HVU adhesive with HIS-N / HIS-RN sleeve

Features:	
	- anchor fastenings flush with surface
	- foil capsule vs. glass
	- no expansion force in base material
	- high loading capacity
	- small edge distance and spacing
	- complete system consisting of robust foil capsule, internally threaded sleeve and setting tool
Material:	
HIS-N:	- carbon steel galvanised to 5 microns
HIS-RN	- stainless steel, A4-70: 1.4401
HVU capsule:	- urethane methacrylate resin, styrene free, hardener, quartz sand or corundum, foil tube

HVU capsule

HIS-N, HIS-RN internally threaded sleeves

Concrete | Small edge distance/ spacing | Fire resistance | Corrosion resistance | Hilti Anchor programme

Basic loading data (for a single anchor): HIS-N

All data on this page applies to

For detailed design method, see pages 212 – 217.

- concrete: See table below.
- correct setting (See setting operations page 211)
- no edge distance and spacing influence
- tensile values are for HIS-N (derived using grade 12.9 rods)
- *shear (steel failure):* rod / bolt of steel grade 5.8

CONC **non-cracked concrete**

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

Anchor size	M8	M10	M12	M16	M20
Tensile, $N_{Ru,m}$	*37.2*	85.1	102.4	161.3	*210.0*
Shear, $V_{Ru,m}$	*11.9*	*18.8*	*27.3*	*50.9*	*79.4*

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

Anchor size	M8	M10	M12	M16	M20
Tensile, N_{Rk}	*35.6*	81.6	66.9	150.3	*174.3*
Shear, V_{Rk}	*11.0*	*17.4*	*25.3*	*47.1*	*73.5*

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
Tensile, N_{Rd}	12.2	19.3	28.1	52.3	81.7
Shear, V_{Rd}	8.8	13.9	20.2	37.7	58.8

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

Anchor size	M8	M10	M12	M16	M20
Tensile, N_{Rec}	8.7	13.8	20.1	37.4	58.6
Shear, V_{Rec}	6.3	9.9	14.5	26.9	42.0

Basic loading data (for a single anchor): HIS-RN

All data on this section applies to

For detailed design method, see pages 212 – 217.

- concrete: See table below.
- correct setting (See setting operations page 211)
- no edge distance and spacing influence
- tensile values are for HIS-RN (derived using grade 12.9 rods)
- *shear (steel failure):* rod / bolt of steel grade A4-70

CONC **non-cracked concrete**

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

Anchor size	M8	M10	M12	M16	M20
Tensile, $N_{Ru,m}$	*40.5*	85.1	102.4	161.3	*173.1*
Shear, $V_{Ru,m}$	*16.6*	*26.3*	*38.2*	*71.2*	*111.1*

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

Anchor size	M8	M10	M12	M16	M20
Tensile, N_{Rk}	*37.5*	81.6	66.9	150.3	*160.3*
Shear, V_{Rk}	*15.4*	*24.4*	*35.4*	*65.9*	*102.9*

Following values according to the

Concrete Capacity Method

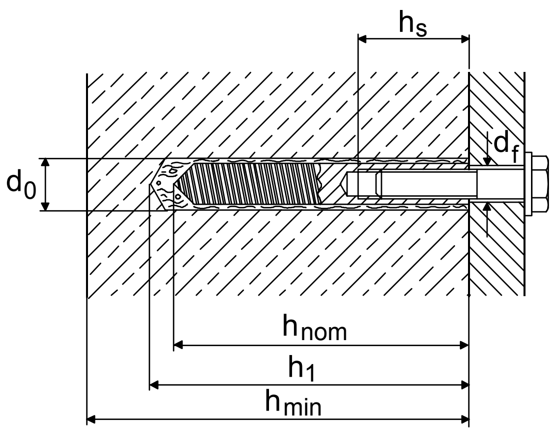
Design resistance, R_d [kN]: concrete, $f_{ck,cube}$ = 25 N/mm^2

Anchor size	M8	M10	M12	M16	M20
Tensile, N_{Rd}	13.7	21.7	31.6	58.8	91.7
Shear, V_{Rd}	9.9	15.6	22.7	42.3	66.0

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

Anchor size	M8	M10	M12	M16	M20
Tensile, N_{Rec}	9.8	15.5	22.5	42.0	65.5
Shear, V_{Rec}	7.1	11.1	16.2	30.2	47.1

