

# fischer Zykon anchor FZA

Anchor design according to fischer specification

## 1. Types



FZA – Bolt anchor (gzv)



FZA – Bolt anchor (A4)



FZA – Bolt anchor (C)



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## Features and Advantages

- European Technical Approval option 1\*) for cracked and non-cracked concrete.
- Independent controlled and confirmed product characteristics (Approval) gives the required safety guarantees.
- Expansion free fixing allows small spacing and edge distances.
- Depth marking (green ring) enable visual control and ensures correct function.
- Fire resistance classifications (F 120) according to test report independently proved gives the safety case of fire.
- Formlocking fit in the undercut enables high loads at shallow anchorage depth.

\*) The conditions of use in the European Technical Approval may vary from those of the Technical Handbook.

## Materials

- Anchor:
- Carbon steel, zinc plated (5 µm) and passivated (gzv)
  - 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	FZA 10x40			FZA 12x40			FZA 14x40			FZA 12x50			FZA 14x60			FZA 18x80			FZA 22x100			FZA 22x125				
	gzv	A4	C	gzv	A4	C	gzv	A4	C	gzv	A4	C	gzv	A4	C	gzv	A4	C	gzv	A4	C	gzv	A4	C		
<b>non-cracked concrete</b>																										
tension	C 20/25	N <sub>U</sub>	[kN]	16.1	14.1		17.1			17.1			23.9			31.4			48.3			67.5			94.3	
	C 50/60	N <sub>U</sub>	[kN]	16.1	14.1		26.4			26.4			29.3	25.6		46.4	40.6		67.4	59.0		104.6			125.6	110.0
shear	≥ C 20/25	V <sub>U</sub>	[kN]	9.6	8.4		17.6	15.4		27.8	24.4		17.6	15.4		27.8	24.4		40.5	35.4		75.4	65.9		75.4	65.9
<b>cracked concrete</b>																										
tension	C 20/25	N <sub>U</sub>	[kN]		12.0		12.0			12.0			16.7			22.0			33.8			47.2			66.0	
	C 50/60	N <sub>U</sub>	[kN]		16.1	14.1		18.5		18.5			25.9	25.6		34.1			52.3			73.1			102.2	
shear	C 20/25	V <sub>U</sub>	[kN]	9.6	8.4		15.5	15.4		15.5			17.6	15.4		27.8	24.4		40.5	35.4		75.4	65.9		75.4	65.9

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

### 3.1 Characteristic resistance

Anchor type	FZA 10x40 M 6			FZA 12x40 M 8			FZA 14x40 M 10			FZA 12x50 M 8			FZA 14x60 M 10			FZA 18x80 M 12			FZA 22x100 M 16			FZA 22x125 M 16			
	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	
<b>non-cracked concrete</b>																									
tension	C 20/25 $N_{Rk}$ [kN]	14.0			14.0			14.0			19.6			25.8			39.7			55.4			77.5		
	C 50/60 $N_{Rk}$ [kN]	16.1	14.1		21.7		21.7		29.3	25.6		39.9		61.5	59.0		85.9		120.0	110.0					
shear	C 20/25 $V_{Rk}$ [kN]	8.0	7.0	14.7	12.8	18.2			14.7	12.8	23.2	20.3	33.8	29.5	62.8	55.0	62.8	55.0							
	$\geq$ C 40/50 $V_{Rk}$ [kN]	8.0	7.0	14.7	12.8	23.2	20.3	14.7	12.8	23.2	20.3	33.8	29.5	62.8	55.0	62.8	55.0								
<b>cracked concrete</b>																									
tension	C 20/25 $N_{Rk}$ [kN]	9.1			9.1			9.1			12.7			16.7			25.8			36.0			50.3		
	C 50/60 $N_{Rk}$ [kN]	14.1			14.1			14.1			19.7			25.9			39.9			55.8			77.9		
shear	C 20/25 $V_{Rk}$ [kN]	8.0	7.0	11.8			11.8			14.7	12.8	23.2	20.3	33.8	29.5	62.8	55.0	62.8	55.0						
	C 50/60 $V_{Rk}$ [kN]	8.0	7.0	14.7	12.8	18.3			14.7	12.8	23.2	20.3	33.8	29.5	62.8	55.0	62.8	55.0							

