




## HVU with HAS/HAS-E rod adhesive anchor system

Mortar system	Benefits
 <p>Hilti HVU foil capsule</p>	<ul style="list-style-type: none"> <li>- suitable for non-cracked concrete C 20/25 to C 50/60</li> <li>- high loading capacity</li> <li>- suitable for dry and water saturated concrete</li> <li>- large diameter applications</li> <li>- high corrosion resistant</li> </ul>
 <p>HAS HAS-R HAS-HCR rod</p>	
 <p>HAS-E HAS-E R HAS-E HCR rod</p>	



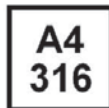
Concrete



Small edge distance and spacing



Fire resistance



Corrosion resistance



High corrosion resistance



European Technical Approval



CE conformity



PROFIS Anchor design software

### Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
European technical approval <sup>a)</sup>	DIBt, Berlin	ETA-05/0255 / 2011-06-23
Fire test report	IBMB, Braunschweig	UB-3333/0891-1 / 2004-03-26
Fire test report ZTV-Tunnel	IBMB, Braunschweig	UB 3333/0891-2 / 2003-08-12
Assessment report (fire)	warringtonfire	WF 327804/B / 2013-07-10

a) All data given in this section according ETA-05/0255, issue 2011-06-23

### Basic loading data (for a single anchor)

All data in this section applies to

For details see Simplified design method

- Correct setting (See setting instruction)
- No edge distance and spacing influence
- Steel failure
- Base material thickness, as specified in the table
- One typical embedment depth, as specified in the table
- One anchor material, as specified in the tables
- Concrete C 20/25,  $f_{ck,cube} = 25 \text{ N/mm}^2$
- Temperature range I  
(min. base material temperature  $-40^\circ\text{C}$ , max. long term/short term base material temperature:  $+24^\circ\text{C}/40^\circ\text{C}$ )
- Installation temperature range  $-5^\circ\text{C}$  to  $+40^\circ\text{C}$

Embedment depth <sup>a)</sup> and base material thickness for the basic loading data.

Mean ultimate resistance, characteristic resistance, design resistance, recommended loads.

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Typical embedment depth [mm]	80	90	110	125	170	210	240	270
Base material thickness [mm]	140	160	210	210	340	370	480	540

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

Mean ultimate resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HAS

Data according ETA-05/0255, issue 2011-06-23								
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Carbon steel, strength class	5.8	5.8	5.8	5.8	5.8	5.8	8.8	8.8
Tensile $N_{Ru,m}$ HAS [kN]	17,9	27,3	39,9	75,6	117,6	168,0	249,3	297,4
Shear $V_{Ru,m}$ HAS [kN]	8,9	13,7	20,0	37,8	58,8	84,0	182,7	221,6

Characteristic resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HAS

Data according ETA-05/0255, issue 2011-06-23								
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Carbon steel, strength class	5.8	5.8	5.8	5.8	5.8	5.8	8.8	8.8
Tensile $N_{Rk}$ HAS [kN]	17,0	26,0	38,0	60,0	111,9	140,0	187,8	224,0
Shear $V_{Rk}$ HAS [kN]	8,5	13,0	19,0	36,0	56,0	80,0	174,0	211,0

Design resistance: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HAS

Data according ETA-05/0255, issue 2011-06-23								
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Carbon steel, strength class	5.8	5.8	5.8	5.8	5.8	5.8	8.8	8.8
Tensile $N_{Rd}$ HAS [kN]	11,3	17,3	25,3	40,0	74,6	93,3	125,2	149,4
Shear $V_{Rd}$ HAS [kN]	6,8	10,4	15,2	28,8	44,8	64,0	139,2	168,8

Recommended loads <sup>a)</sup>: concrete C 20/25 –  $f_{ck,cube} = 25 \text{ N/mm}^2$ , anchor HAS

Data according ETA-05/0255, issue 2011-06-23								
Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Carbon steel, strength class	5.8	5.8	5.8	5.8	5.8	5.8	8.8	8.8
Tensile $N_{rec}$ HAS [kN]	8,1	12,4	18,1	28,6	53,3	66,7	89,4	106,7
Shear $V_{rec}$ HAS [kN]	4,9	7,4	10,9	20,6	32,0	45,7	99,4	120,6

