Deutsches Institut für Bautechnik
Approval body for construction products and types of construction
Bautechnisches Prüfamt
An institution established by the Federal and Laender Governments

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European Technical Assessment

ETA-18/0542 of 6 November 2020

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	NIEDAX Bolt Anchor DAZ, DAZ E4, DAZ HCR
Product family to which the construction product belongs	Mechanical fasteners for use in concrete
Manufacturer	Niedax GmbH & Co. KG Asbacher Straße 144 53545 Linz am Rhein DEUTSCHLAND
Manufacturing plant	NIEDAX
This European Technical Assessment contains	19 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	EAD 330232-00-0601, Edition 10/2016
This version replaces	ETA-18/0542 issued on 28 April 2020

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Specific Part

1 Technical description of the product

The NIEDAX Bolt Anchor DAZ is an anchor made of galvanised steel (DAZ) or made of stainless steel (DAZ E4) or high corrosion resistant steel (DAZ HCR) 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 fastener 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 fastener 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 to tension load (static and quasi-static loading)	See Annex B 3, C 1
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C 2
Displacements (static and quasi-static loading)	See Annex C 5
Characteristic resistance and displacements for seismic performance categories C1 and C2	See Annex C 4
Durability	See Annex B 1

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	See Annex C 3

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

In accordance with the European Assessment Document EAD 330232-00-0601 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 with Deutsches Institut für Bautechnik.

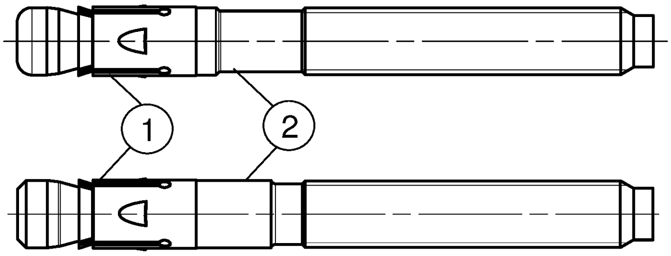
Issued in Berlin on 6 November 2020 by Deutsches Institut für Bautechnik

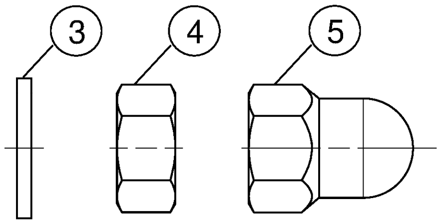
Dipl.-Ing. Beatrix Wittstock
Head of Section

beglaubigt:
Baderschneider

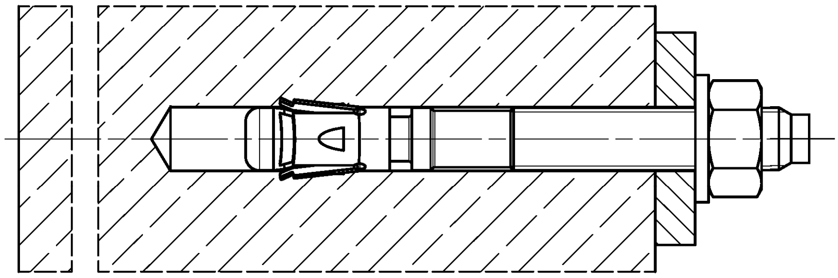
Cone bolt manufactured by cold - forming:

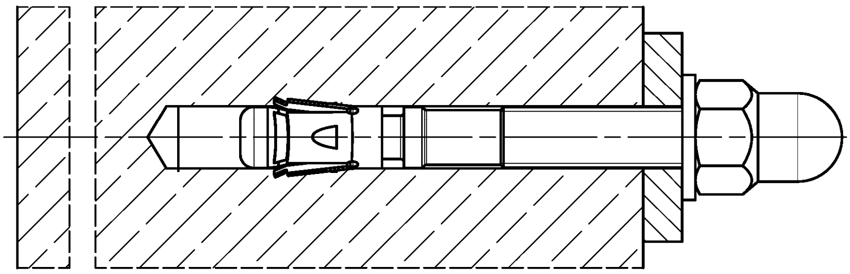
Cone bolt manufactured by turning:





①	Expansion sleeve
②	Cone bolt (cold – formed or turned)
③	Washer
④	Hexagon nut
⑤	NIEDAX DAZ dome nut

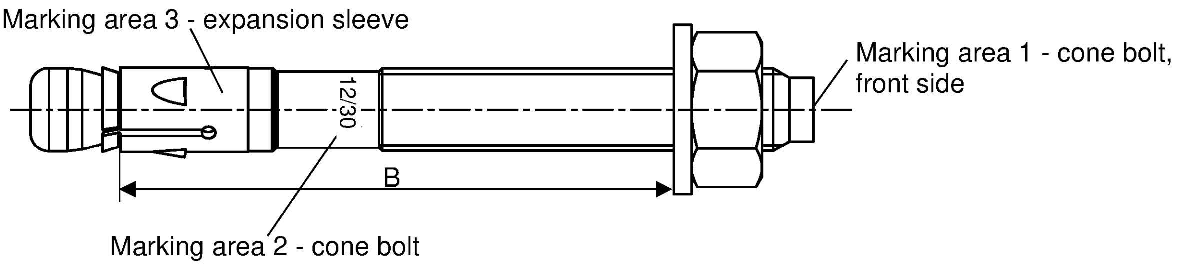




(Fig. not to scale)

