MFPA Leipzig GmbH

Testing, Inspection and Certification Authority for
Construction Products and Construction Types

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Advisory Opinion No. GS 3.2/19-003-1

14 January 2019
No. Copy 1

Subject matter:	Upat High-performance-Bonded-Anchor UHB-I Fire protection assessment of the characteristic steel stresses under tension stress based on the Technical Report TR 020 "Evaluation of anchorages in concrete concerning Resistance to Fire" (May 2004).
Client:	Upat Vertriebs GmbH Bebeltraße 11 79108 Freiburg im Breisgau Germany
Date of order:	4 January 2019
Person in charge:	Dipl.-Ing. S. Bauer
Validity:	The validity of the Advisory Opinion is unlimited and ends as soon as technical regulations change or the reference documents become invalid.

This Advisory Opinion consists of 4 text pages and 2 enclosures.

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1 Objective and request

On 4 January 2019, MFPA Leipzig GmbH was commissioned by Upat Vertriebs GmbH to assess the Upat High-performance-Bonded-Anchor UHB-I under one-sided fire exposure and anchored in a reinforced concrete base to determine the characteristic parameters for a load under tension stress.

2 Description of the tested structure

The Upat High-performance-Bonded-Anchor UHB-I is a torque controlled bonded anchor consisting of a mortar cartridge with mortar UPM 66 and an anchor rod UHB – I – A L or UHB - I – A S with hexagon nut and washer in accordance with ETA-05/0164 [1]. The anchor rod is placed into a drilled hole filled with injection mortar. The load transfer is realised by mechanical interlock of several cones in the bonding mortar and then via a combination of bonding and friction forces in the anchorage ground (concrete). The fastener is only intended for anchoring under mainly static and quasi-static load in reinforced and non-reinforced standard concrete with a strength class between C20/25 and C50/60 in accordance with DIN EN 206-1: 2001-07 [2]. The fastener may be used in cracked and uncracked concrete. A detailed description of the product is not given here. Please refer to ETA-05/0164 [1].

The test of the Upat High-performance-Bonded-Anchor UHB-I was performed using sizes M8, M10 and M16 of the galvanized version with minimum tensile strength class 8.8. The test set-up and the results of this series of tests are included in test report PB III/B-06-065 [3].

3 Test analysis and evaluation

The test analysis for steel failure was performed based on TR 020: 2004-05 [4]. As an exception, all results were included in the analysis, independent of the type of failure.

The determination of the characteristic parameters for other failure types (e.g. "pulling out", or "concrete break-out") was not the subject of the tests; these parameters can be determined according to the simplified design method described in TR 020: 2004-05 [4] or experimentally according to the method described in TR 020: 2004-05 [4].

To determine the characteristic tensile stresses, the values for UHB–I–A L M8 and M12 as well as UHB–I–A S M10 and M12 were analysed based on the test results. The results for UHB–I–A L M10 were calculated by the interpolation of the values for sizes UHB–I–A L M8 and M12 based on the steel cross section. For the bonded fasteners > M12, the cross-sectional stress of size M12 was transferred to determine the results for steel failure. To determine the bond failure values, the average bond strength of the smallest relevant tested fastener was transferred. In each case, the lower failure resistance is decisive and is indicated in the tables below.

This means that the following characteristic parameters for load under centric tension can be specified for the Upat High-performance-Bonded-Anchor UHB-I (table 1 for AL and table 3 for AS). The results for load under shear stress are indicated in table 2 for AL and in table 4 for AS.

