TECHNICAL DATA SHEET

KEM EP Premium Epoxy High Strength Anchoring Adhesive with Seismic Certification

1. Introduction

KEM EP is a high performance epoxy anchoring adhesive for heavy-duty structural fixings in seismic areas.

KEM EP provides excellent adhesive properties and low shrinkage, suitable for use with smooth/diamond cored holes.

Working temperature: from -40 up to 72°C short period, and from -40 up to 50°C long period.

Features:

- European Approval ETA-20/1284 for C1 and C2 Category SEISMIC ZONE EAD 330499-01-0601
- European Approval ETA-20/1284 for cracked concrete op.1 with 100 years working life according to EAD 330499-01-0601
- European Approval ETA-21/0802 for post-installed rebar connection with 100 years working life, for static/quasi static and seismic load, according to EAD 330087-01-0601
- Temperature range after curing: -40 / +50°C (max 72°C for short period)
- High chemical resistance of bonded resin
- Overhead installation

Safety data sheet available on web site www.strongtie.eu/sds

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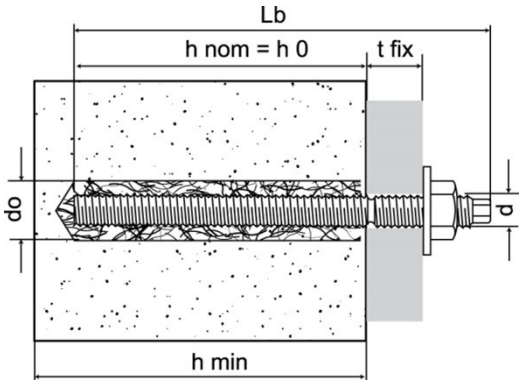
2. Technical Data



tfix	=	fixture thickness
do	=	hole diameter
h0	=	minimum hole depth
hnom	=	nominal embedment depth
hmin	=	minimum support thickness
Tmax	=	torque max
Lb	=	threaded bar length
d	=	threaded bar diameter
Nr	=	approx. n° of trigger pulls per fixing

Resin range	Concrete op. 1	Seismic	Post-installed Rebar	Diamond drilling	R 120
KEM EP 934	CARTRIDGE – bi-component styrene free epoxy 585 ml				Cod. **9340200000000**

GUN - Injection gun	
Injection gun for 585 ml cartridge	Cod. 49930000000
Injection gun for 585 ml cartridge	Cod. 49932000000

MIX - Mixer nozzle	Cod. 94904000000
PUMP - Blow pump for hole cleaning	Cod. 49905000000
TECHNICAL SPRAY G82 - High pressure cleaner - 400ml	Cod. G8200

SCO - Brush for hole cleaning			
Brush Ø	For hole Ø	Total length	Cod.
14	10÷12	300	49999014300
20	14÷18	300	49999020300
30	20÷28	300	49999030300

BFK Threaded bar for solid materials							
Type d x L	tfix [mm]	Wrench - bar	Wrench - nut	Nr	Volume per fixing [ml]	Item code White zinc ptd.	Item code Stainless steel A4
M8x110	15	5	13	1	4	21911b08110	21911x08110
M10x130	25	7	17	2	6	21911b10130	21911x10130
M12x160	30	8	19	3	10	21911b12160	21911x12160
M16x190	40	12	24	5	18	21911b16190	21911x16190
M20x240*	45	13	30	10	45	21911b20240	
M20x260	65	13	30	10	45		21911x20260
M24x300	60	13	36	20	70	21911b24300	21911x24300
M30x380*	70	13	46	40	150	21911b30380	21911x30380[1)]

*Threaded bar without external hexagon
[1)] Inox Stainless steel A4-50

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3. Base Materials

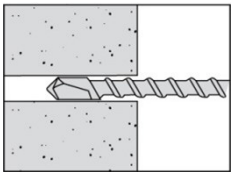
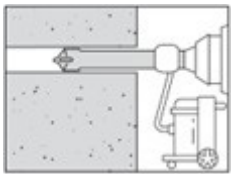
- ● Concrete
- ● Honeycomb brick
- ● Light weight honeycomb brick
- ● Hollow light aggregate block
- ● Solid stone[1)]
- ● Solid brick
- ● Cell like clay brick
- ● Hollow dense aggregate block
- ◒ Aerated concrete
- ● Wood

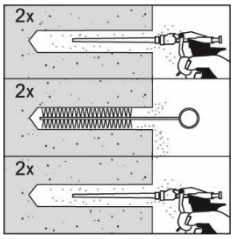
[1)] For application on natural stone or marble, carry out test and wait 24/48 hours for any reactions

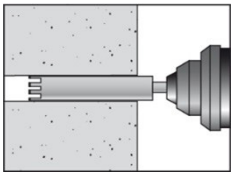
● Suitable applications ◒ Partially suitable applications

4. Installation

Drilling methods	
HD	Hammer Drilling
HDB	Hollow Drill bit System
CD	Compressed air Drilling
DD	Diamond Coring

1a	Drilling (HD, HDB and CD methods)		
	Drill using suitable drill bit		If hollow drill bit HDB according ETA is used no other borehole cleaning procedure is required

2a	Bore hole cleaning (HD and CD drilling methods)
	COMPRESSED AIR 2x compressed air (min 6 bar) 2x brush 2x compressed air (min 6 bar)

1b	Drilling (DD methods)
	Drill to obtain the bore hole with diameter and depth required

