

This translation of the original German version of the
Type Test S-WUE/150438
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Landesgewerbeanstalt Bayern. LGA

Prüfamt für Standsicherheit der Zweigstelle Würzburg
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Date

11th February 2016

Ref no.:

Frick / gr

Type Test Test report no.1

Type test number:	S-WUE/150438
Object:	Type test HALFEN HK5-U and HK5-S Brickwork support bracket
Type test applicant:	HALFEN GmbH Liebigstraße 14, 40764 Langenfeld, Germany
Static documents prepared by:	HALFEN GmbH Liebigstraße 14, 40764 Langenfeld, Germany
Valid until:	31 st January 2021

The HK5-U and HK5-S 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-U 64 pages (pages 1 to 64)

Additional verification for the optional slotted support plate: 17 pages (pages 1 to 17)

1.1.2 Design drawings: 6 drawing (annex 1 to 6)

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 22nd April 2014; Applicant: Stainless Steel Information centre (*Informationsstelle Edelstahl Rostfrei*), 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.

1.2.3 General building authority approval issued by the German Centre of Competence for Construction (Allgemeine bauaufsichtliche Zulassung des Deutschen Instituts für Bautechnik, Berlin), for "HALFEN HTA-ES und HTR-ES anchor channel for precast lintels", Approval number Z-21.4-1989 from 25th October 2013; 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

Basis of structural design

DIN EN 1992-1-1:2011-01

Design of concrete structures
(Eurocode 2)

DIN EN 1992-1-1/NA:2013-04

National annex to EC 2
with amendment

DIN EN 1992-1-1/NA Ber. 1:2012-06

DIN 18800-1

Design of steel structures - Part 1, November 2008

DIN 18800-2

Design of steel structures - Part 2: Structural stability criteria,
buckling of struts and framework structures, November 2008

DIN EN 1996

Design of masonry structures,
published 2013-02

2 Component description:

The HALFEN HK5-U Brickwork support bracket consists of a bracket head, a web plate, a support plate and a pressure plate. The web plate is designed with a diagonal tension strut running from the bottom left to top right and a horizontal compression strut. The support brackets carry 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, 8.0 kN and 12.0 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 or the K5D bracket heads have 20 mm.

In addition, the support bracket described above is also available with an alternative support plate with slotted holes. This support bracket has the designation HK5-S. Here the masonry is placed on a precast lintel; the lintel is suspended from the support brackets using special bolts. For this connection, only the perforated support plate is statically verified.

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, 8.0 kN and 12.0 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

S 235 in stainless steel; material number 1.4401, 1.4404 or 1.4571 ,
Lean- Duplex-Steel, material number 1.4062, 1.4162, 1.4362 or 1.4482

5 Test 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 bracket head plate with width **a**, including the connection to the bracket plate, is not part of the type calculation. The bracket head plate including the adjustable slotted plate and the bolt are regulated in an approval granted by the German Institute for Building Technology, Berlin.
- 5.3** The type calculation includes only the load transfer of the vertical loads specified under items 3.1 and 3.2. Additional anchors are required for any additional horizontal loads that may occur, for example from wind.
- 5.4** From a structural design point of view there are no objections to the brickwork support bracket in accordance with the tested documents. The structure under the pressure plate must be designed as concrete of at least quality class C20/25 and sufficiently reinforced for the transverse tensile forces occurring in the load distribution area. The edge distances of the pressure plates to wall ends and recesses in walls must be taken into account according to the specifications in the construction plans.
- 5.5** Verification of the precast lintel including the support with bolts is not part of the type statics.
- 5.6** The tension and compression struts of the support brackets are in some cases subject to very high loads. To avoid inadmissible notchstress concentration, abrupt sharp corners must be rounded.
- 5.7** The HALFEN Brickwork support brackets type K210, K270 and K350 were additionally designed as complete systems for load category 1.35*12.0 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 capacities of these systems are not exceeded.

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 Specific documents required for individual building applications.

7.1 The available test report no.1, S-WUE/150438, 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 structural engineering findings,

Der Bearbeiter:(Responsible engineer)

Der Leiter: (Head of Division)

Dipl.-Ing. Wolfgang Frick

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

Landesgewerbeanstalt Bayern.

Prüfamt für Standsicherheit der Zweigstelle Würzburg

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Date

12th December 2016

Ref no.:

Frick / gr

Type Test Test report no.1.1

Approval number: S-WUE/150438

Object: Type test HALFEN HK5-U and HK5-S Brickwork support bracket
Object: Alternative design of the weld seam between the support plate and the web plate

Type test applicant: HALFEN GmbH
Liebigstraße 14, 40764 Langenfeld

Static documents prepared by: HALFEN GmbH
Liebigstraße 14, 40764 Langenfeld

Valid until: 31st January 2021

The documents listed under item 1 were checked in addition to the documents for the HK5-U and HK5-S Brickwork support brackets in accordance with Test Report no. 1 as supplements with regard to the current valid standards as types in terms of structural stability.

1 Test documents

1.1 Evaluated documents:

1.1.1 Static calculation:
HALFEN Brickwork support bracket. type HK5-U 9 pages (page 1 bis 9)
Alternative design of the weld seam between
the support plate and the web plate:

1.1.2 Design drawings: 5 drawings (annex 1 bis 5)

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 22nd April 2014; 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.

1.2.3 General building authority approval issued by the German Centre of Competence for Construction (Allgemeine bauaufsichtliche Zulassung des Deutschen Instituts für Bautechnik, Berlin), for "HALFEN HTA-ES und HTR-ES Cast-in channels for precast lintels", Approval number Z-21.4-1989 from 25th October 2013; 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/NA:2013-04	National annex to EC 2
DIN EN 1992-1-1/NA Ber. 1:2012-06	with amendment
DIN 18800 - 1	Steel structures - Part 1 : Calculation and construction, November 2008
DIN18800-2	Steel structures - Part 2: Stability criteria, buckling of struts and framework structures, November 2008
DIN EN 1996	Calculation and construction of masonry structures, published 2013-02

2 Component description:

See Type test no. 1.