Setting details



HVU adhesive with HIS-N / HIS-RN sleeve

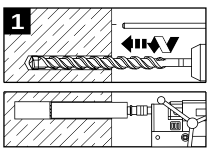
Anchor size			M8	M10	M12	M16	M20
	Foil capsule	HVU...	M10x90	M12x110	M16x125	M20x170	M24x210
	Sleeve	HIS-N ..., HIS-RN ...	M8x90	M10x110	M12x125	M16x170	M20x205
d_0 [mm]	Drill bit diameter		14	18	22	28	32
h_1 [mm]	Hole depth		90	110	125	170	205
h_{min} [mm]	Min. thickness of base material		120	150	170	230	280
h_s [mm]	Thread engagement length	min max	8 20	10 25	12 30	16 40	20 50
d_f [mm]	Rec. clearance hole		9	12	14	18	22
T_{inst} [Nm]	Tightening torque	HIS-N HIS-RN	15 12	28 23	50 40	85 70	170 130
Drill bit		TE-CX-	14/22	-	-	-	-
Drill bit		TE-T-	-	18/32	22/32	28/32	32/37

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

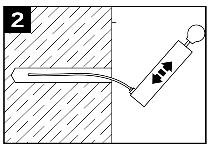
Installation equipment

Rotary hammer (TE5, TE6, TE6A, TE15, TE15-C, TE18-M, TE 55 or TE 76), a drill bit, a setting tool, a TE adapter (TE-C-HIS, TE-F-Y-HIS) with HIS-S - M8 - M20 and a blow-out pump.

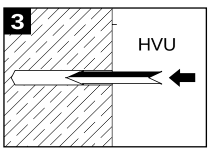
Setting operations



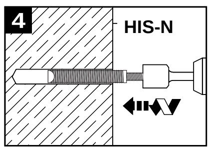
Drill hole.



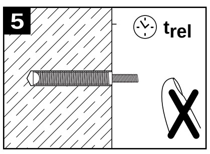
Blow out dust and fragments.



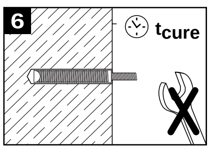
Insert HVU capsule.



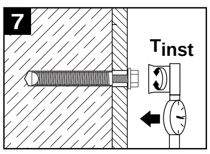
Drive in anchor.



Allow rel time to pass.



Wait for curing.

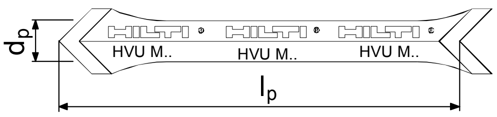


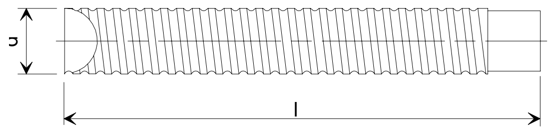
Apply tightening torque.

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

HVU adhesive with HIS-N / HIS-RN sleeve

Anchor geometry and mechanical properties





Anchor size				M8	M10	M12	M16	M20
Capsule			**HVU ...**	M10x90	M12x110	M16x125	M20x170	M24x210
l_p	[mm]	Capsule length		110	127	140	170	200
d_p	[mm]	Capsule diameter		10,7	13,1	17,1	22	25,7
Element			**HIS-N ..., HIS-RN ...**	M8x90	M10x110	M12x125	M16x170	M20x210
l	[mm]	Sleeve length		90	110	125	170	210
d	[mm]	Sleeve outside diameter		12,5	16,5	20,5	25,4	27,6
A_s	[mm²]	Stressed cross-section	Sleeve Bolt	53,6 36,6	110 58,0	170 84,3	255 157	229 245
f_{uk}	[N/mm²]	Nominal tensile strength	HIS-N HIS-RN	510 700	510 700	460 700	460 700	460 700
f_{yk}	[N/mm²]	Yield strength	HIS-N HIS-RN	410 350	410 350	375 350	375 350	375 350
W	[mm³]	Moment of resistance of bolt		31,2	62,3	109	277	375
$M_{Rd,s}$	[Nm]	Design bending resistance of bolt [1)]	5.8 8.8 A2/A4	12,7 20,4 14,3	25,6 41,0 28,7	45,1 75,1 50,6	117,1 187,4 131,4	228,8 366,1 256,7

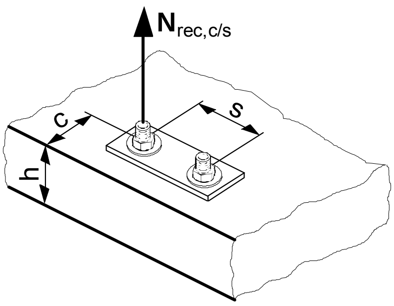
[1)] The design bending resistance of the bolt is calculated from $M_{Rd,s} = (1,2 \cdot W \cdot f_{uk})/\gamma_{ms,b}$, where the partial safety factor, $\gamma_{ms,b}$, for grade 5.8 and 8.8 bolts is 1.25 and 1.56 for A4-70 and A2-70. The final safety check is then $M_{Sk} \cdot \gamma_F \leq M_{Rd,s}$.