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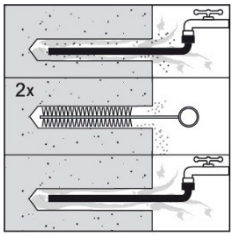
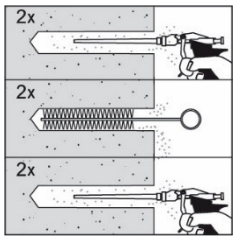
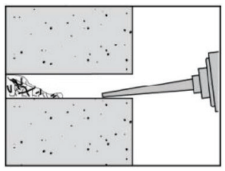
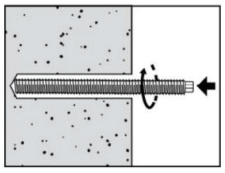
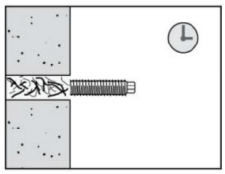
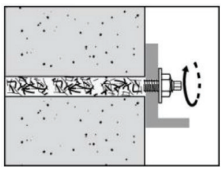
2b	Bore hole cleaning (DD drilling method)		
	WATER JET Rinse with water until clear water comes out 2x brush Rinse with water until clear water comes out		COMPRESSED AIR 2x compressed air (min 6 bar) 2x brush 2x compressed air (min 6 bar)
Warning: standing water in the bore hole must be removed before cleaning!			

3	Resin injection and bar insertion
	Pump resin to waste until the mix is an uniform colour before injecting resin.
	Insert threaded bar before the gel time stated on the packaging.
	Leave resin undisturbed for the curing time stated in the table on the packaging.
	Install the fixing and tighten.

Base material °C	0°C	5°C	+ 10°C	+ 15°C	+ 20°C	+ 25°C	+ 35°C	+ 40°C
Gel time	90 min.	80 min.	60 min.	40 min.	30 min.	12 min.	8 min.	8 min.
Curing time on dry base materials	144 h	48 h	28 h	18 h	12 h	9 h	6 h	4 h
Curing time on wet base materials	288 h	96 h	56 h	36 h	24 h	18 h	12 h	8 h

Cartridge temperature must be between +5°C and 40°C

5. Storage

- Store product in a cool and dry place at a temperature between +5°C and +35°C
- Simpson Strong-Tie guarantees the stability of the product in its unopened packaging for 24 months.

6. Mechanical Properties

6.1 Resin Component			
UV Resistance	Pass		
Watertightness	DIN EN 12390-8	0	[mm]
Density		1,5	[kg / dm^3]
Compressive strength	EN 196 p.1	122	[N / mm^2]
Tensile strength	DIN EN ISO 527 p.2	44	[N / mm^2]
Flexural strength	EN 196 p.1	66	[N / mm^2]
E Modulus	DIN EN ISO 527 p.2	6300	[N / mm^2]
Shrinkage	DIN 52450	< 1,4	[%]
Hardness Shore A	DIN EN ISO 868	99,4	
Hardness Shore D	DIN EN ISO 868	86,1	
Electrical resistance	IEC 93	8,0 x 10^{12}	[Ω]
Thermal conductivity	DIN EN 993 p.15	0,5	[W / m · K]
Thermal heat capacity	DIN EN 993 p.15	1350	[J / Kg · K]

Anchors on Concrete

ETA-20/1284

6.2 Metal Fixing Components		
Type	**Material**	**Coating**
BFK bar	steel grade 5.8	white zinc plated ≥ 5µm ISO 4042
Hex nut	DIN 934 grade 8	
Washer	DIN 125/1	
BFK bar A4	stainless steel grade A4 70	-
Nut A4	stainless steel grade DIN 934 - A4 70	
Washer A4	stainless steel grade DIN 125/1 - A4	

Anchor diameter				M8	M10	M12	M16	M20	M24	M27	M30
Stressed cross-section		A_s	[mm^2]	36,6	58,0	84,3	157	245	353	459	561
Recommended Bending moment	Bar cl. 5.8	$M_{5.8}$	[Nm]	11	21	37	95	185	320	476	640
	Bar cl. 8.8	$M_{8.8}$	[Nm]	17	34	60	152	297	513	762	1028
	Bar cl. A4 70	$M_{A4\ 70}$	[Nm]	12	24	42	107	208	360	250(*)	340(*)

(*) Cl. A4-50 (M27-M30)

KEM EP Premium Epoxy High Strength Anchoring Adhesive with Seismic Certification

7.1 STATIC and QUASI STATIC LOADS THREADED RODS

ETA-20/1284

Single anchor with large anchor spacing and edge distances in concrete C20/25

Design acc. EN 1992-4:2018 (γ_c=1,5; ψ_{sus}=1)

Threaded bar diameter gr. 5.8						M8	M10	M12	M16	M20	M24	M27	M30
Hole diameter				d_o	[mm]	10	12	14	18	22	28	30	35
Nominal embedment depth				h_{nom}	[mm]	80	90	110	125	170	210	240	270
Tensile 24°C [3]	Cracked concrete	HD / CD / HDB 50 years	Characteristic	$N_{rk,cr}$	[kN]	14,1	19,8	35,2	48,1	76,3	104,8	128,0	152,8
			Design	$N_{rd,cr}$ [1]	[kN]	9,4	13,2	23,5	32,1	50,9	69,9	85,4	101,9
			Recommended	N_{cr} [2]	[kN]	6,7	9,4	16,8	22,9	36,3	49,9	61,0	72,5
		HD / CD / HDB 100 years	Characteristic	$N_{rk,cr}$	[kN]	13,1	18,4	31,1	47,1	76,3	104,8	128,0	152,8
			Design	$N_{rd,cr}$ [1]	[kN]	8,7	12,2	20,7	31,4	50,9	69,9	85,4	101,8
			Recommended	N_{cr} [2]	[kN]	6,2	8,8	14,8	22,4	36,3	49,9	61,0	72,7
	Un-cracked concrete	HD / CD / HDB / DD 50 / 100 years	Characteristic	$N_{rk,ucr}$	[kN]	18,5	29,0	42,1	68,8	109,0	149,7	182,9	218,2
			Design	$N_{rd,ucr}$ [1]	[kN]	12,2	19,3	28,1	45,8	72,7	99,8	121,9	145,5
			Recommended	N_{ucr} [2]	[kN]	8,7	13,8	20,0	32,7	51,9	71,3	87,1	103,9
Edge distance				$C_{cr,N}$	[mm]	120	135	165	190	255	315	360	405
Spacing				$S_{cr,N}$	[mm]	$2 \cdot C_{cr,N}$							
Minimum support thickness				h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm			$h_{ef} + 2 \cdot d_o$				
Torque max				T_{max}	[Nm]	10	20	40	60	100	170	250	300

