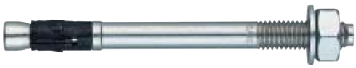
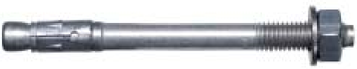
fischer Anchor bolt FAZ II

Anchor design according to fischer specification

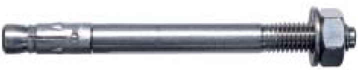
1. Types



FAZ II – (gvz)



FAZ II A4 – (Stainless steel)



FAZ II C – (C-Stainless steel)

FAZ II-GS – (gvz, A4, C) with large washer

European Technical Approval – Option 1 for cracked concrete *)

Fire resistance classification R 120

FM APPROVED from thread M 10

ICC ES ESR-2948 See ICC-ES Evaluation Report at www.ic-es.org Inspection agency: AA-707 *)

ZTV 1200 °C anchor types see test report

CALCULATION WITH CC COMPUFIX CALCULATION SOFTWARE

Features and Advantages

- European Technical Approval option 1*) for cracked and non-cracked concrete.
- ICC-ES Evaluation Report *) for cracked and non-cracked concrete. Seismic design categories A-F. acc. to IBC 2006/2009
- Suitable for concrete C12/15 and natural stone with dense structure.
- Independent controlled and confirmed product characteristics due to the European Technical Approval.
- Fire resistance classifications according to test report, independently proved gives the safety in case of fire.
- Optimized expansion clip ensures uniformed load distribution which allows smallest spacing and edge distances.

*) The conditions of use in the European Technical Approval or in the ICC-ES Evaluation Report may vary from those of the Technical Handbook.

Materials

Anchor bolt:
- Carbon steel, zinc plated (5 µm) and passivated (gvz)
- Stainless steel of corrosion resistance class III, e.g. A4 (1.4401 optional 1.4571, 1.4362) and according to ASTM/AISI steel grade 316
- Highly corrosion-resistant steel of the corrosion resistance class IV, e.g. 1.4529

2. Ultimate resistance of single anchors with large spacing and large edge distance

Mean values

Anchor type		FAZ II 8	FAZ II 10	FAZ II 12	FAZ II 16	FAZ II 20	FAZ II 24
		gvz / A4 / C	gvz / A4 / C	gvz / A4 / C	gvz / A4 / C	gvz / A4	gvz / A4
non-cracked concrete							
Tension	C 20/25 N_u [kN]	16.6	26.7	38.3	54.7	61.6	87.9
	C 50/60 N_u [kN]	16.6	28.6	43.6	69.5	97.4	139.0
Shear	≧ C 20/25 V_u [kN]	12.5	21.6	33.3	70.3	84.3	101.2
cracked concrete							
Tension	C 20/25 N_u [kN]	12.8	20.0	27.4	45.7	55.8	75.6
	C 50/60 N_u [kN]	16.6	28.6	43.4	69.5	88.2	119.5
Shear	≧ C 20/25 V_u [kN]	12.5	21.6	33.3	70.3	84.3	101.2

fischer Anchor bolt FAZ II

Anchor design according to fischer specification

3. Characteristic, design and recommended resistance of single anchors with large spacing and large edge distance

3.1 Characteristic resistance

Anchor type				FAZ II 8 (gvz / A4 / C)	FAZ II 10 (gvz / A4 / C)	FAZ II 12 (gvz / A4 / C)	FAZ II 16 (gvz / A4 / C)	FAZ II 20 (gvz / A4)	FAZ II 24 (gvz / A4)
non-cracked concrete									
Tension	C 20/25	N_{Rk}	[kN]	10.8	17.7	26.6	43.5	55.6	77.6
	C 50/60	N_{Rk}	[kN]	16.0	27.0	41.2	66.0	86.1	120.3
Shear	≧ C 20/25	V_{Rk}	[kN]	12.0	20.0	29.5	55.0	70.0	86.0
cracked concrete									
Tension	C 20/25	N_{Rk}	[kN]	9.0	14.0	20.0	28.2	36.0	50.3
	C 50/60	N_{Rk}	[kN]	14.0	21.7	31.0	43.7	55.8	78.0
Shear	≧ C 20/25	V_{Rk}	[kN]	12.0	20.0	29.5	55.0	70.0	86.0

