

This translation of the original German version of
Type Test S-WUE/170430
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Landesgewerbeanstalt Bayern. LGA

Prüfamt für Standsicherheit der Zweigstelle Würzburg
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Date

14th December 2017

Ref no.:

Fk / sd

Type Test Test report no.1

Type test number:	S-WUE/170430
Object:	Type test HALFEN HK5-W Brickwork support bracket according to Eurocode including alternative design of the compression strut with adjustment screw
Type test applicant:	HALFEN GmbH Liebigstraße 14, 40764 Langenfeld, Germany
Static documents prepared by:	HALFEN GmbH Liebigstraße 14, 40764 Langenfeld, Germany
Valid until:	31st December 2022

The HK5-W Brickwork support brackets were type tested with regard to structural stability on the basis of the documents listed under item 1.

1.1 Test documents

1.1 Evaluated documents:

1.1.1 Static calculation:

HALFEN Brickwork support bracket, type HK5-W 34 pages (pages 1 to 34)

Additional verification for the bracket
with adjustment screw: 17 pages (pages 35 to 51)

1.1.2 Design drawings: 7 drawing (annex 1 to 7)

1.2 Further documents:

1.2.1 General building authority approval issued by the German Centre of Competence for Construction (Allgemeine bauaufsichtliche Zulassung des Deutschen Instituts für Bautechnik, Berlin), for "Products, Stainless steel components and fixings", Approval number Z-30.3-6 from 12th May 2017; Applicant: Stainless Steel Information centre, Sohnstraße 65, 40237 Düsseldorf, Germany.

1.2.2 General building authority approval issued by the German Centre of Competence for Construction (Allgemeine bauaufsichtliche Zulassung des Deutschen Instituts für Bautechnik, Berlin), for "Fixings; steel type 'Duplex' Steel type 1.4062, 1.4162, 1.4362 and 1.4482", Approval number Z-30.3-23; from 6th October 2015; Applicant: HALFEN GmbH, Liebigstraße 14, 40764 Langenfeld.

1.3 Basic documents:

Technical building regulations used as technical guidelines, in particular:

DIN EN 1990: 2010:12	Basics of structural design
DIN EN 1992-1-1:2011-01	Reinforced concrete and prestressed concrete structures (Eurocode 2)
DIN EN 1992-1-1/A1: 2015-03	Amendment A1 to EC 2
DIN EN 1992-1-1/NA: 2013-04	National application document to EC 2
DIN EN 1992-1-1/NA Rep. 1:2012-06	with amendment
DIN EN 1992-1-1/NA/A1	Amendment A1 to the application document
DIN EN 1993-1-1: 2010-12	Design and construction of steel structures
DIN EN 1993-1-1/A1: 2014-07	Amendment A1 to EC3
DIN EN 1993-1-1/NA: 2015-08	National application document to EC3
DIN EN 1993-1-1/NA/A1: 2017-03	Amendment A1 to the application document
DIN EN 1993-1-4: 2015-10	Additional regulations for the use of stainless steels

1.3 Basic documents:

DIN EN 1993-1-4/NA: 2017-01	Applicable national annex
DIN EN 1993-1-8: 2010-12	Design of connections in steel structures
DIN EN 1993-1-8/NA: 2010-12	Applicable national annex
DIN EN 1996-1-1: 2013-02	Masonry constructed buildings

2 Component description:

The HALFEN HK5-W Brickwork support bracket consists of a bracket head, a web plate, a support plate and a pressure plate. The brackets support the dead weight of 11.5 cm thick facing brickwork renders via the support plate and transfer the load to a reinforced concrete substructure. They are designed for loads categories of 4.0 kN and 8.0 kN. Due to the horizontal tolerance of up to 15 mm variations in the ventilation gap are also accounted for. For an 11.5 cm thick render the K4 bracket head has a vertical installation tolerance of 35 mm and the K5, K5C or the K5D bracket heads have 20 mm.

Alternatively, the relevant static analyses for the brickwork support bracket are done using an adjustable screw.