Threaded bar diameter						M8	M10	M12	M16	M20	M24	M27	M30
Shear [4]	C ≥ 10xh_{nom}	cl.5.8	Characteristic	$V_{rk,5.8}$	[kN]	11,0	17,4	25,3	47,1	73,5	105,9	137,7	168,3
			Design	$V_{rd,5.8}$ [1]	[kN]	8,8	13,9	20,2	37,7	58,8	84,7	110,1	134,6
			Recommended	$V_{5.8}$ [2]	[kN]	6,3	9,9	14,4	26,9	42,0	60,5	78,7	96,2
		cl.8.8	Characteristic	$V_{rk,8.8}$	[kN]	14,8	23,2	33,6	62,8	98,0	141,0	183,6	224,0
			Design	$V_{rd,8.8}$ [1]	[kN]	11,8	18,6	26,9	50,2	78,4	113,0	146,9	179,5
			Recommended	$V_{8.8}$ [2]	[kN]	8,4	13,3	19,2	35,9	56,0	80,7	104,9	128,2
		cl.A4-70	Characteristic	$V_{rk,A4-70}$	[kN]	12,8	20,3	29,5	55,0	85,8	123,6	114,8	140,3
			Design	$V_{rd,A4-70}$ [1]	[kN]	8,3	13,1	19,0	35,4	55,3	79,7	48,2 [5]	58,9 [5]
			Recommended	V_{A4-70} [2]	[kN]	5,9	9,3	13,6	25,3	39,5	56,9	34,4 [5]	42,1 [5]

1kN ≅ 100 kgf (Red values = steel failure)

[1] Design loads include γM see ETA

[2] Recommended loads included $\gamma Mx\gamma F$ see ETA, with γF = 1.4

[3] For higher temperatures and for flooded bore holes see the certification ETA-20/1284

[4] Value of pure shear with distance from the edge $C \geq 10 \cdot h_{nom}$

[5] cl. A4-50 (M27-M30)

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7.2 SEISMIC LOADS THREADED RODS

ETA-20/1284

Single anchor with large anchor spacing and edge distances in concrete C20/25

Design acc. EN 1992-4:2018 (γ_c=1,5; ψ_{sus}=1)

Threaded bar diameter gr. 5.8 (min 8.8 or ss 70 for C2)						M8	M10	M12	M16	M20	M24	M27	M30
Hole diameter				d_o	[mm]	10	12	14	18	22	28	30	35
Nominal embedment depth				h_{nom}	[mm]	80	90	110	125	170	210	240	270
Tensile 24°C [3]	Seismic C1	HD / CD / HDB 50 / 100 years	Characteristic	$N_{rk,eq\ C1}$	[kN]	14,1	19,8	33,8	40,9	64,9	89,1	108,8	129,9
			Design	$N_{rd,eq\ C1}$ [1]	[kN]	9,4	13,2	22,5	27,3	43,3	59,4	72,6	86,6
			Recommended	$N_{eq\ C1}$ [2]	[kN]	6,7	9,4	16,1	19,5	30,9	42,4	51,8	61,8
	Seismic C2	HD / CD / HDB 50 / 100 years	Characteristic	$N_{rk,eq\ C2}$	[kN]	-	-	24,0	30,2	53,4	80,7	-	-
			Design	$N_{rd,eq\ C2}$ [1]	[kN]	-	-	16,0	20,1	35,6	53,8	-	-
			Recommended	$N_{eq\ C2}$ [2]	[kN]	-	-	11,4	14,4	25,4	38,4	-	-
Edge distance				$C_{cr,N}$	[mm]	120	135	165	190	255	315	360	405
Spacing				$S_{cr,N}$	[mm]	$2 \cdot C_{cr,N}$							
Minimum support thickness				h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm			$h_{ef} + 2 \cdot d_o$				
Torque max				T_{max}	[Nm]	10	20	40	60	100	170	250	300