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

## Service temperature range

Hilti HVU adhesive 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 HAS**

			Data according ETA-05/0255, issue 2011-06-23							
Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Nominal tensile strength $f_{uk}$	HAS-(E)(F) 5.8	[N/mm <sup>2</sup> ]	500	500	500	500	500	500	-	-
	HAS-(E)(F) 8.8	[N/mm <sup>2</sup> ]	800	800	800	800	800	800	800	800
	HAS-(E)R	[N/mm <sup>2</sup> ]	700	700	700	700	700	700	500	500
	HAS-(E)HCR	[N/mm <sup>2</sup> ]	800	800	800	800	800	700	-	-
Yield strength $f_{yk}$	HAS-(E)(F) 5.8	[N/mm <sup>2</sup> ]	400	400	400	400	400	400	-	-
	HAS-(E)(F) 8.8	[N/mm <sup>2</sup> ]	640	640	640	640	640	640	640	640
	HAS-(E)R	[N/mm <sup>2</sup> ]	450	450	450	450	450	450	210	210
	HAS-(E)HCR	[N/mm <sup>2</sup> ]	640	640	640	640	640	400	-	-
Stressed cross-section $A_s$	HAS	[mm <sup>2</sup> ]	32,8	52,3	76,2	144	225	324	427	519
Moment of resistance $W$	HAS	[mm <sup>3</sup> ]	27,0	54,1	93,8	244	474	809	1274	1706

**Material quality**

Part	Material
Threaded rod HAS-(E)(F) M8-M24	Strength class 5.8, $A_5 > 8\%$ ductile steel galvanized $\geq 5 \mu\text{m}$ (F) hot dipped galvanized $\geq 45 \mu\text{m}$ ,
Threaded rod HAS-(E)(F) M8-M30	Strength class 8.8, $A_5 > 8\%$ ductile steel galvanized $\geq 5 \mu\text{m}$ , (F) hot dipped galvanized $\geq 45 \mu\text{m}$ ,
Threaded rod HAS-(E)R	Stainless steel grade A4, $A_5 > 8\%$ ductile strength class 70 for $\leq M24$ and class 50 for M27 to M30, 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362
Threaded rod HAS-(E)HCR	High corrosion resistant steel, 1.4529; 1.4565 strength $\leq M20$ : $R_m = 800 \text{ N/mm}^2$ , $R_{p0.2} = 640 \text{ N/mm}^2$ , $A_5 > 8\%$ ductile M24: $R_m = 700 \text{ N/mm}^2$ , $R_{p0.2} = 400 \text{ N/mm}^2$ , $A_5 > 8\%$ 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 $\geq 5 \mu\text{m}$ , hot dipped galvanized $\geq 45 \mu\text{m}$ ,
	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-E, HAS-R, HAS-ER HAS-HCR	M8x80	M10x90	M12x110	M16x125	M20x170	M24x210	M27x240	M30x270
Anchor embedment depth [mm]	80	90	110	125	170	210	240	270

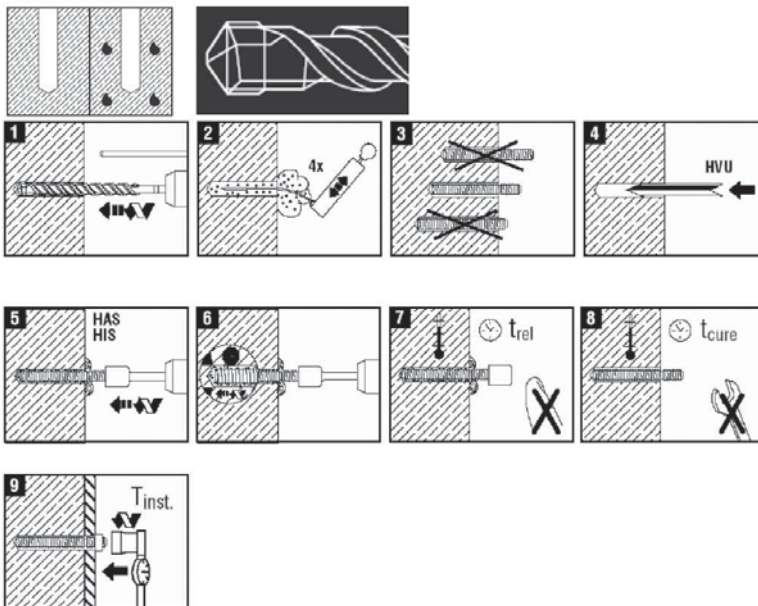
### Setting

#### installation equipment

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
Rotary hammer	TE 1 – TE 30			TE 1 – TE 60	TE 50 – TE 60	TE 50 – TE 80		
Other tools	blow out pump or compressed air gun, setting tools							

