DECLARATION OF PERFORMANCE

DoP 0335

for fischer Bolt Anchor FAZ II Classic (Mechanical anchor for use in concrete) EN

1. Unique identification code of the product-type: **DoP 0335**

2. Intended use/es: **Post-installed fastening in cracked or uncracked concrete, see appendix, especially annexes B1 - B4.**

3. Manufacturer: **fischerwerke GmbH & Co. KG, Klaus-Fischer-Str. 1, 72178 Waldachtal, Germany**

4. Authorised representative: **–**

5. System/s of AVCP: **1**

6. European Assessment Document: **EAD 330232-01-0601**
   European Technical Assessment: **ETA-23/0162; 2024-02-26**
   Technical Assessment Body: **ETA-Danmark A/S**
   Notified body/ies: **2873 TU Darmstadt**

7. Declared performance/s:

Mechanical resistance and stability (BWR 1)

Characteristic resistance to tension load (static and quasi-static loading) Method A:

1 Resistance to steel failure: Annex C1
2 Resistance to pull- out failure: Annex C1
3 Resistance to concrete cone failure: Annex C1
4 Robustness: Annex C1
5 Minimum edge distance and spacing: Annexes C4, C5
6 Edge distance to prevent splitting under load: Annex C1

Characteristic resistance to shear load (static and quasi-static loading), Method A:

7 Resistance to steel failure (shear load): Annex C2
8 Resistance to pry-out failure: Annex C2

Characteristic Resistance for simplified design:

9 Method B: NPD
10 Method C: NPD

Displacements:

11 Displacements under static and quasi-static loading: Annex C8

Characteristic resistance and displacements for seismic performance categories C1 and C2:

12 Resistance to tension load, displacements, category C1: Annexes C1, C6
Resistance to tension load, displacements, category C2: Annexes C1, C7, C8
13 Resistance to shear load, displacements, category C1: Annex C6
Resistance to shear load, displacements, category C2: Annexes C7, C8
14 Factor for annular gap: Annex C6

Safety in case of fire (BWR 2)

15 Reaction to fire: Class (A1)

Resistance to fire:

16 Fire resistance to steel failure (tension load): Annex C3
17 Fire resistance to pull-out failure (tension load): Annex C3
18 Fire resistance to steel failure (shear load): Annex C3

Durability:

19 Durability: Annexes A4, B1

8. Appropriate Technical Documentation and/or Specific Technical Documentation: **–**

The performance of the product identified above is in conformity with the set of declared performance/s. This declaration of performance is issued, in accordance with Regulation (EU) No 305/2011, under the sole responsibility of the manufacturer identified above.

Signed for and on behalf of the manufacturer by:

Dr.-Ing. Oliver Geibig, Managing Director Business Units & Engineering

Jürgen Grün, Managing Director Chemistry & Quality

Tumlingen, 2024-03-15

This DoP has been prepared in different languages. In case there is a dispute on the interpretation the English version shall always prevail.

The Appendix includes voluntary and complementary information in English language exceeding the (language-neutrally specified) legal requirements.

Translation guidance Essential Characteristics and Performance Parameters for Annexes

Mechanical resistance and stability (BWR 1)		
Characteristic resistance to tension load (static and quasi-static loading) Method A:		
1	Resistance to steel failure:	$N_{Rk,s}$ [kN]
2	Resistance to pull-out failure:	$N_{Rk,p}$ [kN], ψ_c [-]
3	Resistance to concrete cone failure:	$k_{cr,N}$, $k_{ucr,N}$ [-], h_{ef}, $c_{cr,N}$ [mm]
4	Robustness:	γ_{inst} [-]
5	Minimum edge distance and spacing:	c_{min}, s_{min}, h_{min} [mm]
6	Edge distance to prevent splitting under load:	$N^0_{Rk,sp}$ [kN], $c_{cr,sp}$ [mm]
Characteristic resistance to shear load (static and quasi-static loading):		
7	Resistance to steel failure (shear load):	$V^0_{Rk,s}$ [kN], $M^0_{Rk,s}$ [Nm], k_7 [-]
8	Resistance to pry-out failure:	k_8 [-]
Characteristic Resistance for simplified design:		
9	Method B:	F^0_{Rk} [kN], $M^0_{Rk,s}$ [Nm], ψ_c [-], c_{cr}, s_{cr}, s_{min}, c_{min}, h_{min} [mm]
10	Method C:	F_{Rk} [kN], $M^0_{Rk,s}$ [Nm], c_{cr}, s_{cr}, s_{min}, h_{min} [mm]
Displacements:		
9	Displacements under static and quasi-static loading:	δ_{N0}, $\delta_{N\infty}$, δ_{V0}, $\delta_{V\infty}$ [mm]
Characteristic resistance and displacements for seismic performance categories C1 and C2:		
12	Resistance to tension load, displacements, category C1:	$N_{Rk,s,C1}$, $N_{Rk,p,C1}$ [kN]
	Resistance to tension load, displacements, category C2:	$N_{Rk,s,C2}$, $N_{Rk,p,C2}$ [kN], $\delta_{N,C2}$ [mm]
13	Resistance to shear load, displacements, category C1:	$V_{Rk,s,C1}$ [kN]
	Resistance to shear load, displacements, category C2:	$V_{Rk,s,C2}$ [kN], $\delta_{V,C2}$ [mm]
14	Factor for annular gap:	α_{gap} [-]
Safety in case of fire (BWR 2)		
15	Reaction to fire:	Class
Resistance to fire:		
16	Fire resistance to steel failure (tension load):	$N_{Rk,s,fi}$ [kN]
17	Fire resistance to pull-out failure (tension load):	$N_{Rk,p,fi}$ [kN]
18	Fire resistance to steel failure (shear load):	$V_{Rk,s,fi}$ [kN], $M^0_{Rk,s,fi}$ [Nm]
Durability:		
19	Durability:	Description/Level

II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product

fischer FAZ II Classic anchor is a torque-controlled expansion anchor consisting of four sizes: M8, M10, M12 and M16. The fasteners are made of:
Galvanised steel (FAZ II Classic) or
stainless steel (FAZ II Classic R).

The single parts are given in the Figure 1. The materials and dimensions of the anchors are summarised in:
Table A4.1, annex A4 and table A3.1, annex A3, respectively.