Threaded bar diameter with special washer (α_{gap} = 1,0)						M8	M10	M12	M16	M20	M24	M27	M30
Shear Seismic C1 [4]	C ≥ 10xh_{nom}	cl.5.8	Characteristic	$V_{rk,5.8\ c1}$	[kN]	7,7	12,2	17,7	33,0	51,5	74,1	96,4	117,8
			Design	$V_{rd,5.8\ c1}$ [1]	[kN]	6,1	9,7	14,2	26,4	41,2	59,3	77,1	94,2
			Recommended	$V_{5.8\ c1}$ [2]	[kN]	4,4	7,0	10,1	18,8	29,4	42,4	55,1	67,3
		cl.8.8	Characteristic	$V_{rk,8.8\ c1}$	[kN]	10,2	16,2	23,6	44,0	68,6	98,8	128,5	157,1
			Design	$V_{rd,8.8\ c1}$ [1]	[kN]	8,2	13,0	18,8	35,2	54,9	79,1	102,8	125,7
			Recommended	$V_{8.8\ c1}$ [2]	[kN]	5,9	9,3	13,4	25,1	39,2	56,5	73,4	89,8
		cl.A4-70	Characteristic	$V_{rk,A4\text{-}70\ c1}$	[kN]	9,1	14,2	20,6	38,5	60,0	86,5	80,3[5]	98,2[5]
			Design	$V_{rd,A4\text{-}70\ c1}$ [1]	[kN]	5,8	9,1	13,2	24,7	38,5	55,4	33,8[5]	41,3[5]
			Recommended	$V_{A4\text{-}70\ c1}$ [2]	[kN]	4,2	6,5	9,4	17,6	27,5	39,6	24,1[5]	29,5[5]
Threaded bar diameter without special washer (α_{gap} = 0,5)						**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Shear Seismic C1 [4]	C ≥ 10xh_{nom}	cl.5.8	Characteristic	$V_{rk,5.8\ c1}$	[kN]	3,9	6,1	8,9	16,5	25,8	37,1	48,2	58,9
			Design	$V_{rd,5.8\ c1}$ [1]	[kN]	3,1	4,9	7,1	13,2	20,6	29,7	38,6	47,1
			Recommended	$V_{5.8\ c1}$ [2]	[kN]	2,2	3,5	5,1	9,4	14,7	21,2	27,6	33,7
		cl.8.8	Characteristic	$V_{rk,8.8\ c1}$	[kN]	5,1	8,1	11,8	22,0	34,3	49,4	64,3	78,6
			Design	$V_{rd,8.8\ c1}$ [1]	[kN]	4,1	6,5	9,4	17,6	27,5	39,6	51,4	62,9
			Recommended	$V_{8.8\ c1}$ [2]	[kN]	3,0	4,7	6,7	12,6	19,6	28,3	36,7	44,9
		cl.A4-70	Characteristic	$V_{rk,A4\text{-}70\ c1}$	[kN]	4,6	7,1	10,3	19,3	30,0	43,3	40,2[5]	49,1[5]
			Design	$V_{rd,A4\text{-}70\ c1}$ [1]	[kN]	2,9	4,6	6,6	12,4	19,3	27,7	16,9[5]	20,7[5]
			Recommended	$V_{A4\text{-}70\ c1}$ [2]	[kN]	2,1	3,3	4,7	8,8	13,8	19,8	12,1[5]	14,8[5]

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Threaded bar diameter with special washer (α_{gap} = 1,0)						M8	M10	M12	M16	M20	M24	M27	M30
Shear Seismic C2 [4]	C ≥ 10xh$_{nom}$	cl.8.8	Characteristic	$V_{rk,8.8\ C2}$	[kN]	-	-	23,6	44,0	68,6	98,8	-	-
			Design	$V_{rd,8.8\ C2}$ [1]	[kN]	-	-	18,9	34,2	54,9	79,1	-	-
			Recommended	$V_{8.8\ C2}$ [2]	[kN]	-	-	13,5	24,4	39,2	56,5	-	-
		cl.A4-70	Characteristic	$V_{rk,A4\text{-}70\ C2}$	[kN]	-	-	20,6	38,5	60,0	86,5	-	-
			Design	$V_{rd,A4\text{-}70\ C2}$ [1]	[kN]	-	-	13,2	24,7	38,5	55,4	-	-
			Recommended	$V_{A4\text{-}70\ C2}$ [2]	[kN]	-	-	9,5	17,6	27,5	39,6	-	-
Threaded bar diameter without special washer (α_{gap} = 0,5)						**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Shear Seismic C2 [4]	C ≥ 10xh$_{nom}$	cl.8.8	Characteristic	$V_{rk,8.8\ C2}$	[kN]	-	-	11,8	22,0	34,3	49,4	-	-
			Design	$V_{rd,8.8\ C2}$ [1]	[kN]	-	-	9,5	17,1	27,5	39,6	-	-
			Recommended	$V_{8.8\ C2}$ [2]	[kN]	-	-	6,8	12,2	19,6	28,3	-	-
		cl.A4-70	Characteristic	$V_{rk,A4\text{-}70\ C2}$	[kN]	-	-	10,3	19,3	30,0	43,3	-	-
			Design	$V_{rd,A4\text{-}70\ C2}$ [1]	[kN]	-	-	6,6	12,4	19,3	27,7	-	-
			Recommended	$V_{A4\text{-}70\ C2}$ [2]	[kN]	-	-	4,8	8,8	13,8	19,8	-	-

1kN ≅ 100 kgf (Red values = steel failure)

[1] Design loads include γM see ETA

[2] Recommended loads included $\gamma Mx\gamma F$ see ETA, with γF = 1.4

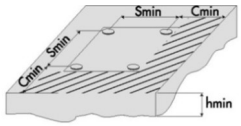
[3] For higher temperatures and for flooded bore holes see the certification ETA-20/1284

[4] Value of pure shear with distance from the edge $C \geq 10 \cdot h_{nom}$

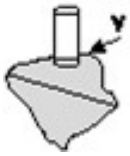
[5] cl. A4-50 (M27-M30)

[6] Seismic resistances include the factors α_{eq} = 0,85 (single anchor under tension in the case of concrete cone failure)

Minimum installation distances

Anchor diameter				M8	M10	M12	M16	M20	M24	M27	M30
	Minimum distance form edge	C_{min}	[mm]	35	40	45	50	60	65	75	80
	Minimum distance between anchors	S_{min}	[mm]	40	50	60	75	95	115	125	140

Shear load across the edge concrete C20/25 at a distance of C_{min}

Anchor diameter				M8	M10	M12	M16	M20	M24	M27	M30
	Cracked concrete	$V_{rd,cmin}$	[kN]	2,0	2,6	3,2	4,1	5,9	7,3	9,3	10,7
		V_{cmin}	[kN]	1,4	1,8	2,3	2,9	4,2	5,2	6,6	7,7