3 Actions

3.1 Permanent loads according to DIN EN 1991-1-1:2010-12 with DIN EN 1991-1-1/NA:2010-12

3.2 Special loads:

Single (point) loads: 4.0 kN and 8.0 kN

These assumptions are considered to be applicable.

4 Construction material

4.1 Concrete compression strength at least C 20/25 (Support structure)

4.2 Structural steel

Lean Duplex steel; material number 1.4062, 1.4162, 1.4362 or 1.4482,
S 355 Stainless steel

4.2 Bolts; strength class 70

5 Test results:

- 5.1** The documents listed under item 1.1 were checked for structural stability, but not for other building regulation requirements or other official requirements. They comply with currently valid technical building regulations.
- 5.2** The HALFEN Brickwork support bracket type K310 were additionally designed as a complete system for load category 1.35*4.0 kN /1.35*8.0 kN by independent comparative calculations as non-linear systems, taking into account the II. order theory with a pre-deformation of the compression strut of 1/200 using the Infocad program. It could be confirmed that the load capacity of this system was not exceeded.
- 5.3** The adjustment screw must be inserted into the sleeve to at least half the length of the weld seam.

6 Special notes

- 6.1** Other information included in the building authority approvals for "Products, Stainless steel components and fixings" and for "Fixings; duplex steels 1.4062, 1.4162, 1.4362 or 1.4482" in particular with regard to welding and corrosion protection must be observed.
- 6.2** Load application into the load-bearing structure using anchor bolts or anchor channels is not included in this calculation. See the relevant building authority approvals for applicable loads. The design of wall claddings and the connection of cladding to the support structure must be carried out using brick tie anchors according to DIN EN 1996.

7 Cases specific documents required for individual building applications

- 7.1** The available test report no.1, S-WUE/170430, and the design plans for the corresponding type in accordance with item 1.1
- 7.2** General construction plans

8 General provisions

- 8.1** The static type test does not release the client from the obligation to obtain a building permit for each building project, unless the applicable building regulations or other legal provisions specifically exempts him from this.
- 8.2** The type test may save the building supervisory authority the task of replicating the static verification in the calculation documents, but not from the obligation to check the conformity of the construction procedure with the conditions and results of the examined documents.

- 8.3** The verified documents may only be used or published in the original version approved by the Structural Safety Body. In cases of doubt, the audited documents held by the Structural Safety Body are authoritative.
- 8.4** On request the period of validity of this type test can be extended by 5 years.
- 8.5** The applicant of the type test must notify the testing authority should significant changes occur before expiry of the type test, in particular:
- with regard to structural statics
 - with regard to application method
 - with regard to the technical specifications on which this static type test is based;
building regulations, approvals or developments in engineering.

Der Bearbeiter:(Responsible engineer)

Der Leiter: (Head of Division)

Dipl.-Ing. Wolfgang Frick

Dipl.-Ing. Dieter Katz
Lld. Baudirektor (Senior Building Manager)

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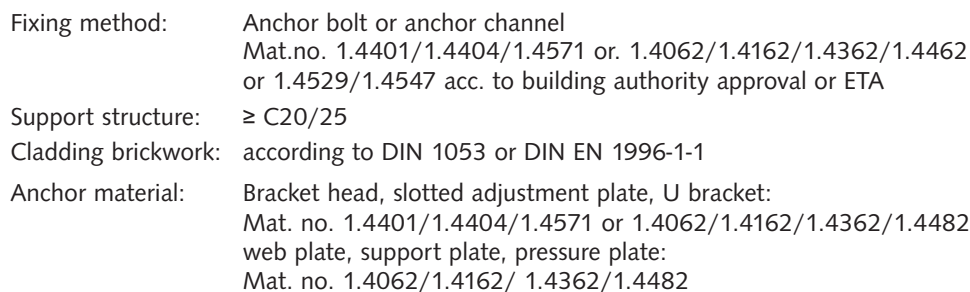