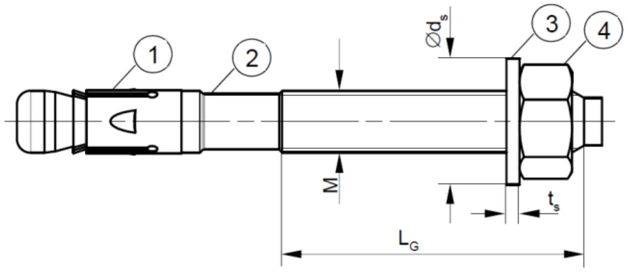


Figure 1: Technical drawing of the fischer FAZ II Classic anchor.

The characteristic material values, dimensions and tolerances of the anchors not indicated in Annexes shall correspond to the respective values laid down in the technical documentation of this European Technical Assessment.

2 Specification of the intended use in accordance with the applicable European Assessment Document (hereinafter EAD)

The anchors are intended to be used with embedment depth given in Annex B2, Table B2.1. The intended use specifications of the product are detailed in Annex B1.

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

The provisions made in this European Technical Assessment are based on an assumed intended working life of the anchor of 50 years.

The indications given on the working life cannot be interpreted as a guarantee given by the producer or Assessment Body 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

Characteristic	Assessment of characteristic
3.1 Mechanical resistance and stability (BWR 1)	
Resistance to steel failure $N_{Rk,s}$ [kN]	**See annex C1**
Resistance to pull-out failure $N_{Rk,p}$[kN] ψc	**See annex C1**
Resistance to concrete cone failure $k_{cr,N}$ $k_{ucr,N}$ h_{ef} $c_{cr,N}$ [mm]	**See annex C1**
Robustness γ_{inst}	**See annex C1**
Mininum edge distance and spacing c_{min} s_{min} h_{min} [mm]	**See annexes C4 & C5**
Edge distance to prevent splitting under load $N^0_{Rk,sp}$ [kN]	**See annex C1**
Characteristic resistance to shear load (static and quasi-static loading)	
Resistance to steel failure under shear load $V^0_{Rk,s}$ [kN] $M^0_{Rk,s}$ [Nm] k_7	**See annex C2**
Resistance to pry-out failure k_8	**See annex C2**
Characteristic resistance for simplified design	
F_{Rk} [kN] $M^0_{RK,s}$ [Nm] c_{cr} s_{cr} h_{min} [mm]	**See annex C1, C2 & C5**
Displacements	
Displacements under static and quasi-static loading δ_{N0} $\delta_{N\infty}$ δ_{v0} $\delta_{v\infty}$	**See annex C8**

Characteristic	Assessment of characteristic
Characteristic resistance and displacements for seismic performance categories C1 and C2	
Resistance to tension load, displacements C1 $N_{Rk,s,C1}$ $N_{Rk,p,C1}$ [kN]	**See annex C1**
C2 $N_{Rk,s,C2}$ $N_{RK,p,C2}$ [kN]	**See annex C7 and C8**
Resistance to shear load, displacements C1 $V_{Rk,s,C1}$ [kN]	**See annex C6**
C2 $V_{Rk,s,C2}$ [kN] $\delta_{v,C2}$ [mm]	**See annex C7 and C8**
Factor for annular gap α_{gap}	**See annex C6**
3.2 Safety in case of fire (BWR2)	
Fire resistance to steel failure (tension load) $N_{Rk,sfl}$ [kN]	**See annex C3**
Fire resistance to pull-out failure (tension lad) $N_{Rk,p,fl}$ [kN]	**See annex C3**
Fire resistance to steel failure (shear load) $V_{Rk,s,fl}$ [kN] $M^0_{Rk,s,fl}$ [Nm]	**See annex C3**
Aspects of durability	
Durability	**No performance assessed**

See additional information in section 3.3 and 3.4

3.3 Methods of assessment

The assessment of the performance of fischer Bolt Anchor FAZ II Classic in relation to the applicable BWR's has been made in accordance with the European Assessment Document (EAD) No. EAD 330232-01-0601; Mechanical fasteners for use in concrete.

3.4 General aspects related to the fitness for use of the product.

The European Technical Assessment is issued for the fischer Bolt Anchor FAZ II Classic based on agreed data/information, deposited with ETA-Danmark, which identifies the product that has been assessed. Changes to the product or production process, which could result in this deposited data/information being incorrect, should be notified to ETA-Danmark before the changes are introduced. ETA-Danmark will decide if such changes affect the ETA and consequently the validity of the CE marking based on the ETA and if so whether further assessment or alterations to the ETA, shall be necessary.

The bolt anchors are manufactured in accordance with the provisions of the European Technical Assessment using the automated manufacturing process as identified during the inspection of the plant by the assessment body issuing the ETA and the notified body and laid down in the technical documentation.

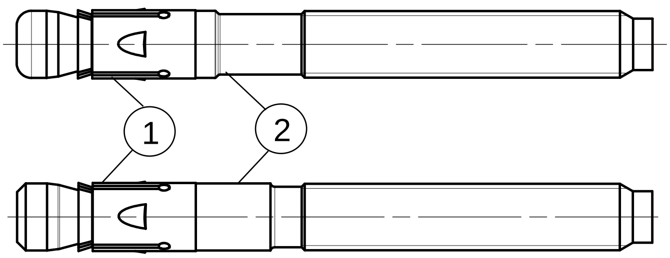
4 Assessment and verification of constancy of performance (hereinafter AVCP) system applied, with reference to its legal base

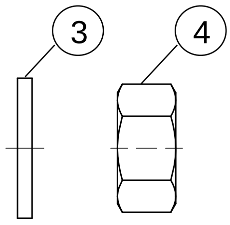
4.1 AVCP system

According to the decision 1996/582/EC of the European Commission, the system(s) of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No. 305/2011) is 1.

