Deutsches Institut für Bautechnik
DIBt

Approval body for construction products and types of construction

Bautechnisches Prüfamt

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European Technical Assessment

ETA-09/0157 of 13 September 2016

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	BTI simplex anchor BAZ
Product family to which the construction product belongs	Torque controlled expansion anchor for use in concrete
Manufacturer	BTI Befestigungstechnik GmbH & Co. KG Salzstraße 51 74653 Ingelfingen DEUTSCHLAND
Manufacturing plant	BTI Herstellwerk 1
This European Technical Assessment contains	21 pages including 3 annexes which form an integral part of this assessment
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	Guideline for European technical approval of "Metal anchors for use in concrete", ETAG 001 Part 2: "Torque controlled expansion anchors", April 2013, used as European Assessment Document (EAD) according to Article 66 Paragraph 3 of Regulation (EU) No 305/2011.

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Specific Part

1 Technical description of the product

The BTI simplex anchor BAZ is an anchor made of galvanised steel (BAZ) or made of stainless steel (BAZ A4) or high corrosion resistant steel (BAZ C) which is placed into a drilled hole and anchored by torque-controlled expansion.

The product description is given in Annex A.

2 Specification of the intended use in accordance with the applicable European Assessment Document

The performances given in Section 3 are only valid if the anchor is used in compliance with the specifications and conditions given in Annex B.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the anchor of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

3 Performance of the product and references to the methods used for its assessment

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance for static and quasi static action	See Annex C 1 to C 3
Characteristic resistance for seismic performance categories C1 and C2	See Annex C 6 to C 7
Displacements under static and quasi static action	See Annex C 8
Displacements under seismic action	See Annex C 9

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Anchorages satisfy requirements for Class A1
Characteristic resistance under fire exposure	See Annex C 4 and C 5

3.3 Safety in use (BWR 4)

The essential characteristics regarding Safety in use are included under the Basic Works Requirement Mechanical resistance and stability.

4 Assessment and verification of constancy of performance (AVCP) system applied, with reference to its legal base

In accordance with guideline for European technical approval ETAG 001, April 2013 used as European Assessment Document (EAD) according to Article 66 Paragraph 3 of Regulation (EU) No 305/2011 the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable European Assessment Document

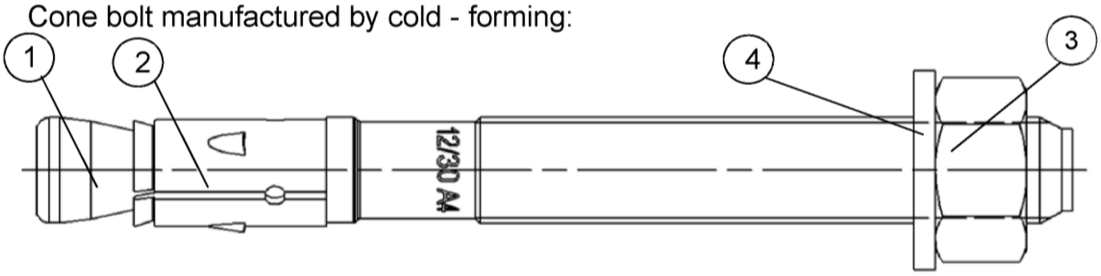
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at Deutsches Institut für Bautechnik.

Issued in Berlin on 13 September 2016 by Deutsches Institut für Bautechnik

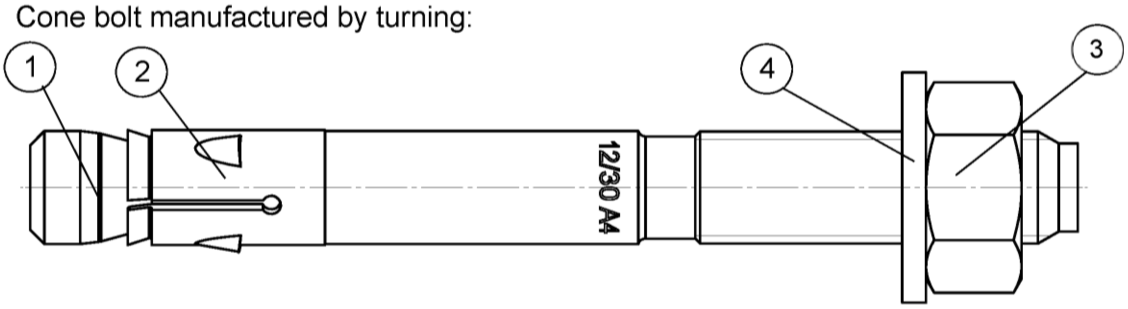
Andreas Kummerow
p.p. Head of Department

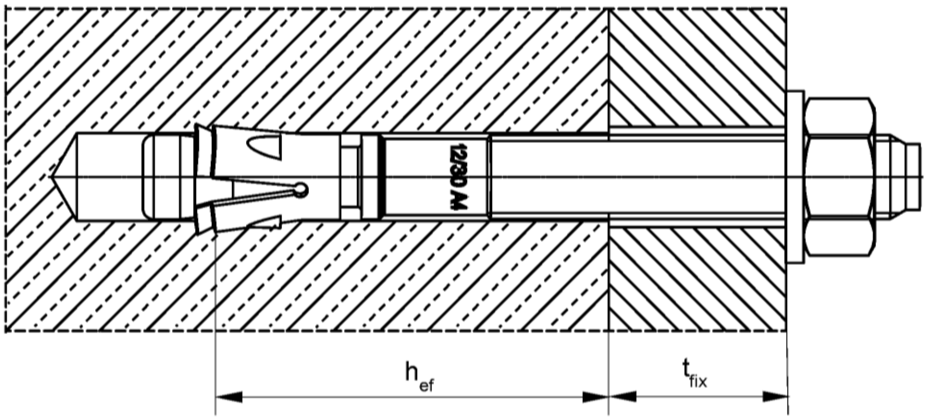
beglaubigt:
Baderschneider

Cone bolt manufactured by cold - forming:



Cone bolt manufactured by turning:





①	Cone bolt (cold – formed or turned)
②	Expansion sleeve
③	Hexagon nut
④	Washer

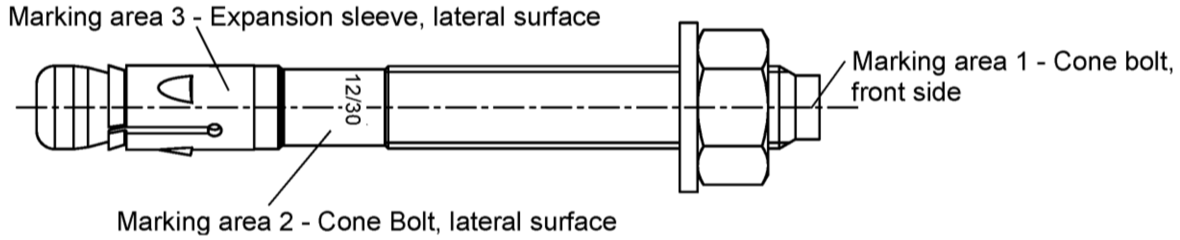
h_{ef} = Effective anchorage depth
t_{fix} = Thickness of fixture

BTI simplex anchor BAZ

Product description
Installed condition

Annex A 1

BAZ for use with standard and reduced anchorage depth ($h_{ef,\,sta}$ and $h_{ef,\,red}$):



Product label, example: BAZ 12/10 A4

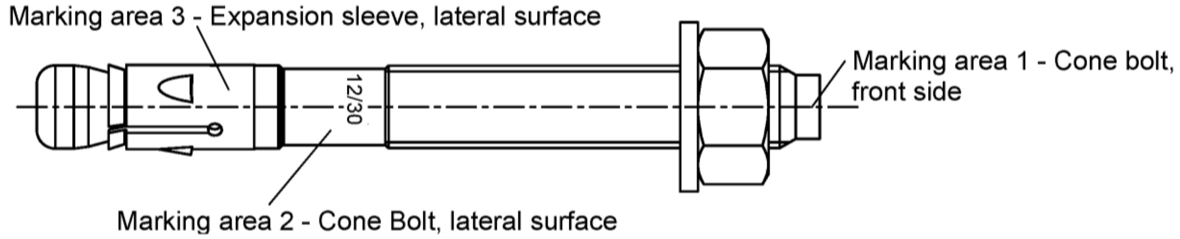
Brand | type of anchor placed on marking area 2 or marking area 3

thread size / max. thickness of fixture (t_{fix}) for $h_{ef,\,sta}$
identification A4 placed on marking area 2

Table A1: Letter-code on marking area 1 and maximum thickness of fixture t_{fix}:

marking		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(K)	(L)	(M)	(N)	(O)	(P)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	(Y)	(Z)
max. t_{fix} for $h_{ef,\,sta}$	M8-M24	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	120	140	160	180	200	250	300	350	400
max. t_{fix} for $h_{ef,\,red}$	M10-M16	25	30	35	40	45	50	55	60	65	70	80	90	100	110	120	140	160	180	200	220	270	320	370	420

BAZ K for use with reduced anchorage depth only ($h_{ef,\,red}$):



Product label, example: BAZ 12/10 K A4

Brand | type of anchor placed on marking area 2 or marking area 3

thread size / max. thickness of fixture (t_{fix})
identification K for $h_{ef,\,red}$
identification A4 placed on marking area 2

Table A2: Letter-code on marking area 1 and maximum thickness of fixture t_{fix}:

marking		(a)	(b)	(c)	(d)
max. t_{fix} for $h_{ef,\,red}$	M8-M16	5	10	15	20

Identification for $h_{ef,\,red}$ are lower-case letters

BTI simplex anchor BAZ	**Annex A 2**
Product description Anchor Types	

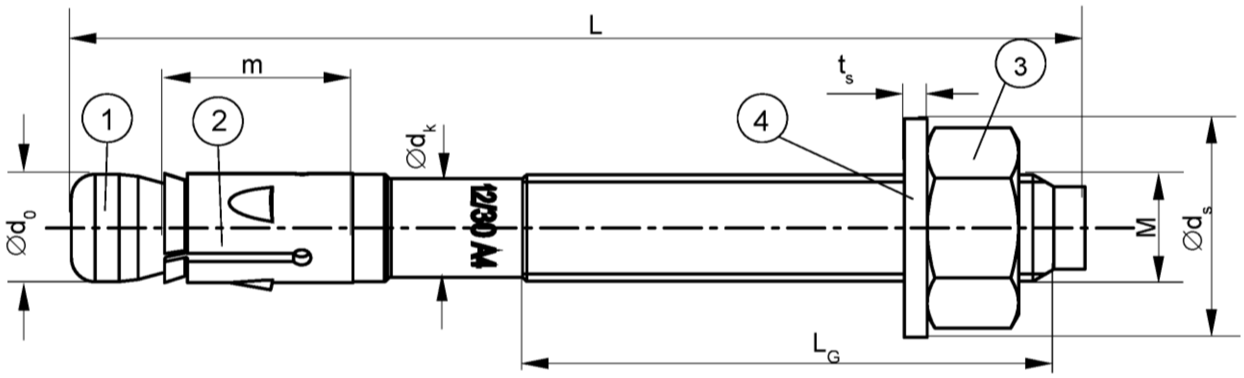


Table A3: Anchor dimensions [mm]

Part	Designation			BAZ, BAZ A4, BAZ C					
				M8	**M10**	**M12**	**M16**	**M20**	**M24**
1	Cone bolt	thread size M		M8	M10	M12	M16	M20	M24
		$\varnothing$ d_0		7,8	9,8	11,8	15,7	19,8	23,5
		$\varnothing$ d_k		7,1	8,9	10,7	14,5	18,2	21,8
		L_G	≥	19	26	31	40	50	57
2	Expansion sleeve	m		17,8	20,0	20,6	27,5	33,4	40,2
		sheet thickness		1,3	1,4	1,6	2,4	2,4	3,0
3	Hexagon nut	wrench size		13	17	19	24	30	36
4	Washer	t_S	≥	1,4	1,8	2,3	2,7	2,7	3,7
		$\varnothing$ d_s	≥	15	19	23	29	36	43
Thickness of fixture		t_{fix}	≥	0	0	0	0	0	0
			≤	200	250	300	400	500	600
Length of anchor		L_{min}	=	54,5	64,5	79	102	141	174
		L_{max}	=	267	336	401	525	644	777

BTI simplex anchor BAZ

Product description
Anchor dimensions

Annex A 3

Table A4: Materials BAZ

Part	Designation	Material
1	Cone bolt	Cold form steel or free cutting steel (zinc plated) Nominal steel tensile strength: $f_{uk} \leq$ 1000 N/mm² (thread)
2	Expansion sleeve	Cold strip, EN 10139:2016 (zinc plated)[1)]
3	Hexagon nut	Steel, property class min. 8, EN ISO 898-2:2012 (zinc plated)
4	Washer	Cold strip, EN 10139: 2016 (zinc plated)