As an alternative to the previous version with two approx. 3 cm long eccentrically arranged double fillet weld for connecting the support plate to the web plate, a double fillet weld of at least 6 cm in length is located centrally for types HK5-U and HK5-S

3 Actions

3.1 Permanant 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, 8.0 kN and 12.0 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 235 Stainless steel; material number 1.4401 , 1.4404 or 1.4571

5 Test test results:

5.1 The documents listed under item 1.1 were checked for stability, but not for other building regulation requirements or other official requirements. They comply with currently valid technical building regulations.

5.2 In addition, the remarks specified in item 7 of type test report no. 1 also apply.

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 Specific documents required for individual building applications.

- 7.1** The available test report no.1, S-WUE/150438, 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 structural engineering findings,

The testing authority will make a decision on further procedure.

Der Bearbeiter:(Responsible engineer)

Der Leiter: (Head of Division)

Dipl.-Ing. Wolfgang Frick

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

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Prüfamt für Standsicherheit der Zweigstelle Würzburg

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Date

21th November 2017

Ref no.:

Frick / gr

Type Test Test report no.1.2

Type test number: S-WUE/150438

Object: Type test HALFEN HK5-U and HK5-S Brickwork support bracket
Object: Addition of the KSC head and
alternative design of the compression strut without **angled edge**
a) With pressure plate
b) With adjustment screw

Type test applicant: HALFEN GmbH
Liebigstraße 14, 40764 Langenfeld

Static documents prepared by: HALFEN GmbH
Liebigstraße 14, 40764 Langenfeld

Valid until: 31st January 2021

The documents listed under item 1 were checked in addition to the documents for the HK5-U and HK5-S Brickwork support brackets in accordance with Test Report no. 1; as supplements with regard to the current valid standards as types in terms of structural stability.

1.1 Test documents

1.1 Evaluated documents:

1.1.1 Static calculation: 60 pages (page 1 bis 60)

1.1.2 Design drawings: 3 drawing (annex 6 bis 8)

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 22nd April 2014; 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.

1.2.3 General building authority approval issued by the German Centre of Competence for Construction (Allgemeine bauaufsichtliche Zulassung des Deutschen Instituts für Bautechnik, Berlin), for "HALFEN HTA-ES und HTR-ES Cast-in channels for precast lintels", Approval number Z-21.4-1989 from 25th October 2013; 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/NA:2013-04	National annex to EC 2
DIN EN 1992-1-1/NA Ber. 1:2012-06	with amendment
DIN EN 1992-1-1/NA/A1	Amendment A 1 for the application document
DIN 18800 - 1	Steel structures - Part 1 : Calculation and construction, November 2008
DIN 18800-2	Steel structures - Part 2: Stability criteria, buckling of struts and framework structures, November 2008
DIN EN 1996	Calculation and construction of masonry structures, published 2013-02

2 Component description:

See type test no. 1 and no. 1.1

For HK5-U or HK5-S Brickwork support brackets with the K5C bracket head, the inner forces are determined. The relevant verifications are carried out insofar as they are decisive for comparison with the tested versions. In addition, the decisive static calculation for the alternative design of the pressure strut without angled edge is carried out a) with pressure plate and b) with adjustment 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, 8.0 kN and 12.0 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 235 Stainless steel; material number 1.4401, 1.4404 or 1.4571 and

S 355 Stainless steel; material number 1.4401, 1.4404 or 1.4571 for the adjustment sleeve

5 Test test results:

5.1 The documents listed under item 1.1 were checked for 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 brackets type K270, K310 and K350 were additionally designed as complete systems for load categories 1.35*4.0 kN, 1.35*12.0 kN and 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 capacities of these systems are not exceeded.

5.3 The adjustment screw must be inserted into the sleeve at least half the welding seam length.

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 Specific documents required for individual building applications

- 7.1** The available test report no.1, no.1.1 and no.1.2, S-WUE/150438, 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 structural engineering findings,

The testing authority will make a decision on further procedure.

Der Bearbeiter:(Responsible engineer)

Der Leiter: (Head of Division)

Dipl.-Ing. Wolfgang Frick

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

Alternative weld seam



Anchor bolts or anchor channels
Mat.no. 1.4401/1.4404/1.4571 or. 1.4062/1.4162/1.4362/1.4462 or.
1.4529/1.4547 acc. to. Building Authority approval or ETA

Cladding brickwork: according to DIN 1053 or DIN EN 1996-1-1

Support structure $\geq C20/25$

Anchor material:

Bracket head, adjustable slotted plate , U bracket:
Mat. no. 1.4401/1.4404/1.4571 S235 or. 1.4062/1.4162/1.4362/1.4482
bracket plate, support plate, pressure plate: Mat. no. 1.4062/ 1.4162/ 1.4362/1.4482



ANNEX 1

Type Test S-WUE/150438

**Brickwork support bracket HK5-U
with bracket head K5
(Resistance projection welding)**

HALFEN GmbH
Liebigstr. 14, 40764 Langenfeld-Richrath
Tel. 02173 970-0, Fax. 02173 970-123

