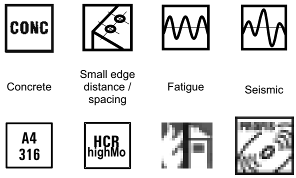
HVU adhesive with HAS rod

Features:	
	- foil capsule vs. glass
	- flexible for inserting into crooked / irregular holes
	- pre-setting / through-setting
	- specials lengths available on request
	- test reports: fire, dynamic (fatigue, shock, seismic), water tightness
Material:	
HVU:	- urethane methacrylate resin – styrene free, hardener, quartz sand or corundum, foil tube
HAS, HAS-E:	- grade 5.8 and 8.8, ISO 898 T1, galvanised to min. 5 microns
HAS-R / -ER:	- stainless steel; A4-70; 1.4401, 1.4404, 1.4571
HAS-HCR:	- stainless steel; 1.4529

HVU capsule

HAS, HAS-R, HAS-HCR

HAS-E, HAS-E-R



Concrete | Small edge distance / spacing | Fatigue | Seismic

Corrosion resistance | High corrosion resistance | Fire resistance | Hilti Anchor programme

Basic loading data (for a single anchor): HVU capsule with HAS, HAS-E

All data on this page applies to

For detailed design method, see pages 204 – 208.

- concrete: See table below.
- correct setting (See setting operations page 203)
- no edge distance and spacing influence
- *steel failure*: steel grade 5.8 for M8 – M24 sizes and steel grade 8.8 for M27 – M39

CONC **non-cracked concrete**

Mean ultimate resistance, $R_{u,m}$ [kN]: concrete ≅ C20/25

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Tensile, $N_{Ru,m}$	*17.7*	*28.2*	*41.1*	*77.9*	*121.7*	*175.2*	320.1	305.1	498.6	534.0	621.6
Shear, $V_{Ru,m}$	*10.7*	*17.0*	*24.7*	*46.7*	*72.9*	*105.0*	*221.4*	*269.1*	*335.3*	*393.5*	*473.3*

Characteristic resistance, R_k [kN]: concrete ≅ C20/25

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Tensile, N_{Rk}	*16.4*	*26.1*	*38.1*	*72.2*	*112.7*	*162.0*	182.4	228.0	440.9	494.0	503.2
Shear, V_{Rk}	*9.9*	*15.8*	*22.9*	*43.2*	*67.5*	*97.3*	*205.0*	*249.1*	*310.5*	*364.4*	*438.3*

Following values according to the

Concrete Capacity Method

Design resistance, R_d [kN]: concrete, $f_{ck,cube}$ = 25 N/mm^2

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Tensile, N_{Rd}	10.9	16.6	23.8	34.7	62.9	90.6	110.9	145.6	171.0	203.3	232.9
Shear, V_{Rd}	7.9	12.6	18.3	34.6	54.0	77.8	164.0	199.3	248.4	291.5	350.6

Recommended load, L_{rec} [kN]: concrete, $f_{ck,cube}$ = 25 N/mm^2

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Tensile, N_{Rec}	7.8	11.8	17.0	24.8	44.9	64.7	79.2	104.0	122.1	145.2	166.4
Shear, V_{Rec}	5.6	9.0	13.1	24.7	38.6	55.6	117.1	142.4	177.4	208.2	250.4

Basic loading data (for a single anchor): HVU capsule with HAS-R, HAS-E-R, HAS-HCR

All data on this section applies to

For detailed design method, see pages 204 – 208.

- concrete: See table below.
- correct setting (See setting operations page 203)
- no edge distance and spacing influence
- *steel failure:* steel grade A4-70 for M8 – M24; for A4 grade, f_{uk} changes for the sizes M27 to M39 from 700 N/mm^2 to 500 N/mm^2.