[1)] Optional stainless steel EN 10088:2014

Table A5: Materials BAZ A4

Part	Designation	Material
1	Cone bolt	stainless steel EN 10088:2014 Nominal steel tensile strength: $f_{uk} \leq$ 1000 N/mm² (thread)
2	Expansion sleeve	stainless steel EN 10088:2014
3	Hexagon nut	stainless steel EN 10088:2014; ISO 3506-2: 2009; property class – min. 70
4	Washer	stainless steel EN 10088:2014

Table A6: Materials BAZ C

Part	Designation	Material
1	Cone bolt	high corrosion resistant steel EN 10088:2014 Nominal steel tensile strength: $f_{uk} \leq$ 1000 N/mm² (thread)
2	Expansion sleeve	stainless steel EN 10088:2014
3	Hexagon nut	high corrosion resistant steel EN 10088:2014; ISO 3506-2:2009; property class – min. 70
4	Washer	high corrosion resistant steel EN 10088:2014

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Specifications of intended use

Anchorages subject to:

<table>
<tr><td colspan="2">Standard anchorage depth</td><td colspan="6">✓</td></tr>
<tr><td colspan="2">Bolt Anchor BAZ, BAZ A4, BAZ C</td><td>M8</td><td>M10</td><td>M12</td><td>M16</td><td>M20</td><td>M24</td></tr>
<tr><td colspan="2">Static and quasi-static loads</td><td colspan="6">✓</td></tr>
<tr><td colspan="2">Cracked and uncracked concrete</td><td colspan="6">✓</td></tr>
<tr><td colspan="2">Fire exposure</td><td colspan="6">✓</td></tr>
<tr><td rowspan="2">Seismic action for Performance Category</td><td>C1</td><td colspan="6">✓</td></tr>
<tr><td>C2[1)]</td><td>-</td><td colspan="4">✓</td><td>-</td></tr>
<tr><td colspan="2">Reduced anchorage depth</td><td colspan="4">✓</td><td colspan="2" rowspan="7">-</td></tr>
<tr><td colspan="2">Bolt Anchor BAZ, BAZ A4, BAZ C</td><td>M8[2)]</td><td>M10</td><td>M12</td><td>M16</td></tr>
<tr><td colspan="2">Static and quasi-static loads</td><td colspan="4">✓</td></tr>
<tr><td colspan="2">Cracked and uncracked concrete</td><td colspan="4">✓</td></tr>
<tr><td colspan="2">Fire exposure</td><td colspan="4">✓</td></tr>
<tr><td rowspan="2">Seismic action for Performance Category</td><td>C1</td><td colspan="4">✓</td></tr>
<tr><td>C2[1)]</td><td>-</td><td colspan="3">✓</td></tr>
</table>

1) BAZ C: Only valid for cold-formed version (see A1)
2) Use restricted to anchoring of structural components which are statically indeterminate

Base materials:

- Reinforced and unreinforced normal weight concrete (cracked and uncracked) according to EN 206-1:2000
- Strength classes C20/25 to C50/60 according to EN 206-1:2000

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions (BAZ, BAZ A4, BAZ C)
- Structures subject to external atmospheric exposure (including industrial and marine environment) and to permanently damp internal condition, if no particular aggressive conditions exist
  (BAZ, BAZ A4, BAZ C)
- Structures subject to external atmospheric exposure and permanently damp internal condition, if other particular aggressive conditions exist
  (BAZ C)
  Note: Particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution
  (e.g. in desulphurization plants or road tunnels where de-icing materials are used)

Design:

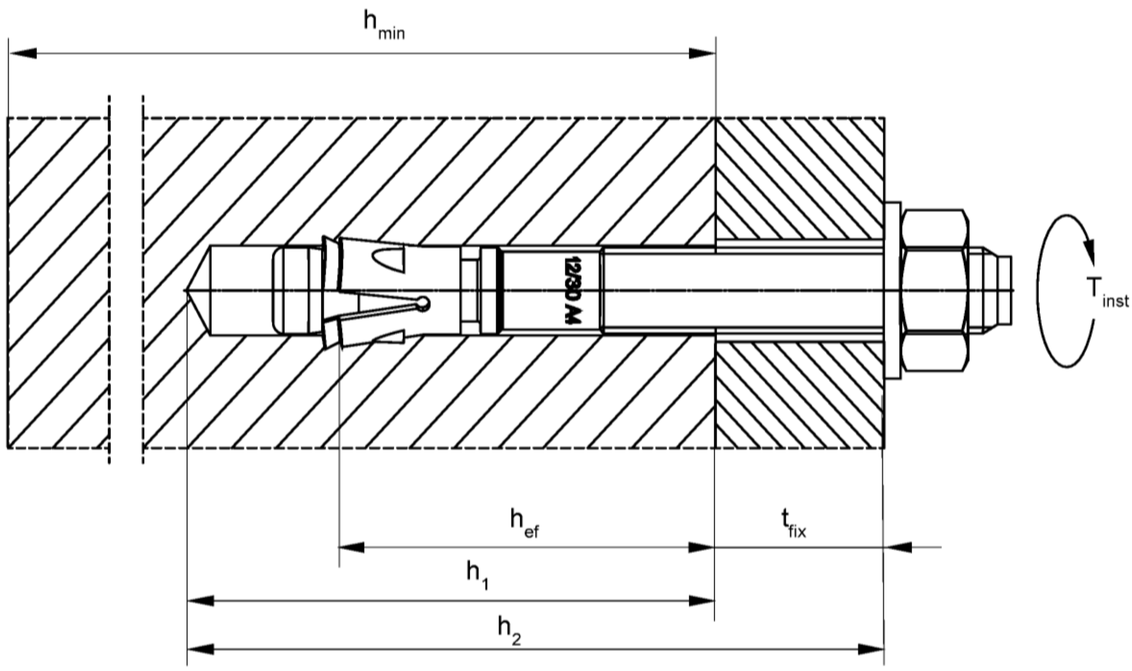
- Anchorages are to be designed under the responsibility of an engineer experienced in anchorages and concrete work
- Verifiable calculation notes and drawings are to be prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings (e.g. position of the anchor relative to reinforcement or to supports, etc.)
- Anchorages under static or quasi-static actions are to be designed in accordance with (please choose the relevant design method):
  - ETAG 001, Annex C, design method A, Edition August 2010 or
  - CEN/TS 1992-4:2009, design method A
- Anchorages under seismic actions (cracked concrete) are to be designed in accordance with:
  - EOTA Technical Report TR 045, Edition February 2013
  - Anchorages shall be positioned outside of critical regions (e.g. plastic hinges) of the concrete structure
  - Fastenings in stand-off installation or with a grout layer under seismic action are not allowed
- Anchorages under fire exposure are to be designed in accordance with:
  - EOTA Technical Report TR 020, Edition May 2004
  - CEN/TS 1992-4:2009, Annex D
  - It must be ensured that local spalling of the concrete cover does not occur