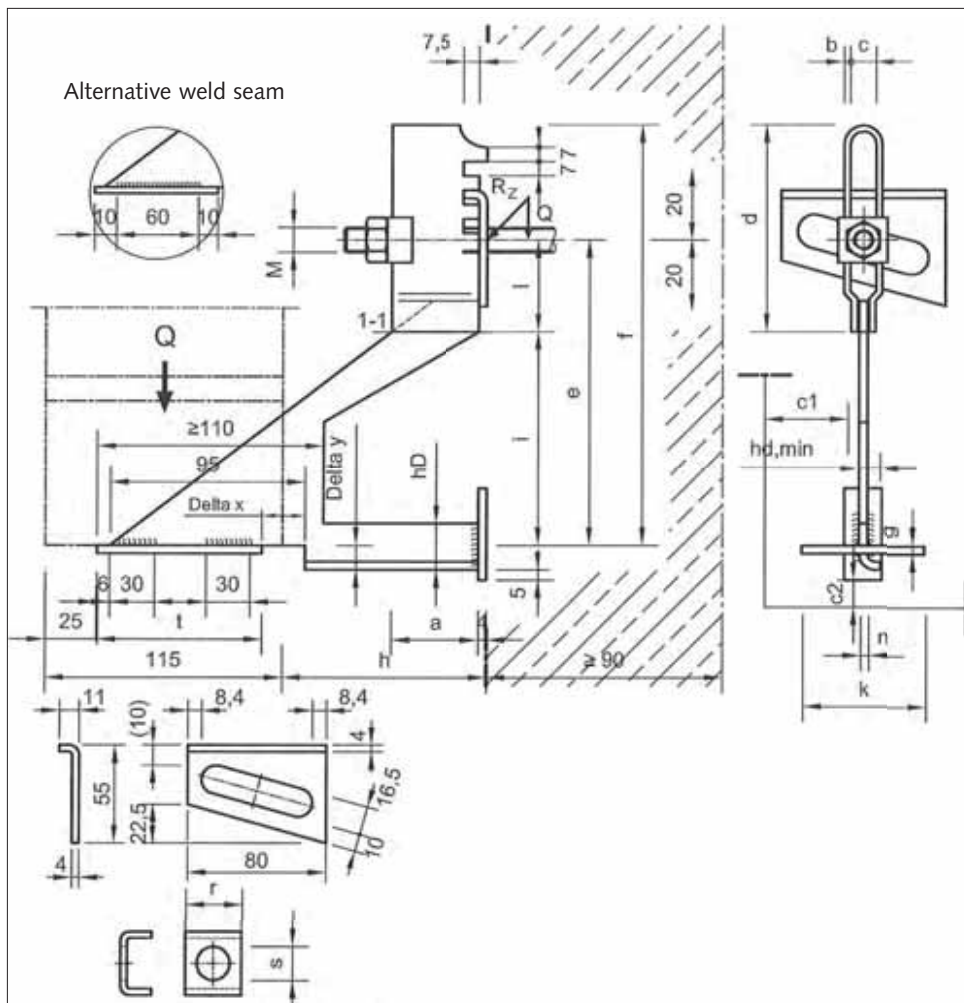
Load		Ventilation gap	Cantilever	Compression strut with angled edge												Support plate	*
Q	Q _g	h	K		Delta i	Delta x	Delta y	e	f	hD	hdm	i	l	n			
[kN]	[kN]	[mm]	[mm]	[-]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	k×t×g	max Rz	[kN]
4.0	5.4	<= 120 ⁺¹⁵	<= 210	Yes	19.5	21.0	10	150	206.5	23	12	105	45	3	60×80×3	9.65	
8.0	10.8			No	15.5	21.0	/	200	260.5	32	/	151	49	4	60×80×4	16.32	
12.0	16.2			No	17.5	1.0	/	264	325.5	36	/	201	63	4	80×100×5	20.98	
4.0	5.4	120 ⁺¹⁵ <h<= 160 ⁺¹⁵	210<K<= 250	Yes	19.5	21.0	13	175	231.5	21	21	130	45	4	60×80×3	9.61	
8.0	10.8			Yes	15.5	21.0	13	250	310.5	21	21	201	49	4	60×80×4	15.26	
12.0	16.2			Yes	17.5	1.0	14	314	375.5	25	21	251	63	4	80×100×5	20.55	
4.0	5.4	180 ⁺¹⁵	270	Yes	19.5	21.0	13	180	236.5	21	21	135	45	4	60×80×3	9.96	
8.0	10.8			Yes	15.5	21.0	13	270	330.5	21	21	221	49	4	60×80×4	15.26	
12.0	16.2			Yes	17.5	1.0	14	334	395.5	25	21	271	63	4	80×100×5	20.69	
4.0	5.4	200 ⁺¹⁵	290	Yes	19.5	21.0	13	200	256.5	21	21	155	45	4	60×80×3	9.69	
8.0	10.8			Yes	15.5	21.0	13	290	350.5	21	21	241	49	4	60×80×4	15.26	
12.0	16.2			Yes	17.5	1.0	16	354	415.5	25	25	291	63	5	80×100×5	20.76	
4.0	5.4	220 ⁺¹⁵	310	Yes	19.5	21.0	13	220	276.5	21	21	175	45	4	60×80×3	9.47	
8.0	10.8			Yes	15.5	21.0	13	310	370.5	21	21	261	49	4	60×80×4	15.26	
12.0	16.2			Yes	17.5	1.0	16	374	435.5	25	25	311	63	5	80×100×5	20.87	
4.0	5.4	240 ⁺¹⁵	330	Yes	19.5	21.0	15	240	296.5	25	25	195	45	5	60×80×3	9.24	
8.0	10.8			Yes	15.5	21.0	15	330	390.5	25	25	281	49	5	60×80×4	15.21	
12.0	16.2			Yes	17.5	1.0	16	394	455.5	25	25	331	63	5	80×100×5	20.97	
4.0	5.4	260 ⁺¹⁵	350	Yes	19.5	21.0	15	260	316.5	25	25	215	45	5	60×80×3	9.10	
8.0	10.8			Yes	15.5	21.0	15	350	410.5	25	25	301	49	5	60×80×4	15.22	
12.0	16.2			Yes	17.5	1.0	16	414	475.5	25	25	351	63	5	80×100×5	21.07	