3.2 Design resistance

Anchor type				FAZ II 8 (gvz / A4 / C)	FAZ II 10 (gvz / A4 / C)	FAZ II 12 (gvz / A4 / C)	FAZ II 16 (gvz / A4 / C)	FAZ II 20 (gvz / A4)	FAZ II 24 (gvz / A4)
non-cracked concrete									
Tension	C 20/25	N_{Rd}	[kN]	7.2	11.8	17.7	29.0	37.0	51.8
	C 50/60	N_{Rd}	[kN]	10.7	18.0	27.5	44.0	57.4	80.2
Shear	≧ C 20/25	V_{Rd}	[kN]	9.6	16.0	23.6	44.0	56.0	68.8
cracked concrete									
Tension	C 20/25	N_{Rd}	[kN]	6.0	9.3	13.3	18.8	24.0	33.5
	C 50/60	N_{Rd}	[kN]	9.3	14.5	20.7	29.2	37.2	52.0
Shear	≧ C 20/25	V_{Rd}	[kN]	9.6	16.0	23.6	44.0	56.0	68.8

3.3 Recommended resistance [1)]

Anchor type				FAZ II 8 (gvz / A4 / C)	FAZ II 10 (gvz / A4 / C)	FAZ II 12 (gvz / A4 / C)	FAZ II 16 (gvz / A4 / C)	FAZ II 20 (gvz / A4)	FAZ II 24 (gvz / A4)
non-cracked concrete									
Tension	C 20/25	N_R	[kN]	5.1	8.4	12.7	20.7	26.5	37.0
	C 50/60	N_R	[kN]	7.6	12.9	19.6	31.4	41.0	57.3
Shear	≧ C 20/25	V_R	[kN]	6.9	11.4	16.9	31.4	40.0	49.1
cracked concrete									
Tension	C 20/25	N_R	[kN]	4.3	6.7	9.5	13.4	17.1	24.0
	C 50/60	N_R	[kN]	6.6	10.3	14.8	20.8	26.6	37.1
Shear	≧ C 20/25	V_R	[kN]	6.9	11.4	16.9	31.4	40.0	49.1

[1)] Material safety factors γ_M and safety factor for action γ_L = 1.4 are included. Material safety factor γ_M depends on failure mode of the anchor.

4. Calculation of tension resistance

The decisive design resistance in tension is the lowest value of following failure modes:

Steel failure: $N_{Rd,s}$

Pull-out / pull-through failure: $N_{Rd,p} = N^0_{Rd,p} \cdot f_{b,N}$

Concrete cone failure: $N_{Rd,c} = N^0_{Rd,c} \cdot f_{b,N} \cdot f_{s1} \cdot f_{s2} \cdot f_{s3} \cdot f_{c1,A} \cdot f_{c1,B} \cdot f_{c2}$

Concrete splitting failure: $N_{Rd,sp} = N^0_{Rd,c} \cdot f_{b,N} \cdot f_{s1,sp} \cdot f_{s2,sp} \cdot f_{s3,sp} \cdot f_{c1,sp,A} \cdot f_{c1,sp,B} \cdot f_{c2,sp} \cdot f_h$

4.1 Steel failure of the highest loaded anchor

Design resistance of single anchor

Anchor type			FAZ II 8			FAZ II 10			FAZ II 12			FAZ II 16			FAZ II 20		FAZ II 24	
			gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	gvz	A4
Design resistance	$N_{Rd,s}$	[kN]	10.7			18.0			27.7			44.0			74.0		100.0	

4.2 Pull-out/pull-through failure of the highest loaded anchor

$$N_{Rd,p} = N^0_{Rd,p} \cdot f_{b,N}$$

Design resistance of single anchor

Anchor type			FAZ II 8	FAZ II 10	FAZ II 12	FAZ II 16	FAZ II 20	FAZ II 24
non-cracked concrete								
Design resistance	$N^0_{Rd,p}$	[kN]	7.2	11.8	17.7	29.0	37.0	51.8
cracked concrete								
Design resistance	$N^0_{Rd,p}$	[kN]	6.0	9.3	13.3	18.8	24.0	33.5