### 3.2 Design resistance

Anchor type	FZA 10x40 M 6			FZA 12x40 M 8			FZA 14x40 M 10			FZA 12x50 M 8			FZA 14x60 M 10			FZA 18x80 M 12			FZA 22x100 M 16			FZA 22x125 M 16			
	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	
<b>non-cracked concrete</b>																									
tension	C 20/25 $N_{Rd}$ [kN]	9.4	7.5	9.4	9.4			9.4			13.1			17.2			26.4			37.0			51.7		
	C 50/60 $N_{Rd}$ [kN]	10.7	7.5	9.4	14.5	13.7	14.5	14.5			19.5	13.7	17.1	26.6	21.7	26.6	41.0	31.6	39.3	57.3		80.0	58.8	73.3	
shear	C 20/25 $V_{Rd}$ [kN]	6.4	4.5	5.6	11.8	8.2	10.2	12.2			11.8	8.2	10.2	18.6	13.0	16.2	27.0	18.9	23.6	50.2	35.3	44.0	50.2	35.3	44.0
	C 40/50 $V_{Rd}$ [kN]	6.4	4.5	5.6	11.8	8.2	10.2	18.6	13.0	16.2	11.8	8.2	10.2	18.6	13.0	16.2	27.0	18.9	23.6	50.2	35.3	44.0	50.2	35.3	44.0
<b>cracked concrete</b>																									
tension	C 20/25 $N_{Rd}$ [kN]	6.1			6.1			6.1			8.5			11.2			17.2			24.0			33.5		
	C 50/60 $N_{Rd}$ [kN]	9.4	7.5	9.4	9.4			9.4			13.1			17.3			26.6			37.2			52.0		
shear	C 20/25 $V_{Rd}$ [kN]	6.4	4.5	5.6	7.9			7.9			11.0	8.2	10.2	18.6	13.0	16.2	27.0	18.9	23.6	48.0	35.3	44.0	50.2	35.3	44.0
	C 50/60 $V_{Rd}$ [kN]	6.4	4.5	5.6	11.8	8.2	10.2	12.2			11.8	8.2	10.2	18.6	13.0	16.2	27.0	18.9	23.6	50.2	35.3	44.0	50.2	35.3	44.0

### 3.3 Recommended resistance <sup>1)</sup>

Anchor type	FZA 10x40 M 6			FZA 12x40 M 8			FZA 14x40 M 10			FZA 12x50 M 8			FZA 14x60 M 10			FZA 18x80 M 12			FZA 22x100 M 16			FZA 22x125 M 16			
	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	
<b>non-cracked concrete</b>																									
tension	C 20/25 $N_R$ [kN]	6.7	5.4	6.7	6.7			6.7			9.3			12.3			18.9			26.4			36.9		
	C 50/60 $N_R$ [kN]	7.7	5.4	6.7	10.3	9.8	10.3	10.3			14.0	9.8	12.2	19.0	15.5	19.0	19.3	22.5	28.1	40.9		57.2	42.0	52.4	
shear	C 20/25 $V_R$ [kN]	4.6	3.2	4.0	7.2	5.9	7.2	7.2			8.4	5.9	7.3	13.3	9.3	11.6	19.3	13.5	16.9	35.9	25.2	31.4	35.9	25.2	31.4
	C 40/50 $V_R$ [kN]	4.6	3.2	4.0	8.4	5.9	7.3	11.2	9.3	11.2	8.4	5.9	7.3	13.3	9.3	11.6	19.3	13.5	16.9	35.9	25.2	31.4	35.9	25.2	31.4
<b>cracked concrete</b>																									
tension	C 20/25 $N_R$ [kN]	4.3			4.3			4.3			6.1			8.0			12.3			17.1			24.0		
	C 50/60 $N_R$ [kN]	6.7	5.4	6.7	6.7			6.7			9.4			12.3			19.0			26.6			37.1		
shear	C 20/25 $V_R$ [kN]	4.6	3.2	4.0	5.6			5.6			7.9	5.9	7.3	13.3	9.3	11.6	19.3	13.5	16.9	34.3	25.2	31.4	35.9	25.2	31.4
	$\geq$ C 45/55 $V_R$ [kN]	4.6	3.2	4.0	8.4	5.9	7.3	8.7			8.4	5.9	7.3	13.3	9.3	11.6	19.3	13.5	16.9	35.9	25.2	31.4	35.9	25.2	31.4