BTI simplex anchor BAZ	**Annex B 1**
Intended Use Specifications	

Table B1: Installation parameters

Type of anchor / size		BAZ, BAZ A4, BAZ C					
		M8	**M10**	**M12**	**M16**	**M20**	**M24**
Nominal drill hole diameter	d_0 = [mm]	8	10	12	16	20	24
Cutting diameter of drill bit	$d_{cut} \leq$ [mm]	8,45	10,45	12,5	16,5	20,55	24,55
Standard anchorage depth	$h_{ef,sta} \geq$ [mm]	45	60	70	85	100	125
Depth of drill hole in concrete for $h_{ef,sta}$	$h_{1,sta} \geq$ [mm]	55	75	90	110	125	155
Reduced anchorage depth	$h_{ef,red} \geq$ [mm]	35[2)]	40	50	65	-	-
Depth of drill hole in concrete for $h_{ef,red}$	$h_{1,red} \geq$ [mm]	45[2)]	55	70	90	-	-
Diameter of clearance hole in the fixture[1)]	$d_f \leq$ [mm]	9	12	14	18	22	26
Required torque moment	T_{inst} = [Nm]	20	45	60	110	200	270

[1)] If a larger diameter of the clearance hole in the fixture is used, see Chapter 4.2.2.1 of ETAG 001, Annex C
[2)] Use restricted to anchoring of structural components which are statically indeterminate



h_{ef} = Effective anchorage depth
t_{fix} = Thickness of fixture
h_1 = Drill hole depth
h_2 = Min.drill hole depth for push-through installation
h_{min} = Thickness of concrete member
T_{inst} = Required torque moment

BTI simplex anchor BAZ	**Annex B 2**
Intended Use Installation parameters	

Table B2: Minimum thickness of concrete members, minimum spacings and minimum edge distances of anchors for **standard anchorage depth ($h_{ef,sta}$)**

Type of anchor / size			BAZ, BAZ A4, BAZ C					
			M8	M10	M12	M16	M20	M24
Standard effective anchorage depth		$h_{ef,sta} \geq$ [mm]	**45**	**60**	**70**	**85**	**100**	**125**
Applications with concrete members of thickness $\geq 2 \times h_{ef,sta}$	**Minimum thickness of concrete member**	$h_{min,1}$ [mm]	**100**	**120**	**140**	**170**	**200**	**250**
	Uncracked concrete							
	Minimum spacing	s_{min} [mm]	40	40	50	65	95	100
		for $c \geq$ [mm]	50	60	70	95	180	200
	Minimum edge distance	c_{min} [mm]	40	45	55	65	95	135
		for $s \geq$ [mm]	100	80	110	150	190	235
	Cracked concrete							
	Minimum spacing	s_{min} [mm]	35	40	50	65	95	100
		for $c \geq$ [mm]	50	55	70	95	140	170
	Minimum edge distance	c_{min} [mm]	40	45	55	65	85	100
		for $s \geq$ [mm]	70	80	110	150	190	220
Applications with concrete members of thickness $< 2 \times h_{ef,sta}$	**Minimum thickness of concrete member**	$h_{min,2}$ [mm]	**80**	**100**	**120**	**140**	**160**	**200**
	Cracked and uncracked concrete							
	Minimum spacing	s_{min} [mm]	35	40	50	80	125	150
		for $c \geq$ [mm]	70	100	90	130	220	230
	Minimum edge distance	c_{min} [mm]	40	60	60	65	125	135
		for $s \geq$ [mm]	100	90	120	180	230	235

Intermediate values for s_{min} and c_{min} inside of the same thickness of concrete member by linear interpolation.

Table B3: Minimum thickness of concrete members, minimum spacings and minimum edge distances of anchors for **reduced anchorage depth ($h_{ef,red}$)**

Type of anchor / size			BAZ, BAZ A4, BAZ C			
			M8	M10	M12	M16
Reduced effective anchorage depth		$h_{ef,red} \geq$ [mm]	**35**[1)]	**40**	**50**	**65**
Applications with concrete members of thickness $\geq 2 \times h_{ef,red}$	**Minimum thickness of concrete member**	$h_{min,3}$ [mm]	**80**	**80**	**100**	**140**
	Uncracked concrete					
	Minimum spacing	s_{min} [mm]	40	40	50	65
		for $c \geq$ [mm]	100	100	110	130
	Minimum edge distance	c_{min} [mm]	45	45	55	65
		for $s \geq$ [mm]	180	180	220	250
	Cracked concrete					
	Minimum spacing	s_{min} [mm]	40	40	50	65
		for $c \geq$ [mm]	90	90	110	130
	Minimum edge distance	c_{min} [mm]	45	45	55	65
		for $s \geq$ [mm]	180	180	220	250

Intermediate values for s_{min} and c_{min} by linear interpolation.
[1)] Only in anchoring structural components which are statically indeterminate

BTI simplex anchor BAZ

Intended Use
Minimum thickness of member, minimum spacings and edge distances

Annex B 3

Table B4: Minimum spacings and minimum edge distances of anchors according to **TR 020 and ETAG 001, Annex C** under **fire exposure** and according to **CEN/TS 1992-4: 2009, Annex D** under **fire exposure**

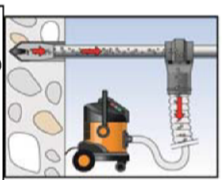
Type of anchor / size			BAZ, BAZ A4, BAZ C					
			M8	M10	M12	M16	M20	M24
Spacing	s_{min}	[mm]	35	40	50	60	95	100
Edge distance	c_{min}	[mm]	$c_{min} = 2 \times h_{ef}$, for fire exposure from more than one side $c_{min} \geq 300$ mm					

Installation instructions

The fitness for use of the anchor can only be assumed if the anchor is installed as follows:

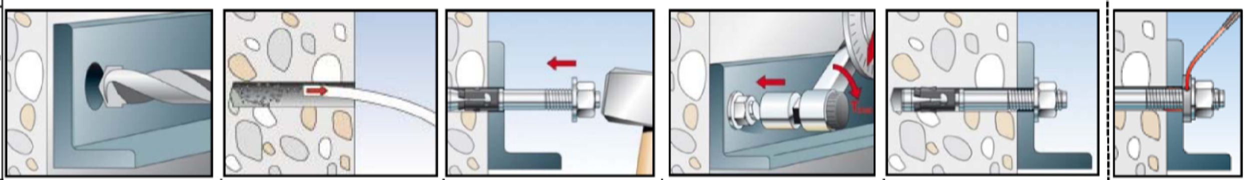
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site
- Use of the anchor only as supplied by the manufacturer without exchanging the components of the anchor
- Checking before placing the anchor to ensure that the strength class of the concrete in which the anchor is to be placed is in the range given and is not lower than that of the concrete to which the characteristic loads apply
- Check of concrete being well compacted, e.g. without significant voids
- Edge distances and spacing not less than the specified values without minus tolerances
- Drill hole perpendicular to concrete surface, positioning without damaging the reinforcement. In case of aborted hole: new drilling at a minimum distance away of twice the depth of the aborted hole or smaller distance if the aborted drill hole is filled with high strength mortar and if under shear or oblique tension load it is not in the direction of load application

Hollow drilling



Continue with step 3, 4 and 5

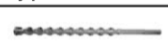
Hammer drilling



1 2 3 4 5

No.	Description	
1	Create drill hole with hammer drill	Create drill hole with hollow drill and vacuum cleaner
2	Clean bore hole	-
3	Set anchor	
4	Expand anchor with prescribed installation torque T_{inst}	
5	Finished installation	

Optional	The gap between bolt and fixture may be filled with mortar; compressive strength ≥ 50 N/mm² for example: UVT Top and UVT Top-Z

Types of drills	
Hammer drill	
Hollow drill	

BTI simplex anchor BAZ

Intended Use
Minimum spacings and minimum edge distances of anchors
Installation parameters

Annex B 4

Table C1: Characteristic values of **tension** resistance for **standard anchorage depth** under static and quasi-static action (Design method A, according to **ETAG 001, Annex C** or **CEN/TS 1992-4:2009**)

Type of anchor / size				BAZ, BAZ A4, BAZ C					
				M8	M10	M12	M16	M20	M24
Steel failure for standard anchorage depth									
Characteristic resistance	BAZ	$N_{Rk,s}$	[kN]	16,0	27,0	41,5	66,0	111,0	150,0
	BAZ A4/C	$N_{Rk,s}$	[kN]	17,0	27,2	44,3	70,6	111,0	160,8
Partial safety factor		γ_{Ms}		1,5					
Pullout failure for standard anchorage depth									
Effective anchorage depth		$h_{ef,sta} \geq$	[mm]	45	60	70	85	100	125
Characteristic resistance in cracked concrete C20/25		$N_{Rk,p}$	[kN]	7,5	12	20	- 1)		
Characteristic resistance in uncracked concrete C20/25		$N_{Rk,p}$	[kN]	9	16	25	- 1)		
Increasing factors for $N_{Rk,p}$ for cracked and uncracked concrete		ψ_c	C25/30	1,10					
			C30/37	1,22					
			C35/45	1,34					
			C40/50	1,41					
			C45/55	1,48					
			C50/60	1,55					
Installation safety factor		γ_2 3) = γ_{inst} 4)		1,0					
Concrete cone and splitting failure for standard anchorage depth in applications with concrete members of thickness ≥ 2x $h_{ef,sta}$									
Effective anchorage depth		h_{ef}	[mm]	45	60	70	85	100	125
Factor for uncracked concrete		k_{ucr} 4)	[-]	10,1					
Factor for cracked concrete		k_{cr}	[-]	7,2					
Min. thickness of concrete member		$h_{min,1}$	[mm]	100	120	140	170	200	250
Characteristic spacing		$s_{cr,N}$	[mm]	3 h_{ef}					
Characteristic edge distance		$c_{cr,N}$	[mm]	1,5 h_{ef}					
Spacing (splitting failure) 2)		$s_{cr,sp}$	[mm]	140	180	210	260	370	430
Edge distance (splitting failure) 2)		$c_{cr,sp}$	[mm]	70	90	105	130	185	215
Concrete cone and splitting failure for standard anchorage depth in applications with concrete members of thickness < 2x $h_{ef,sta}$									
Effective anchorage depth		h_{ef}	[mm]	45	60	70	85	100	125
Factor for uncracked concrete		k_{ucr} 4)	[-]	10,1					
Factor for cracked concrete		k_{cr}	[-]	7,2					
Min. thickness of concrete member		$h_{min,2}$	[mm]	80	100	120	140	160	200
Characteristic spacing		$s_{cr,N}$	[mm]	3 h_{ef}					
Characteristic edge distance		$c_{cr,N}$	[mm]	1,5 h_{ef}					
Spacing (splitting failure) 2)		$s_{cr,sp}$	[mm]	180	240	280	340	480	550
Edge distance (splitting failure) 2)		$c_{cr,sp}$	[mm]	90	120	140	170	240	275

1) Pullout failure not relevant.
2) Intermediate values for $s_{cr,sp}$ and $c_{cr,sp}$ between concrete thickness $h_{min,2}$ and $h_{min,1}$ by linear interpolation.
3) Parameter relevant for design according to ETAG 001, Annex C
4) Parameter relevant for design according to CEN/TS 1992-4:2009

BTI simplex anchor BAZ

Performances
Characteristic values of resistance under tension loads for standard anchorage depth

Annex C 1

Table C2: Characteristic values of **tension** resistance for **reduced anchorage depth** under static and quasi-static action (Design method A, according to **ETAG 001, Annex C** or **CEN/TS 1992-4:2009**)

Type of anchor / size				BAZ, BAZ A4, BAZ C			
				M8	**M10**	**M12**	**M16**
Steel failure for reduced anchorage depth							
Characteristic resistance	BAZ	$N_{Rk,s}$	[kN]	16,0	27,0	41,5	66,0
Characteristic resistance	BAZ A4/C	$N_{Rk,s}$	[kN]	17,0	27,2	44,3	70,6
Partial safety factor		γ_{Ms}		1,5			
Pullout failure for reduced anchorage depth							
Effective anchorage depth		$h_{ef,red} \geq$	[mm]	35 [2)]	40	50	65
Characteristic resistance in cracked concrete C20/25		$N_{Rk,p}$	[kN]	5	- [1)]		
Characteristic resistance in uncracked concrete 20/25		$N_{Rk,p}$	[kN]	- [1)]			
Increasing factors for $N_{Rk,p}$ for cracked and uncracked concrete		ψ_c	C25/30	1,10			
			C30/37	1,22			
			C35/45	1,34			
			C40/50	1,41			
			C45/55	1,48			
			C50/60	1,55			
Installation safety factor		γ_2 [3)] $= \gamma_{inst}$ [4)]		1,0			
Concrete cone and splitting failure for reduced anchorage depth							
Effective anchorage depth		h_{ef}	[mm]	35 [2)]	40	50	65
Factor for uncracked concrete		k_{ucr} [4)]	[-]	10,1			
Factor for cracked concrete		k_{cr} [4)]	[-]	7,2			
Min. thickness of concrete member		$h_{min,3}$	[mm]	80	80	100	140
Characteristic spacing		$s_{cr,N}$	[mm]	3 h_{ef}			
Characteristic edge distance		$c_{cr,N}$	[mm]	1,5 h_{ef}			
Spacing (splitting failure)		$s_{cr,sp}$	[mm]	140	160	200	260
Edge distance (splitting failure)		$c_{cr,sp}$	[mm]	70	80	100	130