4.3 Concrete cone failure and splitting of the most unfavourable anchor

Concrete cone failure: $N_{Rd,c} = N^0_{Rd,c} \cdot f_{b,N} \cdot f_{s1} \cdot f_{s2} \cdot f_{s3} \cdot f_{c1,A} \cdot f_{c1,B} \cdot f_{c2}$

Concrete splitting failure: $N_{Rd,sp} = N^0_{Rd,c} \cdot f_{b,N} \cdot f_{s1,sp} \cdot f_{s2,sp} \cdot f_{s3,sp} \cdot f_{c1,sp,A} \cdot f_{c1,sp,B} \cdot f_{c2,sp} \cdot f_h$

Proof of splitting failure is only necessary if all of the following conditions are met:
- non-cracked concrete
- $c_{cr,sp} > c_{cr,N}$
- $c < 1.2\, c_{cr,sp}$

Design resistance of single anchor

Anchor type			FAZ II 8	FAZ II 10	FAZ II 12	FAZ II 16	FAZ II 20	FAZ II 24
non-cracked concrete								
Design resistance	$N^0_{Rd,c}$	[kN]	11.2	17.2	21.7	29.0	37.0	51.8
cracked concrete								
Design resistance	$N^0_{Rd,c}$	[kN]	7.2	11.2	14.1	18.8	24.0	33.5

4.3.1 Influence of concrete strength for tension

$$f_{b,N} = \sqrt{\frac{f_{ck,cube}}{25}} = \sqrt{\frac{f_{ck,cyl}}{20}}$$

Concrete strength class			C 12/15	C 16/20	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
Cylinder compressive strength	$f_{ck,cyl}$	[N/mm²]	12	16	20	25	30	35	40	45	50
Cube compressive strength	$f_{ck,cube}$	[N/mm²]	15	20	25	30	37	45	50	55	60
Influence factor	$f_{b,N}$	[-]	0.77	0.89	1.00	1.10	1.22	1.34	1.41	1.48	1.55

fischer Anchor bolt FAZ II

Anchor design according to fischer specification

4.3.2 Concrete cone failure

Characteristic edge distance and spacing for design

Anchor type		FAZ II 8	FAZ II 10	FAZ II 12	FAZ II 16	FAZ II 20	FAZ II 24
h_{ef}		45	60	70	85	100	125
$s_{cr,N}$	[mm]	135	180	210	255	300	375
$c_{cr,N}$	[mm]	68	90	105	128	150	188

4.3.2.1 Influence of spacing / concrete cone failure

$$f_{s1} = f_{s2} = f_{s3} = \left(1.0 + \frac{s}{s_{cr,N}}\right) \cdot 0.5 \leqq 1.0$$

$s/s_{cr,N}$	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.55	0.6	0.65	0.7	0.75	0.8	0.85	0.9	0.95	≥1.0
f_{s1}	0.55	0.58	0.6	0.63	0.65	0.68	0.7	0.73	0.75	0.78	0.8	0.83	0.85	0.88	0.9	0.93	0.95	0.98	1.0

4.3.2.2 Influence of edge distance / concrete cone failure

$$f_{c1,A} = 0.7 + 0.3 \cdot \frac{c}{c_{cr,N}} \leqq 1.0 \qquad f_{c1,B} = f_{c2} = \left(1.0 + \frac{c}{c_{cr,N}}\right) \cdot 0.5 \leqq 1.0$$

$c/c_{cr,N}$	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.55	0.6	0.65	0.7	0.75	0.8	0.85	0.9	0.95	≥1.0
$f_{c1,A}$	0.73	0.75	0.76	0.78	0.79	0.81	0.82	0.84	0.85	0.87	0.88	0.9	0.91	0.93	0.94	0.96	0.97	0.99	1.0
$f_{c1,B}$ f_{c2}	0.55	0.58	0.6	0.63	0.65	0.68	0.7	0.73	0.75	0.78	0.8	0.83	0.85	0.88	0.9	0.93	0.95	0.98	1.0

4.3.3 Concrete splitting failure

Characteristic edge distance and spacing for design

Anchor type			FAZ II 8	FAZ II 10	FAZ II 12	FAZ II 16	FAZ II 20	FAZ II 24
	h_{ef}		45	60	70	85	100	125
Application with concrete member thickness h ≧ 2 · h_{ef}	$s_{cr,sp}$	[mm]	135	180	210	255	370	430
	$c_{cr,sp}$	[mm]	68	90	105	128	185	215
	h_{min}	[mm]	100	120	140	170	200	250
Application with concrete member thickness h < 2 · h_{ef}	$s_{cr,sp}$	[mm]	180	240	280	340	480	550
	$c_{cr,sp}$	[mm]	90	120	140	170	240	275
	h_{min}	[mm]	80	100	120	140	160	200