CONC non-cracked concrete

Mean ultimate resistance, $R_{u,m}$ [kN]: concrete ≅ C20/25

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Tensile, $N_{Ru,m}$	*24.8*	*39.6*	*57.8*	*109.1*	*170.3*	*244.4*	*230.7*	*280.2*	*349.4*	*410.1*	*493.0*
Shear, $V_{Ru,m}$	*14.8*	*23.8*	*34.5*	*65.4*	*102.1*	*146.9*	*138.5*	*168.3*	*209.7*	*246.0*	*295.9*

Characteristic resistance, R_k [kN]: concrete ≅ C20/25

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Tensile, N_{Rk}	*23.0*	*36.7*	*53.5*	*101.0*	*157.6*	*226.3*	*213.6*	*259.4*	*323.5*	*379.7*	*456.5*
Shear, V_{Rk}	*13.7*	*22.0*	*32.0*	*60.5*	*94.5*	*136.0*	*128.2*	*155.8*	*194.2*	*227.8*	*274.0*

Following values according to the

Concrete Capacity Method

Design resistance, R_d [kN]: concrete, $f_{ck,cube}$ = 25 N/mm^2

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Tensile, N_{Rd}	12.3	16.6	23.8	34.7	62.9	90.6	89.0	108.1	134.8	158.2	190.2
Shear, V_{Rd}	8.8	14.1	20.5	38.8	60.6	87.2	64.1	77.9	97.1	113.9	137.0

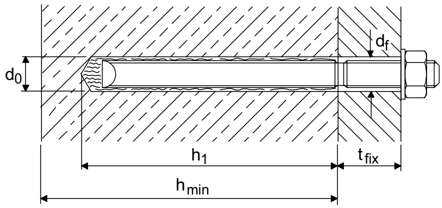
Recommended load, L_{rec} [kN]: concrete, $f_{ck,cube}$ = 25 N/mm^2

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Tensile, N_{Rec}	8.8	11.8	17.0	24.8	44.9	64.7	63.6	77.2	96.3	113.0	135.9
Shear, V_{Rec}	6.3	10.1	14.6	27.7	43.3	62.3	45.8	55.6	69.4	81.3	97.9

3

HVU adhesive with HAS rod

Setting details



Anchor size			M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Foil capsule		HVU	M8x80	M10x90	M12x110	M16x125	M20x170	M24x210	M27x240	M30x270	M33x300	M36x330	M39x360
Anchor rod[1]	HAS /-E/-R/-ER/-HCR		M8x80/ 14	M10x90/ 21	M12x110/ 28	M16x125/ 38	M20x170/ 48	M24x210/ 54	M27x240/ 60	M30x270/ 70	M33x300/ 80	M36x330/ 90	M39x360/ 100
d_0	Drill bit diameter	[mm]	10	12	14	18	24	28	30	35	37	40	42
h_1=h_{nom}	Hole depth = Embedment depth	[mm]	80	90	110	125	170	210	240	270	300	330	360
h (min)	Min. thickness of base material	[mm]	110	120	140	170	220	270	300	340	380	410	450
t_{fix} (max)	Max. fixture thickness	[mm]	14	21	28	38	48	54	60	70	80	90	100
d_f	Clearance hole rec. / max.	[mm] / [mm]	9 / 11	12 / 13	14 / 15	18 / 19	22 / 25	26 / 29	30 / 31	33 / 36	36 / 38	39 / 41	42 / 43
T_{inst}	Tightening torque	[Nm]	15	30	50	100	160	240	270	300	1200	1500	1800
Drill bit		TE-CX-	10/22	12/22	14/22	-	-	-	-	-	-	-	-
		TE-T-	-	-	-	18/32	24/32	28/52	30/57	-	-	-	-
Rec. diamond drilling machine			DD EC-1								DD 100 // DD 160 E		

[1] The values for the maximum fixture thickness are only valid for the HAS anchor rods given in this table.
If other HAS rods are used, these values will change. (Example: HAS M12x110/128; t_{fix} = 128 mm)

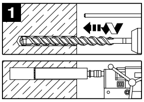
Temperature[1] when setting:	Min. time to wait before removing **SCREWED-ON** setting tool, t_{rel}	Curing timebefore anchor can be fully loaded, t_{cure}
20°C and above	8 min.	20 min.
10°C to 20°C	20 min.	30 min.
0°C to 10°C	30 min.	60 min.
-5°C to 0°C	60 min.	5 hours

[1] If the temperature is less than –5°C, contact your Hilti technical service.

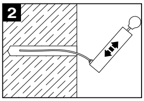
Installation equipment

Rotary hammer (TE1, TE 2, TE5, TE6, TE6A, TE15, TE15-C, TE18-M, TE 35, TE 55 or TE 76) or a diamond drilling machine, a drill bit, a TE-C HEX, TE-C-E TE-Y-E setting tool and a blow-out pump.

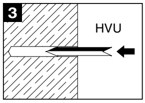
Setting operations



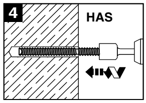
Drill hole.