* max. acting force at the connection for the fixing

Load		a	b		c	d	r	s	M	min c1 (**)	min c2 (**)
Q	Q _{st}		(1.4401/ 1.4404/ 1.4571)	(1.4062/ 1.4162/ 1.4362/ 1.4482)							
[kN]	[kN]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
4.0	5.4	43	3	3	12.5	121	22	13	M10/ M12	20	0
8.0	10.8	46	5	3	16.5	109.5	25	17	M12/ M16	20	13.8
12.0	16.2	49	6	4	16.5	124.5	25	17	M16	20	19.9

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

1. For low loads ($Q_{z,vorh} < Q_d$) 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 $\geq$ 15 Nm, M12 $\geq$ 25 Nm, M16 $\geq$ 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.
4. Bracket spacing is generally 25 cm, unless additional support angles are installed, then spacing distances are greater.
5. The bracket head including the diagonal adjustment bracket and the horizontal welding seam bracket head / bracket plate in section 1-1 or the resistance projection welded connection, bracket head / bracket plate, are not part of this type test, these are regulated in a separate building authority approval.



- Fixing method:** Anchor bolts or anchor channels
Mat.no. 1.4401/1.4404/1.4571 or. 1.4062/1.4162/1.4362/1.4462 or. 1.4529/1.4547 acc. to. Building Authority approval or ETA
- Cladding brickwork:** according to DIN 1053 or DIN EN 1996-1-1
- Support structure** $\geq$ C20/25
- Anchor material:** Bracket head, adjustable slotted plate, U bracket:
Mat. no. 1.4401/1.4404/1.4571 S235 or. 1.4062/1.4162/1.4362/1.4482
bracket plate, support plate, pressure plate: Mat. no. 1.4062/ 1.4162/ 1.4362/1.4482

Load Q [kN]	Q _d [kN]	Ventilation gap h [mm]	Cantilever K [mm]	Compression strut with angled edge [-]	Delta x	Delta y	e	f	hD	hdmin	i	l	n	Support plate k×t×g	* max Rzd [kN]
					[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		
4.0	5.4	<= 120 ¹⁵	<= 210	Yes	21.0	10	150	206.5	23	12	105	45	3	60×80×3	9.65
8.0	10.8			No	21.0	/	200	260.5	32	/	151	49	4	60×80×4	16.32
12.0	16.2			No	1.0	/	264	325.5	36	/	201	63	4	80×100×5	20.98
4.0	5.4	120 ¹⁵ <h<= 160 ¹⁵	210<K<= 250	Yes	21.0	13	175	231.5	21	21	130	45	4	60×80×3	9.61
8.0	10.8			Yes	21.0	13	250	310.5	21	21	201	49	4	60×80×4	15.26
12.0	16.2			Yes	1.0	14	314	375.5	25	21	251	63	4	80×100×5	20.55
4.0	5.4	180 ¹⁵	270	Yes	21.0	13	180	236.5	21	21	135	45	4	60×80×3	9.96
8.0	10.8			Yes	21.0	13	270	330.5	21	21	221	49	4	60×80×4	15.26
12.0	16.2			Yes	1.0	14	334	395.5	25	21	271	63	4	80×100×5	20.69
4.0	5.4	200 ¹⁵	290	Yes	21.0	13	200	256.5	21	21	155	45	4	60×80×3	9.69
8.0	10.8			Yes	21.0	13	290	350.5	21	21	241	49	4	60×80×4	15.26
12.0	16.2			Yes	1.0	16	354	415.5	25	25	291	63	5	80×100×5	20.76
4.0	5.4	220 ¹⁵	310	Yes	21.0	13	220	276.5	21	21	175	45	4	60×80×3	9.47
8.0	10.8			Yes	21.0	13	310	370.5	21	21	261	49	4	60×80×4	15.26
12.0	16.2			Yes	1.0	16	374	435.5	25	25	311	63	5	80×100×5	20.87
4.0	5.4	240 ¹⁵	330	Yes	21.0	15	240	296.5	25	25	195	45	5	60×80×3	9.24
8.0	10.8			Yes	21.0	15	330	390.5	25	25	281	49	5	60×80×4	15.21
12.0	16.2			Yes	1.0	16	394	455.5	25	25	331	63	5	80×100×5	20.97
4.0	5.4	260 ¹⁵	350	Yes	21.0	15	260	316.5	25	25	215	45	5	60×80×3	9.10
8.0	10.8			Yes	21.0	15	350	410.5	25	25	301	49	5	60×80×4	15.22
12.0	16.2			Yes	1.0	16	414	475.5	25	25	351	63	5	80×100×5	21.07

