	M12	M16
HST and **HST-R**					
Displacement DLS	$\delta_{V,seis(DLS)}$	[mm]	4,2	5,3	5,7
Displacement ULS	$\delta_{V,seis(DLS)}$	[mm]	7,5	7,9	8,9

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