NIEDAX Bolt Anchor DAZ, DAZ E4, DAZ HCR	**Annex A 1**
Product description Installed condition	

Product label and letter-code:



Product label, example: FAZ II 12/30 R

Brand | type of fastener placed at marking area 2 or marking area 3

Thread size / max. thickness of the fixture (t_{fix}) identification R or HCR placed at marking area 2

FAZ II: carbon steel, galvanized
FAZ II R: stainless steel
FAZ II HCR: high corrosion resistant steel

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

Marking		(a)	(b)	(c)	(d)	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(K)
Max. t_{fix}		5	10	15	20	5	10	15	20	25	30	35	40	45	50
B ≥ [mm]	M6	-				45	50	55	60	65	70	75	80	85	90
	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
	M20	-				105	110	115	120	125	130	135	140	145	150
	M24					130	135	140	145	150	155	160	165	170	175

Marking		(L)	(M)	(N)	(O)	(P)	(R)	(S)	(T)	(U)	(V)	(W)	(X)	(Y)	(Z)
Max. t_{fix}		60	70	80	90	100	120	140	160	180	200	250	300	350	400
B ≥ [mm]	M6	100	110	120	130	140	160	180	200	220	240	290	340	390	440
	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
	M20	160	170	180	190	200	220	240	260	280	300	350	400	450	500
	M24	185	195	205	215	225	245	265	285	305	325	375	425	475	525

Calculation existing h_{ef} for installed fasteners:

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

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

(Fig. not to scale)

NIEDAX Bolt Anchor DAZ, DAZ E4, DAZ HCR

Product description
Product label and letter code

Annex A 2

Product dimensions

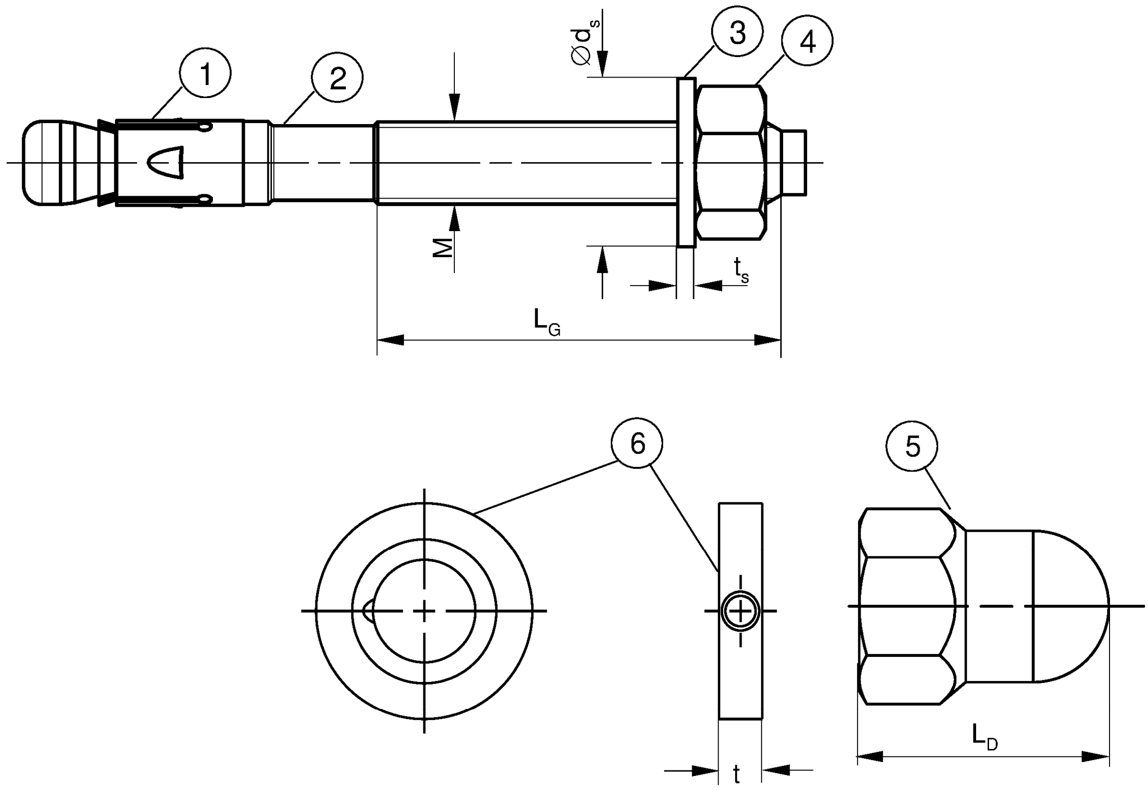


Table A3.1: Dimensions [mm]