Table 1 Characteristic resistance for the Upat High-performance-Bonded-Anchor UHB-I – version AL (galvanized, strength class ≥ 8.8) under tension load

UHB–I–A L			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Anchorage depth	h_{ef}	[mm]	60	95	100 120	125 145 160	210	210
30 min	$N_{Rk,s,fi(30)}$	[kN]	2.3	3.6	5.1	9.5	14.9	21.5
60 min	$N_{Rk,s,fi(60)}$	[kN]	1.8	2.7	3.8	7.0	11.0	15.8
90 min	$N_{Rk,s,fi(90)}$	[kN]	1.2	1.8	2.4	4.5	7.1	10.2
120 min	$N_{Rk,s,fi(120)}$	[kN]	0.9	1.4	1.7	3.3	5.2	7.4

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Table 2 *Characteristic resistance for the Upat High-performance-Bonded-Anchor UHB-I – version AL (galvanized, strength class ≥ 8.8) under shear load*

UHB–I–A L			M8	M10	M12	M16	M20	M24
Anchorage depth	h_{ef}	[mm]	60	95	100 120	125 145 160	210	210
30 min	$V_{Rk,s,fi(30)}$	[kN]	2.8	4.3	6.1	11.4	17.8	25.7
60 min	$V_{Rk,s,fi(60)}$	[kN]	2.1	3.3	4.9	9.1	14.2	20.4
90 min	$V_{Rk,s,fi(90)}$	[kN]	1.4	2.4	3.6	6.8	10.6	15.5
120 min	$V_{Rk,s,fi(120)}$	[kN]	1.0	1.9	3.0	5.6	8.8	12.7

Table 3 *Characteristic resistance for the Upat High-performance-Bonded-Anchor UHB-I – version AS (galvanized, strength class ≥ 8.8) under tension load*

UHB–I–A S			M10	M12	M16	M20	M24
Anchorage depth	h_{ef}	[mm]	60 75	75	95	170	170
30 min	$N_{Rk,s,fi(30)}$	[kN]	3.4	4.4	8.3	12.9	18.7
60 min	$N_{Rk,s,fi(60)}$	[kN]	2.4	3.5	6.1	10.2	14.8
90 min	$N_{Rk,s,fi(90)}$	[kN]	1.4	2.6	4.4	7.5	10.9
120 min	$N_{Rk,s,fi(120)}$	[kN]	0.9	2.1	3.6	6.1	8.9

Table 4 *Characteristic resistance for the Upat High-performance-Bonded-Anchor UHB-I – version AS (galvanized, strength class ≥ 8.8) under shear load*

UHB–I–A S			M10	M12	M16	M20	M24
Anchorage depth	h_{ef}	[mm]	60 75	75	95	170	170
30 min	$V_{Rk,s,fi(30)}$	[kN]	4.1	4.9	9.2	14.4	20.8
60 min	$V_{Rk,s,fi(60)}$	[kN]	2.9	4.0	7.5	11.7	17.0
90 min	$V_{Rk,s,fi(90)}$	[kN]	1.8	3.1	5.9	9.3	13.3
120 min	$V_{Rk,s,fi(120)}$	[kN]	1.2	2.7	5.0	7.8	11.4

The values were determined for use in uncracked reinforced concrete. The characteristic resistances against pulling out were determined using the simplified verification procedure according to TR 020: 2004-05 [4], section 2.2.1.2. This means that even if the determined bond strengths are reduced to 70%, steel failure is still decisive. For this reason, the results can be transferred to use in cracked reinforced concrete.

4 Special notes

The evaluation above only applies to Upat High-performance-Bonded-Anchor UHB-I which are installed in compliance with the installation instructions of Upat Vertriebs GmbH.

For the dimensioning of the Upat High-performance-Bonded-Anchor UHB-I, the characteristic steel stresses at normal temperature must also be taken into account; the lower load bearing capacity is decisive.

The assessment only applies with the Upat injection mortar UPM 66.

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Furthermore, the assessment only applies to bonded anchors made of galvanized steel with a minimum strength class of ≥ 8.8, stainless steel A4 or highly corrosion-resistant steel 1.4529 in uncracked and cracked reinforced concrete.