4.3.3.1 Influence of spacing / concrete splitting failure

$$f_{s1,sp} = f_{s2,sp} = f_{s3,sp} = \left(1.0 + \frac{s}{s_{cr,sp}}\right) \cdot 0.5 \leqq 1.0$$

$s/s_{cr,sp}$	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.55	0.6	0.65	0.7	0.75	0.8	0.85	0.9	0.95	≥1.0
$f_{s,sp}$	0.55	0.58	0.6	0.63	0.65	0.68	0.7	0.73	0.75	0.78	0.8	0.83	0.85	0.88	0.9	0.93	0.95	0.98	1.0

4.3.3.2 Influence of edge distance / concrete splitting failure

$$f_{c1,sp,A} = 0.7 + 0.3 \cdot \frac{c}{c_{cr,sp}} \leqq 1.0 \qquad f_{c1,sp,B} = f_{c2,sp} = \left(1.0 + \frac{c}{c_{cr,sp}}\right) \cdot 0.5 \leqq 1.0$$

$c/c_{cr,sp}$	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.55	0.6	0.65	0.7	0.75	0.8	0.85	0.9	0.95	≥1.0
$f_{c1,sp,A}$	0.73	0.75	0.76	0.78	0.79	0.81	0.82	0.84	0.85	0.87	0.88	0.9	0.91	0.93	0.94	0.96	0.97	0.99	1.0
$f_{c1,sp,B}$ $f_{c2,sp}$	0.55	0.58	0.6	0.63	0.65	0.68	0.7	0.73	0.75	0.78	0.8	0.83	0.85	0.88	0.9	0.93	0.95	0.98	1.0

4.3.3.3 Influence of concrete thickness / concrete splitting failure

$$f_h = \left(\frac{h}{h_{min}}\right)^{2/3} \leqq 1.5$$

h/h_{min}	1.0	1.05	1.1	1.15	1.2	1.25	1.3	1.35	1.4	1.45	1.5	1.55	1.6	1.65	1.7	1.75	1.8	≥1.84
f_h	1.0	1.03	1.07	1.1	1.13	1.16	1.19	1.22	1.25	1.28	1.31	1.34	1.37	1.4	1.42	1.45	1.48	1.5

5. Calculation of shear resistance

The decisive design resistance in shear is the lowest value of the following failure modes:

Steel failure: $V_{Rd,s}$

Pryout failure: $V_{Rd,cp} = N_{Rd,c} \cdot k$

Concrete edge failure: $V_{Rd,c} = V^0_{Rd,c} \cdot f_{b,V} \cdot f_{\alpha,V} \cdot f_{s1,V} \cdot f_{s2,V} \cdot f_{c2,V} \cdot f_{h,V} \cdot f_m$

5.1 Steel failure for the highest loaded anchor

Design resistance of single anchor

Anchor type	FAZ II 8			FAZ II 10			FAZ II 12			FAZ II 16			FAZ II 20		FAZ II 24	
	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	gvz	A4
Design resistance $V_{Rd,s}$ [kN]	9.6			16.0			23.6			44.0			56.0		68.8	

5.2 Pryout failure for the most unfavourable anchor

$$V_{Rd,cp} = N_{Rd,c} \cdot k$$

k-factor

Anchor type	FAZ II 8	FAZ II 10	FAZ II 12	FAZ II 16	FAZ II 20	FAZ II 24
k	2.0	2.2	2.4	2.8	2.8	2.8

5.3 Concrete edge failure for the most unfavourable anchor

$$V_{Rd,c} = V^{0}_{Rd,c} \cdot f_{b,V} \cdot f_{\alpha,V} \cdot f_{s1,V} \cdot f_{s2,V} \cdot f_{c2,V} \cdot f_{h,V} \cdot f_{m}$$

Proof of concrete edge failure is only necessary, if the following condition is met:

- c < max (10 h_{ef} ; 60 d) with d = nominal anchor diameter

Design resistance of single anchor in concrete C 20/25 dependent on edge distance c_1

edge distance [mm]	$V^0_{Rd,c}$ [kN]											
	FAZ II 8		FAZ II 10		FAZ II 12		FAZ II 16		FAZ II 20		FAZ II 24	
	non-cracked concrete	cracked concrete	non-cracked concrete	cracked concrete	non-cracked concrete	cracked concrete	non-cracked concrete	cracked concrete	non-cracked concrete	cracked concrete	non-cracked concrete	cracked concrete
40	3.3	2.4										
45	3.9	2.8	4.3	3.0								
50	4.5	3.2	4.9	3.5								
55	5.1	3.6	5.6	3.9	5.9	4.2						
60	5.7	4.1	6.2	4.4	6.6	4.7						
65	6.4	4.5	6.9	4.9	7.3	5.2	8.1	5.7				
70	7.1	5.0	7.7	5.4	8.1	5.7	8.9	6.3				
75	7.8	5.5	8.4	5.9	8.9	6.3	9.7	6.9				
80	8.5	6.0	9.2	6.5	9.7	6.8	10.5	7.4				
85	9.2	6.5	9.9	7.0	10.5	7.4	11.4	8.1		8.7		
90	10.0	7.1	10.7	7.6	11.3	8.0	12.2	8.7		9.3		
95	10.8	7.6	11.5	8.2	12.1	8.6	13.1	9.3	14.1	10.0		
100	11.6	8.2	12.4	8.8	13.0	9.2	14.1	10.0	15.1	10.7		11.6
110	13.2	9.4	14.1	10.0	14.8	10.5	15.9	11.3	17.0	12.1		13.1
120	14.9	10.6	15.9	11.2	16.6	11.8	17.9	12.7	19.1	13.5		14.6
130	16.7	11.8	17.7	12.5	18.5	13.1	19.9	14.1	21.2	15.0		16.2
135	17.6	12.4	18.7	13.2	19.5	13.8	20.9	14.8	22.2	15.8	24.0	17.0
140	18.5	13.1	19.6	13.9	20.5	14.5	21.9	15.5	23.3	16.5	25.1	17.8
150	20.4	14.4	21.6	15.3	22.5	15.9	24.1	17.0	25.5	18.1	27.5	19.4
160	22.3	15.8	23.6	16.7	24.6	17.4	26.2	18.6	27.8	19.7	29.8	21.1
180	26.3	18.6	27.8	19.7	28.9	20.5	30.7	21.8	32.5	23.0	34.8	24.6
200	30.5	21.6	32.1	22.8	33.4	23.6	35.4	25.1	37.4	26.5	39.9	28.3
250	41.8	29.6	43.9	31.1	45.5	32.2	48.0	34.0	50.5	35.7	53.6	37.9
300	54.2	38.4	56.7	40.2	58.6	41.5	61.7	43.7	64.6	45.8	68.3	48.4
350	67.5	47.8	70.5	49.9	72.7	51.5	76.3	54.1	79.7	56.5	84.0	59.5
400	81.7	57.9	85.1	60.3	87.7	62.1	91.8	65.1	95.7	67.8	100.6	71.3
450	96.7	68.5	100.6	71.2	103.5	73.3	108.2	76.6	112.6	79.8	118.1	83.7
500	112.4	79.6	116.8	82.7	120.1	85.0	125.3	88.8	130.3	92.3	136.4	96.6
550			133.8	94.8	137.4	97.3	143.2	101.5	148.7	105.3	155.4	110.1
600			151.5	107.3	155.4	110.1	161.8	114.6	167.8	118.8	175.2	124.1
650					174.1	123.4	181.1	128.3	187.6	132.9	195.6	138.6
700					193.5	137.1	201.1	142.4	208.0	147.4	216.7	153.5
750					213.5	151.2	221.6	157.0	229.1	162.3	238.4	168.9
800							242.8	172.0	250.8	177.7	260.8	184.7
850							264.5	187.4	273.1	193.4	283.7	201.0
900							286.8	203.2	296.0	209.6	307.2	217.6
1000							333.1	235.9	343.3	243.2	355.9	252.1
1100									392.8	278.2	406.7	288.1
1200									444.2	314.7	459.5	325.5
1300											514.2	364.3
1400											570.8	404.3
1500											629.2	445.7