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Type Test S-WUE/170430

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- For low loads ($Q_{z,vorh} < Q_d$) the diagonal tensile forces can be calculated in relation $R_{z,vorh} = \frac{R_{zd} \cdot Q_{vorh}}{Q_d}$
- The following torques must be applied when installing the fixing bolts:
M10 $\geq$ 15 Nm, M12 $\geq$ 25 Nm , M16 $\geq$ 60 Nm
- The design loads for the fixings materials used can be found in the relevant building authority approvals. If the tightening torques in the approvals are other than those specified under item 2, then these must be applied.
- Bracket spacing is generally 25 cm, unless additional support angles are installed, then spacing distances are greater.
- The bracket head including the slotted adjustment plate and the horizontal welding seam bracket head / web plate in section 1-1 or the connection bracket head / web plate using resistance projection welding are not part of this type test, these are regulated in a separate building authority approval.



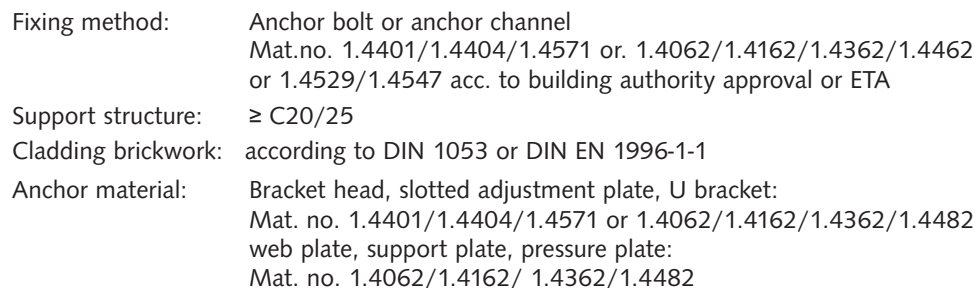
* max. acting force at the connection for the fixing

**) The minimum edge distances of the pressure plates c1 and c2 were determined for a concrete strength of C20/25.

1. For low loads ($Q_{z, \text{vorh}} < Q_d$) the diagonal tensile forces can be

calculated in relation $R_{z,vorh} = \frac{R_{zd} \cdot Q_{vorh}}{Q_d}$

2. The following torques must be applied when installing the fixing bolts: M10 $\triangleright$ 15 Nm, M12 $\triangleright$ 25 Nm, M16 $\triangleright$ 60 Nm
3. The design loads for the fixings materials used can be found in the relevant building authority approvals. If the tightening torques in the approvals are other than those specified under item 2, then these must be applied.
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5. The bracket head including the slotted adjustment plate and the horizontal welding seam bracket head / web plate in section 1-1 or the connection bracket head / web plate using resistance projection welding are not part of this type test, these are regulated in a separate building authority approval.