[1)] Pullout failure not relevant.
[2)] Use restricted to anchoring of structural components which are statically indeterminate
[3)] Parameter relevant for design according to ETAG 001, Annex C
[4)] Parameter relevant for design according to CEN/TS 1992-4:2009

BTI simplex anchor BAZ

Performances
Characteristic values of resistance under tension for reduced anchorage depth

Annex C 2

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Table C3: Characteristic values of **shear** resistance for **standard and reduced anchorage depth** under static and quasi-static action (Design method A, according to **ETAG 001, Annex C or CEN/TS 1992-4:2009**)

Type of anchor / size				BAZ, BAZ A4, BAZ C					
				M8	**M10**	**M12**	**M16**	**M20**	**M24**
Steel failure without lever arm for standard and reduced anchorage depth									
Characteristic resistance	BAZ	$V_{Rk,s}$	[kN]	12,0	20,0	29,5	55,0	70,0	86,0
	BAZ A4/C	$V_{Rk,s}$	[kN]	17,6	23,8	36,5	70,9	94,4	138,2
Partial safety factor		γ_{Ms}		1,25					
Factor for ductility		k_2 2)	[-]	1,0					
Standard anchorage depth									
Steel failure with lever arm									
Characteristic bending resistance	BAZ	$M^0_{Rk,s}$	[Nm]	26	52	92	233	487	769
	BAZ A4/C	$M^0_{Rk,s}$	[Nm]	29	56	94	256	454	785
Partial safety factor		γ_{Ms}		1,25					
Factor for ductility		k_2 2)	[-]	1,0					
Concrete pryout failure									
Factor k according to ETAG 001, Annex C or k_3 according to CEN/TS 1992-4		k 1) $= k_{(3)}$ 2)	[-]	2,2		2,4	2,8		
Concrete edge failure									
Effective length of anchor in shear loading		l_f	[mm]	45	60	70	85	100	125
Effective diameter of anchor		d_{nom}	[mm]	8	10	12	16	20	24
Installation safety factor		γ_2 1) $= \gamma_{inst}$ 2)		1,0					
Reduced anchorage depth									
Steel failure with lever arm									
Characteristic bending resistance	BAZ	$M^0_{Rk,s}$	[Nm]	15	38,3	89	171	-	-
	BAZ A4/C	$M^0_{Rk,s}$	[Nm]	18,9	38,3	90,7	179,5	-	-
Partial safety factor		γ_{Ms}		1,25					
Factor for ductility		k_2 2)	[-]	1,0					
Concrete pryout failure									
Factor k according to ETAG 001, Annex C or k_3 according to CEN/TS 1992-4		k 1) $= k_{(3)}$ 2)	[-]	1,0	2,0	2,3		-	-
Concrete edge failure									
Effective length of anchor in shear loading		l_f	[mm]	35	40	50	65	-	-
Effective diameter of anchor		d_{nom}	[mm]	8	10	12	16	-	-

1) Parameter relevant for design according to ETAG 001, Annex C
2) Parameter relevant for design according to CEN/TS 1992-4:2009

BTI simplex anchor BAZ

Performances
Characteristic values of resistance under shear loads

Annex C 3

Table C4: Characteristic values of **tension** resistance under **fire exposure** in cracked and uncracked concrete for **standard and reduced anchorage depth** (Design according to **TR 020 and ETAG 001, Annex C** or **CEN/TS 1992-4: 2009, Annex D)**

Type of anchor / size **BAZ, BAZ A4, BAZ C**	**R30** Fire resistance 30 minutes			**R60** Fire resistance 60 minutes		
	$N_{Rk,s,fi,30}$ [kN]	$N_{Rk,p,fi,30}$ [kN]	$N^0_{Rk,c,fi,30}$ [kN]	$N_{Rk,s,fi,60}$ [kN]	$N_{Rk,p,fi,60}$ [kN]	$N^0_{Rk,c,fi,60}$ [kN]
Standard anchorage depth						
M8	1,4	2,0	2,4	1,2	2,0	2,4
M10	2,8	3,3	5,0	2,3	3,3	5,0
M12	5,0	5,0	7,4	4,1	5,0	7,4
M16	9,4	7,1	12,0	7,7	7,1	12,0
M20	14,7	9,0	18,0	12,0	9,0	18,0
M24	21,1	12,6	31,4	17,3	12,6	31,4
Reduced anchorage depth						
M8	0,9[1)] (0,6)[2)]	0,9[1)] (0,6)[2)]	0,9[1)] (0,6)[2)]	0,8[1)] (0,6)[2)]	0,8[1)] (0,6)[2)]	0,8[1)] (0,6)[2)]
M10	2,8	2,3	1,8	2,3	2,3	1,8
M12	5,0	3,2	3,2	4,1	3,2	3,2
M16	9,4	4,7	6,1	7,7	4,7	6,1

	R90 Fire resistance 90 minutes			**R120** Fire resistance 120 minutes		
	$N_{Rk,s,fi,90}$ [kN]	$N_{Rk,p,fi,90}$ [kN]	$N^0_{Rk,c,fi,90}$ [kN]	$N_{Rk,s,fi,120}$ [kN]	$N_{Rk,p,fi,120}$ [kN]	$N^0_{Rk,c,fi,120}$ [kN]
Standard anchorage depth						
M8	0,9	2,0	2,4	0,8	1,6	1,9
M10	1,9	3,3	5,0	1,6	2,6	4,0
M12	3,2	5,0	7,4	2,8	4,0	5,9
M16	6,0	7,1	12,0	5,2	5,6	9,6
M20	9,4	9,0	18,0	8,1	7,2	14,4
M24	13,5	12,6	31,4	11,6	10,1	25,1
Reduced anchorage depth						
M8	0,5	0,5	0,5	0,3	0,3	0,3
M10	1,9	2,3	1,8	1,6	1,8	1,4
M12	3,2	3,2	3,2	2,8	2,5	2,5
M16	6,0	4,7	6,1	5,2	3,8	4,9