5.3.1 Influence of concrete strength for shear

$$f_{b,V} = \sqrt{\frac{f_{ck,\,cube}}{25}} = \sqrt{\frac{f_{ck,\,cyl}}{20}}$$

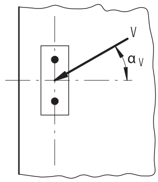
Concrete strength class			C 12/15	C 16/20	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
Cylinder compressive strength	$f_{ck,cyl}$	[N/mm²]	12	16	20	25	30	35	40	45	50
Cube compressive strength	$f_{ck,cube}$	[N/mm²]	15	20	25	30	37	45	50	55	60
Influence factor	$f_{b,V}$	[-]	0.77	0.89	1.00	1.10	1.22	1.34	1.41	1.48	1.55

5.3.2 Influence of load direction

$$f_{\alpha,V} = \sqrt{\frac{1}{(\cos\alpha_V)^2 + \left(\frac{\sin\alpha_V}{2.5}\right)^2}} \leqq 2.5$$

	0	10	20	30	40	50	60	70	80	90
$f_{\alpha,V}$	1.00	1.01	1.05	1.13	1.24	1.40	1.64	1.97	2.32	2.50

For angle α ≧ 90° the component of the shear load acting away from the edge may be neglected and the proof may be done with the component of the load acting parallel to the edge.



5.3.3 Influence of spacing

$$f_{s1,V} = f_{s2,V} = \frac{1}{6} \cdot \frac{s}{c_1} + \frac{1}{2} \leqq 1.0$$

s/c_1	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	≧3.0
$f_{s1,V}$	0.58	0.6	0.62	0.63	0.65	0.67	0.7	0.73	0.77	0.8	0.83	0.87	0.9	0.93	0.97	1.0

5.3.4 Influence of edge distance

Distance to second edge; $c_1 < c_2$

$$f_{c2,V} = \left(\frac{1}{2} + \frac{1}{3} \cdot \frac{c_2}{c_1}\right) \cdot \left(0.7 + 0.3 \cdot \frac{c_2}{1.5 \cdot c_1}\right) \leqq 1.0$$

c_2/c_1	1.0	1.1	1.2	1.3	1.4	≧1.5
$f_{c2,V}$	0.75	0.8	0.85	0.9	0.95	1.0

5.3.5 Influence of member thickness

$$f_{h,V} = \left(\frac{h}{1.5 \cdot c_1}\right)^{0.5} \leqq 1.0$$

h/c_1	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.3	1.4	≧1.5
$f_{h,V}$	0.26	0.37	0.45	0.52	0.58	0.63	0.68	0.73	0.77	0.82	0.89	0.93	0.97	1.0

5.3.6 Influence of group with ≧ 4 anchors in a row at the edge

f_m

s/c_1	0.25	0.5	1.0	≧2.0
f_m	0.3	0.5	0.75	1.0

fischer Anchor bolt FAZ II

Anchor design according to fischer specification

6. Summary of required proof:

6.1 Tension: $N_{Sd} \leqq N_{Rd}$ = *lowest value of* $N_{Rd,s}$; $N_{Rd,p}$; $N_{Rd,c}$; $N_{Rd,sp}$

6.2 Shear: $V_{Sd} \leqq V_{Rd}$ = *lowest value of* $V_{Rd,s}$; $V_{Rd,cp}$; $V_{Rd,c}$

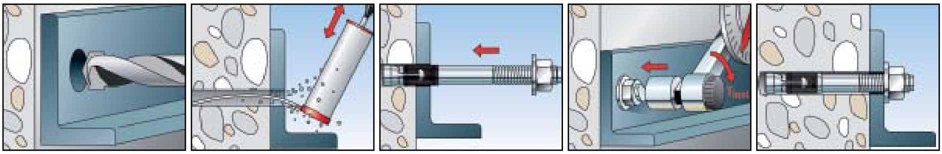
6.3 Combined tension and shear load:

$$\frac{N_{Sd}}{N_{Rd}} + \frac{V_{Sd}}{V_{Rd}} \leqq 1.2$$

N_{Sd} ; V_{Sd} = tension/shear component of the design load acting on the most unfavourable single anchor