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 the 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



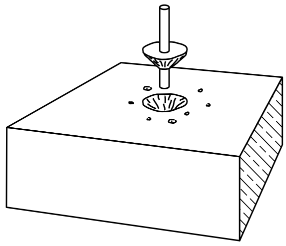
The design tensile resistance of a single anchor is the lower of

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

$N_{Rd,s}$: steel resistance of the bolt or sleeve

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

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



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

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

Anchor size	M8	M10	M12	M16	M20
$N^{o}_{Rd,c}$ [kN]	22.6	35.4	46.9	85.1	120.1
h_{nom} [mm] Nominal anchorage depth	90	110	125	170	205

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

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

Concrete strength designation (ENV 206)	compressive cylinder strength, $f_{ck,cyl}$ [N/mm²]	**compressive cube strength, $f_{ck,cube}$ [N/mm²]**	$f_{B,N}$
C16/20	16	**20**	**0.95**
C20/25	20	**25**	**1**
C25/30	25	**30**	**1.04**
C30/37	30	**37**	**1.10**
C35/45	35	**45**	**1.16**
C40/50	40	**50**	**1.20**
C45/55	45	**55**	**1.24**
C50/60	50	**60**	**1.28**
	Concrete cylinder: height 30cm, 15cm diameter	Concrete cube: side length 15cm	
	Concrete test specimen geometry		

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

for $f_{ck,cube(150)}$ =20 N/mm²

$$f_{B,N} = 1 + \left(\frac{f_{ck,cube} - 25}{125}\right)$$

Limits: 25 N/mm² $\leq f_{ck,cube(150)} \leq$ 60 N/mm²

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

Spacing, s [mm]	Anchor size M8	M10	M12	M16	M20
45	0.63				
50	0.64				
55	0.65	0.63			
60	0.67	0.64			
65	0.68	0.65	0.63		
70	0.69	0.66	0.64		
80	0.72	0.68	0.66		
90	0.75	0.70	0.68	0.63	
100	0.78	0.73	0.70	0.65	
110	0.81	0.75	0.72	0.66	0.63
120	0.83	0.77	0.74	0.68	0.65
140	0.89	0.82	0.78	0.71	0.67
160	0.94	0.86	0.82	0.74	0.70
180	1.00	0.91	0.86	0.76	0.72
200		0.95	0.90	0.79	0.74
220		1.00	0.94	0.82	0.77
250			1.00	0.87	0.80
280				0.91	0.84
310				0.96	0.88
340				1.00	0.91
390					0.98
410					1.00

$$f_{A,N} = 0.5 + \frac{s}{4 \cdot h_{nom}}$$

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

HVU adhesive with HIS-N / HIS-RN sleeve

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

Edge distance, c [mm]	Anchor size				
	M8	M10	M12	M16	M20
45	0.64				
50	0.68				
55	0.72	0.64			
60	0.76	0.67			
65	0.80	0.71	0.65		
70	0.84	0.74	0.68		
80	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	0.67
120			0.97	0.79	0.70
140			1.00	0.87	0.77
160				0.96	0.84
180				1.00	0.91
210					1.00

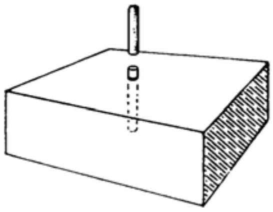
$$f_{R,N} = 0.28 + 0.72 \frac{c}{h_{nom}}$$

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

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

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

Anchor size		M8	M10	M12	M16	M20
$N_{Rd,s}^{sleeve}$ [kN] Sleeve	HIS-N	18,2	37,4	52,1	78,2	70,2
	HIS-RN	15,6	32,1	49,6	74,4	66,8
$N_{Rd,s}^{bolt}$ [kN] Bolt	grade 5.8	12,2	19,3	28,1	52,3	81,7
	grade 8.8	19,5	30,9	44,9	84,0	130,7
	grade A4-70	13,7	21,7	31,6	58,8	91,7



1) The design tensile resistance is calculated from the characteristic tensile resistance, $N_{Rk,s}$, by $N_{Rd,s} = A_s \cdot f_{uk}/\gamma_{Ms,N}$, where the partial safety factor, $\gamma_{Ms,N}$, for the sleeve / bolts of grades 5.8 and 8.8 is 1.5 or 1.87 for grade A4-70 and 2.4 for the sleeve.

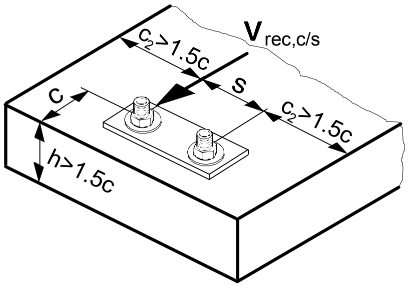
N_{Rd} : System design tensile resistance

$$N_{Rd} = \text{lower of } N_{Rd,c},\ N_{Rd,s}^{sleeve} \text{ or } N_{Rd,s}^{bolt}$$

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.)