The assessment applies in general to a one-sided fire exposure of the structural elements. In the event of a fire load on several sides, the verification procedure can only be applied if the edge distance of the anchor is $c \geq 300$ mm and $\geq 2\ h_{ef}$.

The assessment only applies in combination with reinforced concrete ceilings of strength class ≥ C 20/25 and ≤ C 50/60 acc. to EN 206-1: 2000-12 [2], which have at least the fire-resistance rating which corresponds to the fire-resistance period of the anchors. In addition, the notes contained in DIN EN 1992-1 [5] (see section 4.5) on the avoidance of concrete spallation also apply. This means that the moisture content must be less than three % by weight (or four according to the National Annex).

This document does not replace a certificate of conformity or suitability according to national and European building codes.

Leipzig, 14 January 2019

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Dipl.-Ing. S. Hauswaldt	Dipl.-Ing. M. Juknat	Dipl.-Ing. S. Bauer
Head of Business Division	*Head of Work Group*	*Testing Engineer*

List of enclosures

Enclosure 1	Installation parameters of Upat High-performance-Bonded-Anchor UHB-I-A L
Enclosure 2	Installation parameters of Upat High-performance-Bonded-Anchor UHB-I-A S

Related documents

[1] European Technical Assessment ETA-18/0864 *trade name: Upat High-performance-Bonded-Anchor UHB-I; product family: Torque controlled bonded anchor for use in concrete*, DIBt: 12 December 2018, Upat Vertriebs GmbH

[2] DIN EN 206-1: 2001-07 *Concrete - Specification, performance, production and conformity*

[3] Test report PB III/B-06-065 *Testing in accordance with the Technical Report TR 020 for determining the fire resistance duration as a function of the centric tensile load or the shear load*, MFPA Leipzig GmbH: 18 April 2006

[4] TR 020: 2004-05 *Evaluation of Anchorages in Concrete concerning Resistance to Fire*

[5] DIN EN 1992-1-2: 2010-12 *Design of concrete structures - Part 1-2: General rules - Structural fire design*

Enclosure 1 Installation parameters of Upat High-performance-Bonded-Anchor UHB-I-A L

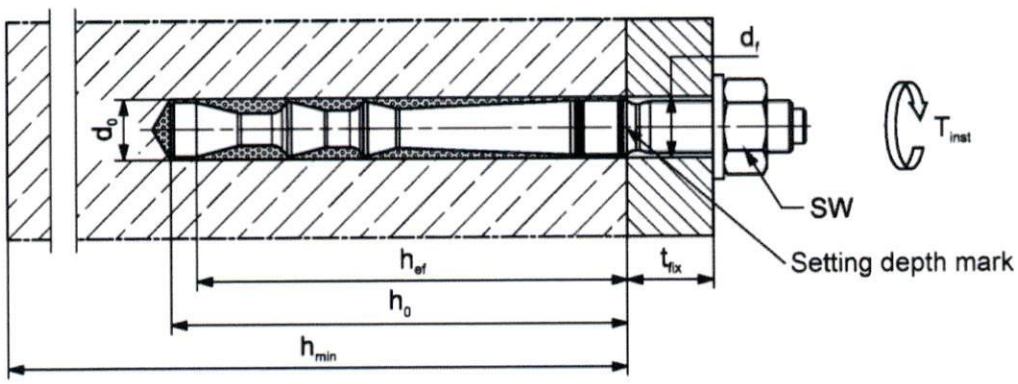

Figure A1.1 Illustration of Upat High-performance-Bonded-Anchor UHB-I-A L in installed condition

Table A1.1 Installation parameters of Upat High-performance-Bonded-Anchor UHB-I-A L

