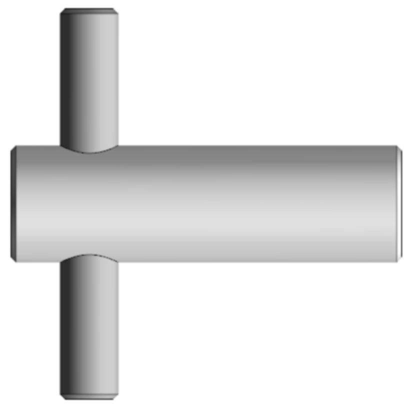
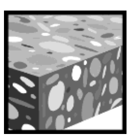
HCS Cast-in socket

Anchor version		Benefits
	HCS Carbon steel HCS-R stainless steel	- simple will proven design - easy installation to formwork - for use with bolts or threaded rods - available in 5µm galvanised or stainless steel A4 to suit environmental conditions - HCS-R with head markings for easy identification


Concrete

Corrosion resistance

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
- screw or rod with steel grade 4.6 (carbon steel) and/or A4-50 (stainless steel)

Mean Ultimate Resistance

Anchor Size		M8x40	M10x50	M12x60	M16x70
Tensile $N_{Ru,m}$					
HCS (4.6)	[kN]	12,1	16,7	23,4	27,4
HCS-R (A4-50)	[kN]	12,1	16,7	23,4	27,4
Shear $V_{Ru,m}$					
HCS (4.6)	[kN]	*7,7*	*12,2*	*17,7*	*33,0*
HCS-R (A4-50)	[kN]	*9,6*	*15,2*	*22,1*	*41,2*

Characteristic Resistance

Anchor Size		M8x40	M10x50	M12x60	M16x70
Tensile N_{Rk}					
HCS (4.6)	[kN]	9,1	12,6	17,5	20,6
HCS-R (A4-50)	[kN]	9,1	12,6	17,5	20,6
Shear V_{Rk}					
HCS (4.6)	[kN]	*7,3*	*11,6*	*16,9*	*31,4*
HCS-R (A4-50)	[kN]	*9,2*	*14,5*	*21,1*	*39,3*

Design Resistance

Anchor Size		M8x40	M10x50	M12x60	M16x70
Tensile N_{Rd}					
HCS (4.6)	[kN]	6,1	8,4	11,7	13,7
HCS-R (A4-50)	[kN]	6,1	8,4	11,7	13,7
Shear V_{Rd}					
HCS (4.6)	[kN]	4,4	7,0	10,1	18,8
HCS-R (A4-50)	[kN]	3,8	6,1	8,9	16,5

Recommended loads a)

Anchor Size		M8x40	M10x50	M12x60	M16x70
Tensile N_{rec}					
HCS (4.6)	[kN]	4,3	6,0	8,4	9,8
HCS-R (A4-50)	[kN]	4,3	6,0	8,4	9,8
Shear V_{rec}					
HCS (4.6)	[kN]	3,1	5,0	7,2	13,5
HCS-R (A4-50)	[kN]	2,7	4,4	6,3	11,8

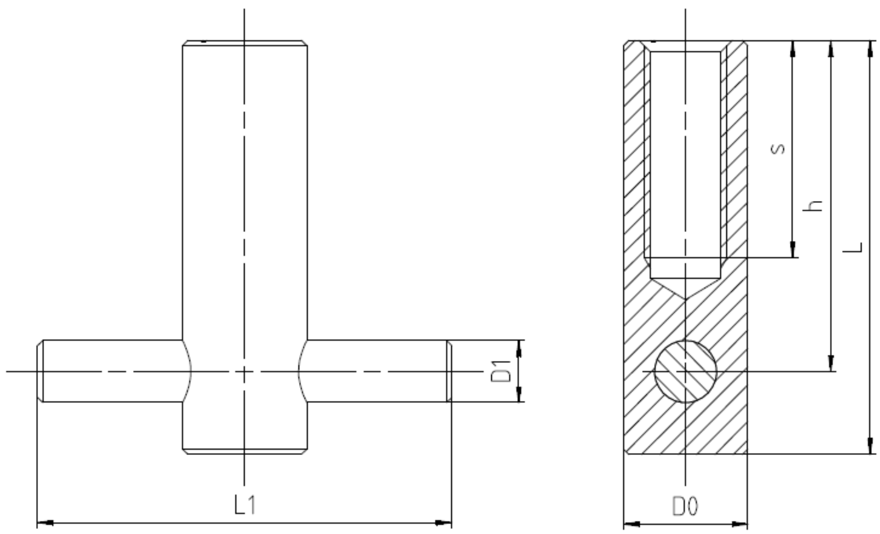
a) With overall partial safety factor for action γ =1.4. The partial safety factor for action depend on the type of loading and shall be taken from national regulations.