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

SHEAR

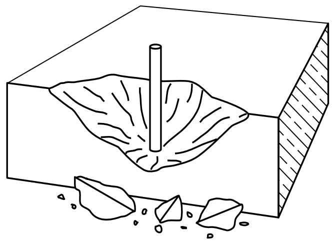
The design shear resistance of a single anchor is the lower of

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

$V_{Rd,s}$: steel resistance of the bolt

$V_{Rd,c}$: 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 $f_{\beta,V}$.



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

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

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

Anchor size		M8	M10	M12	M16	M20
$V^0_{Rd,c}$ [1)] [kN]		3.6	5.4	7.6	12.8	19.2
c_{min} [mm]	Min. edge distance	45	55	65	85	105

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

f_{BV}: 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]**	$f_{B,V}$
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		

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

Limits:
20 N/mm^2 $\leq f_{ck,cube(150)} \leq$ 60 N/mm^2

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

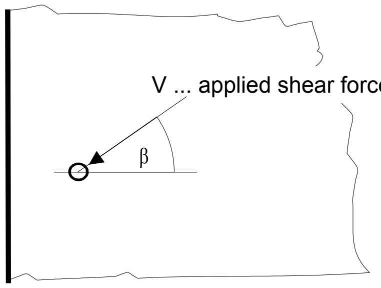
Angle, ß [°]	$f_{\beta,V}$
0 to 55	**1**
60	**1.1**
70	**1.2**
80	**1.5**
90 to 180	**2**

Formulae:

$$f_{\beta,V} = 1 \qquad \text{for } 0° \le ß \le 55°$$

$$f_{\beta,V} = \frac{1}{\cos ß + 0{,}5 \sin ß} \qquad \text{for } 55° < ß \le 90°$$

$$f_{\beta,V} = 2 \qquad \text{for } 90° < ß \le 180°$$



$f_{AR,V}$: Formulae for edge distance and spacing influence

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

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

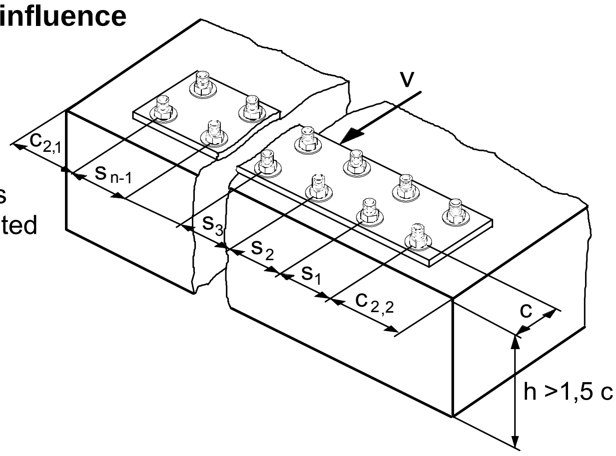
Formula for **two**-anchor fastening anchors (edge plus 1 spacing) only valid for s < 3c

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

General formula for **n**-anchor fastening (edge plus n-1 spacing) only valid where s_1 and s_{n-1} are each < 3c and c_2 > 1.5c

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

results tabulated below



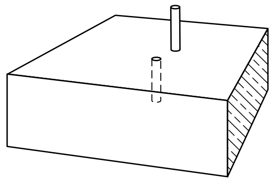
Note: It is assumed that only the row of anchors closest to the free concrete edge carries the centric shear load.

$f_{AR,V}$: 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 at the top of the page.**

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



Anchor size				M8	M10	M12	M16	M20
$V_{Rd,s}$ [1]	[kN]	Bolt	steel grade 5.8	8.8	13.9	20.2	37.7	58.8
			steel grade 8.8	14.1	22.3	32.4	60.3	94.1
			A4-70	9.9	15.6	22.7	42.3	66.0

[1] The design shear resistance is calculated from $V_{Rd,s}= (0,6\ A_s\ f_{uk})/\gamma_{Ms,V}$. The values for the stressed cross-section, A_s , of the bolt and the nominal tensile steel strength, f_{uk} , are taken from the bolt standard ISO 898. The partial safety factor, $\gamma_{Ms,V}$, for grades 5.8 and 8.8 is 1.25 and 1.56 for grade A4-70.

V_{Rd} : System design shear resistance

$$\boxed{V_{Rd} = \text{lower of } V_{Rd,c} \text{ and } V_{Rd,s}^{\text{bolt}}}$$

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