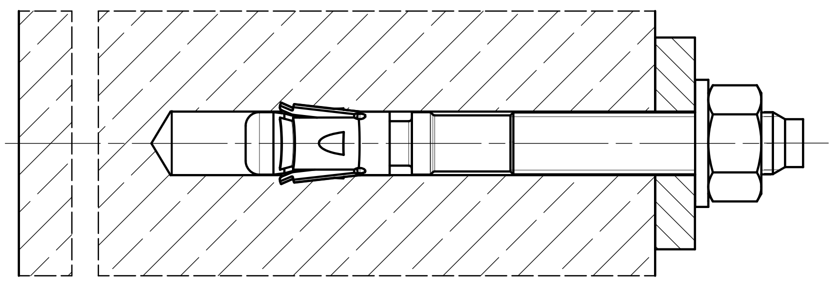
Cone bolt manufactured by cold - forming:

Cone bolt manufactured by turning:



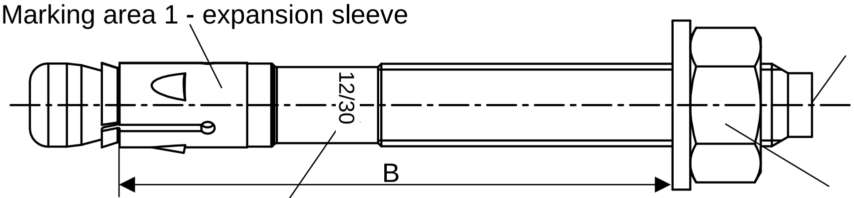


① Expansion sleeve
② Cone bolt (cold – formed or turned)
③ Washer
④ Hexagon nut



(Figure not to scale)

Product marking and letter-code:



Product marking, example: FAZ II Classic 12/30 R

Brand | type of fastener placed at marking area 1 or 3

Thread size / max. thickness of the fixture (t_{fix}) identification R placed at marking area 1 or 3

FAZ II Classic: carbon steel, galvanised
FAZ II Classic R: stainless steel

Table A2.1: Letter - code at marking area 2

Marking		(a)	(b)	(c)	(d)	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(K)
Max. t_{fix} [mm]		5	10	15	20	5	10	15	20	25	30	35	40	45	50
B ≥ [mm]	M8	40	45	-		50	55	60	65	70	75	80	85	90	95
	M10	45	50	55	60	65	70	75	80	85	90	95	100	105	110
	M12	55	60	65	70	75	80	85	90	95	100	105	110	115	120
	M16	70	75	80	85	90	95	100	105	110	115	120	125	130	135

Marking		(L)	(M)	(N)	(O)	(P)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	(Y)	(Z)
Max. t_{fix} [mm]		60	70	80	90	100	120	140	160	180	200	250	300	350	400
B ≥ [mm]	M8	105	115	125	135	145	165	185	205	225	245	295	345	395	445
	M10	120	130	140	150	160	180	200	220	240	260	310	360	410	460
	M12	130	140	150	160	170	190	210	230	250	270	320	370	420	470
	M16	145	155	165	175	185	205	225	245	265	285	335	385	435	485

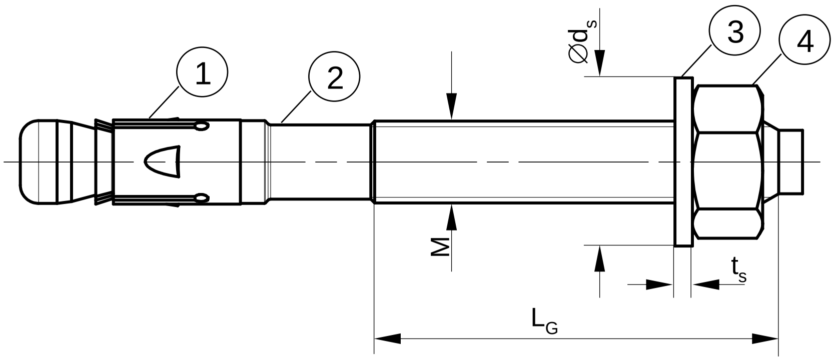
Calculation existing h_{ef} for installed fasteners:

existing h_{ef} = $B_{(according\ to\ table\ A2.1)}$ – existing t_{fix}

Thickness of the fixture t_{fix} including thickness of filling conical washer t and e.g. thickness of grout layer t_{grout} or other non-structural layers

(Figure not to scale)

Product dimensions



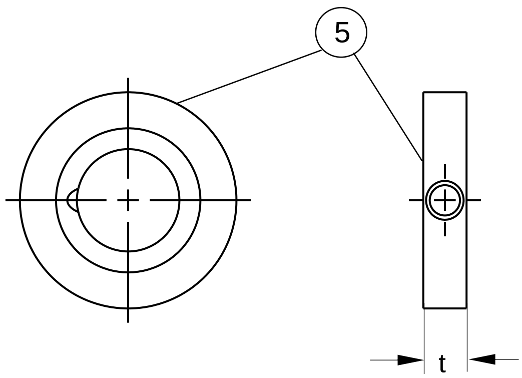


Table A3.1: Dimensions [mm]

Part	Designation			FAZ II Classic, FAZ II Classic R M8	M10	M12	M16
1	Expansion sleeve	Sheet thickness		1,3	1,4	1,6	2,4
2	Cone bolt	Thread size M		8	10	12	16
		L_G	≥	19	26	31	40
3	Washer	t_S	≥	1,4	1,8	2,3	2,7
		$\varnothing d_s$	≥	15	19	23	29
4	Hexagon nut	Wrench size		13	17	19	24
5	fischer filling conical washer FFD	t	=	6			7

(Figure not to scale)

Table A4.1: Materials FAZ II Classic

Part	Designation	Material	
		FAZ II Classic	FAZ II Classic R
	Steel grade	Steel	Stainless steel R
		Zinc plated ≥ 5 µm, ISO 4042:2018	Acc. to EN 10088:2014 Corrosion resistance class CRC III acc. to EN 1993-1-4:2006+A1:2015
1	Expansion sleeve	Cold strip, EN 10139:2016 or stainless steel EN 10088:2014	Stainless steel EN 10088:2014
2	Cone bolt	Cold form steel or free cutting steel	Stainless steel EN 10088:2014
3	Washer	Cold strip, EN 10139:2016	
4	Hexagon nut	Steel, property class min. 8, EN ISO 898-2:2012	Stainless steel ISO 3506-2:2020; property class – min. 70
5	fischer filling conical washer FFD	Cold form steel or free cutting steel	Stainless steel EN 10088:2014

Specifications of intended use

Fastenings subject to:

Size	FAZ II Classic, FAZ II Classic R			
	M8	**M10**	**M12**	**M16**
Hammer drilling with standard drill bit 	✓			
Hammer drilling with hollow drill bit with automatic cleaning 	✓			
Diamond drilling 	✓ (for non seismic applications only)			
Static and quasi-static loads	✓			
Cracked and uncracked concrete				
Fire exposure				
Seismic performance category C1	✓			
Seismic performance category C2	-[1)]	✓		