Material properties of HCS

Anchor Size		M8x40	M10x50	M12x60	M16x70
Nominal tensile strength f_{uk} [N/mm2]					
Anchor body	HCS	430			
Anchor pin	HCS	430			
Anchor body	HCS-R	580			
Anchor pin	HCS-R	580			
Stressed cross-section A_S [mm^2] Hexagon Bolt		36,6	58	84,3	157

Material quality

Part		Material
Anchor body	HCS	Steel Fe/Zn5 galvanized to min. 5µm
Anchor pin	HCS	Steel Fe/Zn5 galvanized to min. 5µm
Anchor body	HCS-R	Stainless Steel A4
Anchor body	HCS-R	Stainless Steel A4



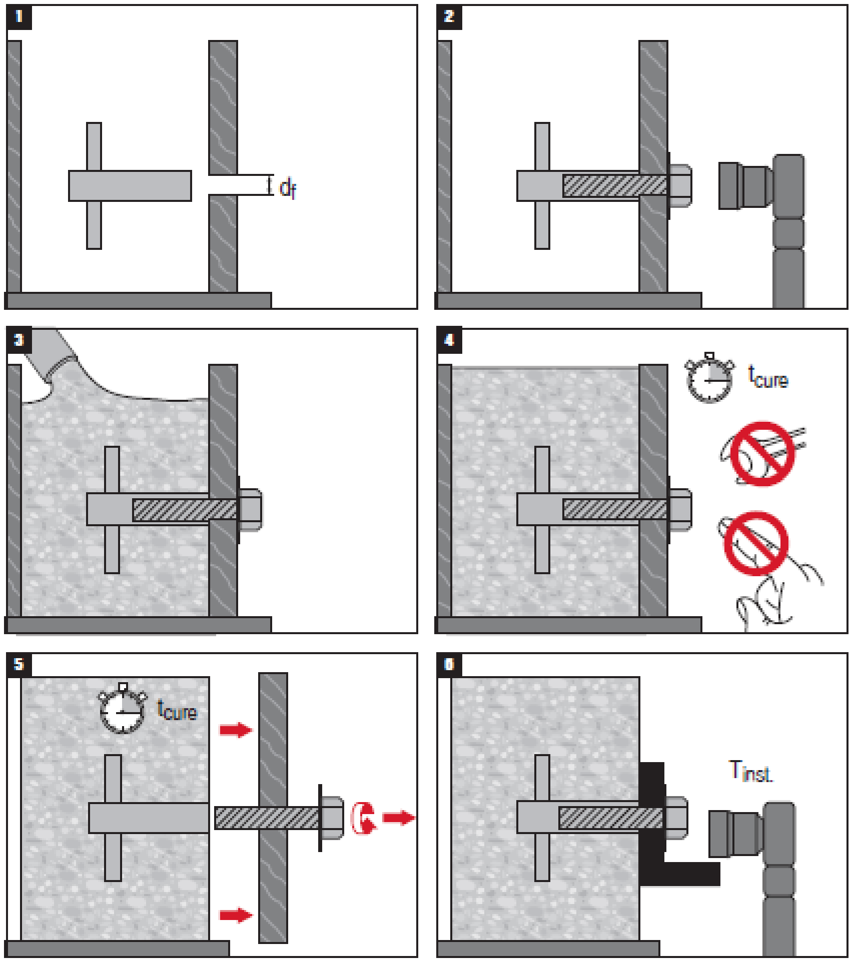
Anchor dimensions

Anchor Size			M8x40	M10x50	M12x60	M16x70
Anchor body diameter	D_0	[mm]	12	16	18	22
Anchor Length	L	[mm]	40	50	60	70
Anchor pin diameter	D_1	[mm]	6	8	8	12
Anchor pin position from top	h	[mm]	32	40	50	56
Allowable Screwing Depth	$h_{s,min}$	[mm]	10	12	14	19
	$h_{s,max}$	[mm]	21	23	26	33
Anchor pin length	L_1	[mm]	40	50	60	90
Maximum torque moment	T_{inst}	[Nm]	8	15	25	50