Part	Designation			DAZ, DAZ E4, DAZ HCR						
				M6	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
1	Expansion sleeve	Sheet thickness		0,8	1,3	1,4	1,6	2,4		3,0
2	Cone bolt	Thread size M		6	8	10	12	16	20	24
		L_G	≥	10	19	26	31	40	50	57
3	Washer	t_s	≥	1,4		1,8	2,3	2,7		3,7
		$\varnothing d_s$	≥	11	15	19	23	29	36	43
4 & 5	Hexagon nut / NIEDAX DAZ dome nut	Wrench size		10	13	17	19	24	30	36
5		L_D	≥	-		22	27	33	-	
6	NIEDAX filling disc FFD	t	=	6				7	8	10

(Fig. not to scale)

NIEDAX Bolt Anchor DAZ, DAZ E4, DAZ HCR

Product description
Dimensions

Annex A 3

Table A4.1: Materials DAZ (ISO 4042:2018/Zn5/An(A2K))

Part	Designation	Material
1	Expansion sleeve	Cold strip, EN 10139:2016 or stainless steel EN 10088:2014
2	Cone bolt	Cold form steel or free cutting steel
3	Washer	Cold strip, EN 10139:2016
4	Hexagon nut	Steel, property class min. 8, EN ISO 898-2:2012

Table A4.2: Materials DAZ E4

Part	Designation	Material
1	Expansion sleeve	Stainless steel EN 10088:2014
2	Cone bolt	
3	Washer	
4	Hexagon nut	Stainless steel EN 10088:2014; ISO 3506-2:2018; property class – min. 70

Table A4.3: Materials DAZ HCR

Part	Designation	Material
1	Expansion sleeve	Stainless steel EN 10088:2014
2	Cone bolt	High corrosion resistant steel EN 10088:2014
3	Washer	
4	Hexagon nut	High corrosion resistant steel EN 10088:2014; ISO 3506-2:2018; property class – min. 70

(Fig. not to scale)

NIEDAX Bolt Anchor DAZ, DAZ E4, DAZ HCR

Product description
Materials

Annex A 4

Specifications of intended use

Anchorages subject to:

Size		DAZ, DAZ E4, DAZ HCR						
		M6	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Static and quasi-static loads								
Cracked and uncracked concrete					✓			
Fire exposure								
Seismic performance category	C1	-				✓		
	C2[1)]	-				✓		-

[1)] DAZ HCR: Only valid for cold-formed version (according to Annex A1)

Base materials:
- Compacted reinforced and unreinforced normal weight concrete without fibres (cracked and uncracked) according to EN 206-1:2013+A1:2016
- Strength classes C20/25 to C50/60 according to EN 206-1:2013+A1:2016

Use conditions (Environmental conditions):
- Structures subject to dry internal conditions (DAZ, DAZ E4, DAZ HCR)
- Structures subject to external atmospheric exposure (including industrial and marine environment) and to permanently damp internal condition, if no particular aggressive conditions exist
  (DAZ E4, DAZ HCR)
- Structures subject to external atmospheric exposure and permanently damp internal condition, if other particular aggressive conditions exist
  (DAZ HCR)

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 deicing 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.)
- Design of fastenings according to EN 1992-4:2018 and EOTA Technical Report TR 055
- For effective embedment depth h_{ef} < 40 mm only statically indeterminate fixings (e.g. light-weight suspended ceilings with internal exposure) are covered by the ETA

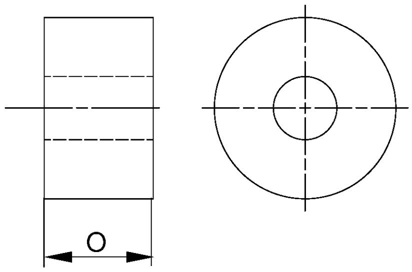
NIEDAX Bolt Anchor DAZ, DAZ E4, DAZ HCR	**Annex B 1**
Intended Use Specifications	