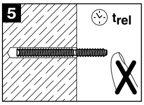
Blow out dust and fragments.



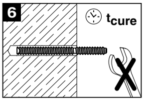
Insert HVU capsule.



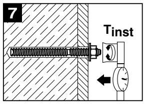
Drive in anchor.



Allow gel time to pass.



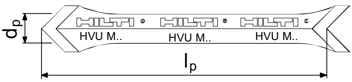
Wait for curing.

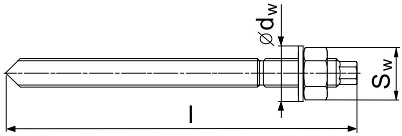


Apply tightening torque.

°C	t_{rel}	t_{cure}
-5° ... 0°	60'	5 h
0° ... 10°	30'	60'
10° ... 20°	20'	30'
20° ... 40°	8'	20'

Anchor geometry and mechanical properties





Anchor size			M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
Foil capsule		**HVU**	M8x80	M10x90	M12x110	M16x125	M20x170	M24x210	M27x240	M30x270	M33x300	M36x330	M39x360
l_p [mm]	HVU capsule length		110	110	127	140	170	200	225	260	290	320	350
d_p [mm]	HVU capsule diameter		9.3	10.7	13.1	17.1	22.0	25.7	26.8	31.5	31.5	32.0	35.0
Anchor rod		**HAS**	M8x80/ 14	M10x90/ 21	M12x110/ 28	M16x125/ 38	M20x170/ 48	M24x210/ 54	M27x240/ 60	M30x270/ 70	M33x300/ 80	M36x330/ 90	M39x360/ 100
l [mm]	Anchor length		110	130	160	190	240	290	340	380	420	460	510
A_s [mm²]	Stressed cross-section		32.8	52.3	76.2	144	225	324	427	519	647	759	913
f_{uk} [N/mm²]	Nominal tensile strength	HAS 5.8	500	500	500	500	500	500	-	-	-	-	-
		HAS 8.8	-	-	-	-	-	-	800	800	800	800	800
		HAS-R -HCR	700	700	700	700	700	700	500	500	500	500	500
f_{yk} [N/mm²]	Yield strength	HAS 5.8	400	400	400	400	400	400	-	-	-	-	-
		HAS 8.8	-	-	-	-	-	-	640	640	640	640	640
		HAS-R -HCR	450	450	450	450	450	450	250	250	250	250	250
W [mm³]	Moment of resistance		26.5	53.3	93.9	244	477	824	1245	1668	2322	2951	3860
$M_{Rd,s}$ [Nm]	Design bending resistance[1]	HAS 5.8	12.7	25.6	45.1	117.1	228.8	395.3	-	-	-	-	-
		HAS 8.8	-	-	-	-	-	-	956.1	1280.8	1783.5	2266.5	2987.8
		HAS-R -HCR	14.3	28.7	50.6	131.4	256.7	443.5	478.8	641.5	893.0	1134.9	1484.5
S_w [mm]	Width across flats		13	17	19	24	30	36	41	46	50	55	59
d_w [mm]	Washer diameter		16	20	24	30	37	44	50	56	60	66	72

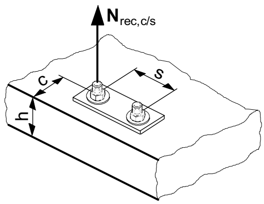
1) The design bending resistance of the anchor rod is calculated from $M_{Rd,s} = (1.2 \cdot W \cdot f_{uk})/\gamma_{Ms,b}$, where the partial safety factor, $\gamma_{Ms,b}$, for grade 5.8 and 8.8 rods is 1.25 and for 1.56 for A4-70 and HCR. The final safety check is then $M_{Sk} \cdot \gamma_F \le M_{Rd,s}$

3

Detailed design method - Hilti CC

(The Hilti CC method is a simplified version of ETAG Annex C.)

Caution: In view of the high loads transferable with HVU, it must be verified by the user that the load acting on the concrete structure, including the loads introduced by the anchor fastening, do not cause failure, e.g. cracking, of the concrete structure.



