fischer Resin anchor R

Anchor design according to fischer specification

1. Types

RG M8 - M20 - threaded rod (gvz, A4 and C)
with external hexagon head

RG M24 - M30 - threaded rod (gvz, A4 and C)
straight cut

R M - Resin capsule R M8 - M30

European Technical Approval - Option 7 for non-cracked concrete *)

Fire resistance classification R 120

CALCULATION WITH CC COMPUFIX CALCULATION SOFTWARE

Features and Advantages

- European Technical Approval option 7*) for non-cracked concrete.
- The expansion stress free anchoring allows minimal spacing and edge distances and guarantees a save use with small anchor plates and edge distances.
- The included setting tool guarantees save anchoring of threaded rods (M8 - M20).
- The resin capsule is approved for water filled drill holes and enables the use independently of weather conditions.
- The resin seals the drill hole and avoids penetration of dampness and gives therefore corrosion protection for the embedded steel.
- Large range of available fixing length gives perfect allocation to the given fixture.
- Threaded rods don't need a torque moment because of that a stand-off installation is easy to realise.

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

Materials

Threaded rod :
- 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.

Resin capsule:
- Vinylester resin (styrene-free), quartz sand and hardener

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

Mean values

Anchor type	R M8 RG M8			R M10 RG M10			R M12 RG M12			R M16 RG M16			R M20 RG M20			R M24 RG M24			R M27 RG M27			R M30 RG M30		
	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C
non-cracked concrete temperature range (+ 80 °C / + 50 °C) [2]																								
tension C 20/25 N_u [kN]	20.0	27.3		31.5	42.6		46.2	56.8		81.8			131.7			184.4			246.9			289.2		
shear ≥ C 20/25 V_u [kN]	12.0	16.1		19.0	25.6		27.6	37.2		51.4	69.2		80.3	108.0		115.6	155.7		150.4	202.4		183.8	247.4	

1) The loads apply to fischer threaded rods and careful drill hole cleaning, carried out with a brush and blow-out tool and temperature in the substrate in the area of the mortar with short term temperature T ≤ + 80 °C and long term temperature T ≤ + 50 °C (see also „Installation details, section 7").

2) (short term temperature / long term temperature)

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

3.1 Characteristic resistance [1)]

Anchor type	R M8 RG M8			R M10 RG M10			R M12 RG M12			R M16 RG M16		
	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C
non-cracked concrete												
temperature range (+ 80 °C / + 50 °C) [2)]												
tension C 20/25 N_{Rk} [kN]	22.1			31.1			41.5			59.7		
shear ≧ C 20/25 V_{Rk} [kN]	7.4	12.8		13.3	20.3		19.3	29.5		35.9	54.8	

Anchor type	R M20 RG M20			R M24 RG M24			R M27 RG M27			R M30 RG M30		
	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C
non-cracked concrete												
temperature range (+ 80 °C / + 50 °C) [2)]												
tension C 20/25 N_{Rk} [kN]	96.1			134.6			180.2			211.1		
shear ≧ C 20/25 V_{Rk} [kN]	56.0	85.7		80.7	123.4		105.1	160.8		128.3	196.2	

1) The loads apply to fischer threaded rods and careful drill hole cleaning, carried out with a brush and blow-out tool and temperature in the substrate in the area of the mortar with short term temperature T ≤ + 80 °C and long term temperature T ≤ + 50 °C (see also „Installation details, section 7").

2) (short term temperature / long term temperature)

3.2 Design resistance [1)]

Anchor type	R M8 RG M8			R M10 RG M10			R M12 RG M12			R M16 RG M16		
	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C
non-cracked concrete												
temperature range (+ 80 °C / + 50 °C) [2)]												
tension C 20/25 N_{Rd} [kN]	12.3			17.3			27.6			39.8		
shear ≧ C 20/25 V_{Rd} [kN]	5.9	8.2	10.2	10.6	13.0	16.2	15.4	18.9	23.6	28.7	35.1	43.8