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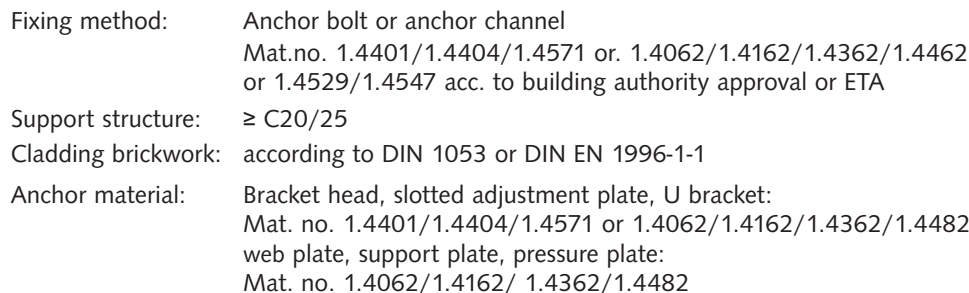
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Load		Ventilation gap	Cantilever										*
Q [kN]	Q _d [kN]	h [mm]	K [mm]	Delta i [mm]	e [mm]	f [mm]	g [mm]	i [mm]	k [mm]	l [mm]	m [mm]	n [mm]	max R _d [kN]
4.0	5.4	<= 80 ⁻¹⁵	170	19.5	150	198.5	10	105	55	45	90	3	8.73
8.0	10.8			15.5	200	250.5	10	151	75	49	120	5	14.51
4.0	5.4	<= 90 ⁻¹⁵	180	19.5	150	198.5	10	105	55	45	90	3	9.09
8.0	10.8			15.5	200	250.5	10	151	75	49	120	4	14.94
4.0	5.4	<= 100 ⁻¹⁵	190	19.5	150	198.5	10	105	55	45	90	3	9.46
8.0	10.8			15.5	200	250.5	10	151	75	49	120	3	15.35
4.0	5.4	<= 110 ⁻¹⁵	200	19.5	150	198.5	10	105	55	45	90	3	9.83
8.0	10.8			15.5	200	250.5	10	151	75	49	120	3	15.85
4.0	5.4	<= 120 ⁻¹⁵	210	19.5	150	198.5	10	105	55	45	90	3	10.21
8.0	10.8			15.5	200	250.5	10	151	75	49	120	3	16.32
4.0	5.4	120 ⁻¹⁵ <h<= 160 ⁻¹⁵	210<K<= 250	19.5	175	223.5	10	130	55	45	90	4	10.20
8.0	10.8			15.5	250	300.5	10	201	75	49	120	4	15.71
4.0	5.4	180 ⁻¹⁵	270	19.5	180	228.5	10	135	55	45	90	4	10.57
8.0	10.8			15.5	270	320.5	10	221	75	49	120	4	15.68
4.0	5.4	200 ⁻¹⁵	290	19.5	200	248.5	10	155	55	45	90	4	10.20
8.0	10.8			15.5	290	340.5	10	241	75	49	120	4	15.65
4.0	5.4	220 ⁻¹⁵	310	19.5	220	268.5	10	175	55	45	90	4	9.91
8.0	10.8			15.5	310	360.5	10	261	75	49	120	4	15.62
4.0	5.4	240 ⁻¹⁵	330	19.5	240	288.5	10	195	55	45	90	5	9.68
8.0	10.8			15.5	330	380.5	10	281	75	49	120	5	15.60
4.0	5.4	260 ⁻¹⁵	350	19.5	260	308.5	10	215	55	45	90	5	9.49
8.0	10.8			15.5	350	400.5	10	301	75	49	120	5	15.58

Load		a	b	c	d	r	s	M	min c1 (**)	min c2 (**)	
Q	Q _d		(1.4401/(1.4404/ 1.4571))	(1.4362/1.4482/ 1.4062/1.4162)							
[kN]	[kN]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	
4.0	5.4	43	3	3	12.5	113	22	13	M10/ M12	20	1
8.0	10.8	46	5	3	16.5	115	25	17	M12/ M16	20	14

1. For low loads ($Q_{z,vorh} < Q_d$) the diagonal tensile forces can be calculated in relation $R_{z,vorh} = \frac{R_{zd} \cdot Q_{vorh}}{Q_d}$
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* max. acting force at the connection for the fixing