TENSION

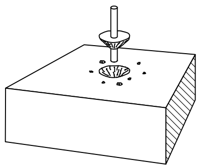
The design tensile resistance of a single anchor is the lower of

$N_{Rd,c}$: concrete cone/pull-out resistance

$N_{Rd,s}$: steel resistance

$N_{Rd,c}$: Concrete cone/pull-out resistance

$$N_{Rd,c} = N^{o}_{Rd,c} \cdot f_{B,N} \cdot f_T \cdot f_{A,N} \cdot f_{R,N}$$



$N^0_{Rd,c}$: Concrete cone/pull-out design resistance

- Concrete compressive strength, $f_{ck,cube(150)}$ = 25 N/mm²

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
$N^0_{Rd,c}$ [1) [kN]	12.4	16.6	23.8	34.7	62.9	90.6	110.9	145.6	171.0	203.3	232.9
h_{nom} [mm] Nominal anchorage depth	80	90	110	125	170	210	240	270	300	330	360

1) The design tensile resistance is calculated from the characteristic tensile resistance, $N°_{Rk,c}$, by $N°_{Rd,c} = N°_{Rk,c}/\gamma_{Mc,N}$, where the partial safety, $\gamma_{Mc,N}$, factor is 1.8.

$f_{B,N}$: Influence of concrete strength

Designation of grade of concrete (ENV 206)	Cylinder compressive strength, $f_{ck,cyl}$ [N/mm²]	**Cube compressive strength, $f_{ck,cube}$ [N/mm²]**	**$f_{B,N}$**
C16/20	16	**20**	**0.94**
C20/25	20	**25**	**1**
C25/30	25	**30**	**1.05**
C30/37	30	**37**	**1.12**
C35/45	35	**45**	**1.20**
C40/50	40	**50**	**1.25**
C45/55	45	**55**	**1.30**
C50/60	50	**60**	**1.35**

Concrete cylinder: height 30cm, 15cm diameter	Concrete cube: side length 15cm
Concrete test specimen geometry	

$$f_{B,N} = 1 + \left(\frac{f_{ck,cube} - 25}{80}\right)$$

for $f_{ck,cube}$= 20N/mm²

$$f_{B,N} = 1 + \left(\frac{f_{ck,cube} - 25}{100}\right)$$

Limits:
25 N/mm² ≤ $f_{ck,cube}$ ≤ 60 N/mm²

f_T :Influence of anchorage depth

$$f_T = \frac{h_{act}}{h_{nom}}$$

Limits to actual anchorage depth h_{act}: $h_{nom} \le h_{act} \le 2.0\ h_{nom}$

$f_{A,N}$: Influence of anchor spacing

Anchor spacing, s [mm]	Anchor size										
	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
40	0,63										
45	0,64	0,63									
50	0,66	0,64									
55	0,67	0,65	0,63								
60	0,69	0,67	0,64								
65	0,70	0,68	0,65	0,63							
70	0,72	0,69	0,66	0,64							
80	0,75	0,72	0,68	0,66							
90	0,78	0,75	0,70	0,68	0,63						
100	0,81	0,78	0,73	0,70	0,65						
120	0,88	0,83	0,77	0,74	0,68	0,64	0,63				
140	0,94	0,89	0,82	0,78	0,71	0,67	0,65	0,63			
160	1,00	0,94	0,86	0,82	0,74	0,69	0,67	0,65	0,63		
180		1,00	0,91	0,86	0,76	0,71	0,69	0,67	0,65	0,64	0,63
200			0,95	0,90	0,79	0,74	0,71	0,69	0,67	0,65	0,64
220			1,00	0,94	0,82	0,76	0,73	0,70	0,68	0,67	0,65
250				1,00	0,87	0,80	0,76	0,73	0,71	0,69	0,67
280					0,91	0,83	0,79	0,76	0,73	0,71	0,69
310					0,96	0,87	0,82	0,79	0,76	0,73	0,72
340					1,00	0,90	0,85	0,81	0,78	0,76	0,74
390						0,96	0,91	0,86	0,83	0,80	0,77
420						1,00	0,94	0,89	0,85	0,82	0,79
450							0,97	0,92	0,88	0,84	0,81
480							1,00	0,94	0,90	0,86	0,83
540								1,00	0,95	0,91	0,88
600									1,00	0,95	0,92
660										1,00	0,96
720											1,00

$$f_{A,N} = 0{,}5 + \frac{s}{4h_{nom}}$$

Limits: $s_{min} \le s \le s_{cr,N}$
$s_{min}=0{,}5 \cdot h_{nom}$
$s_{cr,N}=2{,}0 \cdot h_{nom}$