#### Setting instruction

Dry and water-saturated concrete, hammer drilling



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.

### Curing time for general conditions

Data according ETA-05/0255, issue 2011-06-23	
Temperature of the base material	Curing time before anchor can be fully loaded $t_{cure}$
20 °C to 40 °C	20 min
10 °C to 19 °C	30 min
0 °C to 9 °C	1 h
-5 °C to - 1 °C	5 h

### Setting details

			Data according ETA-05/0255, issue 2011-06-23							
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 anchorage and drill hole depth	$h_{ef}$	[mm]	80	90	110	125	170	210	240	270
Minimum base material thickness	$h_{min}^{a)}$	[mm]	110	120	140	170	220	270	300	340
Diameter of clearance hole in the fixture	$d_f$	[mm]	9	12	14	18	22	26	30	33
Minimum spacing	$s_{min}$	[mm]	40	45	55	65	90	120	130	135
Minimum edge distance	$c_{min}$	[mm]	40	45	55	65	90	120	130	135
Critical spacing for splitting failure	$s_{cr,sp}$		$2 c_{cr,sp}$							
Critical edge distance for splitting failure <sup>b)</sup>	$c_{cr,sp}$	[mm]	$1,0 \cdot h_{ef}$ for $h / h_{ef} \geq 2,0$							
			$4,6 h_{ef} - 1,8 h$ for $2,0 > h / h_{ef} > 1,3$							
			$2,26 h_{ef}$ for $h / h_{ef} \leq 1,3$							
Critical spacing for concrete cone failure	$s_{cr,N}$		$2 c_{cr,N}$							
Critical edge distance for concrete cone failure <sup>c)</sup>	$c_{cr,N}$		$1,5 h_{ef}$							
Critical spacing for concrete cone failure	$s_{cr,N}$		$2 c_{cr,N}$							
Critical edge distance for concrete cone failure	$c_{cr,N}$		$1,5 h_{ef}$							
Torque moment <sup>c)</sup>	$T_{max}$	[Nm]	10	20	40	80	150	200	270	300

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

- a)  $h$ : base material thickness ( $h \geq h_{min}$ )
- b)  $h$ : base material thickness ( $h \geq h_{min}$ )
- c) This is the maximum recommended torque moment to avoid splitting failure during installation for anchors with minimum spacing and/or edge distance.

## Simplified design method

Simplified version of the design method according EOTA Technical Report TR 029. Design resistance according data given in ETA-05/0255, issue 2011-06-23.

- 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 same side: They will be lower than the exact values according EOTA Technical Report 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.

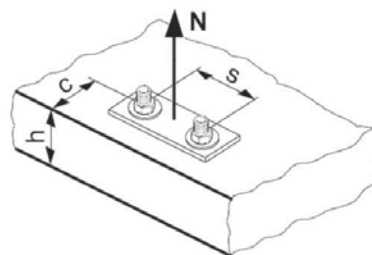
## Tension loading

### The design tensile resistance is the lower value of

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

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

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



## Basic design tensile resistance

### Design steel resistance $N_{Rd,s}$

		Data according ETA-05/0255, issue 2011-06-23							
Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
$N_{Rd,s}$	HAS-(E)(F) 5.8 [kN]	11,3	17,3	25,3	48,0	74,7	106,7	-	-
	HAS-(E)(F) 8.8 [kN]	18,0	28,0	40,7	76,7	119,3	170,7	231,3	281,3
	HAS-(E)-R [kN]	12,3	19,8	28,3	54,0	84,0	119,8	75,9	92,0
	HAS-(E)-HCR [kN]	18,0	28,0	40,7	76,7	119,3	106,7	-	-