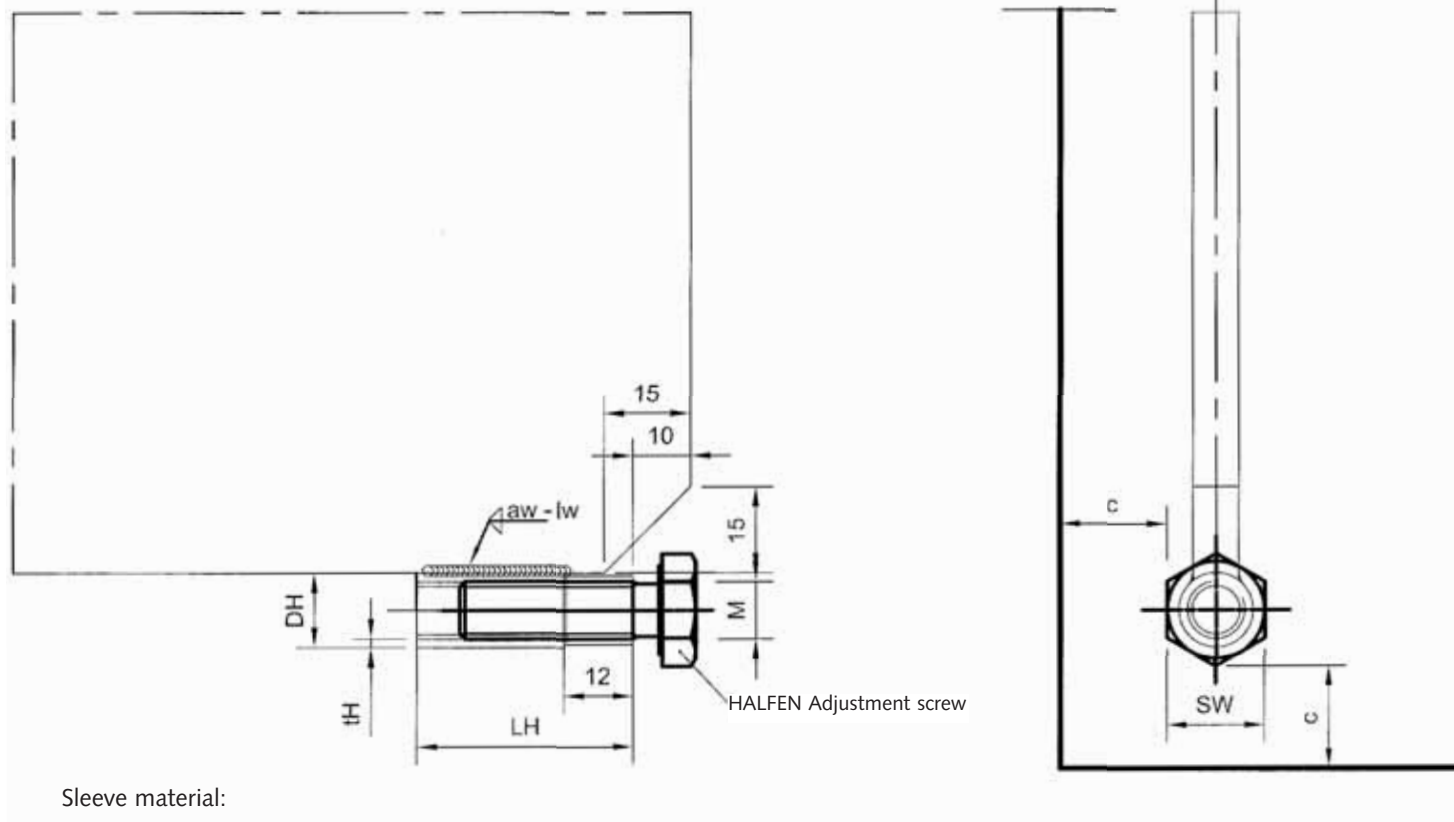
***) The minimum edge distances of the pressure plates c1 and c2 were determined for a concrete strength of C20/25.

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Alternative with adjustable bolt

Load		D _H [mm]	L _H [mm]	t _H [mm]	a _H [mm]	l _H [mm]	M _H [mm]	min sw [mm]	Bracket head K4	Bracket head K5	Bracket head K5C	Bracket head K5D
Q	Q _d								min c*)	min c*)	min c*)	min c*)
[kN]	[kN]								[mm]	[mm]	[mm]	[mm]
4.0	5.4	16	38	2.0	2.0	26	10	17.5	18	15	18	15
8.0	10.8	18	50	2.0	2.0	38	12	20.5	20	18	20	18

*) The minimum edge distance c was determined for a concrete strength of C20/25.



Sleeve material:

- 1) 1.4401 / 1.4404 / 1.4571 (S 355)
- 2) 1.4362 / 1.4482 / 1.4062 / 1.4162

Support structure ≥ C20/25

HALFEN Adjustment screw: Stainless steel, strength class A4-70