[1)] Values for $s_{cr,fi}$ = 120 mm and $c_{cr,fi}$ = 60 mm
[2)] Values for $s_{cr,fi}$ = 100 mm and $c_{cr,fi}$ = 50 mm

BTI simplex anchor BAZ

Performances:
Characteristic values of resistance under tension loads

Annex C 4

Table C5: Characteristic values of **shear** resistance under **fire exposure** in cracked and uncracked concrete for **standard and reduced anchorage depth** (Design according to **TR 020 and ETAG 001, Annex C** or **CEN/TS 1992-4:2009, Annex D)**

Type of anchor / size **BAZ, BAZ A4, BAZ C**	R30 Fire resistance 30 minutes			R60 Fire resistance 60 minutes		
	$V_{Rk,s,fi,30}$ [kN]	$M^0_{Rk,s,fi,30}$ [Nm]	k(3)	$V_{Rk,s,fi,60}$ [kN]	$M^0_{Rk,s,fi,60}$ [Nm]	k(3)
Standard anchorage depth						
M8	1,8	1,4	2,2	1,6	1,2	2,2
M10	3,6	3,6	2,2	2,9	3,0	2,2
M12	6,3	7,8	2,4	4,9	6,4	2,4
M16	11,7	19,9	2,8	9,1	16,3	2,8
M20	18,2	39,0	2,8	14,2	31,8	2,8
M24	26,3	67,3	2,8	20,5	55,0	2,8
Reduced anchorage depth						
M8	1,8	1,4	1,0	1,6	1,2	1,0
M10	3,6	3,6	2,0	2,9	3,0	2,0
M12	6,3	7,8	2,3	4,9	6,4	2,3
M16	11,7	20,0	2,3	9,1	16,3	2,3

	R90 Fire resistance 90 minutes			R120 Fire resistance 120 minutes		
	$V_{Rk,s,fi,90}$ [kN]	$M^0_{Rk,s,fi,90}$ [Nm]	k(3)	$V_{Rk,s,fi,120}$ [kN]	$M^0_{Rk,s,fi,120}$ [Nm]	k(3)
Standard anchorage depth						
M8	1,3	1,0	2,2	1,2	0,8	2,2
M10	2,2	2,4	2,2	1,9	2,1	2,2
M12	3,5	5,0	2,4	2,8	4,3	2,4
M16	6,6	12,6	2,8	5,3	11,0	2,8
M20	10,3	24,6	2,8	8,3	21,4	2,8
M24	14,8	42,6	2,8	11,9	37,0	2,8
Reduced anchorage depth						
M8	1,3	1,0	1,0	1,2	0,9	1,0
M10	2,2	2,4	2,0	1,9	2,1	2,0
M12	3,5	5,0	2,3	2,8	4,3	2,3
M16	6,6	12,6	2,3	5,3	11,0	2,3

Concrete pryout failure: In Equation (5.6) of ETAG 001, Annex C, 5.2.3.3 the $k_{(3)}$-factor of Table C5 and the relevant values of $N_{0Rk,c,fi}$ of Table C4 have to be considered.
Concrete edge failure: The characteristic resistance $V^0_{Rk,c,fi}$ in concrete C20/25 to C50/60 is determined by: $V^0_{Rk,c,fi} = 0,25 \times V^0_{Rk,c}$ (R30, R60, R90), $V^0_{Rk,c,fi} = 0,20 \times V^0_{Rk,c}$ (R120) with $V^0_{Rk,c}$ as initial value of the characteristic resistance in cracked concrete C20/25 under normal temperature according to ETAG 001, Annex C, 5.2.3.4.

Table C6: Valid anchor sizes for seismic design, **performance category C1, standard and reduced anchorage depth**

Type of anchor / size		BAZ, BAZ A4, BAZ C					
		M8	**M10**	**M12**	**M16**	**M20**	**M24**
Standard effective anchorage depth	$h_{ef,sta} \geq$ [mm]	45	60	70	85	100	125
Thickness of fixture	$t_{fix,min}$ = [mm]	0	0	0	0	0	0
	$t_{fix,max}$ = [mm]	100	100	120	160	250	300
Length of anchor	L_{min} = [mm]	54,5	84,5	99	122	141	174
	L_{max} = [mm]	167	186	221	285	394	477
Reduced effective anchorage depth	$h_{ef,red} \geq$ [mm]	-	40	50	65	-	-
Thickness of fixture	$t_{fix,min}$ = [mm]		0	0	0		
	$t_{fix,max}$ = [mm]		120	140	180		
Length of anchor	L_{min} = [mm]		64,5	79	102		
	L_{max} = [mm]		186	221	285		

Table C7: Valid anchor sizes for seismic design, **performance category C2, standard and reduced anchorage depth**

Type of anchor / size		BAZ, BAZ A4, BAZ C [1)]					
		M8	**M10**	**M12**	**M16**	**M20**	**M24**
Standard effective anchorage depth	$h_{ef,sta} \geq$ [mm]	-	60	70	85	100	-
Thickness of fixture	$t_{fix,min}$ = [mm]		0	0	0	0	
	$t_{fix,max}$ = [mm]		100	120	160	250	
Length of anchor	L_{min} = [mm]		84,5	99	122	141	
	L_{max} = [mm]		186	221	285	394	
Reduced effective anchorage depth	$h_{ef,red} \geq$ [mm]	-	40	50	65	-	-
Thickness of fixture	$t_{fix,min}$ = [mm]		0	0	0		
	$t_{fix,max}$ = [mm]		120	140	180		
Length of anchor	L_{min} = [mm]		64,5	79	102		
	L_{max} = [mm]		186	221	284,5		

[1)] BAZ C: Only valid for cold-formed version (see A1)

BTI simplex anchor BAZ	**Annex C 6**
Performances: Valid sizes in cracked concrete for seismic design	

Table C8: Characteristic values of **tension and shear** resistance for **standard- and reduced anchorage depth** under **seismic action**
(Design according to **TR 045: Performance category C1**)