<sup>1)</sup> Material safety factors  $\gamma_M$  and safety factor for action  $\gamma_L = 1.4$  are included. Material safety factor  $\gamma_M$  depends on failure mode of the anchor.

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## 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: *Failure mode is not decisive*
- Concrete cone failure:  $N_{Rd,c} = N_{Rd,c}^0 \cdot f_{b,N} \cdot f_{s1} \cdot f_{s2} \cdot f_{s3} \cdot f_{c1,A} \cdot f_{c1,B} \cdot f_{c2}$
- Concrete splitting failure: *Failure mode is not decisive*

### 4.1 Steel failure of the highest loaded anchor

Design resistance of single anchor

Anchor type	FZA 10x40 M 6			FZA 12x40 M 8			FZA 14x40 M 10			FZA 12x50 M 8			FZA 14x60 M 10			FZA 18x80 M 12			FZA 22x100 M 16			FZA 22x125 M 16		
	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C
design resistance $N_{Rd,s}$ [kN]	10.7	7.5	9.4	19.5	13.7	17.1	30.9	21.7	27.1	19.5	13.7	17.1	30.9	21.7	27.1	44.9	31.6	39.3	84.0	58.8	73.3	84.0	58.8	73.3

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

*Failure mode is not decisive and therefore may be neglected*

### 4.3 Concrete cone failure and splitting of the most unfavourable anchor

- Concrete cone failure:  $N_{Rd,c} = N_{Rd,c}^0 \cdot f_{b,N} \cdot f_{s1} \cdot f_{s2} \cdot f_{s3} \cdot f_{c1,A} \cdot f_{c1,B} \cdot f_{c2}$
- Concrete splitting failure: *Failure mode is not decisive*

Design resistance of single anchor

Anchor type	FZA 10x40 M 6	FZA 12x40 M 8	FZA 14x40 M 10	FZA 12x50 M 8	FZA 14x60 M 10	FZA 18x80 M 12	FZA 22x100 M 16	FZA 22x125 M 16
eff. anchorage depth $h_{ef}$ [mm]	40	40	40	50	60	80	100	125
<b>non-cracked concrete</b>								
design resistance $N_{Rd,c}^0$ [kN]	9.4	9.4	9.4	13.1	17.2	26.4	37.0	51.7
<b>cracked concrete</b>								
design resistance $N_{Rd,c}^0$ [kN]	6.1	6.1	6.1	8.5	11.2	17.2	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/mm <sup>2</sup> ]	12	16	20	25	30	35	40	45	50
cube compressive strength $f_{ck,cube}$ [N/mm <sup>2</sup> ]	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

#### 4.3.2 Concrete cone failure

Characteristic edge distance and spacing for design

Anchor type	FZA 10x40 M 6	FZA 12x40 M 8	FZA 14x40 M 10	FZA 12x50 M 8	FZA 14x60 M 10	FZA 18x80 M 12	FZA 22x100 M 16	FZA 22x125 M 16
$h_{ef}$	40	40	40	50	60	80	100	125
$s_{cr,N}$ [mm]	120	120	120	150	180	240	300	375
$c_{cr,N}$ [mm]	60	60	60	75	90	120	150	188