Anchor type	R M20 RG M20			R M24 RG M24			R M27 RG M27			R M30 RG M30		
	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C
non-cracked concrete												
temperature range (+ 80 °C / + 50 °C) [2)]												
tension C 20/25 N_{Rd} [kN]	64.1			89.7			120.2			140.7		
shear ≧ C 20/25 V_{Rd} [kN]	44.8	54.9	68.6	64.6	79.1	98.7	84.1	103.1	128.6	102.6	125.8	157.0

1) The loads apply to fischer threaded rods and careful drill hole cleaning, carried out with a brush and blow-out tool and temperature in the substrate in the area of the mortar with short term temperature T ≤ + 80 °C and long term temperature T ≤ + 50 °C (see also „Installation details, section 7").

2) (short term temperature / long term temperature)

3.3 Recommended resistance [1) 2)]

Anchor type	R M8 RG M8			R M10 RG M10			R M12 RG M12			R M16 RG M16		
	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C
non-cracked concrete												
temperature range (+ 80 °C / + 50 °C) [3)]												
tension C 20/25 N_R [kN]	8.8			12.3			19.7			28.4		
shear ≧ C 20/25 V_R [kN]	4.2	5.9	7.3	7.6	9.3	11.6	11.0	13.5	16.9	20.5	25.1	31.3

Anchor type	R M20 RG M20			R M24 RG M24			R M27 RG M27			R M30 RG M30		
	gvz	A4	C	gvz	A4	C	gvz	A4	C	gvz	A4	C
non-cracked concrete												
temperature range (+ 80 °C / + 50 °C) [3)]												
tension C 20/25 N_R [kN]	45.8			64.1			85.8			100.5		
shear ≧ C 20/25 V_R [kN]	32.0	39.2	49.0	46.1	56.5	70.5	60.1	73.6	91.9	73.3	89.8	112.1

1) The loads apply to fischer threaded rods and careful drill hole cleaning, carried out with a brush and blow-out tool and temperature in the substrate in the area of the mortar with short term temperature T ≤ + 80 °C and long term temperature T ≤ + 50 °C (see also „Installation details, section 7").

2) 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.

3) (short term temperature / long term temperature)

4. Calculation of tension resistance

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

Steel failure: $N_{Rd,s}$

Combined pull-out and concrete cone failure:

$$N_{Rd,p} = N^0_{Rd,p} \cdot f_{b,N,p} \cdot f_{s1,p} \cdot f_{s2,p} \cdot f_{s3,p} \cdot f_{c1,p,A} \cdot f_{c1,p,B} \cdot f_{c2,p}$$

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

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

4.1 Steel failure of the highest loaded anchor

Design resistance of single anchor

Anchor type			R M8 RG M8			R M10 RG M10			R M12 RG M12			R M16 RG M16			R M20 RG M20			R M24 RG M24			R M27 RG M27			R M30 RG M30		
			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]	12.8	13.9	17.3	20.1	21.9	27.3	29.5	31.6	39.3	55.0	58.8	73.3	85.2	92.0	115	123	132	165	160	172	215	196	210	262

4.2 Combined pull-out and concrete cone failure

$$N_{Rd,p} = N^0_{Rd,p} \cdot f_{b,N,p} \cdot f_{s1,p} \cdot f_{s2,p} \cdot f_{s3,p} \cdot f_{c1,p,A} \cdot f_{c1,p,B} \cdot f_{c2,p}$$

Design resistance of single anchor

Anchor type			R M8 RG M8	R M10 RG M10	R M12 RG M12	R M16 RG M16	R M20 RG M20	R M24 RG M24	R M27 RG M27	R M30 RG M30
eff. anchorage depth	h_{ef}	[mm]	80	90	110	125	170	210	250	280
non-cracked concrete										
temperature range (+ 80 °C / + 50 °C) [1]										
	$N^0_{Rd,p}$	[kN]	12.3	17.3	27.6	39.8	64.1	89.7	120.2	140.7
temperature range (+ 120 °C / + 72 °C) [1]										
	$N^0_{Rd,p}$	[kN]	11.2	14.9	22.1	31.4	49.8	68.6	127.2	149.5