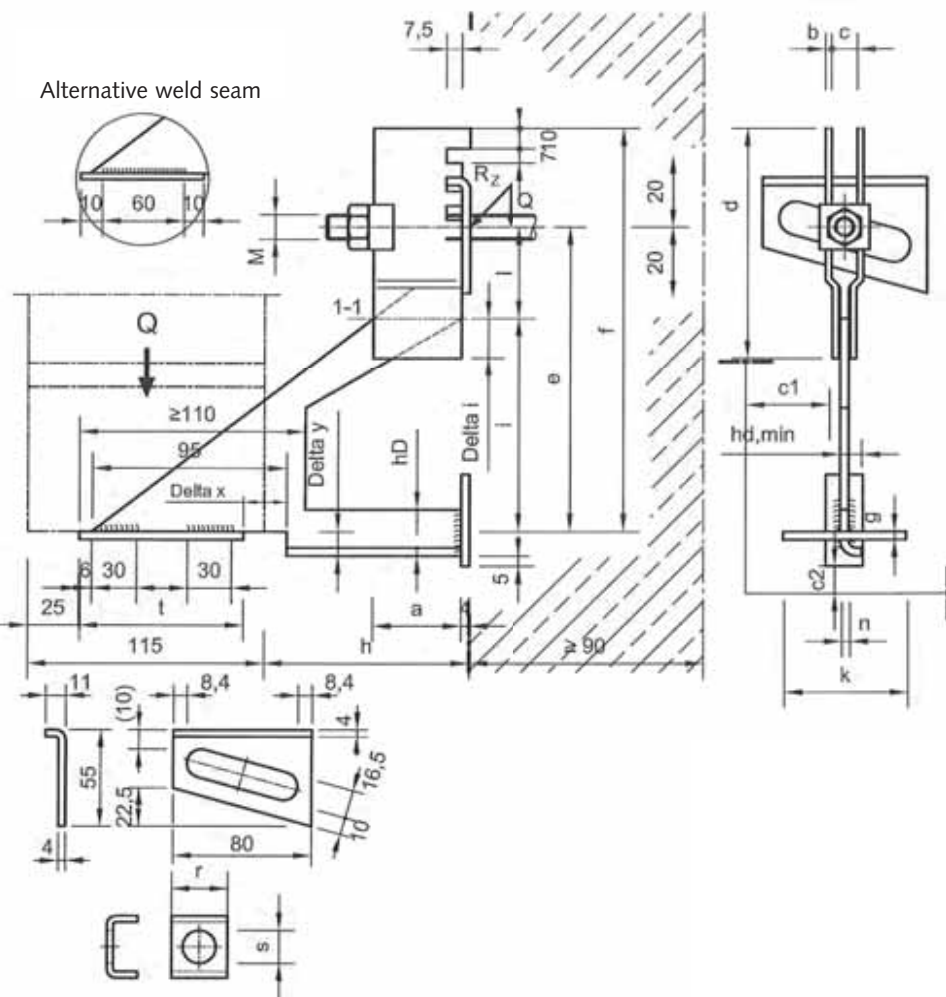
* max. acting force at the connection for the fixing

Load		a	b		c	d	r	s	M	min c1 (**)	min c2 (**)
Q	Q _i		(1.4401/ 1.4404/ 1.4571)	(1.4062/ 1.4162/ 1.4362/ 1.4482)							
[kN]	[kN]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
4.0	5.4	43	3	3	12.5	101,5	22	13	M10/ M12	20	0
8.0	10.8	46	5	3	16.5	109,5	25	17	M12/ M16	20	13.8
12.0	16.2	49	6	4	16.5	124,5	25	17	M16	20	19.9

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

- 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 diagonal adjustment bracket and the horizontal welding seam bracket head / bracket plate in section 1-1 or the resistance projection welded connection, bracket head / bracket plate, are not part of this type test, these are regulated in a separate building authority approval.

Alternative weld seam



Anchor bolts or anchor channels
Mat.no. 1.4401/1.4404/1.4571 or. 1.4062/1.4162/1.4362/1.4462 or.
1.4529/1.4547 acc. to. Building Authority approval or ETA

Anchor material: Bracket head, adjustable slotted plate, U bracket:
Mat. no. 1.4401/1.4404/1.4571 S235 or. 1.4062/1.4162/1.4362/1.4482
bracket plate, support plate, pressure plate: Mat. no. 1.4062/ 1.4162/ 1.4362/1.4482



Type Test S-WUE/150438

**Brickwork support bracket HK5-U
with bracket head K5D
(Resistance projection welding)**

HALFEN GmbH
Liebigstr. 14, 40764 Langenfeld-Richrath
Tel. 02173 970-0, Fax. 02173 970-123

Load		Ventilation gap	Cantilever	Compression strut with angled edge													Support plate	*
Q [kN]	Q _s [kN]	h [mm]	K [mm]		Delta i [mm]	Delta x [mm]	Delta y [mm]	e [mm]	f [mm]	hD [mm]	hd,min [mm]	i [mm]	l [mm]	n [mm]	k×t×g	max Rzd [kN]		
4.0	5.4	<= 120° ¹⁵	<= 210	Yes	19.5	21.0	10	150	198.5	23	12	105	45	3	60×80×3	9.65		
8.0	10.8			No	15.5	21.0	/	200	250.5	32	/	151	49	4	60×80×4	16.32		
12.0	16.2			No	17.5	1.0	/	264	314.5	36	/	201	63	4	60×100×5	20.98		
4.0	5.4	120° ¹⁵ <h<= 160° ¹⁵	210<K<= 250	Yes	19.5	21.0	13	175	213.5	21	21	130	45	4	60×80×3	9.61		
8.0	10.8			Yes	15.5	21.0	13	250	300.5	21	21	201	49	4	60×80×4	15.26		
12.0	16.2			Yes	17.5	1.0	14	314	364.5	25	21	251	63	4	60×100×5	20.55		
4.0	5.4	180° ¹⁵	270	Yes	19.5	21.0	13	180	228.5	21	21	135	45	4	60×80×3	9.96		
8.0	10.8			Yes	15.5	21.0	13	270	320.5	21	21	221	49	4	60×80×4	15.26		
12.0	16.2			Yes	17.5	1.0	14	334	384.5	25	21	271	63	4	60×100×5	20.69		
4.0	5.4	200° ¹⁵	290	Yes	19.5	21.0	13	200	248.5	21	21	155	45	4	60×80×3	9.69		
8.0	10.8			Yes	15.5	21.0	13	290	340.5	21	21	241	49	4	60×80×4	15.26		
12.0	16.2			Yes	17.5	1.0	16	354	404.5	25	25	291	63	5	60×100×5	20.76		
4.0	5.4	220° ¹⁵	310	Yes	19.5	21.0	13	220	288.5	21	21	175	45	4	60×80×3	9.47		
8.0	10.8			Yes	15.5	21.0	13	310	360.5	21	21	261	49	4	60×80×4	15.26		
12.0	16.2			Yes	17.5	1.0	16	374	424.5	25	25	311	63	5	60×100×5	20.87		
4.0	5.4	240° ¹⁵	330	Yes	19.5	21.0	15	240	288.5	25	25	195	45	5	60×80×3	9.24		
8.0	10.8			Yes	15.5	21.0	15	330	380.5	25	25	281	49	5	60×80×4	15.21		
12.0	16.2			Yes	17.5	1.0	16	394	444.5	25	25	331	63	5	60×100×5	20.97		
4.0	5.4	260° ¹⁵	350	Yes	19.5	21.0	15	260	308.5	25	25	215	45	5	60×80×3	9.10		
8.0	10.8			Yes	15.5	21.0	15	350	400.5	25	25	301	49	5	60×80×4	15.22		
12.0	16.2			Yes	17.5	1.0	16	414	464.5	25	25	351	63	5	60×100×5	21.07		