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## 4.3.2.1 Influence of spacing / concrete cone failure

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

s/s <sub>cr,N</sub>	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 <sub>s1</sub>	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

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

c/c <sub>cr,N</sub>	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 <sub>c1,A</sub>	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 <sub>c1,B</sub> f <sub>c2</sub>	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

Failure mode is not decisive and therefore may be neglected

## 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:

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

### 5.1 Steel failure for the highest loaded anchor

Design resistance of single anchor

Anchor type	FZA 10x40		FZA 12x40		FZA 14x40		FZA 12x50		FZA 14x60		FZA 18x80		FZA 22x100		FZA 22x125									
	M 6	M 8	M 8	M 10	M 8	M 10	M 8	M 10	M 10	M 12	M 12	M 16	M 16	M 16	M 16									
	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C						
design resistance V <sub>Rd,s</sub> [kN]	6.4	4.5	5.6	11.8	8.2	10.2	18.6	13.0	16.2	11.8	8.2	10.2	18.6	13.0	16.2	27.0	18.9	23.6	50.2	35.3	44.0	50.2	35.3	44.0

### 5.2 Pryout failure for the most unfavourable anchor

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

k-factor

Anchor type	FZA 10x40	FZA 12x40	FZA 14x40	FZA 12x50	FZA 14x60	FZA 18x80	FZA 22x100	FZA 22x125
	M 6	M 8	M 10	M 8	M 10	M 12	M 16	M 16
k	1.3	1.3	1.3	1.3	2.0	2.0	2.0	2.0

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## 5.3 Concrete edge failure of the most unfavourable anchor

$$V_{Rd,c} = V^o_{Rd,c} \cdot f_{b,V} \cdot f_{\alpha,V} \cdot f_{s1,V} \cdot f_{s2,V} \cdot f_{c2,V} \cdot f_{h,V} \cdot f_m$$

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]	$V^o_{Rd,c}$ [kN]							
	FZA 10x40 M6		FZA 12x40 M8		FZA 14x40 M10		FZA 12x50 M8	
	non-cracked concrete	cracked concrete	non-cracked concrete	cracked concrete	non-cracked concrete	cracked concrete	non-cracked concrete	cracked concrete
35	2.8	2.0						
40	3.4	2.4	3.5	2.5				
45	3.9	2.8	4.1	2.9			4.2	3.0
50	4.5	3.2	4.7	3.3			4.9	3.4
55	5.2	3.7	5.3	3.8			5.5	3.9
60	5.8	4.1	6.0	4.2			6.2	4.4
65	6.5	4.6	6.6	4.7			6.9	4.9
70	7.2	5.1	7.3	5.2	7.5	5.3	7.6	5.4
75	7.9	5.6	8.0	5.7	8.2	5.8	8.3	5.9
80	8.6	6.1	8.8	6.2	8.9	6.3	9.1	6.4
85	9.3	6.6	9.5	6.8	9.7	6.9	9.9	7.0
90	10.1	7.2	10.3	7.3	10.5	7.4	10.7	7.6
95	10.9	7.7	11.1	7.9	11.3	8.0	11.5	8.1
100	11.7	8.3	11.9	8.4	12.1	8.6	12.3	8.7
120	15.0	10.6	15.3	10.9	15.6	11.0	15.8	11.2
125	15.9	11.3	16.2	11.5	16.5	11.7	16.7	11.8
130	16.8	11.9	17.1	12.1	17.4	12.3	17.6	12.5
135	17.7	12.5	18.0	12.8	18.3	13.0	18.6	13.2
140	18.6	13.2	19.0	13.4	19.3	13.6	19.5	13.8
160	22.5	15.9	22.8	16.2	23.2	16.4	23.5	16.6
180	26.5	18.8	26.9	19.1	27.3	19.3	27.7	19.6
200	30.7	21.8	31.2	22.1	31.6	22.4	32.0	22.7
250	42.1	29.8	42.7	30.2	43.2	30.6	43.7	31.0
300	54.5	38.6	55.3	39.1	55.9	39.6	56.5	40.0
350	67.9	48.1	68.8	48.7	69.5	49.2	70.2	49.7
400	82.1	58.2	83.1	58.9	84.0	59.5	84.8	60.1
450	97.2	68.8	98.3	69.7	99.3	70.4	100.3	71.0
500	113.0	80.0	114.3	81.0	115.4	81.8	116.5	82.5
550	129.6	91.8	131.0	92.8	132.3	93.7	133.4	94.5
600	146.8	104.0	148.4	105.1	149.8	106.1	151.1	107.0
650			166.5	117.9	168.0	119.0	169.4	120.0
700			185.2	131.2	186.8	132.3	188.3	133.4
750			204.5	144.8	206.3	146.1	207.9	147.3
800					226.3	160.3		
850					246.9	174.9		
900								
950								
1000								
1100								
1200								
1300								
1400								