N_{Rd} ; V_{Rd} = tension/shear design resistance including safety factors of the most unfavourable single anchor

7. Installation details



fischer Anchor bolt FAZ II

Anchor design according to fischer specification

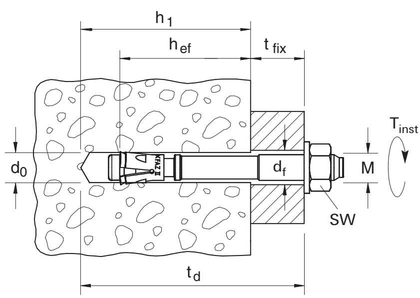
8. Anchor installation data

Anchor type			FAZ II 8	FAZ II 10	FAZ II 12	FAZ II 16	FAZ II 20	FAZ II 24
diameter of thread			M 8	M 10	M 12	M 16	M 20	M 24
nominal drill hole diameter	d_0	[mm]	8	10	12	16	20	24
drill depth	h_1	[mm]	55	75	90	110	125	155
effective anchorage depth	h_{ef}	[mm]	45	60	70	85	100	125
drill hole depth for through fixing	t_d	[mm]	$t_d = h_1 + t_{fix}$					
clearance-hole in fixture to be attached	d_f	[mm]	≦ 9	≦ 12	≦ 14	≦ 18	≦ 22	≦ 26
wrench size	SW	[mm]	13	17	19	24	30	36
required torque	T_{inst}	[Nm]	20	45	60	110	200	270

Minimum member thickness and characteristic edge distance and spacing for design

Anchor type			FAZ II 8	FAZ II 10	FAZ II 12	FAZ II 16	FAZ II 20	FAZ II 24
	h_{ef}		45	60	70	85	100	125
minimum thickness of concrete member	h_{min}	[mm]	100	120	140	170	200	250
	cracked concrete [1]							
Application with concrete member thickness h ≧ 2 · h_{ef}	s_{min}	[mm]	35	40	45	60	95	100
	for c ≧	[mm]	50	55	70	95	140	170
	c_{min}	[mm]	40	45	55	65	85	100
	for s ≧	[mm]	70	80	110	150	190	220
	non-cracked concrete [1]							
	s_{min}	[mm]	40	40	50	60	95	100
	for c ≧	[mm]	50	60	70	95	180	200
	c_{min}	[mm]	40	45	55	65	95	135
	for s ≧	[mm]	100	80	110	150	190	235
minimum thickness of concrete member	h_{min}	[mm]	80	100	120	140	160	200
	cracked and non-cracked concrete							
Application with concrete member thickness h < 2 · h_{ef}	s_{min}	[mm]	35	40	50	80	125	150
	for c ≧	[mm]	70	100	90	130	220	230
	c_{min}	[mm]	40	60	60	65	125	135
	for s ≧	[mm]	100	90	120	180	230	235

[1] Intermediate values by linear interpolation.



9. Mechanical anchor material characteristics

Anchor type			FAZ II 8	FAZ II 10	FAZ II 12	FAZ II 16	FAZ II 20	FAZ II 24
			gvz / A4 / C	gvz / A4 / C	gvz / A4 / C	gvz / A4 / C	gvz / A4	gvz / A4
stressed cross sectional area cone bolt	A_s	[mm²]	21.1	36.3	55.4	88.3	156.1	230.0
section modulus cone bolt	W	[mm³]	13.8	30.9	58.2	116.9	275.2	490.9
design value of bending moment	$M^0_{Rd,s}$	[Nm]	20.8	46.4	73.6	186.4	389.6	615.2
yield strength cone bolt	f_{yk}	[N/mm²]	600	600	600	600	560	544
tensile strength cone bolt	f_{uk}	[N/mm²]	750	750	750	750	700	680
stressed cross sectional area threaded part	A_s	[mm²]	36.6	58.0	84.3	157.0	245.0	353.0
section modulus threaded part	W	[mm³]	31.2	62.3	109.2	277.5	540.9	935.5
yield strength threaded part	f_{yk}	[N/mm²]	560	560	560	560	560	544
tensile strength threaded part	f_{uk}	[N/mm²]	700	700	700	700	700	680

10. Load displacement curves for tension in non-cracked concrete ($f_{ck,cube\ (200)}$ = 30 N/mm²)