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7.3 STATIC and QUASI STATIC LOADS REBAR as ANCHORS

ETA-20/1284

Single anchor with large anchor spacing and edge distances in concrete C20/25

Design acc. EN 1992-4:2018 (γ_c=1,5; ψ_{sus}=1)

Rebar diameter B500[5] (EN 10080)							Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Nominal embedment depth				h_{nom}	[mm]		80	90	110	115	125	170	210	250	280
Hole diameter				d_o	[mm]		12	14	16	18	20	25	32	35	40
Tensile 24°C [3]	Cracked concrete	HD / CD / HDB 50 years	Characteristic	$N_{rk,cr}$	[kN]		14,1	19,8	35,3	42,5	48,1	76,3	104,8	136,1	161,3
			Design	$N_{rd,cr}$ [1]	[kN]		9,4	13,2	23,5	28,3	32,1	50,9	69,9	90,8	107,6
			Recommended	N_{cr} [2]	[kN]		6,7	9,4	16,8	20,2	22,9	36,5	49,9	64,8	76,8
		HD / CD / HDB 100 years	Characteristic	$N_{rk,cr}$	[kN]		13,1	18,4	31,1	37,9	47,1	76,3	104,8	136,1	161,3
			Design	$N_{rd,cr}$ [1]	[kN]		8,7	12,2	20,7	25,3	31,4	50,9	69,9	90,8	107,6
			Recommended	N_{cr} [2]	[kN]		6,2	8,8	14,8	18,1	22,4	36,3	49,9	64,8	76,8
	Un-cracked concrete	HD / CD 50 / 100 years	Characteristic	$N_{rk,ucr}$	[kN]		27,6	42,0	56,7	60,7	68,7	109,0	149,7	194,4	230,5
			Design	$N_{rd,ucr}$ [1]	[kN]		19,8	28,0	37,8	40,4	45,8	72,7	99,8	129,6	153,7
			Recommended	N_{ucr} [2]	[kN]		14,1	20,0	27,0	28,9	32,7	51,9	71,3	92,6	109,8
		HDB 50 / 100 years	Characteristic	$N_{rk,ucr}$	[kN]		28,2	39,6	53,9	60,7	68,7	109,0	149,7	194,4	230,5
			Design	$N_{rd,ucr}$ [1]	[kN]		18,8	26,4	35,9	40,4	45,8	72,7	99,8	129,6	153,7
			Recommended	N_{ucr} [2]	[kN]		13,4	18,8	25,7	28,9	32,7	51,9	71,3	92,6	109,8
		DD 50 / 100 years	Characteristic	$N_{rk,ucr}$	[kN]		28,2	36,8	53,9	60,7	68,7	109,0	149,7	194,4	230,5
			Design	$N_{rd,ucr}$ [1]	[kN]		18,8	24,5	35,9	40,4	45,8	72,7	99,8	129,6	153,7
			Recommended	N_{ucr} [2]	[kN]		13,4	17,5	25,7	28,9	32,7	51,9	71,3	92,6	109,8
Edge distance				$C_{cr,N}$	[mm]		120	135	165	175	190	255	315	375	420
Spacing				$S_{cr,N}$	[mm]		$2 \cdot C_{cr,N}$								
Minimum support thickness				h_{min}	[mm]		h_{ef} + 30 mm ≥ 100 mm		$h_{ef} + 2 \cdot d_o$						
Minimum distance form edge				C_{min}	[mm]		35	40	45	50	50	60	70	75	85
Minimum distance between anchors				S_{min}	[mm]		40	50	60	70	75	95	120	130	150

Rebar diameter						Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Shear [4]	C ≥ 10xh_{nom}	Rebar B400[5]	Characteristic	$V_{rk,B400}$	[kN]	11,0	17,3	24,9	33,9	44,2	69,1	108,0	135,5	176,9
			Design	$V_{rd,B400}$ [1]	[kN]	7,3	11,5	16,6	22,6	29,5	46,1	72,0	90,3	117,9
			Recommended	V_{B400} [2]	[kN]	5,2	8,2	11,9	16,1	21,1	32,9	51,4	64,5	84,3
		Rebar B500[5]	Characteristic	$V_{rk,B500}$	[kN]	13,8	21,6	31,1	42,3	55,3	86,4	135,0	169,3	221,2
			Design	$V_{rd,B500}$ [1]	[kN]	9,2	14,4	20,7	28,2	36,9	57,6	90,0	112,9	147,5
			Recommended	V_{B500} [2]	[kN]	6,6	10,3	14,8	20,2	26,3	41,1	64,3	80,6	105,3

1kN ≅ 100 kgf (Red values = steel failure)

[1] Design loads include γ_M see ETA

[2] Recommended loads included $\gamma_{Mx}\gamma_F$ see ETA, with γ_F = 1.4

[3] For higher temperatures and for flooded bore holes see the certification ETA-20/1284

[4] Value of pure shear with distance from the edge $C \geq 10 \cdot h_{nom}$

[5] Calculation carried out considering f_{uk}/f_{yk} = 1,10 see EC2-Annex C

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7.4 SEISMIC LOADS REBAR as ANCHORS

ETA-20/1284

Single anchor with large anchor spacing and edge distances in concrete C20/25

Design acc. EN 1992-4:2018 (γ_c=1,5; ψ_{sus}=1)