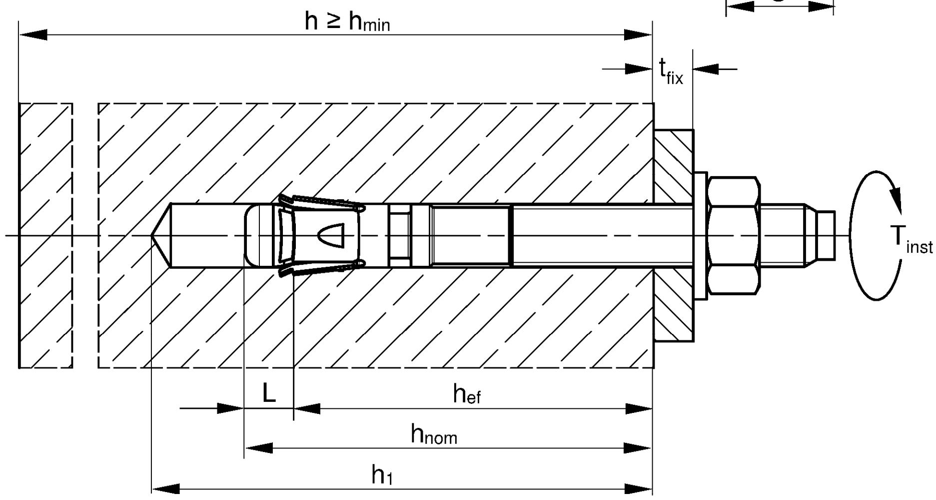
Deutsches Institut für Bautechnik DIBt

Table B2.1: Installation parameters

Size			DAZ, DAZ E4, DAZ HCR						
			M6	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Nominal drill hole diameter	d_0 =	[mm]	6	8	10	12	16	20	24
Maximum bit diameter with hammer or hollow drilling	$d_{cut,max}$	[mm]	6,40	8,45	10,45	12,5	16,5	20,55	24,55
Maximum bit diameter with diamond drilling	$d_{cut,max}$	[mm]	-	8,15		12,25	16,45	20,50	24,40
Overall fastener embedment depth in the concrete	$h_{nom} \geq$ (L)	[mm]	46,5 (6,5)	44,5 (9,5)	52,0 (12)	63,5 (13,5)	82,5 (17,5)	120 (20)	148,5 (23,5)
			Existing h_{ef} + L = h_{nom}						
Depth of drill hole to deepest point	$h_1 \geq$	[mm]	h_{nom} + 5					h_{nom} + 10	
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	7	9	12	14	18	22	26
Required setting torque	T_{inst} =	[Nm]	8	20	45	60	110	200	270
Excess length after hammering-in the cone bolt (for NIEDAX dome nut applications according to Annex B6)	O =	[mm]	-		12	16	20	-	

Setting gauge DAZ SL-H
for anchor with NIEDAX DAZ dome nut:





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

(Fig. not to scale)

NIEDAX Bolt Anchor DAZ, DAZ E4, DAZ HCR

Intended Use
Installation parameters

Annex B 2

Table B3.1: Minimum thickness of concrete members, minimum spacing and minimum edge distance

<table>
<tr><td colspan="3" rowspan="2">Size</td><td colspan="7">DAZ, DAZ E4, DAZ HCR</td></tr>
<tr><td>M6</td><td>M8</td><td>M10</td><td>M12</td><td>M16</td><td>M20</td><td>M24</td></tr>
<tr><td colspan="10">Minimum edge distance</td></tr>
<tr><td>Uncracked concrete</td><td rowspan="2">c_{min}</td><td rowspan="5">[mm]</td><td rowspan="2">45</td><td rowspan="2">40</td><td rowspan="2">45</td><td rowspan="2">55</td><td rowspan="2">65</td><td>95</td><td>135</td></tr>
<tr><td>Cracked concrete</td><td>85</td><td>100</td></tr>
<tr><td>Corresponding spacing</td><td>s</td><td colspan="7">according to Annex B4</td></tr>
<tr><td>Minimum thickness of concrete member</td><td>h_{min}</td><td colspan="3">80</td><td>100</td><td>140</td><td>160</td><td>200</td></tr>
<tr><td>Thickness of concrete member</td><td>h ≥</td><td colspan="4">max. {h_{min}; h_1[1)] + 30}</td><td colspan="3">max. {h_{min}; h_1[1)] + 2 · d_o}</td></tr>
<tr><td colspan="10">Minimum spacing</td></tr>
<tr><td>Uncracked concrete</td><td rowspan="2">s_{min}</td><td rowspan="5">[mm]</td><td rowspan="2">35</td><td>40</td><td rowspan="2">40</td><td rowspan="2">50</td><td rowspan="2">65</td><td rowspan="2">95</td><td rowspan="2">100</td></tr>
<tr><td>Cracked concrete</td><td>35</td></tr>
<tr><td>Corresponding edge distance</td><td>c</td><td colspan="7">according to Annex B4</td></tr>
<tr><td>Minimum thickness of concrete member</td><td>h_{min}</td><td colspan="3">80</td><td>100</td><td>140</td><td>160</td><td>200</td></tr>
<tr><td>Thickness of concrete member</td><td>h ≥</td><td colspan="4">max. {h_{min}; h_1[1)] + 30}</td><td colspan="3">max. {h_{min}; h_1[1)] + 2 · d_o}</td></tr>
<tr><td colspan="10">Minimal splitting area</td></tr>
<tr><td>Uncracked concrete</td><td rowspan="2">$A_{sp,req}$</td><td rowspan="2">[·1000 mm²]</td><td>5,1</td><td>18</td><td>37</td><td>54</td><td>67</td><td>100</td><td>117,5</td></tr>
<tr><td>Cracked concrete</td><td>1,5</td><td>12</td><td>27</td><td>40</td><td>50</td><td>77</td><td>87,5</td></tr>
</table>

[1)] h_1 according to Annex B2

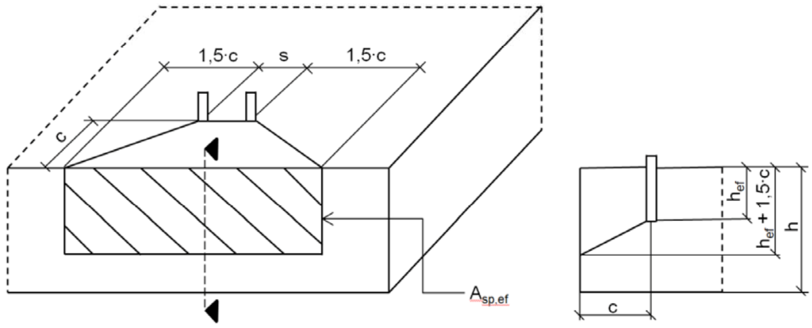
Splitting failure applied for minimum edge distance and spacing in dependence of the h_{ef}