3

$f_{R,N}$: Influence of edge distance

Edge distance, c [mm]	Anchor size										
	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
40	0,64										
45	0,69	0,64									
50	0,73	0,68									
55	0,78	0,72	0,64								
60	0,82	0,76	0,67								
65	0,87	0,80	0,71	0,65							
70	0,91	0,84	0,74	0,68							
80	1,00	0,92	0,80	0,74							
90		1,00	0,87	0,80	0,66						
100			0,93	0,86	0,70						
110			1,00	0,91	0,75	0,66					
120				0,97	0,79	0,69	0,64				
140				1,00	0,87	0,76	0,70	0,65			
160					0,96	0,83	0,76	0,71	0,66		
180					1,00	0,90	0,82	0,76	0,71	0,67	0,64
210						1,00	0,91	0,84	0,78	0,74	0,70
240							1,00	0,92	0,86	0,80	0,76
270								1,00	0,93	0,87	0,82
300									1,00	0,93	0,88
330										1,00	0,94
360											1,00

$$f_{R,N} = 0{,}28 + 0{,}72\,\frac{c}{h_{nom}}$$

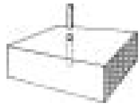
Limits: $c_{min} \le c \le c_{cr,N}$
$c_{min} = 0{,}5 \cdot h_{nom}$
$c_{cr,N} = 1{,}0 \cdot h_{nom}$

Note: If more than 3 edges are smaller than $c_{cr,N}$, consult your Hilti technical advisory service.

HVU adhesive with HAS rod

$N_{Rd,s}$ [1)] : Steel design tensile resistance

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
HAS grade 5.8 [2)] [kN]	10,9	17,4	25,4	48,1	75,1	108,1	*142,3*	*173,0*	*215,7*	*253,1*	*304,3*
HAS grade 8.8 [2)] [kN]	*17,5*	*27,9*	*40,7*	*78,9*	*120,1*	*172,9*	227,8	276,8	345,2	404,9	486,9
HAS-R,HAS-HCR[2)3)] [kN]	12,3	19,6	28,6	54,0	84,3	121,0	*89,0*	*108,1*	*134,8*	*158,2*	*190,2*



1) The design tensile resistance is calculated from the characteristic tensile resistance, $N_{Rk,s}$, using $N_{Rd,s}= A_s \cdot f_{uk}/\gamma_{Ms,N}$, where the partial safety factor, $\gamma_{Ms,N}$, for grade 5.8 and 8.8 is 1.5; 1.87 for grades A4-70 and HCR of the M8 to M24 sizes and 2.4 for grades A4-70 and HCR in the sizes M27 – M39.

2) Data given in *italics* applies to non-standard rods.

3) Note: The values for the nominal tensile steel strength, f_{uk}, for grade A4 change for the M27 to M39 sizes from 700 N/mm² to 500 N/mm² and the yield strength, f_{yk}, changes for the M27 to M39 sizes from 450 N/mm² to 250 N/mm². The partial safety factor, $\gamma_{Ms,N}$, changes with the steel strengths as stated in note 1) above.

N_{Rd} : System design tensile resistance

N_{Rd} = lower of $N_{Rd,c}$ and $N_{Rd,s}$

Combined loading: Only if tensile load and shear load applied (See page 31 and section 4 “Examples”).

Detailed design method – Hilti CC

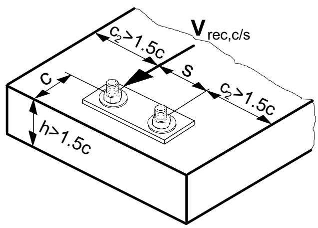
(The Hilti CC method is a simplified version of ETAG Annex C.)

SHEAR

The design shear resistance of a single anchor is the lower of

$V_{Rd,c}$: concrete edge resistance

$V_{Rd,s}$: steel resistance

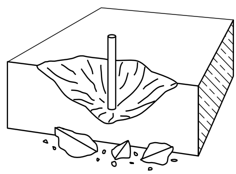


Note: If the conditions for h and c_2 are not met, consult your Hilti technical advisory service.