Rebar diameter B500[5] (EN 10080)						Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Nominal embedment depth				h_{nom}	[mm]	80	90	110	115	125	170	210	250	280
Hole diameter				d_o	[mm]	12	14	16	18	20	25	32	35	40
Tensile 24°C[3]	Cracked concrete	HD / CD / HDB 50 years	Characteristic	$N_{rk,cr}$	[kN]	14,1	19,8	35,2	42,5	48,1	76,3	104,8	136,1	161,3
			Design	$N_{rd,cr}$[1]	[kN]	9,4	13,2	23,5	24,1	27,3	43,2	59,4	77,1	91,4
			Recommended	N_{cr}[2]	[kN]	6,7	9,4	16,1	17,2	19,5	30,9	42,4	55,1	65,3
Edge distance				$C_{cr,N}$	[mm]	120	135	165	175	190	255	315	375	420
Spacing				$S_{cr,N}$	[mm]	$2 \cdot C_{cr,N}$								
Minimum support thickness				h_{min}	[mm]	hef + 30 mm ≥ 100 mm		$h_{ef} + 2 \cdot d_o$						
Minimum distance form edge				C_{min}	[mm]	35	40	45	50	50	60	70	75	85
Minimum distance between anchors				S_{min}	[mm]	40	50	60	70	75	95	120	130	150

Rebar diameter with special washer (α_{gap} = 1,0)						Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Shear Seismic C1 [4]	C ≥ 10xh_{nom}	Rebar B400[6]	Characteristic	$V_{rk,B400\ C1}$	[kN]	7,7	12,1	17,4	23,7	31,0	48,4	75,6	94,8	123,9
			Design	$V_{rd,B400\ C1}$[1]	[kN]	5,2	8,1	11,6	15,8	20,6	32,3	50,4	63,2	82,6
			Recommended	$V_{B400\ C1}$[2]	[kN]	3,7	5,8	8,3	11,3	14,7	23,0	36,0	45,2	59,0
		Rebar B500[6]	Characteristic	$V_{rk,B500\ C1}$	[kN]	9,7	15,1	21,8	29,6	38,7	60,5	94,5	118,5	154,8
			Design	$V_{rd,B500\ C1}$[1]	[kN]	6,5	10,1	14,5	19,8	25,8	40,3	63,0	79,0	103,2
			Recommended	$V_{B500\ C1}$[2]	[kN]	4,6	7,2	10,4	14,1	18,4	28,8	45,0	56,4	73,7

Rebar diameter without special washer (α_{gap} = 0,5)						Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Shear Seismic C1 [4]	C ≥ 10xh_{nom}	Rebar B400[6]	Characteristic	$V_{rk,B400\ C1}$	[kN]	3,9	6,1	8,7	11,9	15,5	24,2	37,8	47,4	62,0
			Design	$V_{rd,B400\ C1}$[1]	[kN]	2,6	4,1	5,8	7,9	10,3	16,2	25,2	31,6	41,3
			Recommended	$V_{B400\ C1}$[2]	[kN]	1,9	2,9	4,2	5,7	7,4	11,5	18,0	22,6	29,5
		Rebar B500[6]	Characteristic	$V_{rk,B500\ C1}$	[kN]	4,9	7,6	10,9	14,8	19,4	30,3	47,3	59,3	77,4
			Design	$V_{rd,B500\ C1}$[1]	[kN]	3,3	5,1	7,3	9,9	12,9	20,2	31,5	39,5	51,6
			Recommended	$V_{B500\ C1}$[2]	[kN]	2,3	3,6	5,2	7,1	9,2	14,4	22,5	28,2	36,9

1kN ≅ 100 kgf (Red values = steel failure)

1) Design loads include γM

2) Recommended loads included $\gamma Mx\gamma F$ see ETA, with γF = 1.4

3) For higher temperatures and for flooded bore holes see the certification ETA-20/1284

4) Value of pure shear with distance from the edge $C \geq 10 \cdot h_{nom}$

5) Seismic resistances include the factors α_{eq} = 0,85 (single anchor under tension in the case of concrete cone failure

6) Calculation carried out considering f_{uk}/f_{yk} = 1,10 see EC2-Annex C

7) Drilling methods HD, HDB, CD.

7.5 Calculation of Design Seismic Resistance

Tensile load $N_{rd,eq} = \alpha_{gap} \cdot \alpha_{eq} \cdot N^{0}_{rd,eq}$

Shear load $V_{rd,eq} = \alpha_{gap} \cdot \alpha_{eq} \cdot V^{0}_{rd,eq}$

Reduction factors for resistance under seismic actions

		Tension failure					Shear failure		
		Steel [$N_{Rk,s}$]	Pull-out [$N_{Rk,p}$]	Comb. [$N_{Rk,p-c}$]	Concr. cone [$N_{Rk,c}$]	Splitting [$N_{Rk,sp}$]	Steel [$V_{Rk,s}$]	Concr. Edge [$V_{Rk,c}$]	Pry-out [$V_{Rk,cp}$]
α_{gap}	Reduction factor for gap hole fixture and fasteners	1	1	1	1	1	0,5*	0,5*	0,5*
α_{eq}	Reduction factor for single fasteners	1	1	1	0,85	1	1	1	0,85
	Reduction factor for fasteners group	1	0,85	0,85	0,75	0,85	0,85	0,85	0,75

*) α_{gap} = 1,0 for filled annular gap between anchor and clearance hole in the fixture, that is the case for the values in above tables

Recommended seismic performance categories for anchors

Seismicity level [a]		Importance Class acc. to EN 1998-1:2004, 4.2.5			
	$a_g \cdot S$ [c]	I	II	III	IV
Molto basso / Very low [b]	$a_g \cdot S \leq 0{,}05$ g	No additional requirement			
Basso / Low [b]	$0{,}05\ g < a_g \cdot S \leq 0{,}1$ g	C1	C1 [d] or C2 [e]		C2
> Basso / > Low [b]	$a_g \cdot S > 0{,}1$ g	C1	C2		

[a] The values defining the seismicity levels may be found in the National Annex of EN 1998-1 (Eurocode 8)
[b] Definition according to EN 1998-1:2004, 3.2.1.
[c] a_g = Design ground acceleration on type A ground (EN 1998-1:2004, Table 3.2.1)
S = Soil factor (see e.g. EN 1998-1:2004, 3.2.2)
[d] C1 for fixing non-structural elements to structure
[e] C2 for fixing structural elements to structure

The load values are only valid if the installation has been carried out correctly. The design engineer is responsible for the designing and calculation of the fixing.