[1)] No performance assessed

Base materials:

- Compacted reinforced and unreinforced normal weight concrete without fibres (cracked or uncracked) according to EN 206:2013+A2:2021
- Strength classes C20/25 to C50/60 according to EN 206:2013+A2:2021

Use conditions (Environmental conditions):

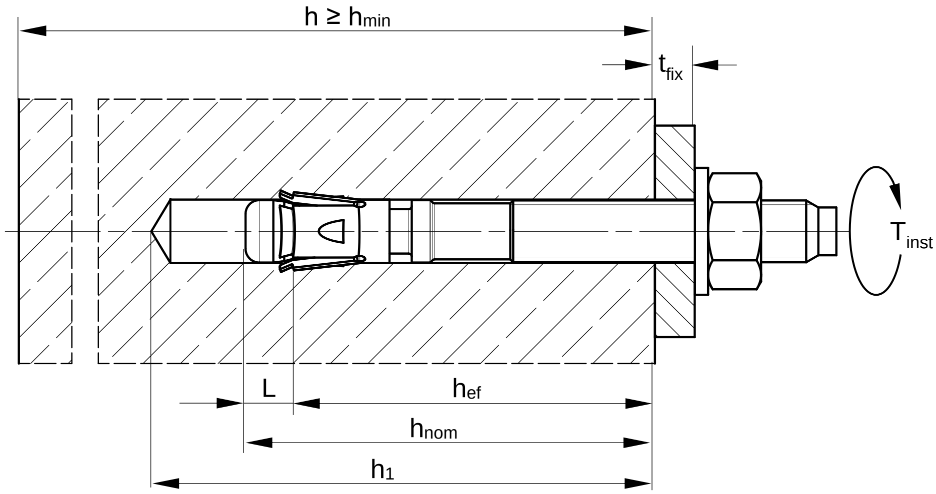
- Structures subject to dry internal conditions (FAZ II Classic, FAZ II Classic R)
- For all other conditions according to EN 1993-1-4:2006 + A1:2015 corresponding to corrosion resistance class
  - CRC III: for FAZ II Classic R

Design:

- Fastenings are to be designed under the responsibility of an engineer experienced in fastenings and concrete work
- Verifiable calculation notes and drawings are to be prepared taking account of the loads to be anchored. The position of the fastener is indicated on the design drawings (e.g. position of the fastener relative to reinforcement or to supports, etc.)
- Fastenings in stand-off installation or with a grout layer under seismic action are not covered
- In case of seismic applications the fastener shall be positioned outside of critical regions (e.g. plastic hinges) of the concrete structure
- Design of fastenings according to EN 1992-4:2018 and EOTA Technical Report TR 055:2018

Table B2.1: Installation parameters

Size			FAZ II Classic, FAZ II Classic R			
			M8	**M10**	**M12**	**M16**
Nominal drill hole diameter	d_0 =	[mm]	8	10	12	16
Maximum bit diameter with hammer or hollow drilling	$d_{cut,max}$	[mm]	8,45	10,45	12,5	16,5
Maximum bit diameter with diamond drilling	$d_{cut,max}$	[mm]	8,15	10,45	12,25	16,45
Effective embedment depth	$h_{ef} \geq$	[mm]	35-90	40-100	50-125	65-160
Length from h_{ef} to end of cone bolt	L	[mm]	9,5	11,5	13,5	17,5
Overall fastener embedment depth in the concrete	$h_{nom} \geq$	[mm]	h_{ef} + L			
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	h_{nom} + 3		h_{nom} + 5	
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	9	12	14	18
Required setting torque	T_{inst} =	[Nm]	20	45	60	110



h_{ef} = Effective embedment depth
t_{fix} = Thickness of the fixture
h_1 = Depth of drill hole to deepest point
h = Thickness of the concrete member
h_{min} = Minimum thickness of concrete member
h_{nom} = Overall fastener embedment depth in the concrete
T_{inst} = Required setting torque
L = Length from h_{ef} to end of cone bolt

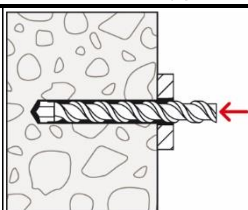
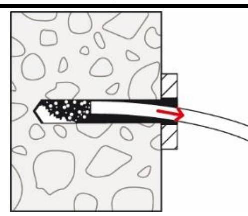
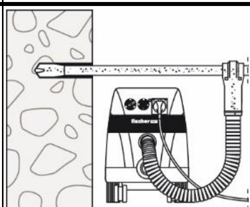
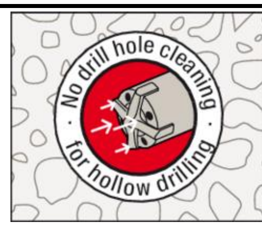
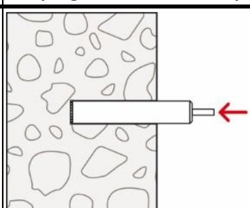
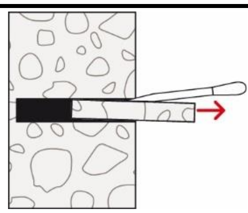
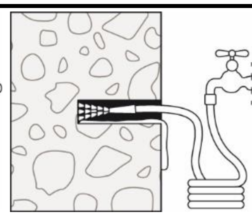
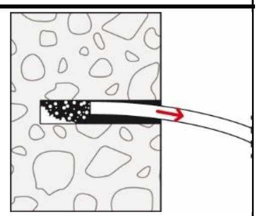
(Figure not to scale)

Installation instructions:

- Fastener installation carried out by appropriately qualified personnel according to the design drawings and under the supervision of the person responsible for technical matters on the site
- Use of the fastener only as supplied by the manufacturer without exchanging the components of the fastener
- Hammer, hollow or diamond drilling according to Annex B1 + B2
- Drill hole created perpendicular +/- 5° to concrete surface, positioning without damaging the reinforcement
- In case of aborted hole: new drilling at a minimum distance twice the depth of the aborted drill 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
- For Seismic C2 applications with shear loads, the annular gap must be filled

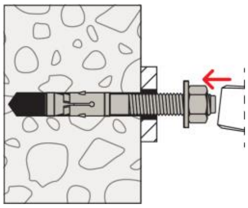
Installation instructions: Drilling and cleaning the hole