[1] (short term temperature / long term temperature)

4.2.1 Influence of concrete strength / combined pull-out and concrete cone failure

$f_{b,N,p}$

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	$f_{b,N,p}$	[-]	0.85	0.9	1.00	1.06	1.14	1.22	1.27	1.31	1.35

4.2.2 Characteristic edge distance and spacing for design of combined pull-out and concrete cone failure

Anchor type			R M8 RG M8	R M10 RG M10	R M12 RG M12	R M16 RG M16	R M20 RG M20	R M24 RG M24	R M27 RG M27	R M30 RG M30
eff. anchorage depth	h_{ef}	[mm]	80	90	110	125	170	210	250	280
temperature range (+ 80 °C / + 50 °C) [1]										
	$s_{cr,Np}$	[mm]	194	242	277	360	438	511	575	620
	$c_{cr,Np}$	[mm]	97	121	139	180	219	255	287	310
temperature range (+ 120 °C / + 72 °C) [1]										
	$s_{cr,Np}$	[mm]	185	225	248	320	386	447	592	639
	$c_{cr,Np}$	[mm]	92	113	124	160	193	223	296	319

[1] (short term temperature / long term temperature)

4.2.2.1 Influence of spacing / combined pull-out and concrete cone failure

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

$s/s_{cr,Np}$	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
$f_{s1,p}$	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

4.2.2.2 Influence of edge distance / combined pull-out and concrete cone failure

$$f_{c1,p,A} = 0.7 + 0.3 \cdot \frac{c}{c_{cr,Np}} \leqq 1.0$$

$$f_{c1,p,B} = f_{c2,p} = \left(1.0 + \frac{c}{c_{cr,Np}}\right) \cdot 0.5 \leqq 1.0$$

$c/c_{cr,Np}$	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
$f_{c1,p,A}$	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
$f_{c1,p,B}$ $f_{c2,p}$	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 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	R M8 RG M8	R M10 RG M10	R M12 RG M12	R M16 RG M16	R M20 RG M20	R M24 RG M24	R M27 RG M27	R M30 RG M30
non-cracked concrete								
Design resistance $N^0_{Rd,c}$ [kN]	24.1	28.7	38.8	47.1	74.6	102.5	133.1	157.7

4.3.1 Influence of concrete strength for tension

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

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	$f_{b,N,c}$	[-]	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 values for design

Anchor type eff. anchorage depth h_{ef} [mm]	R M8 RG M8 80	R M10 RG M10 90	R M12 RG M12 110	R M16 RG M16 125	R M20 RG M20 170	R M24 RG M24 210	R M27 RG M27 250	R M30 RG M30 280
$s_{cr,N}$ [mm]	240	270	330	375	510	630	750	840
$c_{cr,N}$ [mm]	120	135	165	188	255	315	375	420

fischer Resin anchor R

Anchor design according to fischer specification

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_s	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

$$f_{c1,A} = 0.7 + 0.3 \cdot \frac{c}{c_{cr,N}} \leqq 1.0$$

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

$c/c_{cr,N}$	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 values for design

Anchor type				**R M8 RG M8**	**R M10 RG M10**	**R M12 RG M12**	**R M16 RG M16**	**R M20 RG M20**	**R M24 RG M24**	**R M27 RG M27**	**R M30 RG M30**
eff. anchorage depth		h_{ef}	**[mm]**	**80**	**90**	**110**	**125**	**170**	**210**	**250**	**280**
application with concrete member thickness	$h/h_{ef} \geqq 2.0$	$s_{cr,sp}$	[mm]	160	180	220	250	340	420	500	560
		$c_{cr,sp}$	[mm]	80	90	110	125	170	210	250	280
	$2.0 > h/h_{ef} > 1.3$	$s_{cr,sp}$	[mm]	$f_{scr,sp} \cdot h_{ef}$ ($f_{scr,sp}$ see below)							
		$c_{cr,sp}$	[mm]	$s_{cr,sp}/2$							
	$h/h_{ef} \leqq 1.3$	$s_{cr,sp}$	[mm]	362	407	497	565	768	949	1130	1266
		$c_{cr,sp}$	[mm]	181	203	249	283	384	475	565	633
		h_{min}	[mm]	110	120	150	160	220	280	330	370