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edge distance [mm]	FZA 14x60 M10		FZA 18x80 M12		FZA 22x100 M16		FZA 22x125 M16	
	non-cracked concrete	cracked concrete	non-cracked concrete	cracked concrete	non-cracked concrete	cracked concrete	non-cracked concrete	cracked concrete
35								
40								
45								
50								
55	5.9	4.2						
60	6.6	4.7						
65	7.3	5.2						
70	8.0	5.7	8.9	6.3				
75	8.8	6.2	9.7	6.9				
80	9.6	6.8	10.6	7.5				
85	10.4	7.4	11.4	8.1				
90	11.2	8.0	12.3	8.7				
95	12.1	8.6	13.2	9.4				
100	12.9	9.2	14.1	10.0	15.3	10.8		
120	16.5	11.7	18.0	12.7	19.4	13.7		
125	17.5	12.4	19.0	13.4	20.4	14.5	21.4	15.2
130	18.4	13.1	20.0	14.2	21.5	15.2	22.5	16.0
135	19.4	13.7	21.0	14.9	22.6	16.0	23.6	16.7
140	20.4	14.4	22.1	15.6	23.7	16.8	24.8	17.5
160	24.5	17.3	26.4	18.7	28.2	20.0	29.4	20.9
180	28.8	20.4	30.9	21.9	32.9	23.3	34.3	24.3
200	33.3	23.6	35.6	25.2	37.9	26.8	39.4	27.9
250	45.3	32.1	48.2	34.2	51.0	36.2	53.0	37.5
300	58.4	41.4	61.9	43.9	65.3	46.3	67.6	47.9
350	72.5	51.3	76.6	54.3	80.5	57.0	83.2	58.9
400	87.4	61.9	92.2	65.3	96.7	68.5	99.7	70.6
450	103.2	73.1	108.6	76.9	113.6	80.5	117.0	82.9
500	119.7	84.8	125.8	89.1	131.4	93.1	135.2	95.8
550	137.0	97.1	143.7	101.8	149.9	106.2	154.1	109.1
600	155.0	109.8	162.4	115.0	169.2	119.8	173.7	123.0
650	173.7	123.0	181.7	128.7	189.1	134.0	194.0	137.4
700	193.0	136.7	201.7	142.9	209.7	148.5	215.0	152.3
750	213.0	150.8	222.3	157.5	230.9	163.6	236.6	167.6
800	233.5	165.4	243.5	172.5	252.7	179.0	258.8	183.3
850	254.6	180.4	265.3	187.9	275.1	194.9	281.6	199.5
900			287.7	203.8	298.1	211.2	305.0	216.0
950			310.6	220.0	321.7	227.9	328.9	233.0
1000			334.0	236.6	345.8	244.9	353.4	250.3
1100			382.5	270.9	395.5	280.1	403.9	286.1
1200					447.2	316.8	456.5	323.3
1300					500.8	354.8	510.9	361.9
1400					556.3	394.1	567.2	401.8