$V_{Rd,c}$: Concrete edge design resistance

The lowest concrete edge resistance must be calculated. All near edges must be checked, (not only the edge in the direction of shear). The direction of shear is accounted for by the factor $f_{\beta,V}$.

$$V_{Rd,c} = V^0_{Rd,c} \cdot f_{B,V} \cdot f_{AR,V} \cdot f_{\beta,V}$$



$V^0_{Rd,c}$: Concrete edge design resistance

- Concrete compressive strength, $f_{ck,cube(150)} = 25\ N/mm^2$
- at a minimum edge distance c_{min}

Anchor size	M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
$V^o_{Rd,c}$ [1] [kN]	2.6	3.4	5.0	6.7	12.4	18.5	23.6	30.2	36.8	44.3	52.1
c_{min} [mm] min. edge distance	40	45	55	65	85	105	120	135	150	165	180

1) The design shear resistance is calculated from the characteristic shear resistance, $V^o_{Rk,c}$, using $V^o_{Rd,c} = V^o_{Rk,c}/\gamma_{Mc,V}$, where the partial safety factor, $\gamma_{Mc,V}$, is 1.5.

$f_{B,V}$: Influence of concrete strength

Concrete strength designation (ENV 206)	Cylinder compressive strength, $f_{ck,cyl}$ [N/mm²]	**Cube compressive strength, $f_{ck,cube}$ [N/mm²]**	$f_{B,N}$
C16/20	16	**20**	**0.89**
C20/25	20	**25**	**1**
C25/30	25	**30**	**1.1**
C30/37	30	**37**	**1.22**
C35/45	35	**45**	**1.34**
C40/50	40	**50**	**1.41**
C45/55	45	**55**	**1.48**
C50/60	50	**60**	**1.55**
	Concrete cylinder: height 30cm, 15cm diameter	Concrete cube: side length 15cm	
	Concrete test specimen geometry		

$$f_{B,V} = \sqrt{\frac{f_{ck,cube}}{25}}$$

Limits:
$20\ N/mm^2 \le f_{ck,cube} \le 60\ N/mm^2$

$f_{AR,V}$: Influence of spacing and edge distance

Formula for **single**-anchor fastening influenced only by edge

$$f_{AR,V} = \frac{c}{c_{min}}\sqrt{\frac{c}{c_{min}}}$$

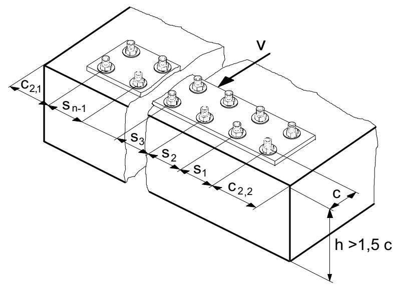
Formula for **two**-anchor fastening (edge plus 1 spacing) only valid for s < 3c

$$f_{AR,V} = \frac{3c + s}{6c_{min}}\sqrt{\frac{c}{c_{min}}}$$

results tabulated below

General formula for **n**-anchor fastening (edge plus n-1 spacing) only valid where s_1 and s_{n-1} are each < 3c and c2 > 1.5c

$$f_{AR,V} = \frac{3c + s_1 + s_2 + ... + s_{n-1}}{3nc_{min}} \cdot \sqrt{\frac{c}{c_{min}}}$$



Note: It is assumed that only the row of anchors closest to the free concrete edge carries the centric shear load.