$f_{scr,sp}$

h/h_{ef}	1.3	1.35	1.4	1.45	1.5	1.55	1.6	1.65	1.7	1.75	1.8	1.85	1.9	1.95	2.0
$f_{scr,sp}$	4.52	4.34	4.16	3.98	3.8	3.62	3.44	3.26	3.08	2.9	2.72	2.54	2.36	2.18	2.0

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 / 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: $V_{Rd,cp} = k \cdot min\ (N_{Rd,p}\ ;\ N_{Rd,c})$

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

5.1 Steel failure for the highest loaded anchor

Design resistance of single anchor

Anchor type	R M8 RG M8			R M10 RG M10			R M12 RG M12			R M16 RG M16			R M20 RG M20			R M24 RG M24			R M27 RG M27			R M30 RG M30		
	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 $V_{Rd,s}$ [kN]	5.9	8.2	10.2	10.6	13.0	16.2	15.4	18.9	23.6	28.7	35.1	43.8	44.8	54.9	68.6	64.6	79.1	98.7	84.1	103	129	103	126	157

5.2 Pryout failure for the most unfavourable anchor

$$V_{Rd,cp} = k \cdot min\ (\ N_{Rd,p}\ ;\ N_{Rd,c}\ )$$

k-factor

Anchor type	R M8 to R M30 RG M8 to RG M30
k	2.0

fischer Resin anchor R

Anchor design according to fischer specification

5.3 Concrete edge failure for the most unfavourable anchor

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

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] R M8 RG M8	R M10 RG M10	R M12 RG M12	R M16 RG M16	R M20 RG M20	R M24 RG M24	R M27 RG M27	R M30 RG M30
40	3.7							
45	4.3	4.7						
50	5.0	5.3						
55	5.6	6.0	6.6					
60	6.3	6.8	7.3					
65	7.0	7.5	8.1	8.9				
70	7.8	8.3	8.9	9.7				
75	8.5	9.0	9.7	10.6				
80	9.3	9.8	10.6	11.5				
85	10.1	10.7	11.4	12.4	14.1			
90	10.9	11.5	12.3	13.3	15.1			
95	11.7	12.3	13.2	14.3	16.1			
100	12.6	13.2	14.1	15.2	17.2	19.0		
110	14.3	15.0	16.0	17.2	19.3	21.2		
120	16.1	16.9	17.9	19.3	21.5	23.6		
130	17.9	18.8	20.0	21.4	23.8	26.0	28.0	
140	19.9	20.8	22.0	23.5	26.1	28.5	30.6	32.4
150	21.8	22.8	24.1	25.8	28.5	31.0	33.3	35.2
160	23.9	24.9	26.3	28.1	30.9	33.6	36.0	38.0
170	25.9	27.1	28.6	30.4	33.4	36.2	38.8	40.9
180	28.1	29.3	30.8	32.8	36.0	38.9	41.6	43.8
190	30.3	31.5	33.2	35.2	38.6	41.7	44.4	46.7
200	32.5	33.8	35.6	37.7	41.2	44.5	47.4	49.8
250	44.3	46.0	48.2	50.8	55.2	59.1	62.6	65.5
300	57.2	59.2	61.9	65.0	70.2	74.9	79.0	82.4
350	71.1	73.4	76.5	80.2	86.2	91.6	96.3	100.2
400	85.8	88.5	92.0	96.3	103.2	109.3	114.6	119.0
500	117.7	121.2	125.6	130.9	139.5	147.1	153.6	159.0
600	152.6	156.8	162.1	168.6	178.9	187.9	195.7	202.1
700	190.1	195.1	201.4	209.0	221.0	231.5	240.6	248.0
800	230.2	235.8	243.2	251.9	265.7	277.7	288.1	296.5
900		279.0	287.3	297.2	312.7	326.3	337.9	347.4
1000			333.6	344.6	362.0	377.1	390.0	400.5
1200			432.3	445.8	466.9	485.1	500.6	513.1
1400				554.6	579.4	600.8	618.9	633.6
1600					699.1	723.7	744.5	761.3
1800					825.4	853.2	876.7	895.7
2000						989.1	1015.3	1036.5
2200						1130.9	1159.9	1183.3
2400							1310.2	1335.8
2600							1466.0	1493.7
2800								1657.0