* max. acting force at the connection for the fixing

Load		a	b		c	d	r	s	M	min c1 (**)	min c2 (**)
Q	Q _d		(1.4401/ 1.4404/ 1.4571)	(1.4062/ 1.4162/ 1.4362/ 1.4482)							
[kN]	[kN]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
4.0	5.4	43	3	3	12.5	113	22	13	M10/ M12	20	0
8.0	10.8	46	5	3	16.5	115	25	17	M12/ M16	20	13.8
12.0	16.2	49	6	4	16.5	131	25	17	M16	20	19.9

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

1. For low loads ($Q_{z,vorh} < Q_d$) 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.
4. Bracket spacing is generally 25 cm, unless additional support angles are installed, then spacing distances are greater.
5. The bracket head including the diagonal adjustment bracket and the horizontal welding seam bracket head / web plate in section 1-1 or the resistance projection welded connection, bracket head / bracket plate, are not part of this type test, these are regulated in a separate building authority approval.

[illegible]

Anchor bolts or anchor channels
Mat.no. 1.4401/1.4404/1.4571 or. 1.4062/1.4162/1.4362/1.4462 or.
1.4529/1.4547 acc. to. Building Authority approval or ETA

Support structure $\geq$ C20/25

Anchor material: Bracket head, adjustable slotted plate, U bracket:
Mat. no. 1.4401/1.4404/1.4571 S235 or. 1.4062/1.4162/1.4362/1.4482
bracket plate, support plate, pressure plate: Mat. no. 1.4062/ 1.4162/ 1.4362/1.4482



Type Test S-WUE/150438

**Brickwork support bracket HK5-U
with bracket head K5D
(Welded seam)**

HALFEN GmbH
Liebigstr. 14, 40764 Langenfeld-Richrath
Tel. 02173 970-0, Fax. 02173 970-123

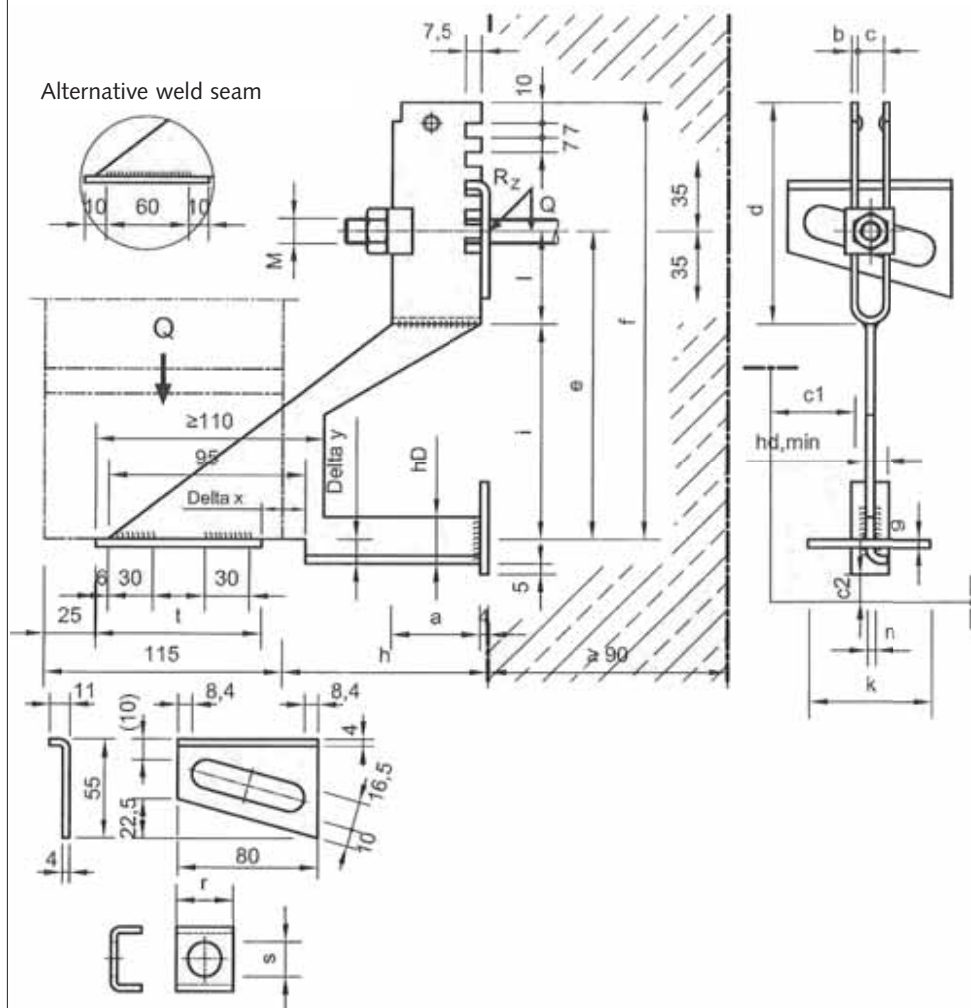
Load		Ventilation gap	Cantilever	Compression strut with angled edge												Support plate	
Q ₁ [kN]	Q ₂ [kN]	h [mm]	K [mm]	[-]	Delta x [mm]	Delta y [mm]	e [mm]	f [mm]	hD [mm]	hDmin [mm]	i [mm]	l [mm]	n [mm]		k×t×g	max Rz [kN]	
4.0	5.4	<= 120 ⁻¹⁵	<= 210	Yes	21.0	10	150	206.5	23	12	105	45	3	60×80×3	9.65		
8.0	10.8			No	21.0	/	200	260.5	32	/	151	49	4	60×80×4	16.32		
12.0	16.2			No	1.0	/	264	325.5	36	/	201	63	4	80×100×5	20.98		
4.0	5.4	120 ⁻¹⁵ <h<= 160 ⁻¹⁵	210<K<= 250	Yes	21.0	13	175	231.5	21	21	130	45	4	60×80×3	9.61		
8.0	10.8			Yes	21.0	13	250	310.5	21	21	201	49	4	60×80×4	15.26		
12.0	16.2			Yes	1.0	14	314	375.5	25	21	251	63	4	80×100×5	20.55		
4.0	5.4	180 ⁻¹⁵	270	Yes	21.0	13	180	236.5	21	21	135	45	4	60×80×3	9.96		
8.0	10.8			Yes	21.0	13	270	330.5	21	21	221	49	4	60×80×4	15.26		
12.0	16.2			Yes	1.0	14	334	395.5	25	21	271	63	4	80×100×5	20.69		
4.0	5.4	200 ⁻¹⁵	290	Yes	21.0	13	200	256.5	21	21	155	45	4	60×80×3	9.69		
8.0	10.8			Yes	21.0	13	290	350.5	21	21	241	49	4	60×80×4	15.26		
12.0	16.2			Yes	1.0	16	354	415.5	25	25	291	63	5	80×100×5	20.76		
4.0	5.4	220 ⁻¹⁵	310	Yes	21.0	13	220	276.5	21	21	175	45	4	60×80×3	9.47		
8.0	10.8			Yes	21.0	13	310	370.5	21	21	261	49	4	60×80×4	15.26		
12.0	16.2			Yes	1.0	16	374	435.5	25	25	311	63	5	80×100×5	20.87		
4.0	5.4	240 ⁻¹⁵	330	Yes	21.0	15	240	296.5	25	25	195	45	5	60×80×3	9.24		
8.0	10.8			Yes	21.0	15	330	390.5	25	25	281	49	5	60×80×4	15.21		
12.0	16.2			Yes	1.0	16	394	455.5	25	25	331	63	5	80×100×5	20.97		
4.0	5.4	260 ⁻¹⁵	350	Yes	21.0	15	260	316.5	25	25	215	45	5	60×80×3	9.10		
8.0	10.8			Yes	21.0	15	350	410.5	25	25	301	49	5	60×80×4	15.22		
12.0	16.2			Yes	1.0	16	414	475.5	25	25	351	63	5	80×100×5	21.07		