Types of drills and cleaning

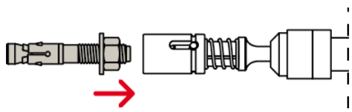
Hammer drill (e.g. fischer Quattric II)		 1: Drill the hole	 2: Clean the hole	Continue with step 5	
Hollow drill (e.g. fischer FHD)		 1: Drill the hole with automatic cleaning (e.g. fischer FVC)	 Cleaning obsolete	Continue with step 5	
Diamond drill, for non seismic applications only		 1: Drill the hole	 2: Break the drill core and remove it	 3: Flush the drill hole, until clear water emerges from the drill hole	 4: Clean the hole

Installation instructions: Installation of the fastener

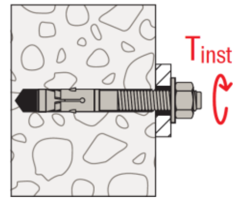
<u>HEXAGON NUT:</u>



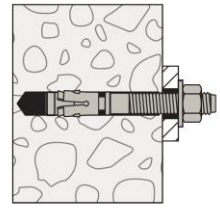
5.a: Set the fastener
e.g. with hammer



5.b: Set the fastener
e.g. fischer FA-ST II



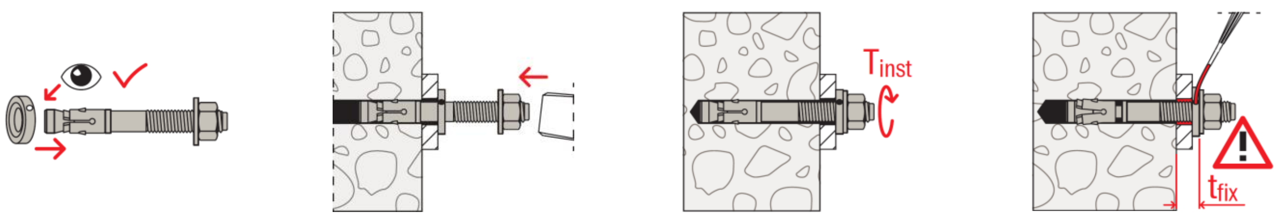
6: Apply T_{inst}



7: Installed fastener

<u>fischer Filling conical washer FFD for seismic application or minimising the annular gap:</u>

The gap between bolt and fixture may be filled with mortar (compressive strength ≥ 50 N/mm² e.g. fischer FIS SB) after last step (for eliminating the annular gap). The FFD is additional to the standard washer. The thickness of the FFD must be considered for definition of t_{fix}. Countersunk of the FFD in direction to the anchor plate. Installation with hexagon nut is permitted.
For seismic C2 applications, with shear loads, the annular gap must be filled. This application is not permitted without annular gap filling.



<table>
<tr><th colspan="9">Table C1.1: Characteristic values of tension resistance under static and quasi-static action</th></tr>
<tr><td colspan="4" rowspan="2">Size</td><td colspan="5">FAZ II Classic, FAZ II Classic R</td></tr>
<tr><td colspan="2">M8</td><td>M10</td><td>M12</td><td>M16</td></tr>
<tr><td colspan="9">Steel failure</td></tr>
<tr><td rowspan="2">Characteristic resistance</td><td>FAZ II Classic</td><td rowspan="2">$N_{Rk,s}$</td><td rowspan="2">[kN]</td><td colspan="2">16,5</td><td>27,2</td><td>41,6</td><td>66,2</td></tr>
<tr><td>FAZ II Classic R</td><td colspan="2">16,5</td><td>27,2</td><td>41,6</td><td>66,2</td></tr>
<tr><td rowspan="2">Partial factor for steel failure</td><td>FAZ II Classic</td><td rowspan="2">γ_{Ms} 1)</td><td rowspan="2">[-]</td><td colspan="5" rowspan="2">1,5</td></tr>
<tr><td>FAZ II Classic R</td></tr>
<tr><td colspan="9">Pullout failure</td></tr>
<tr><td colspan="2">Effective embedment depth for calculation</td><td>h_{ef}</td><td>[mm]</td><td>40 3) - < 45</td><td>45-90</td><td>40-100</td><td>50-125</td><td>65-160</td></tr>
<tr><td colspan="2">Characteristic resistance in cracked concrete C20/25</td><td rowspan="2">$N_{Rk,p}$ (C20/25)</td><td rowspan="2">[kN]</td><td>5,5</td><td>8</td><td>13</td><td>20</td><td>27,0</td></tr>
<tr><td colspan="2">Characteristic resistance in uncracked concrete C20/25</td><td colspan="2">14</td><td>20</td><td>22</td><td>38,6</td></tr>
<tr><td colspan="2" rowspan="6">Increasing factor ψ_c for cracked or uncracked concrete
$N_{Rk,p} = \psi_c \cdot N_{Rk,p}$ (C20/25)</td><td rowspan="6">[-]</td><td>C25/30</td><td colspan="5">1,12</td></tr>
<tr><td>C30/37</td><td colspan="5">1,22</td></tr>
<tr><td>C35/45</td><td colspan="5">1,32</td></tr>
<tr><td>C40/50</td><td colspan="5">1,41</td></tr>
<tr><td>C45/55</td><td colspan="5">1,50</td></tr>
<tr><td>C50/60</td><td colspan="5">1,58</td></tr>
<tr><td colspan="2">Installation sensitivity factor</td><td>γ_{inst}</td><td>[-]</td><td colspan="5">1,0</td></tr>
<tr><td colspan="9">Concrete cone and splitting failure</td></tr>
<tr><td colspan="2">Factor for uncracked concrete</td><td>$k_{ucr,N}$</td><td rowspan="2">[-]</td><td colspan="5">11,0 2)</td></tr>
<tr><td colspan="2">Factor for cracked concrete</td><td>$k_{cr,N}$</td><td colspan="5">7,7 2)</td></tr>
<tr><td colspan="2">Characteristic spacing</td><td>$s_{cr,N}$</td><td rowspan="2">[mm]</td><td colspan="5">$3 \cdot h_{ef}$</td></tr>
<tr><td colspan="2">Characteristic edge distance</td><td>$c_{cr,N}$</td><td colspan="5">$1,5 \cdot h_{ef}$</td></tr>
<tr><td colspan="2">Characteristic spacing for splitting failure</td><td>$s_{cr,sp}$</td><td>[mm]</td><td colspan="5">$2 \cdot c_{cr,sp}$</td></tr>
<tr><td rowspan="6">Characteristic edge distance for splitting failure h</td><td>≥ 80</td><td rowspan="6">$c_{cr,sp}$</td><td rowspan="6">[mm]</td><td colspan="2">$2,4 \cdot h_{ef}$</td><td>$2 \cdot h_{ef}$</td><td></td><td rowspan="3">- 5)</td></tr>
<tr><td>≥ 100</td><td colspan="2" rowspan="5">$2 \cdot h_{ef}$</td><td>$2,4 \cdot h_{ef}$</td><td>$2 \cdot h_{ef}$</td></tr>
<tr><td>≥ 120</td><td rowspan="4">$1,9 \cdot h_{ef}$</td><td>$2,1 \cdot h_{ef}$</td></tr>
<tr><td>≥ 140</td><td rowspan="3">$1,5 \cdot h_{ef}$</td><td rowspan="3">$2 \cdot h_{ef}$</td></tr>
<tr><td>≥ 160</td></tr>
<tr><td>≥ 200</td></tr>
<tr><td colspan="2">Characteristic resistance to splitting</td><td>$N^0_{Rk,sp}$</td><td>[kN]</td><td colspan="5">min $\{N^0_{Rk,c}; N_{Rk,p}\}$ 4)</td></tr>
</table>