5.3.1 Influence of cracked concrete

f_{cr}

	Non-cracked concrete
f_{cr}	1.0

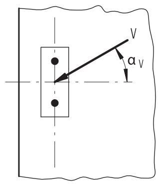
5.3.2 Influence of concrete strength for shear

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

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

5.3.3 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 $\alpha \geqq 90°$ 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.

5.3.4 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

5.3.5 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

5.3.6 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

5.3.7 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

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* $V_{Rd,s}$; $V_{Rd,cp}$; $V_{Rd,c}$

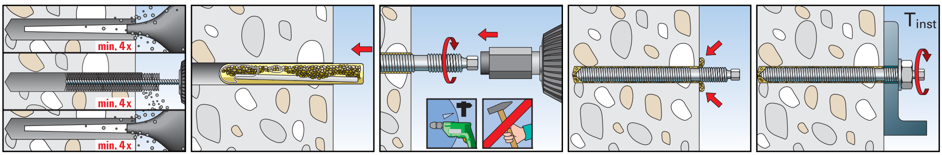
6.3 Combined tension and shear load:

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

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

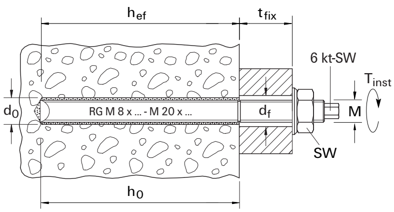


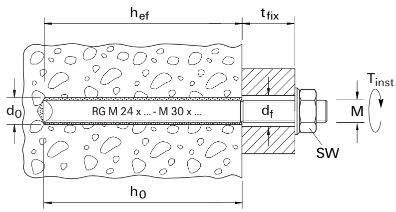
fischer Resin anchor R

Anchor design according to fischer specification

8. Anchor installation data

Anchor type			**R M 8** **RG M 8**	**R M 10** **RG M 10**	**R M 12** **RG M 12**	**R M 16** **RG M 16**	**R M 20** **RG M 20**	**R M 24** **RG M 24**	**R M 27** **RG M 27**	**R M 30** **RG M 30**
diameter of thread			M 8	M 10	M 12	M 16	M 20	M 24	M 27	M 30
nominal drill hole diameter	d_0	[mm]	10	12	14	18	25	28	32	35
drill depth	h_0	[mm]	80	90	110	125	170	210	250	280
effective anchorage depth	h_{ef}	[mm]	80	90	110	125	170	210	250	280
clearance-hole in fixture to be attached	d_f	[mm]	≤ 9	≤ 12	≤ 14	≤ 18	≤ 22	≤ 26	≤ 30	≤ 33
wrench size	SW	[mm]	13	17	19	24	30	36	41	46
required torque	T_{inst}	[Nm]	10	20	40	60	120	150	200	300
minimum thickness of concrete member	h_{min}	[mm]	110	120	150	160	220	280	330	370
minimum spacing	s_{min}	[mm]	40	45	55	65	85	105	125	140
minimum edge distances	c_{min}	[mm]	40	45	55	65	85	105	125	140





9. Curing times

Temperature at anchoring base	**Curing time in [1]** dry concrete	**Curing time in [1]** wet concrete
- 5 °C to - 1 °C	4 h	8 h
± 0 °C to + 9 °C	45 min.	90 min.
+ 10 °C to + 20 °C	20 min.	40 min.
> + 20 °C	10 min.	20 min.

The anchor may be installed in dry or wet concrete or in flooded holes excepting sea water (premium-cleaning acc. to ETA-approval).