Base material thickness, anchor spacing and edge distance

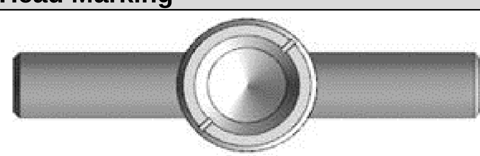
Anchor Size			M8x40	M10x50	M12x60	M16x70
Nominal embedment depth	h_{nom}	[mm]	40	50	60	70
Effective anchorage depth	h_{ef}	[mm]	29	36	45	50
Min. base material thickness	h	[mm]	100	100	100	100
Minimum spacing	s_{min}	[mm]	58	72	90	100
Minimum edge distance	c_{min}	[mm]	44	54	68	75
Critical spacing	s_{cr}	[mm]	$3\ h_{ef}$			
Critical edge distance	c_{cr}	[mm]	$1{,}5\ h_{ef}$			

Setting instruction



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

Anchor Marking

Bottom Marking	Head Marking
	
HCS / HCS-R	HCS-R only

Simplified design method

Simplified version of the design method according ETAG 001, Annex C.

- Influence of concrete strength
- Influence of edge distance
- Influence of spacing
- Valid for a group of two anchors.

The design method is based on the following simplification:

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

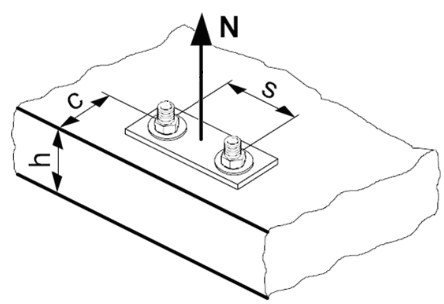
The values are valid for one anchor.

Tension loading

The design tensile resistance is the lower value of

- Steel resistance: $N_{Rd,s}$
- Concrete pull-out resistance: $N_{Rd,p} = N^0_{Rd,p} \cdot f_B$
- 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
$N_{Rd,s}$	HCS (4.6)	[kN]	7,3	11,6	16,9	31,4
	HCS (8.8)	[kN]	9,3	16,6	20,5	31,9
	HCS-R (A4-50)	[kN]	6,4	10,2	14,8	27,5
	HCS-R (A4-70)	[kN]	11,0	21,1	24,7	31,3

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

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

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

Anchor size		M8	M10	M12	M16
$N^0_{Rd,c}$	[kN]	6,1	8,4	9,1	13,1

Influencing factors

Influence of concrete strength

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

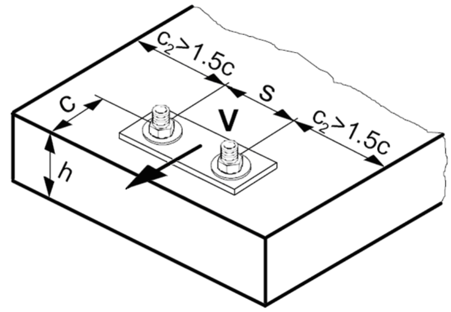
Anchor size	M8	M10	M12	M16
$f_{re,N} = 0,5 + h_{ef}/200mm \leq 1$	0,65 a)	0,7 a)	0,75 a)	0,78 a)

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
$V_{Rd,s}$	HCS (4.6)	[kN]	4,4	7,0	10,1	18,8
	HCS (8.8)	[kN]	10,4	18,6	23,3	29,5
	HCS-R (A4-50)	[kN]	3,8	6,1	8,9	16,5
	HCS-R (A4-70)	[kN]	8,2	13,1	19,0	35,3

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

Anchor size	M8	M10	M12	M16
k	1,7	1,7	1,7	2,0

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

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

Anchor size		M8	M10	M12	M16
$V^0_{Rd,c}$	[kN]	11,7	18,9	22,9	31,7

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

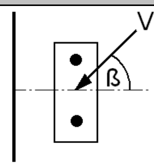
Influencing factors

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
$f_h = \{h/(1,5 \cdot c)\}^{1/2} \leq 1$	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
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	0,22	0,20	0,23	0,20

Influence of edge distance [a)]

c/d	4	6	8	10	15	20	30	40
$f_c = \quad (d / c)^{0,19}$	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 refer to section “Anchor Design” in Hilti Fastening Technology Manual.