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

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

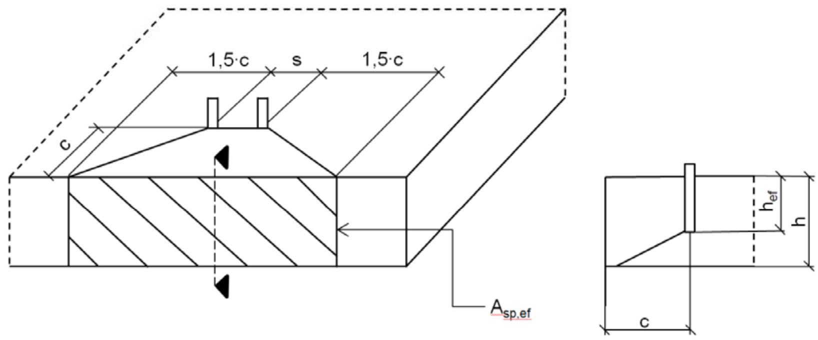
$A_{sp,req}$ = required splitting area
$A_{sp,ef}$ = effective splitting area (according to Annex B4)

Table B4.1: Effective splitting area $A_{sp,ef}$ with member thickness $h > h_{ef} + 1{,}5 \cdot c$ and $h \geq h_{min}$



Single anchor and group of anchors with $s > 3 \cdot c$	$A_{sp,ef} = (6 \cdot c) \cdot (h_{ef} + 1{,}5 \cdot c)$	[mm²]	with $c \geq c_{min}$
Group of anchors with $s \leq 3 \cdot c$	$A_{sp,ef} = (3 \cdot c + s) \cdot (h_{ef} + 1{,}5 \cdot c)$	[mm²]	with $c \geq c_{min}$ and $s \geq s_{min}$

Table B4.2: Effective splitting area $A_{sp,ef}$ with member thickness $h \leq h_{ef} + 1{,}5 \cdot c$ and $h \geq h_{min}$



Single anchor and group of anchors with $s > 3 \cdot c$	$A_{sp,ef} = 6 \cdot c \cdot$ existing h	[mm²]	with $c \geq c_{min}$
Group of anchors with $s \leq 3 \cdot c$	$A_{sp,ef} = (3 \cdot c + s) \cdot$ existing h	[mm²]	with $c \geq c_{min}$ and $s \geq s_{min}$

Edge distance and axial spacing shall be rounded to at least 5 mm

(Fig. not to scale)

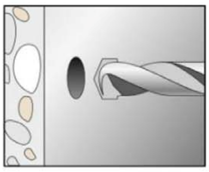
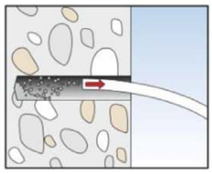
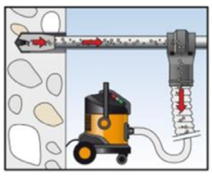
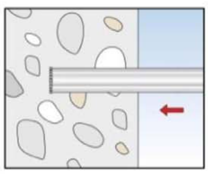
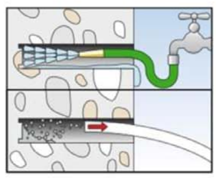
NIEDAX Bolt Anchor DAZ, DAZ E4, DAZ HCR	**Annex B 4**
Intended Use Minimum thickness of member, minimum spacings and edge distances	

Installation instructions:

- 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 Exception: NIEDAX DAZ dome nut.
- 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
- Hammer, hollow or diamond drilling according to Annex B5
- 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
- It must be ensured that in case of fire local spalling of the concrete cover does not occur
- 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

Installation instructions: Drilling and cleaning the hole

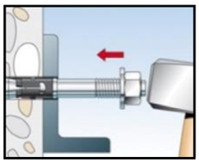
Types of drills and cleaning

Hammer drill		 1: Drill the hole	 2: Clean the hole
Hollow drill		 1: Drill the hole with automatic cleaning	-
Diamond drill, for non seismic applications only and ≥ drill ∅ 8		 1: Drill the hole	 2: Clean the hole

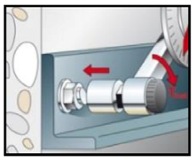
NIEDAX Bolt Anchor DAZ, DAZ E4, DAZ HCR	**Annex B 5**
Intended Use Installation instructions	

Installation instructions: Installation of the anchor

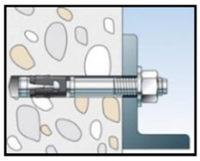
<u>HEXAGON NUT:</u>



3: Set the fastener



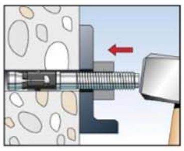
4: Apply T_{inst}



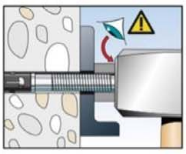
5: Installed fastener

<u>NIEDAX DAZ DOME NUT:</u>

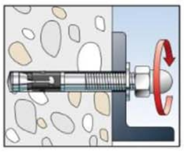
Option 1: Push through installation with setting gauge SL-H:



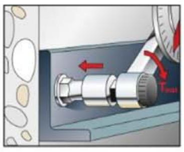
3: Set the fastener using setting gauge



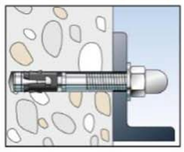
4: Check offset



5: Turn on the washer and NIEDAX DAZ dome nut

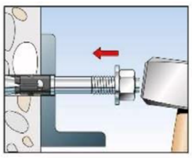


6: Apply T_{inst}

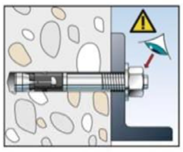


7: Installed fastener

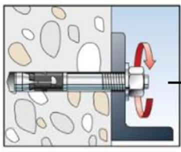
Option 2: Push through installation with hexagon nut:



3: Set the fastener

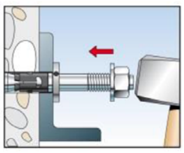
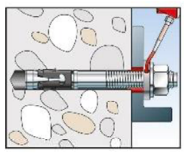


4: check setting position: Visible one turn of a thread



4.1: Remove nut

<u>NIEDAX FILLING DISC FFD optional for seismic C2 application or minimizing the annular gap:</u>

Optional	The gap between bolt and fixture may be filled with mortar (compressive strength ≥ 50 N/mm² e.g. fischer FIS SB) after step 7 (for eliminating the annular gap). The filling disc is additional to the standard washer. The thickness of the filling disc must be considered for definition of t_{fix} Countersunk of the filling disc in direction to the anchor plate.	 

NIEDAX Bolt Anchor DAZ, DAZ E4, DAZ HCR

Intended Use
Installation instructions

Annex B 6

Deutsches Institut für Bautechnik DIBt

Table C1.1: Characteristic **tension** resistance under static and quasi-static action

Size				DAZ, DAZ E4, DAZ HCR							
				M6	**M8**		**M10**	**M12**	**M16**	**M20**	**M24**
Steel failure											
Characteristic resistance	DAZ	$N_{Rk,s}$	[kN]	7,6	16,6		28,3	43,2	67,0	123,3	176,7
	DAZ E4/HCR	$N_{Rk,s}$	[kN]	11,4	17,0		29,0	44,3	70,6	124,9	183,6
Partial factor for steel failure		γ_{Ms} 1)	[-]	1,5							
Pullout failure											
Effective embedment depth for calculation		h_{ef}	[mm]	40	35 - < 45	45	40 - 60	50 - 70	65 - 85	100	125
Characteristic resistance in cracked concrete C20/25		$N_{Rk,p}$	[kN]	1,5	5,5	8	13	20	27,0	34,4	48,1
Characteristic resistance in uncracked concrete C20/25		$N_{Rk,p}$	[kN]	10,5	14		20	22	38,6	49,2	68,8
Increasing factors for $N_{Rk,p}$ for cracked and uncracked concrete		ψ_c	C25/30	1,12							
			C30/37	1,22							
			C35/45	1,32							
			C40/50	1,41							
			C45/55	1,50							
			C50/60	1,58							
Installation factor		γ_{inst}	[-]	1,0							
Concrete cone and splitting failure											
Factor for uncracked concrete		$k_{ucr,N}$	[-]	11,0 2)							
Factor for cracked concrete		$k_{cr,N}$	[-]	7,7 2)							
Characteristic spacing		$s_{cr,N}$	[mm]	$3 \cdot h_{ef}$							
Characteristic edge distance		$c_{cr,N}$	[mm]	$1,5 \cdot h_{ef}$							
Spacing		$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$							
Edge distance for h = 80		$c_{cr,sp}$	[mm]	40	$2,4 \cdot h_{ef}$		$2 \cdot h_{ef}$	inadmissible			
Edge distance for h = 100		$c_{cr,sp}$	[mm]		$2 \cdot h_{ef}$		$2,4 \cdot h_{ef}$	$2 \cdot h_{ef}$	inadmissible		
Edge distance for h = 120		$c_{cr,sp}$	[mm]				$1,9 \cdot h_{ef}$	$2,1 \cdot h_{ef}$	inadmissible		
Edge distance for h = 140		$c_{cr,sp}$	[mm]					$1,5 \cdot h_{ef}$	$2 \cdot h_{ef}$	inadmissible	
Edge distance for h = 160		$c_{cr,sp}$	[mm]							$2,4 \cdot h_{ef}$	inadmissible
Edge distance for h = 200		$c_{cr,sp}$	[mm]								$2,2 \cdot h_{ef}$
Characteristic resistance to splitting		$N^0_{Rk,sp}$	[kN]	min $\{N^0_{Rk,c}; N_{Rk,p}\}$ 3)							

1) In absence of other national regulations
2) Based on concrete strength as cylinder strength
3) $N^0_{Rk,c}$ according to EN 1992-4:2018