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# fischer Zykon anchor FZA

Anchor design according to fischer specification

## 5.3.1 Influence of concrete strength for shear

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

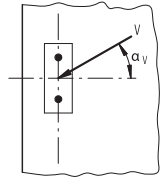
Concrete strength class		C 12/15	C 16/20	C 20/25	C 25/30	C 30/37	C 35/45	C 40/50	C 45/55	C 50/60
cylinder compressive strength	$f_{ck, cyl}$ [N/mm <sup>2</sup> ]	12	16	20	25	30	35	40	45	50
cube compressive strength	$f_{ck, cube}$ [N/mm <sup>2</sup> ]	15	20	25	30	37	45	50	55	60
influence factor	$f_{b,V}$ [-]	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

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

	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  $\alpha \geq 90^\circ$  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.



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## 5.3.3 Influence of spacing

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

$s/c_1$	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	$\geq 3.0$
$f_{s1,V}$	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;  $c_1 < c_2$

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

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

## 5.3.5 Influence of member thickness

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

$h/c_1$	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	$\geq 1.5$
$f_{h,V}$	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 $\geq 4$ anchors in a row at the edge

$f_m$				
$s/c_1$	0.25	0.5	1.0	$\geq 2.0$
$f_m$	0.3	0.5	0.75	1.0

# fischer Zykon anchor FZA

Anchor design according to fischer specification

## 6. Summary of required proof:

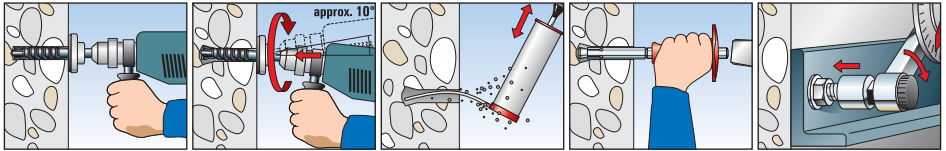
- 6.1 Tension:  $N_{Sd} \leq N_{Rd} = \text{lowest value of } N_{Rd,s}; N_{Rd,p}; N_{Rd,c}; N_{Rd,sp}$
- 6.2 Shear:  $V_{Sd} \leq V_{Rd} = \text{lowest value of } V_{Rd,s}; V_{Rd,cp}; V_{Rd,c}$
- 6.3 Combined tension and shear load:

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

$N_{Sd}; V_{Sd}$  = 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

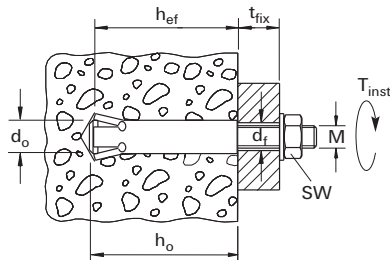
## 7. Installation details



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## 8. Anchor installation data

Anchor type	FZA 10x40	FZA 12x40	FZA 14x40	FZA 12x50	FZA 14x60	FZA 18x80	FZA 22x100	FZA 22x125
	M 6	M 8	M 10	M 8	M 10	M 12	M 16	M 16
diameter of thread	M 6	M 8	M 10	M 8	M 10	M 12	M 16	M 16
nominal drill hole diameter	$d_0$ [mm]	10	12	14	12	14	18	22
drill depth	$h_0$ [mm]	43	43	43	54	63	83	103
effective anchorage depth	$h_{ef}$ [mm]	40	40	40	50	60	80	100
clearance-hole in fixture to be attached	$d_f$ [mm]	$\leq 7$	$\leq 9$	$\leq 12$	$\leq 9$	$\leq 12$	$\leq 14$	$\leq 18$
wrench size	SW [mm]	10	13	17	13	17	19	24
required torque	$T_{inst}$ [Nm]	8.5	20	40	20	40	60	100
minimum thickness of concrete member	$h_{min}$ [mm]	100	100	100	110	130	160	200
minimum spacing	$s_{min}$ [mm]	40	40	70	50	60	80	100
minimum edge distances	$c_{min}$ [mm]	35	40	70	45	55	70	100