* max. acting force at the connection for the fixing

Load		a	b		c	d	r	s	M	min c1 (**)	min c2 (**)
Q	Q _i		(1.4401/ 1.4404/ 1.4571)	(1.4062/ 1.4162/ 1.4362/ 1.4482)							
[kN]	[kN]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
4.0	5.4	43	3	3	12.5	93.5	22	13	M10/ M12	20	0
8.0	10.8	46	5	3	16.5	99.5	25	17	M12/ M16	20	13.8
12.0	16.2	49	6	4	16.5	113.5	25	17	M16	20	19.9

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

1. For low loads ($Q_{z,vorh} < Q_d$) 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 $\geq$ 15 Nm, M12 $\geq$ 25 Nm , M16 $\geq$ 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.
4. Bracket spacing is generally 25 cm, unless additional support angles are installed, then spacing distances are greater.
5. The bracket head including the diagonal adjustment bracket and the horizontal welding seam bracket head / web plate in section 1-1 or the resistance projection welded connection, bracket head / bracket plate, are not part of this type test, these are regulated in a separate building authority approval.



Fixing method: Anchor bolts or anchor channel
Mat.no. 1.4401/1.4404/1.4571 or. 1.4062/1.4162/1.4362/1.4462 or. 1.4529/1.4547 acc. to. Building Authority approval or ETA

Cladding brickwork: according to DIN 1053 or DIN EN 1996-1-1

Support structure $\geq$ C20/25

Anchor material: Bracket head, adjustable slotted plate, U bracket:
Mat. no. 1.4401/1.4404/1.4571 S235 or. 1.4062/1.4162/1.4362/1.4482
bracket plate, support plate, pressure plate: Mat. no. 1.4062/ 1.4162/ 1.4362/1.4482