1) In absence of other national regulations
2) Based on concrete strength as cylinder strength
3) For dry internal exposure and statically indeterminate redundant components, the minimum effective embedment depth can be reduced to 35 mm without reduction of $N_{Rk,p}$.
4) $N^0_{Rk,c}$ according to EN 1992-4:2018
5) No performance assessed

Table C2.1: Characteristic values of **shear** resistance under static and quasi-static action

Size				FAZ II Classic, FAZ II Classic R			
				M8	**M10**	**M12**	**M16**
Steel failure without lever arm							
Characteristic resistance	FAZ II Classic	$V^0_{Rk,s}$	[kN]	14,1	22,9	32,4	59,8
	FAZ II Classic R			14,4	19,2	38,7	64,6
Partial factor for steel failure		γ_{Ms} [1)]	[-]	1,25			
Factor for ductility		k_7		1,0			
Steel failure with lever arm and Concrete pryout failure							
Effective embedment depth for calculation		h_{ef}	[mm]	45-90	60-100	70-125	85-160
Characteristic bending resistance	FAZ II Classic, FAZ II Classic R	$M^0_{Rk,s}$	[Nm]	27	54	93	241
Factor for pryout failure		k_8	[-]	2,8	3,2		
Effective embedment depth for calculation		h_{ef}	[mm]	40[2)] - < 45	40 - < 60	50 - < 70	65 - < 85
Characteristic bending resistance	FAZ II Classic	$M^0_{Rk,s}$	[Nm]	20	51	93	241
	FAZ II Classic R			20	51	93	241
Factor for pryout failure		k_8	[-]	2,5	2,6	3,1	3,2
Partial factor for steel failure		γ_{Ms} [1)]	[-]	1,25			
Factor for ductility		k_7		1,0			
Concrete edge failure							
Effective embedment depth for calculation		l_f	[mm]	h_{ef}			
Outside diameter of a fastener		d_{nom}		8	10	12	16

[1)] In absence of other national regulations

[2)] For dry internal exposure and statically indeterminate redundant components, the minimum effective embedment depth can be reduced to 35 mm without reduction of $N_{Rk,p}$.

Table C3.1: Characteristic values of **tension** resistance under **fire exposure**

Size					FAZ II Classic, FAZ II Classic R							
					M8		M10		M12		M16	
			$h_{ef} \geq$	[mm]	35	45	40	60	50	70	65	85
Characteristic resistance **steel failure**	FAZ II Classic, FAZ II Classic R	$N_{Rk,s,fi}$	R30	[kN]	1,4		2,8		5,0		9,4	
			R60		1,2		2,3		4,1		7,7	
			R90		0,9		1,9		3,2		6,0	
			R120		0,8		1,6		2,8		5,2	
Characteristic resistance **Concrete cone failure**		$N_{Rk,c,fi}$	R30 - R90		$7{,}7 \cdot h_{ef}^{1,5} \cdot (20)^{0,5} \cdot h_{ef} / 200 / 1000$							
			R120		$7{,}7 \cdot h_{ef}^{1,5} \cdot (20)^{0,5} \cdot h_{ef} / 200 / 1000 \cdot 0{,}8$							
Characteristic resistance **pullout failure**		$N_{Rk,p,fi}$	R30 / R60 / R90		1,3		2,3		3,2	4,0	4,7	7,1
			R120		1,0		1,8		2,5	3,2	3,8	5,6

Table C3.2: Characteristic values of **shear** resistance under **fire exposure**

FAZ II Classic, FAZ II Classic R				R30		R60	
				$V_{Rk,s,fi,30}$ [kN]	$M^0_{Rk,s,fi,30}$ [Nm]	$V_{Rk,s,fi,60}$ [kN]	$M^0_{Rk,s,fi,60}$ [Nm]
M8	$h_{ef} \geq$	35	[mm]	1,8	1,4	1,6	1,2
M10		40		3,6	3,6	2,9	3,0
M12		50		6,3	7,8	4,9	6,4
M16		65		11,7	19,9	9,1	16,3

FAZ II Classic, FAZ II Classic R				R90		R120	
				$V_{Rk,s,fi,90}$ [kN]	$M^0_{Rk,s,fi,90}$ [Nm]	$V_{Rk,s,fi,120}$ [kN]	$M^0_{Rk,s,fi,120}$ [Nm]
M8	$h_{ef} \geq$	35	[mm]	1,3	1,0	1,2	0,8
M10		40		2,2	2,4	1,9	2,1
M12		50		3,5	5,0	2,8	4,3
M16		65		6,6	12,6	5,3	11,0

Concrete pryout failure according to EN 1992-4:2018

Table C3.3: Minimum spacings and minimum edge distances of fasteners under **fire exposure** for **tension** and **shear** load

Size			FAZ II Classic, FAZ II Classic R			
			M8	M10	M12	M16
Spacing	s_{min}	[mm]	Annex C4			
Edge distance	c_{min}		$c_{min} = 2 \cdot h_{ef}$, for fire exposure from more than one side $c_{min} \geq 300$ mm			