Type of anchor / size			BAZ, BAZ A4, BAZ C					
			M8	**M10**	**M12**	**M16**	**M20**	**M24**
Steel failure for standard anchorage depth								
Characteristic resistance tension load C1	$h_{ef,sta}$	$N_{Rk,s,C1}$ [kN]	16,0	27,0	41,0	66,0	111,0	150,0
	$h_{ef,red.}$		-				-	-
Partial safety factor		$\gamma_{Ms,C1}$ [-]	1,5					
Pullout failure for standard anchorage depth								
Characteristic resistance tension load in cracked concrete C1	$h_{ef,sta}$	$N_{Rk,p,C1}$ [kN]	4,6	8,0	16,0	28,2	36,0	50,3
	$h_{ef,red.}$		-				-	-
Installation safety factor		$\gamma_{2,C1}$ [-]	1,0					
Steel failure without lever arm for standard anchorage depth								
Characteristic resistance shear load C1	$h_{ef,sta}$	$V_{Rk,s,C1}$ [kN]	11	17	27	47	56	69
	$h_{ef,red.}$		-				-	-
Partial safety factor		$\gamma_{Ms,C1}$ [-]	1,25					

Table C9: Characteristic values of **tension and shear** resistance for **standard- and reduced anchorage depth** under **seismic action**
(Design according to **TR 045: Performance category C2**)

Type of anchor / size			BAZ, BAZ A4, BAZ C [1)]					
			M8	**M10**	**M12**	**M16**	**M20**	**M24**
Steel failure for standard anchorage depth								
Characteristic resistance tension load C2	$h_{ef,sta}$	$N_{Rk,s,C2}$ [kN]	-	27	41	66	111	-
	$h_{ef,red.}$						-	
Partial safety factor		$\gamma_{Ms,C2}$ [-]	1,5					
Pullout failure for standard anchorage depth								
Characteristic resistance tension load in cracked concrete C2	$h_{ef,sta}$	$N_{Rk,p,C2}$ [kN]	-	5,1	7,4	21,5	30,7	-
	$h_{ef,red.}$			2,7	4,4	16,4	-	
Installation safety factor		$\gamma_{2,C2}$ [-]	1,0					
Steel failure without lever arm for standard anchorage depth								
Characteristic resistance shear load C2	$h_{ef,sta}$	$V_{Rk,s,C2}$ [kN]	-	10,0	17,4	27,5	39,9	-
	$h_{ef,red.}$			7,0	12,7	22,0	-	
Partial safety factor		$\gamma_{Ms,C2}$ [-]	1,25					

[1)] BAZ C: Only valid for cold-formed version (see A1)

BTI simplex anchor BAZ

Performances:
Characteristic values of resistance under tension and shear loads under seismic action

Annex C 7

Table C10: Displacements due to tension loads for **standard and reduced anchorage depth** (Design method A, according to **ETAG 001, Annex C** or **CEN/TS 1992-4:2009**)

Type of anchor / size			BAZ, BAZ A4, BAZ C					
			M8	M10	M12	M16	M20	M24
Values for standard anchorage depth								
Tension load in cracked concrete	N	[kN]	2,3	4,2	7,5	13,2	16,4	22,9
Displacement	δ_{N0}	[mm]	0,5	0,5	0,7	1,0	1,2	1,2
	$\delta_{N\infty}$	[mm]	1,8	1,7	1,4	1,2	1,4	1,5
Tension load in uncracked concrete	N	[kN]	4,2	7,5	11,7	18,7	23,3	32,5
Displacement	δ_{N0}	[mm]	0,3	0,3	0,5	0,7	1,2	1,2
	$\delta_{N\infty}$	[mm]	1,2				1,4	1,5
Values for reduced anchorage depth								
Tension load in cracked concrete	N	[kN]	2,3	4,2	6,0	9,0	-	-
Displacement	δ_{N0}	[mm]	0,5	0,5	0,7	1,0		
	$\delta_{N\infty}$	[mm]	1,2					
Tension load in uncracked concrete	N	[kN]	4,2	5,7	8,5	12,6	-	-
Displacement	δ_{N0}	[mm]	0,3	0,3	0,5	0,7		
	$\delta_{N\infty}$	[mm]	1,2					

Table C11: Displacements due to shear loads for **standard and reduced anchorage depth** (Design method A, according to **ETAG 001, Annex C** or **CEN/TS 1992-4:2009**)

Type of anchor / size			BAZ					
			M8	M10	M12	M16	M20	M24
Shear load in cracked and uncracked concrete	V	[kN]	6,9	11,4	16,9	31,4	39,4	48,5
Displacement	δ_{V0}	[mm	2,4	4,2	4,5	3,0	3,6	3,6
	$\delta_{V\infty}$	[mm	3,6	6,3	6,8	4,5	5,4	5,4
Dübeltyp / Größe			BAZ A4, BAZ C					
			M8	M10	M12	M16	M20	M24
Querlast in gerissenem und ungerissenem Beton	V	[kN]	10,1	13,6	20,9	40,5	53,9	79,0
Verschiebung	δ_{V0}	[mm	1,8	2,0	2,2	3,0	1,9	4,7
	$\delta_{V\infty}$	[mm	2,7	3,0	3,4	4,5	2,9	7,1

Table C12: Displacements due to tension loads for **standard and reduced anchorage depth** (Design according to **TR 045: Performance category C2**)

Type of anchor / size			BAZ, BAZ A4, BAZ C					
			M8	**M10**	**M12**	**M16**	**M20**	**M24**
Values for standard anchorage depth								
Displacement DLS	$\delta_{N,C2\,(DLS)}$	[mm]	-	2,7	4,4	4,4	5,6	-
Displacement ULS	$\delta_{N,C2\,(ULS)}$	[mm]	-	11,5	13,0	12,3	14,4	-
Values for reduced anchorage depth								
Displacement DLS	$\delta_{N,C2\,(DLS)}$	[mm]	-	2,7	4,4	4,4	-	-
Displacement ULS	$\delta_{N,C2\,(ULS)}$	[mm]	-	11,5	13,0	12,3	-	-

Table C13: Displacements due to shear loads for **standard and reduced anchorage depth** (Design according to **TR 045: Performance category C2**)

Type of anchor / size			BAZ, BAZ A4, BAZ C					
			M8	**M10**	**M12**	**M16**	**M20**	**M24**
Values for standard anchorage depth								
Displacement DLS	$\delta_{V,C2\,(DLS)}$	[mm]	-	4,1	4,4	4,3	4,8	-
Displacement ULS	$\delta_{V,C2\,(ULS)}$	[mm]	-	6,2	7,8	8,1	11,2	-
Values for reduced anchorage depth								
Displacement DLS	$\delta_{V,C2\,(DLS)}$	[mm]	-	3,6	4,7	5,5	-	-
Displacement ULS	$\delta_{V,C2\,(ULS)}$	[mm]	-	5,0	7,5	10,1	-	-