$f_{AR,V}$: Influence of edge distance and spacing

$f_{AR,V}$		c/c_{min} →															
		1,0	1,2	1,4	1,6	1,8	2,0	2,2	2,4	2,6	2,8	3,0	3,2	3,4	3,6	3,8	4,0
Single anchor with edge influence,		1,00	1,31	1,66	2,02	2,41	2,83	3,26	3,72	4,19	4,69	5,20	5,72	6,27	6,83	7,41	8,00
s/c_{min} ↓	1,0	0,67	0,84	1,03	1,22	1,43	1,65	1,88	2,12	2,36	2,62	2,89	3,16	3,44	3,73	4,03	4,33
	1,5	0,75	0,93	1,12	1,33	1,54	1,77	2,00	2,25	2,50	2,76	3,03	3,31	3,60	3,89	4,19	4,50
	2,0	0,83	1,02	1,22	1,43	1,65	1,89	2,13	2,38	2,63	2,90	3,18	3,46	3,75	4,05	4,35	4,67
	2,5	0,92	1,11	1,32	1,54	1,77	2,00	2,25	2,50	2,77	3,04	3,32	3,61	3,90	4,21	4,52	4,83
	3,0	1,00	1,20	1,42	1,64	1,88	2,12	2,37	2,63	2,90	3,18	3,46	3,76	4,06	4,36	4,68	5,00
	3,5		1,30	1,52	1,75	1,99	2,24	2,50	2,76	3,04	3,32	3,61	3,91	4,21	4,52	4,84	5,17
	4,0			1,62	1,86	2,10	2,36	2,62	2,89	3,17	3,46	3,75	4,05	4,36	4,68	5,00	5,33
	4,5				1,96	2,21	2,47	2,74	3,02	3,31	3,60	3,90	4,20	4,52	4,84	5,17	5,50
	5,0					2,33	2,59	2,87	3,15	3,44	3,74	4,04	4,35	4,67	5,00	5,33	5,67
	5,5						2,71	2,99	3,28	3,57	3,88	4,19	4,50	4,82	5,15	5,49	5,83
	6,0						2,83	3,11	3,41	3,71	4,02	4,33	4,65	4,98	5,31	5,65	6,00
	6,5							3,24	3,54	3,84	4,16	4,47	4,80	5,13	5,47	5,82	6,17
	7,0								3,67	3,98	4,29	4,62	4,95	5,29	5,63	5,98	6,33
	7,5									4,11	4,43	4,76	5,10	5,44	5,79	6,14	6,50
	8,0										4,57	4,91	5,25	5,59	5,95	6,30	6,67
	8,5											5,05	5,40	5,75	6,10	6,47	6,83
	9,0											5,20	5,55	5,90	6,26	6,63	7,00
	9,5												5,69	6,05	6,42	6,79	7,17
	10,0													6,21	6,58	6,95	7,33
	10,5														6,74	7,12	7,50
	11,0															7,28	7,67
	11,5																7,83
	12,0																8,00

These results are for a two-anchor fastening.
For fastenings with more than two anchors, use the general formulae for n anchors.

$f_{\beta,V}$: Influence of shear loading direction

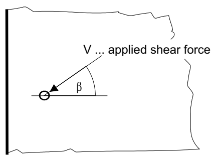
Angle, β [°]	$f_{\beta,V}$
0 to 55	**1**
60	**1.1**
70	**1.2**
80	**1.5**
90 to 180	**2**

Formulae:

$f_{\beta,V} = 1$ for $0° \leq \beta \leq 55°$

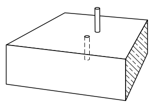
$f_{\beta,V} = \dfrac{1}{\cos\beta + 0.5\sin\beta}$ for $55° < \beta \leq 90°$

$f_{\beta,V} = 2$ for $90° < \beta \leq 180°$



$V_{Rd,s}$ 1) : Steel design shear resistance

Anchor size		M8	M10	M12	M16	M20	M24	M27	M30	M33	M36	M39
HAS grade 5.8 2)	[kN]	7,9	12,6	18,3	34,6	54,0	77,8	*102,5*	*124,6*	*155,3*	*182,2*	*219,1*
HAS grade 8.8 2)	[kN]	*12,6*	*20,1*	*29,3*	*55,3*	*86,4*	*124,4*	164,0	199,3	248,4	291,5	350,6
HAS-R, HAS-HCR 2) 3)	[kN]	8.8	14.1	20.5	38.8	60.6	87.2	*64.1*	*77.9*	*97.1*	*113.9*	*137*



1) The design shear resistance is calculated using $V_{Rd,s}$= (0,6 A_s f_{uk})/$\gamma_{Ms,V}$. The values for the stressed cross-section, A_s , and the nominal tensile strength of steel, f_{uk}, are given in the table "Anchor mechanical properties and geometry". The partial safety factor, $\gamma_{Ms,V}$, is 1.25 for grades 5.8 and 8.8; 1.56 for grade sA4-70 and HCR in the sizes M8 to M24, and 2.0 for grade A4-70 in the sizes M27 to M39.

2) Data given in *italics* applies to non-standard rods.

3) Note: The values for the nominal tensile strength of steel, f_{uk}, for grade A4-70 change for the M27 to M39 sizes from 700 N/mm² to 500 N/mm² and the yield strength, f_{yk} , changes for the M27 to M39 sizes from 450N/mm² to 250N/mm². The partial safety factor, $\gamma_{Ms,V}$, changes the steel strengths as stated in note 1) above.

V_{Rd} : System design shear resistance

V_{Rd} = lower of $V_{Rd,c}$ and $V_{Rd,s}$

Combined loading: Only if tensile load and shear load applied (See page 31 and section 4 "Examples").