Table C4.1: Minimum thickness of concrete members, minimum spacing and minimum edge distance

Size			M8	M10	M12	M16
			FAZ II Classic, FAZ II Classic R			
Minimum edge distance						
Uncracked concrete	c_{min}	[mm]	40	45	55	65
Cracked concrete	c_{min}	[mm]	40	45	55	65
Corresponding	s	[mm]	according to Annex C5			
Minimum thickness of concrete member	h_{min}	[mm]	80		100	140
Thickness of concrete member	h ≥	[mm]	max. {h_{min}; 1,5 · h_{ef}}			
Minimum spacing						
Uncracked concrete	s_{min}	[mm]	40	40	50	65
Cracked concrete	s_{min}	[mm]	35	40	50	65
Corresponding	c	[mm]	according to Annex C5			
Minimum thickness of concrete member	h_{min}	[mm]	80		100	140
Thickness of concrete member	h ≥	[mm]	max. {h_{min}; 1,5 · h_{ef}}			
Minimum splitting area						
Uncracked concrete	$A_{sp,req}$	[·1000 mm²]	18	37	54	67
Cracked concrete	$A_{sp,req}$	[·1000 mm²]	12	27	40	50

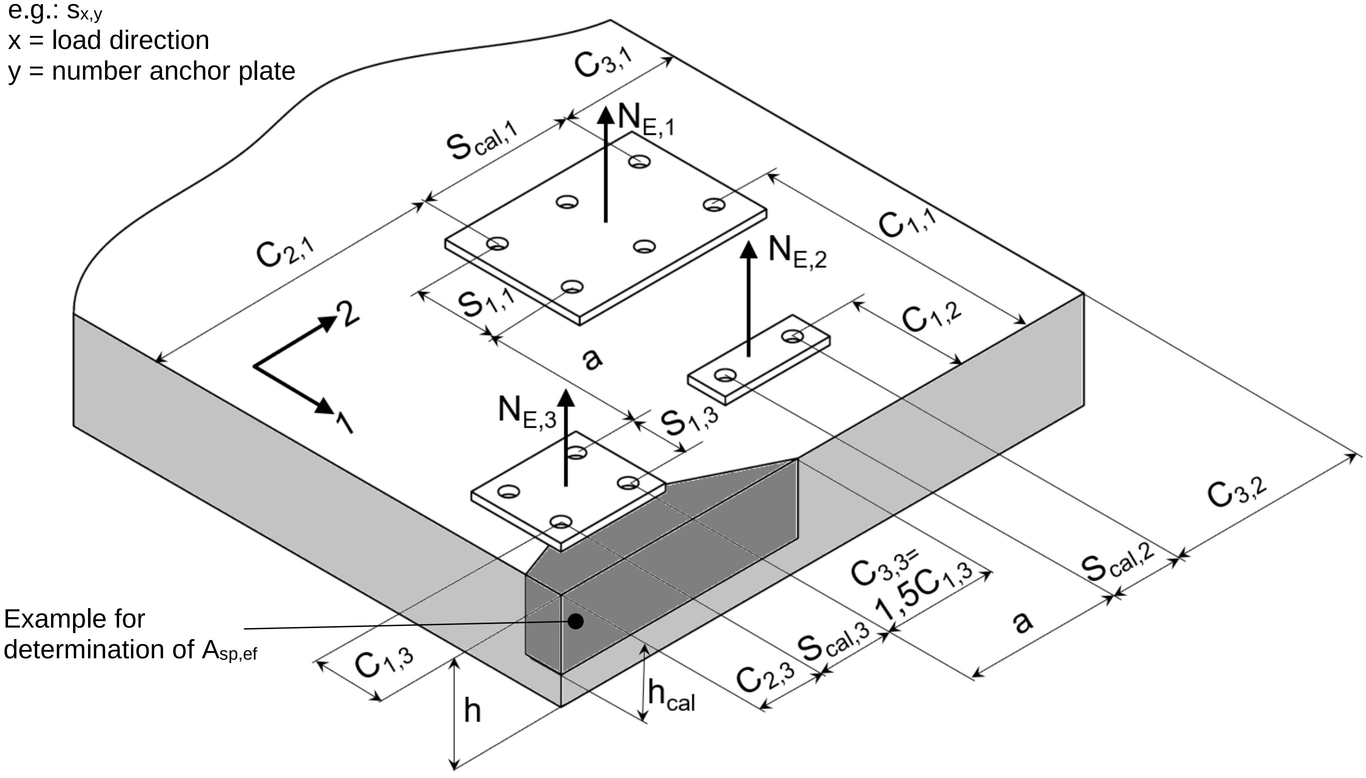
Table C4.2: Minimum spacing and minimum edge distances - calculated values for **for cracked concrete with one edge** (c_2 and $c_3 \geq 1,5\ c_1$)

Type of anchor / size		FAZ II Classic, FAZ II Classic R							
		M8		M10		M12		M16	
Effective anchorage depth	$h_{ef} \geq$ [mm]	35	45	40	60	50	70	65	85
Minimum thickness of concrete member	h ≥ [mm]	80	85	80	120	100	140	140	180
Minimum spacing	s_{min} [mm]	35		40		50		65	
	for c ≥ [mm]	40		100	65	120	80	100	75
Minimum edge distance	c_{min} [mm]	40		60	45	70	55	65	
	for s ≥ [mm]	35		160	90	190	125	165	85

Determination of $A_{sp,ef}$ for each existing free edge

Splitting failure applied for minimum edge distance and spacing in depending on h_{ef}

Definition Index:
cal = calculatory
e.g.: $s_{x,y}$
x = load direction
y = number anchor plate



Example for different anchor plates: For considering all free edges the direction 1 and 2 must be swaped.