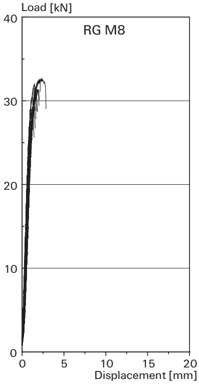
[1] In wet concrete and flooded holes the curing time has to be doubled.

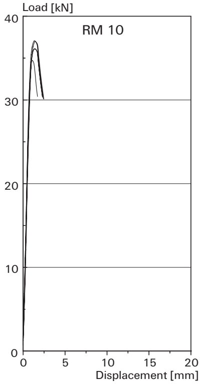
10. Mechanical characteristics

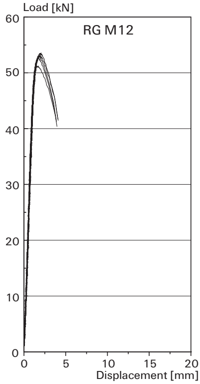
Anchor type			**R M 8 / RG M 8** gvz	**A4**	**C**	**R M 10 / RG M 10** gvz	**A4**	**C**	**R M 12 / RG M 12** gvz	**A4**	**C**	**R M 16 / RG M 16** gvz	**A4**	**C**
stressed cross sectional area anchor rod	A_s	[mm²]	36.6			58.0			84.3			157.0		
resisting moment anchor rod	W	[mm³]	31.2			62.3			109.2			277.5		
design value of bending moment	$M^0_{Rd,s}$	[Nm]	15.6	16.8	21.0	31.1	33.5	41.8	54.5	58.7	73.3	138.1	149.0	185.9
yield strength anchor rod	f_{yk}	[N/mm²]	420	450	560	420	450	560	420	450	560	420	450	560
tensile strength anchor rod	f_{uk}	[N/mm²]	520	700		520	700		520	700		520	700	

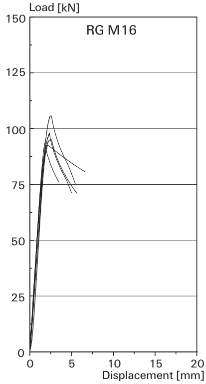
Anchor type			**R M 20 / RG M 20** gvz	**A4**	**C**	**R M 24 / RG M 24** gvz	**A4**	**C**	**R M 27 / RG M 27** gvz	**A4**	**C**	**R M 30 / RG M 30** gvz	**A4**	**C**
stressed cross sectional area anchor rod	A_s	[mm²]	245.0			353.0			459.0			561.0		
resisting moment anchor rod	W	[mm³]	540.9			935.5			1387			1874		
design value of bending moment	$M^0_{Rd,s}$	[Nm]	269.7	290.9	363.0	466.0	502.6	627.3	693.3	748.1	933.6	934.4	1008	1258
yield strength anchor rod	f_{yk}	[N/mm²]	420	450	560	420	450	560	420	450	560	420	450	560
tensile strength anchor rod	f_{uk}	[N/mm²]	520	700		520	700		520	700		520	700	

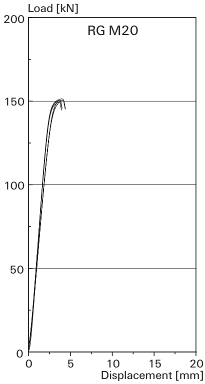
11. Load displacement curves for tension in non-cracked concrete ($f_{ck,cube(200)}$ = 30 N/mm^2)

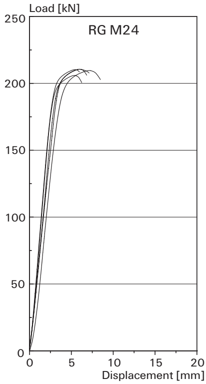


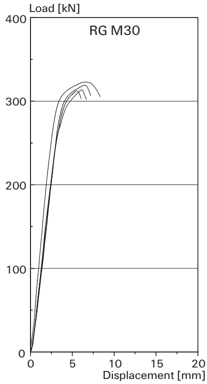












Notes