NIEDAX Bolt Anchor DAZ, DAZ E4, DAZ HCR	**Annex C 1**
Performances Characteristic values of resistance under tension loads	

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

Size				DAZ, DAZ E4, DAZ HCR						
				M6	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Steel failure without lever arm										
Characteristic resistance	DAZ	$V^0_{Rk,s}$	[kN]	5,9	13,6	21,4	30,6	55,0	81,4	110,1
	DAZ E4/HCR	$V^0_{Rk,s}$	[kN]	8,8	16,8	26,5	38,3	69,8	106,3	148,5
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]	40	45	60	70	85	100	125
Characteristic bending resistance	DAZ	$M^0_{Rk,s}$	[Nm]	11,4	26	52	92	233	513	865
	DAZ E4/HCR	$M^0_{Rk,s}$	[Nm]	10,7	29	59	100	256	519	898
Factor for pryout failure		k_8	[-]	2,6	2,8	3,2		3,0	2,6	2,4
Effective embedment depth for calculation		h_{ef}	[mm]	-2)	35 - < 45	40 - < 60	50 - < 70	65 - < 85	-2)	
Characteristic bending resistance	DAZ	$M^0_{Rk,s}$	[Nm]		20	44	92	184		
	DAZ E4/HCR	$M^0_{Rk,s}$	[Nm]		21	45	100	193		
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}	[mm]	6	8	10	12	16	20	24

1) In absence of other national regulations

2) Performance not declared

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

Size				DAZ, DAZ E4, DAZ HCR						
				M6	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
	$h_{ef} \geq$		[mm]	40	35 / 45	40 / 60	50 / 70	65 / 85	100	125
Characteristic resistance **steel failure**	$N_{Rk,s,fi}$	R30	[kN]	0,6[1)] / 0,9[2)]	1,4	2,8	5,0	9,4	14,7	21,1
		R60		0,4[1)] / 0,9[2)]	1,2	2,3	4,1	7,7	12,0	17,3
		R90		0,3[1)] / 0,9[2)]	0,9	1,9	3,2	6,0	9,4	13,5
		R120		0,2[1)] / 0,7[2)]	0,8	1,6	2,8	5,2	8,1	11,6
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		0,4	0,9 / 2,0	2,2 / 3,3	3,0 / 5,0	4,5 / 6,8	8,6	12,0
		R60			0,8 / 2,0					
		R90			0,5 / 2,0					
		R120		0,3	0,3 / 1,6	1,7 / 2,6	2,4 / 4,0	3,6 / 5,4	6,9	9,6

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

Size **DAZ, DAZ E4, DAZ HCR**			**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]
M6	$h_{ef} \geq$	40	0,6[1)] / 0,9[2)]	0,5[1)] / 0,2[2)]	0,4[1)] / 0,9[2)]	0,3[1)] / 0,1[2)]
M8		35	1,8	1,4	1,6	1,2
M10		40	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
M20		100	18,2	39,0	14,2	31,8
M24		125	26,3	67,3	20,5	55,0

Size **DAZ, DAZ E4, DAZ HCR**			**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]
M6	$h_{ef} \geq$	40	0,3[1)] / 0,9[2)]	0,2[1)] / 0,1[2)]	0,2[1)] / 0,7[2)]	0,2[1)] / 0,1[2)]
M8		35	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
M20		100	10,3	24,6	8,3	21,4
M24		125	14,8	42,6	11,9	37,0

Concrete pryout failure according to EN 1992-4:2018

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

Size			DAZ, DAZ E4, DAZ HCR						
			M6	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Spacing	s_{min}	[mm]	Annex B3						
Edge distance	c_{min}		$c_{min} = 2 \cdot h_{ef}$, for fire exposure from more than one side $c_{min} \geq 300$ mm						

1) DAZ
2) DAZ E4 / HCR

NIEDAX Bolt Anchor DAZ, DAZ E4, DAZ HCR

Performances
Characteristic values of resistance under fire exposure

Annex C 3

Table C4.1: Characteristic values of **tension and shear** resistance under **seismic action category C1**

Size			M6	M8	M10	M12	M16	M20	M24
			DAZ, DAZ E4, DAZ HCR						
Length of anchor	L_{max}	[mm]	-[2]	167	186	221	285	394	477
Effective embedment depth	h_{ef}	[mm]		45	40 - 60	50 - 70	65 - 85	100	125
With filling of the annular gap	α_{gap}	[-]	1,0						
Steel failure									
Characteristic resistance tension load C1	$N_{Rk,s,eq,C1}$	[kN]	-[2]	16,0	27,0	41,0	66,0	111,0	150,0
Partial factor for steel failure	$\gamma_{Ms,eq,C1}$[1]	[-]		1,5					
Pullout failure									
Characteristic resistance tension load in cracked concrete C1	$N_{Rk,p,eq,C1}$	[kN]	-[2]	4,6	8,0	16,0	28,2	36,0	50,3
Installation factor	γ_{inst}	[-]		1,0					
Steel failure without lever arm									
Characteristic resistance shear load C1	$V_{Rk,s,eq,C1}$	[kN]	-[2]	11	17	27	47	56	69
Partial factor for steel failure	$\gamma_{Ms,eq,C1}$[1]	[-]		1,25					