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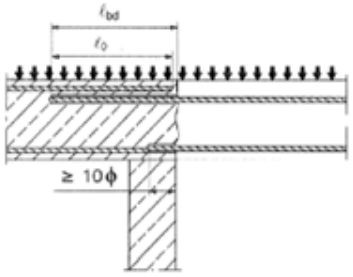
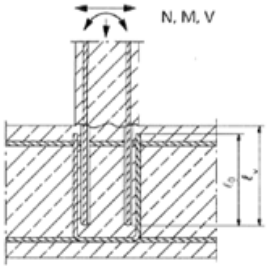
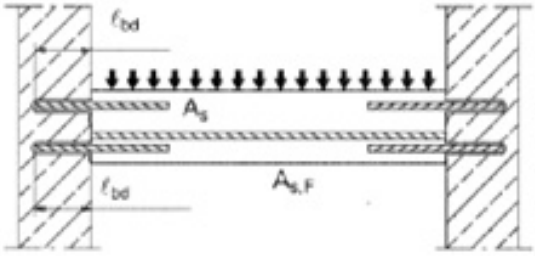
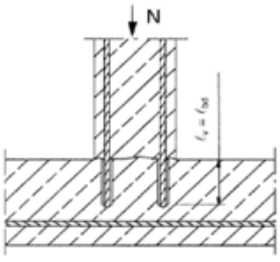
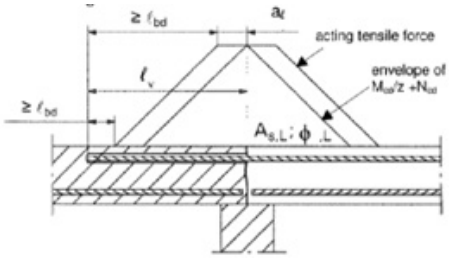
7.6 POST-INSTALLED REINFORCING BARS

ETA-21/0802

APPLICATION EXAMPLES	
Overlapping joints for rebar connections of slabs and beams	
Overlapping joints at a foundation of a wall or column where the rebars are stressed in tension	
End anchoring of slabs or beams	
Rebar connection for components stressed primarily in compression	
Anchoring of reinforcement to cover the line of acting tensile force	

Note: in the figures above no transverse reinforcement is represented, the transverse reinforcement as required by EC2 shall be present, furthermore the shear transfer between old and new concrete shall be designed according to EC2.

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8. DESIGN VALUES of BOND RESISTANCE (static/quasi static and seismic load)

Design acc. to EN1992-1-1:2004+AC2010, EN 1992-1-2:2004+AC:2008 and Annex B2 and B3 of ETA-21/0802

ETA-21/0802

Post-installed rebar connection				Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø22	Ø24	Ø25	Ø28	Ø32
Hole diameter	d_0	HD / DD / HDB	[mm]	12	14	16	18	20	25	28	32	32	35	40
		CD		-	-	16	18	20	26	28	32	32	35	40
Max embedment depth $l_{v\,MAX}$		HD / CD / DD	[mm]	800	1000	1300			1000					
		HDB		800	1000									
Min anchorage depth		$\ell_{b\,MIN}$	[mm]	Eq. 8.6 – Eq. 8.7 EN 1992-1-1:2004+AC2010										
Min overlap length		$\ell_{0\,MIN}$	[mm]	Eq. 8.11 EN 1992-1-1:2004+AC2010										
Amplification factor		$\alpha_{lb} = \alpha_{lb,100y}$	C12/15 - C50/60	1,0										
		$\alpha_{lb,seis} = \alpha_{lb,seis,100y}$	C16/20 - C50/60	-	1,0									
Minimum spacing		s_{min}	[mm]	≥ 5·Ø ≥ 50 mm										
Minimum concrete cover min C		Without Drilling Aid	[mm]	[1),3)] 30 mm + 0,06·lv ≥ 2·Ø								[1),3)] 40 mm + 0,06·lv ≥ 2·Ø		
				[2)] 50 mm + 0,08·lv								[2)] 60 mm + 0,08·lv ≥ 2·Ø		
		With Drilling Aid		[1),3)] 30 mm + 0,02·lv ≥ 2·Ø								[1),3)] 40 mm + 0,02·lv ≥ 2·Ø		
				[2)] 50 mm + 0,02·lv								[2)] 60 mm + 0,02·lv ≥ 2·Ø		
				[4)] 30 mm + 0,02·lv ≥ 2·Ø								[4)] 40 mm + 0,02·lv ≥ 2·Ø		
				Distance of 1st edge					**Distance of 2nd edge**					
Minimum concrete cover seismic category $c_{min,seis}$		Design condition	edge	[1),2),3)] ≥ 2·Ø					[1),2),3)] ≥ 2·Ø					
			corner	[1),2),3)] ≥ 2·Ø					[1),2),3)] ≥ 2·Ø					
			edge	[4)] ≥ 4·Ø					[4)] ≥ 8·Ø					
			corner	[4)] ≥ 6·Ø					[4)] ≥ 6·Ø					