Anchor rod UHB - I - A L	**Thread**		**M8x**	**M10x**	**M12x**		**M16x**			**M20x**	**M24x**
			60	**95**	**100**	**120**	**125**	**145**	**160**	**210**	**210**
Cone diameter	d_k		9,4	10,7	12,5		16,8			23,0	
Width across flats	SW		13	17	19		24			30	36
Nominal drill hole diameter	d_0		10	12	14		18			25	
Drill hole depth	h_0		66	101	106	126	131	151	166	216	
Effective anchorage depth	h_{ef}		60	95	100	120	125	145	160	210	
Minimum spacing and minimum edge distance	$s_{min} = c_{min}$	[mm]	40		50		55	60	70	90	
Diameter of clearance hole in the fixture — pre-positioned anchorage	$d_f \leq$		9	12	14		18			22	26
Diameter of clearance hole in the fixture — push through anchorage	$d_f \leq$		11	14	16		20			26	
Min. thickness of concrete member	h_{min}		100	140		170		190	220	280	
Installation torque	T_{inst}	[Nm]	15	20	40		60			100	
Thickness of fixure	$t_{fix} \leq$	[mm]	1500								
Filling disk [1]	$\geq d_a$	[mm]	-	26	30		38			46	54
	t_s		-	6	6		7			8	10

[1] Using filling disk reduces t_{fix} (usable length of the anchor)

Enclosure 2 Installation parameters of Upat High-performance-Bonded-Anchor UHB-I-A S

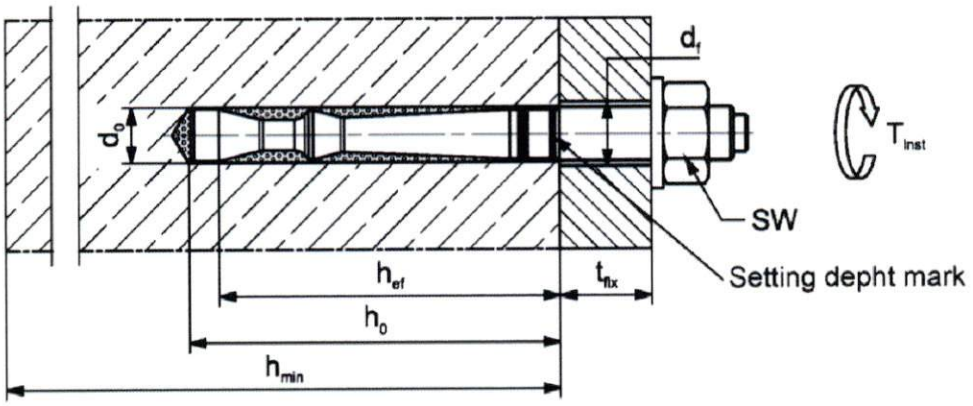

Figure A4.2 Illustration of Upat High-performance-Bonded-Anchor UHB-I-A S in installed condition

Table A4.2 Installation parameters Upat High-performance-Bonded-Anchor UHB-I-A S

Anchor rod UHB - I - A S		**Thread**		**M10x**		**M12x**	**M16x**	**M20x**	**M24x**
				60	**75**	**75**	**95**	**170**	**170**
Cone diameter	d_k			9,4		11,3	14,5	23,0	
Width across flats	SW			17		19	24	30	36
Nominal drill hole diameter	d_0			10		12	16	25	
Drill hole depth	h_0			66	81	81	101	176	
Effective anchorage depth	h_{ef}			60	75	75	95	170	
Minimum spacing and minimum edge distance	$s_{min} = c_{min}$		[mm]	40			50	80	
Diameter of clearance hole in the fixture	pre-positioned anchorage	$d_f \leq$		12		14	18	22	26
	push through anchorage	$d_f \leq$		12		14	18	26	
Min. thickness of concrete member		h_{min}		100	120		150	240	
Installation torque		T_{inst}	[Nm]	15		30	50	100	
Thickness of fixure		$t_{fix} \leq$		1500					
filling disk [1]		$\geq d_a$	[mm]	26		30	38	46	54
		t_s		6		6	7	8	10

[1] Using filling disk reduces t_{fix} (usable length of the anchor)