[1] In absence of other national regulations
[2] Performance not declared

Table C4.2: Characteristic values of **tension and shear** resistance under **seismic action category C2**

Size			M6	M8	M10	M12	M16	M20	M24
			DAZ, DAZ E4, DAZ HCR[1]						
Length of anchor	L_{max}	[mm]	-[3]		186	221	285	394	-[3]
With filling of the annular gap	α_{gap}	[-]	1,0						
Steel failure									
Characteristic resistance tension load C2	$N_{Rk,s,eq,C2}$	[kN]	-[3]		27	41	66	111	-[3]
Partial factor for steel failure	$\gamma_{Ms,eq,C2}$[2]	[-]			1,5				
Pullout failure									
Characteristic resistance tension load in cracked concrete C2	h_{ef}	[mm]	-[3]		60	70	85	100	-[3]
	$N_{Rk,p,eq,C2}$	[kN]			5,1	7,4	21,5	30,7	
	h_{ef}	[mm]			40-59	50-69	65-84	-[3]	
	$N_{Rk,p,eq,C2}$	[kN]			2,7	4,4	16,4		
Installation factor	γ_{inst}	[-]	1,0						
Steel failure without lever arm									
Characteristic resistance shear load C2	h_{ef}	[mm]	-[3]		60	70	85	100	-[3]
	$V_{Rk,s,eq,C2}$	[kN]			10,0	17,4	27,5	39,9	
	h_{ef}	[mm]			40-59	50-69	65-84	-[3]	
	$V_{Rk,s,eq,C2}$	[kN]			7,0	12,7	22,0		
Partial factor for steel failure	$\gamma_{Ms,eq,C2}$[2]	[-]	1,25						

[1] DAZ HCR: Only valid for cold-formed version (according to Annex A1)
[2] In absence of other national regulations
[3] Performance not declared

NIEDAX Bolt Anchor DAZ, DAZ E4, DAZ HCR

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

Annex C 4

Table C5.1: Displacements under static and quasi static **tension** loads

Size			DAZ, DAZ E4, DAZ HCR						
			M6	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Displacement – factor for tensile load[1]									
δ_{N0} - factor	in cracked concrete	[mm/kN]	0,13	0,22	0,12	0,09	0,08	0,07	0,05
$\delta_{N\infty}$ - factor	in cracked concrete	[mm/kN]	1,00	0,78	0,40	0,19	0,09		0,07
δ_{N0} - factor	in uncracked concrete	[mm/kN]	0,16	0,07	0,05	0,06		0,05	0,04
$\delta_{N\infty}$ - factor	in uncracked concrete	[mm/kN]	0,24	0,29	0,21	0,14	0,10	0,06	0,05

Table C5.2: Displacements under static and quasi static **shear** loads

Size			DAZ						
			M6	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Displacement – factor for shear load[2]									
δ_{V0} – factor	in cracked and uncracked concrete	[mm/kN]	0,6	0,35	0,37	0,27	0,10	0,09	0,07
$\delta_{V\infty}$ - factor	in cracked and uncracked concrete	[mm/kN]	0,9	0,52	0,55	0,40	0,14	0,15	0,11
			DAZ E4, DAZ HCR						
δ_{V0} - factor	in cracked and uncracked concrete	[mm/kN]	0,6	0,23	0,19	0,18	0,10	0,11	0,07
$\delta_{V\infty}$ - factor	in cracked and uncracked concrete	[mm/kN]	0,9	0,27	0,22	0,16	0,11	0,05	0,09

[1] Calculation of effective displacement:
$\delta_{N0} = \delta_{N0-\text{factor}} \cdot N_{ED}$
$\delta_{N\infty} = \delta_{N\infty-\text{factor}} \cdot N_{ED}$
(N_{ED}: Design value of the applied tension force)

[2] Calculation of effective displacement:
$\delta_{V0} = \delta_{V0-\text{factor}} \cdot V_{ED}$
$\delta_{V\infty} = \delta_{V\infty-\text{factor}} \cdot V_{ED}$
(V_{ED}: Design value of the applied shear force)

Table C5.3: Displacements under **tension** loads for **category C2** for all embedment depths

Size			DAZ, DAZ E4, DAZ HCR						
			M6	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Displacement DLS	$\delta_{N,eq,C2(DLS)}$	[mm]	-[1]		2,7	4,4		5,6	-[1]
Displacement ULS	$\delta_{N,eq,C2\,(ULS)}$	[mm]			11,5	13,0	12,3	14,4	

[1] Performance not declared

Table C5.4: Displacements under **shear** loads for **category C2** for all embedment depths

Size			DAZ, DAZ E4, DAZ HCR						
			M6	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Displacement DLS	$\delta_{V,eq,C2\,(DLS)}$	[mm]	-[1]		4,1	4,7	5,5	4,8	-[1]
Displacement ULS	$\delta_{V,eq,C2\,(ULS)}$	[mm]			6,2	7,8	10,1	11,2	

[1] Performance not declared

NIEDAX Bolt Anchor DAZ, DAZ E4, DAZ HCR

Performances
Displacements under tension and shear loads

Annex C 5