### Design combined pull-out and concrete cone resistance $N_{Rd,p} = N_{Rd,p}^0 \cdot f_{B,p} \cdot f_{h,p}$

		Data according ETA-05/0255, issue 2011-06-23							
Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
Typical embedment depth $h_{ef,typ}$ [mm]		80	90	110	125	170	200	210	270
$N_{Rd,p}^0$	Temperature range I [kN]	16,7	23,3	33,3	40,0	76,7	93,3	133,3	166,7
$N_{Rd,p}^0$	Temperature range II [kN]	13,3	16,7	26,7	33,3	50,0	76,7	93,3	113,3
$N_{Rd,p}^0$	Temperature range III [kN]	6,0	8,0	10,7	16,7	26,7	40,0	50,0	50,0

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

Design splitting resistance <sup>a)</sup>  $N_{Rd,sp} = N_{Rd,c}^0 \cdot f_B \cdot f_{h,N} \cdot f_{1,sp} \cdot f_{2,sp} \cdot f_{3,sp} \cdot f_{re,N}$

		Data according ETA-05/0255, issue 2011-06-23							
Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
$N_{Rd,c}^0$	[kN]	24,1	28,7	38,8	47,1	74,6	102,5	125,2	149,4

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

### Influencing factors

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

Concrete strength designation (ENV 206)	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
$f_{B,p} = (f_{ck,cube}/25N/mm^2)^{0,14}$ <sup>a)</sup>	1	1,03	1,06	1,09	1,10	1,12	1,13

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

$f_{h,p} = 1$
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#### Influence of concrete strength on concrete cone resistance

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

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

#### Influence of edge distance <sup>a)</sup>

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

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

#### Influence of anchor spacing <sup>a)</sup>

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

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

#### Influence of embedment depth on concrete cone resistance

$f_{h,N} = 1$
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### Influence of reinforcement

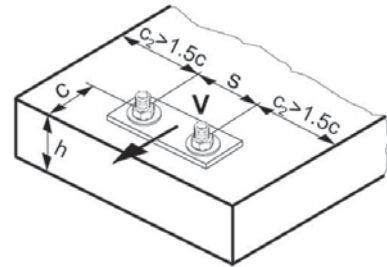
$h_{ef}$ [mm]	40	50	60	70	80	90	$\geq 100$
$f_{re,N} = 0,5 + h_{ef}/200\text{mm} \leq 1$	0,7 <sup>a)</sup>	0,75 <sup>a)</sup>	0,8 <sup>a)</sup>	0,85 <sup>a)</sup>	0,9 <sup>a)</sup>	0,95 <sup>a)</sup>	1

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

### Shear loading

The design shear resistance is the lower value of

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



### Basic design shear resistance

#### Design steel resistance $V_{Rd,s}$

		Data according ETA-05/0255, issue 2011-06-23							
Anchor size		M8	M10	M12	M16	M20	M24	M27	M30
$V_{Rd,s}$	HAS -(E) [kN]	6,6	10,6	15,2	28,8	44,9	64,1	138,8	168,6
	HAS -(E)F [kN]	10,6	16,9	24,4	46,1	71,8	102,6	138,8	168,6
	HAS -(E)-R [kN]	7,5	11,9	17,1	32,4	50,5	72,1	45,5	55,3
	HAS -(E)-HCR [kN]	10,6	16,9	24,4	46,1	71,8	64,1	-	-

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

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
k	2							

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

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

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
$V_{Rd,c}^0$ [kN]	5,9	8,5	11,6	18,8	27,3	37	45,1	53,8

- 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
$f_B = (f_{ck,cube}/25\text{N/mm}^2)^{1/2}$ a)	1	1,1	1,22	1,34	1,41	1,48	1,55

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

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

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

### Influence of base material thickness

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

### Influence of anchor spacing and edge distance <sup>a)</sup> for concrete edge resistance: $f_4$

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

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

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

### Influence of embedment depth

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30
$f_{hef} = 0,05 \cdot (h_{ef} / d)^{1,68}$	2,39	2	2,07	1,58	1,82	1,91	1,96	2

### Influence of edge distance <sup>a)</sup>

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".