# fischer Zykon anchor FZA

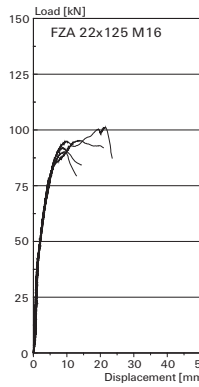
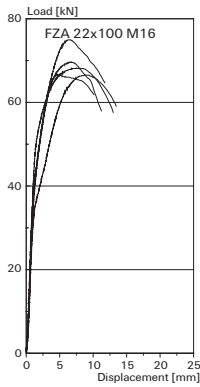
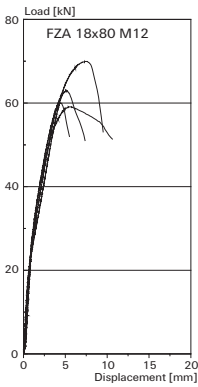
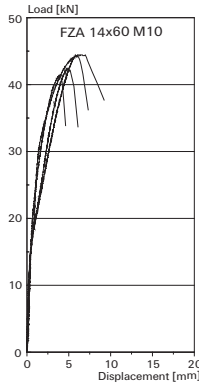
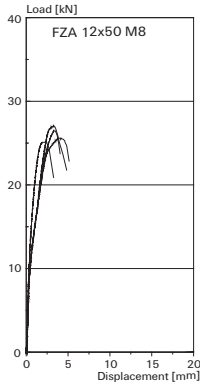
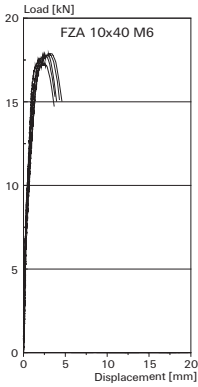
Anchor design according to fischer specification

## 9. Mechanical anchor material characteristics

Anchor type	FZA 10x40 M 6			FZA 12x40 M 8			FZA 14x40 M 10			FZA 12x50 M 8			FZA 14x60 M 10			FZA 18x80 M 12			FZA 22x100 M 16			FZA 22x125 M 16		
	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C
stressed cross sectional area cone bolt $A_s$ [mm <sup>2</sup> ]	20.1			36.6			58.0			36.6			58.0			84.3			157			157		
resisting moment cone bolt $W$ [mm <sup>3</sup> ]	12.7			31.2			62.3			31.2			62.3			109			278			278		
design value of bending moment $M_{Rd,s}^b$ [Nm]	9.8	6.9	8.6	24.0	16.8	21.0	47.8	33.5	41.8	24.0	16.8	21.0	47.8	33.5	41.8	84.0	58.7	73.3	212.8	148.7	185.6	212.8	148.7	185.6
yield strength cone bolt $f_{yk}$ [N/mm <sup>2</sup> ]	640	450	560	640	450	560	640	450	560	640	450	560	640	450	560	640	450	560	640	450	560	640	450	560
tensile strength cone bolt $f_{uk}$ [N/mm <sup>2</sup> ]	800	700	800	800	700	800	800	700	800	800	700	800	800	700	800	800	700	800	800	700	800	800	700	800

## 10. Load displacement curves for tension in non-cracked concrete ( $f_{ck,cube}(200) = 30 \text{ N/mm}^2$ )

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# Notes

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