General formulation for each free edge: $A_{sp,ef} = (c_2 + s_{cal} + c_3) \cdot h_{cal} \geq (^n/_2) \cdot A_{sp,req}$
with:
Edge distance c_1: $c_{min} \leq c_1$
Edge distance c_2: $c_{min} \leq c_2 \leq 1,5 \cdot c_1$
Edge distance c_3: $c_{min} \leq c_3 \leq 1,5 \cdot c_1$
Calculation spacing, distance between outer anchors s_{cal}: $s_{min} \leq s_{cal} \leq 3,0 \cdot c_1$
Distance between group of anchors a: For $a \geq 3,0\ c_1$ no influence between the anchor groups is taken into account.
Number of anchors n of an anchor plate as well close and parallel to the edge
Effective member thickness h_{cal}: $h_{min} \leq h$; $h_{cal} \leq h$; $h_{cal} \leq (h_{ef} + 1,5 \cdot c_1)$
c_1, c_2, c_3, h and s_{cal} have to be set in way that the requirement is fullfiled

For the calculation of minimum spacing and minimum edge distance of fasteners in combination with different embedment depths and thicknesses of concrete members the following equation shall be fulfilled:

$$\mathbf{A_{sp,req} < A_{sp,ef}}$$

$A_{sp,req}$ = required splitting area (according to Annex C 4)
$A_{sp,ef}$ = effective splitting area

(Figure not to scale)

Table C6.1: Characteristic values of **tension and shear** resistance under **seismic action category C1**

Size			FAZ II Classic, FAZ II Classic R				
			M8		M10	M12	M16
Effective embedment depth	h_{ef}	[mm]	40-45	45-90	40-100	50-125	85-160
With filling of the annular gap	α_{gap}	[-]	1,0				
Without filling of the annular gap	α_{gap}	[-]	0,5				
Steel failure $N_{Rk,s,C1} = N_{Rk,s}$; $\gamma_{Ms,C1} = \gamma_{Ms}$ (see Annex C1)							
Pullout failure							
Characteristic resistance in cracked concrete C1	$N_{Rk,p,C1}$	[kN]	5,1	7,4	11,6	20,0	27,0
Installation sensitivity factor	γ_{inst}	[-]	1,0				
Concrete cone failure and splitting failure $N_{Rk,c,C1} = N_{Rk,c}$; $N_{Rk,sp,C1} = N_{Rk,sp}$ (see Annex C1)							
Steel failure without lever arm							
			FAZ II Classic, FAZ II Classic R				
Characteristic resistance C1	h_{ef}	[mm]	45-90		40-100	50-125	65-160
Characteristic resistance C1	$V_{Rk,s,C1}$	[kN]	11		17	27	47
Partial factor for steel failure	$\gamma_{Ms,C1}$ [1]	[-]	1,25				

[1] In absence of other national regulations

Table C7.1: Characteristic values of **tension and shear** resistance under **seismic action category C2**

Size			FAZ II Classic, FAZ II Classic R			
			M8	**M10**	**M12**	**M16**
Steel failure						
Characteristic resistance tension load C2	$N_{Rk,s,C2}$	[kN]	-[3)]	27	41	66
Partial factor for steel failure	$\gamma_{Ms,C2}$[1)]	[-]		1,5		
Pullout failure						
Characteristic resistance tension load in cracked concrete C2	h_{ef}	[mm]	-[3)]	60	70	85
	$N_{Rk,p,C2}$	[kN]		5,1	7,4	21,5
	h_{ef}	[mm]		40-59	50-69	65-84
	$N_{Rk,p,C2}$	[kN]		2,7	4,4	16,4
Installation sensitivity factor	γ_{inst}	[-]	1,0			
Concrete cone failture and splitting failure $N_{rk,c,C2}=N_{Rk,c}$; $N_{Rk,sp,C2}=N_{Rk,sp}$ (see Annex C1)						
Steel failure without lever arm						
Characteristic resistance shear load C2	h_{ef}	[mm]	-[3)]	60	70	85
	$V_{Rk,s,C2}$[2)]	[kN]		10,0	17,4	27,5
	h_{ef}	[mm]		40-59	50-69	65-84
	$V_{Rk,s,C2}$[2)]	[kN]		7,0	12,7	22,0
Partial factor for steel failure	$\gamma_{Ms,C2}$[1)]	[-]	1,25			

[1)] In absence of other national regulations

[2)] Filling of the annular gap according to Annex B4 required

[3)]No performance assessed

Table C8.1: Displacements under static and quasi static **tension** loads

Size			FAZ II Classic, FAZ II Classic R			
			M8	**M10**	**M12**	**M16**
Displacement – factor for tensile load[1]						
δ_{N0} - factor	in cracked concrete	[mm/kN]	0,22	0,12	0,09	0,08
$\delta_{N\infty}$ - factor	in cracked concrete	[mm/kN]	0,78	0,40	0,19	0,09
δ_{N0} - factor	in uncracked concrete	[mm/kN]	0,07	0,05	0,06	
$\delta_{N\infty}$ - factor	in uncracked concrete	[mm/kN]	0,29	0,21	0,14	0,10

Table C8.2: Displacements under static and quasi static **shear** loads

Size			**M8**	**M10**	**M12**	**M16**
Displacement – factor for shear load[2]						
			FAZ II Classic, FAZ II Classic R			
δ_{V0} - factor	in cracked or uncracked concrete	[mm/kN]	0,35	0,37	0,27	0,10
$\delta_{V\infty}$ - factor	in cracked or uncracked concrete	[mm/kN]	0,52	0,55	0,40	0,14

[1] Calculation of effective displacement:
$\delta_{N0} = \delta_{N0}$ - factor · N
$\delta_{N\infty} = \delta_{N\infty}$ - factor · N

N = Action tension loading

[2] Calculation of effective displacement:
$\delta_{V0} = \delta_{V0}$ - factor · V
$\delta_{V\infty} = \delta_{V\infty}$ - factor · V

V = Action shear loading

Table C8.3: Displacements under **tension** loads for **category C2** for all embedment depths

Size			FAZ II Classic, FAZ II Classic R			
			M8	**M10**	**M12**	**M16**
Displacement DLS	$\delta_{N,C2(DLS)}$	[mm]	-[1]	2,7	2,2	4,4
Displacement ULS	$\delta_{N,C2\ (ULS)}$	[mm]	-[1]	11,5	10,9	12,3

Table C8.4: Displacements under **shear** loads for **category C2** for all embedment depths

Size			FAZ II Classic, FAZ II Classic R			
			M8	**M10**	**M12**	**M16**
Displacement DLS	$\delta_{V,C2\ (DLS)}$	[mm]	-[1]	4,1	4,7	5,5
Displacement ULS	$\delta_{V,C2\ (ULS)}$	[mm]	-[1]	6,2	7,8	10,1

[1] No performance assessed