DESIGN of BOND RESISTANCE [N/mm²]			Concrete class EN206							
$f_{bd,PIR}=f_{bd}\bullet k_b$ - $f_{bd,PIR,100y}=f_{bd}\bullet k_{b,100y}$ $f_{bd,PIR,seis}=f_{bd}\bullet k_{b,seis}$ - $f_{bd,PIR,seis,100y}=f_{bd}\bullet k_{b,seis,100y}$			C12/15	C16/20	C20/25	C25/30	C30/37	C40/50	C45/55	C50/60
for good bond conditions	$f_{bd,PIR}$ $f_{bd,PIR,100y}$	Ø8- Ø32	1,6	2,0	2,3	2,7	3,0	3,7	4,0	4,3
for good bond conditions, seismic category	$f_{bd,PIR,seis}$ $f_{bd,PIR,seis,100y}$	Ø8- Ø32	-	2,0	2,3	2,7	3,0	3,7	4,0	4,3
reduction factor for all drilling methods	$k_b = k_{b,100y}$		1,0							
	$k_{b,seis} = k_{b,seis,100y}$		-	1,0						
factor "for all other bond conditions"	$\eta 1$		0,7							
Under FIRE EXPOSURE	$f_{bd,fi}$	[N/mm²]	$f_{bd,fi} = k_{fi}(\theta) \cdot f_{bd,PIR} \cdot \gamma c / \gamma M,fi$ [5)]							
	$f_{bd,fi,100y}$	[N/mm²]	$f_{bd,fi,100y} = k_{fi,100y}(\theta) \cdot f_{bd,PIR,100y} \cdot \gamma c / \gamma M,fi$ [5)]							

1) HD= hammer drilling;
2) CD= compressed air drilling;
3) HDB= hammer drilling with hollow drill bit;
4) DD= diamond drilling;
5) With:

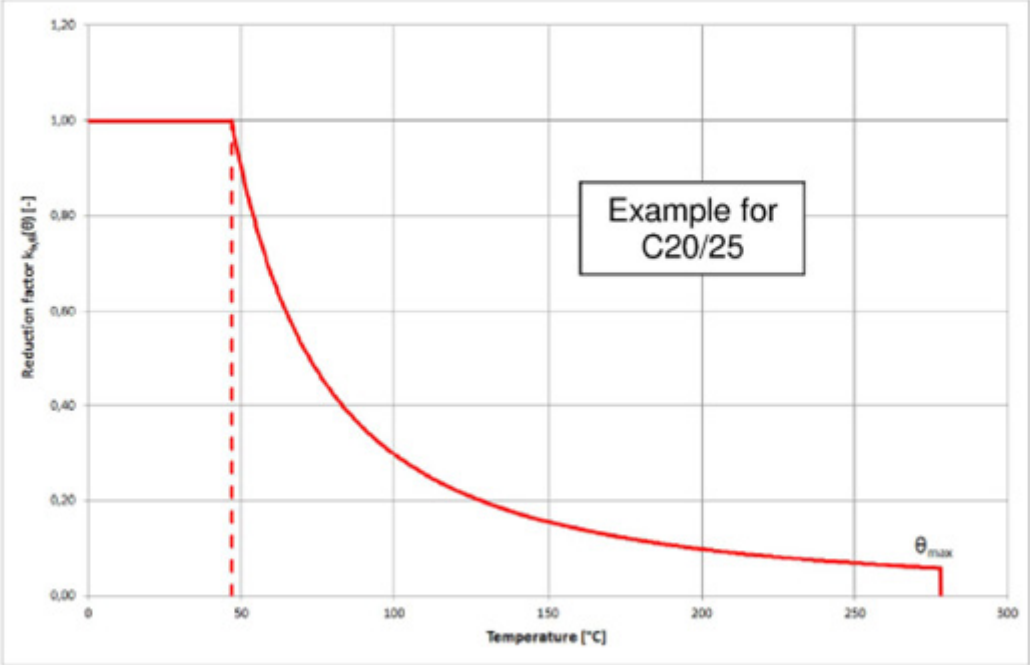
$k_{fi}(\theta) = kfi,100y(\theta) = 4673,8\cdot\theta^{(-1,598)}/(f_{(bd,PIR)}\cdot 4,3) \leq 1,0$ for $\theta \leq 278°$

$k_{fi}(\theta) = kfi,100y(\theta) = 0$ for $\theta > 278°$

γc = 1,5 recommended safety factor acc.to EN 1992-1-1

$\gamma M,fi$ = 1,0 safety factor under fire exposure acc.to EN 1992-1-2

Example graph of Reduction factor $k_{fi}(\theta)$, $k_{fi,100y}(\theta)$ for concrete classes C20/25 for good bond conditions:



9. Resin Chemical Resistance

Chemical agent	Concentration	Resistant	Not resistant
Acetic acid	10		●
Acetone	5		●
Acetone / Acetone	100		●
Ethyl alcohol, aqueous solution	50		●
Ethyl alcohol, aqueous solution	100		●
Chlorinated lime	10		●
Citric acid	10		●
Chlorine water, swimming pool	All		●
Demineralized Water	All		●
Diesel oil	100	●	
Formic acid	10	●	
Formic acid	30		●
Fuel Oil		●	
Gasoline (premium grade)	100	●	
(Ethylene glycol)		●	
Hydraulic fluid			●
Hydrogen peroxide	10		●
Isopropyl alcohol	100		●
Lactic acid	All		●
Linseed oil	100	●	
Lubricating oil	100	●	
Nitric acid	10		●
Methanol	100		●
Phosphoric acid	10	●	
Phosphoric acid	85	●	
Calcium chloride, suspended in water		●	
Sea water, salty	All	●	
Sodium carbonate	All	●	
Sulfuric acid	All		●

Results shown in the table are applicable to brief period of chemical contact with full cured adhesive (e.g. temporary contact with adhesive during a spill)

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