Load		Ventilation gap	Cantilever	Compression strut with angled edge	Delta x	Delta y	e	f	hD	hdmin	i	l	n	Support plate	*
Q [kN]	Q _d [kN]	h [mm]	K [mm]	[-]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	k x t x g	max Rz d [kN]
4.0	5.4	<= 120 ⁻¹⁵	<= 210	Yes	21.0	10	150	212.5	23	12	105	45	3	60x80x3	10.53
8.0	10.8			No	21.0	/	200	264.5	32	/	151	49	4	60x80x4	17.22
12.0	16.2			No	1.0	/	250	314.5	36	/	201	49	4	80x100x5	22.22
4.0	5.4	120 ⁻¹⁵ <h<= 160 ⁻¹⁵	210<K<= 250	Yes	21.0	13	175	237.5	21	21	130	45	4	60x80x3	10.31
8.0	10.8			Yes	21.0	13	250	314.5	21	21	201	49	4	60x80x4	15.79
12.0	16.2			Yes	1.0	14	300	364.5	25	21	251	49	4	80x100x5	21.41
4.0	5.4	180 ⁻¹⁵	270	Yes	21.0	13	180	242.5	21	21	135	45	4	60x80x3	10.68
8.0	10.8			Yes	21.0	13	270	334.5	21	21	221	49	4	60x80x4	15.75
12.0	16.2			Yes	1.0	14	320	384.5	25	21	271	49	4	80x100x5	21.51
4.0	5.4	200 ⁻¹⁵	290	Yes	21.0	13	200	262.5	21	21	155	45	4	60x80x3	10.29
8.0	10.8			Yes	21.0	13	290	354.5	21	21	241	49	4	60x80x4	15.71
12.0	16.2			Yes	1.0	16	340	404.5	25	25	291	49	5	80x100x5	21.54
4.0	5.4	220 ⁻¹⁵	310	Yes	21.0	13	220	282.5	21	21	175	45	4	60x80x3	9.99
8.0	10.8			Yes	21.0	13	310	374.5	21	21	261	49	4	60x80x4	15.68
12.0	16.2			Yes	1.0	16	360	424.5	25	25	311	49	5	80x100x5	21.62
4.0	5.4	240 ⁻¹⁵	330	Yes	21.0	15	240	302.5	25	25	195	45	5	60x80x3	9.68
8.0	10.8			Yes	21.0	15	330	394.5	25	25	281	49	5	60x80x4	15.60
12.0	16.2			Yes	1.0	16	380	444.5	25	25	331	49	5	80x100x5	21.69
4.0	5.4	260 ⁻¹⁵	350	Yes	21.0	15	260	322.5	25	25	215	45	5	60x80x3	9.49
8.0	10.8			Yes	21.0	15	350	414.5	25	25	301	49	5	60x80x4	15.58
12.0	16.2			Yes	1.0	16	400	464.5	25	25	351	49	5	80x100x5	21.75

* max. acting force at the connection for the fixing

Load		a	b	c	d	r	s	M	min c1	min c2
Q [kN]	Q _d [kN]	[mm]	(1.4401 / 1.4404 / 1.4571)	(1.4062 / 1.4162 / 1.4362 / 1.4482)	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
4.0	5.4	43	3	3	12.5	107.5	22	13	M10/ M12	20
8.0	10.8	46	5	3	16.5	113.5	25	17	M12/ M16	20
12.0	16.2	49	6	4	16.5	113.5	25	17	M16	20

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

- 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 $\triangleright$ 15 Nm, M12 $\triangleright$ 25 Nm, M16 $\triangleright$ 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 diagonal adjustment bracket and the horizontal welding seam bracket head / bracket plate in section 1-1 or the resistance projection welded connection, bracket head / web plate, are not part of this type test, these are regulated in a separate building authority approval.

[illegible]

Fixing method:	Anchor bolts or anchor channels Mat.no. 1.4401/1.4404/1.4571 or 1.4062/1.4162/1.4362/1.4462 or. 1.4529/1.4547 acc. to. Building Authority approval or ETA
Cladding brickwork:	according to DIN 1053 or DIN EN 1996-1-1
Support structure	≥ C20/25
Anchor material:	Bracket head, adjustable slotted plate, U bracket: Mat. no. 1.4401/1.4404/1.4571 S235 or. 1.4062/1.4162/1.4362/1.4482 bracket plate, support plate, pressure plate: Mat. no. 1.4062/ 1.4162/ 1.4362/1.4482



Type Test S-WUE/150438

Brickwork support bracket HK5-U with bracket head K5C

HALFEN GmbH
Liebigstr. 14, 40764 Langenfeld-Richrath
Tel. 02173 970-0, Fax. 02173 970-123

Load		Ventilation gap	Cantilever	Compression strut with angled edge												Support plate	
Q [kN]	Q _c [kN]	h [mm]	K [mm]	[-]	Delta x [mm]	Delta y [mm]	e [mm]	f [mm]	hD [mm]	hd.min [mm]	i [mm]	l [mm]	n [mm]		k×t×g	max Rz [kN]	
4.0	5.4	<= 120 ⁻¹⁵	<= 210	Yes	21.0	10	136	184.5	23	12	105	31	3		60×80×3	10.46	
8.0	10.8			No	21.0	/	186	236.5	32	/	151	35	4		60×80×4	17.15	
12.0	16.2			No	1.0	/	236	386.5	36	/	201	35	4		80×100×5	22.17	
4.0	5.4	120 ⁻¹⁵ <h<= 160 ⁻¹⁵	210<K<= 250	Yes	21.0	13	161	209.5	21	21	130	31	4		60×80×3	10.26	
8.0	10.8			Yes	21.0	13	236	286.5	21	21	201	35	4		60×80×4	15.75	
12.0	16.2			Yes	1.0	14	286	336.5	25	21	251	35	4		80×100×5	21.38	
4.0	5.4	180 ⁻¹⁵	270	Yes	21.0	13	166	214.5	21	21	135	31	4		60×80×3	10.63	
8.0	10.8			Yes	21.0	13	256	306.5	21	21	221	35	4		60×80×4	15.71	
12.0	16.2			Yes	1.0	14	306	356.5	25	21	271	35	4		80×100×5	21.48	
4.0	5.4	200 ⁻¹⁵	290	Yes	21.0	13	186	234.5	21	21	155	31	4		60×80×3	10.25	
8.0	10.8			Yes	21.0	13	276	326.5	21	21	241	35	4		60×80×4	15.68	
12.0	16.2			Yes	1.0	16	326	376.5	25	25	291	35	5		80×100×5	21.51	
4.0	5.4	220 ⁻¹⁵	310	Yes	21.0	13	206	254.5	21	21	175	31	4		60×80×3	9.95	
8.0	10.8			Yes	21.0	13	296	346.5	21	21	261	35	4		60×80×4	15.65	
12.0	16.2			Yes	1.0	16	346	396.5	25	25	311	35	5		80×100×5	21.59	
4.0	5.4	240 ⁻¹⁵	330	Yes	21.0	15	226	274.5	25	25	195	31	5		60×80×3	9.65	
8.0	10.8			Yes	21.0	15	316	366.5	25	25	281	35	5		60×80×4	15.57	
12.0	16.2			Yes	1.0	16	366	416.5	25	25	331	35	5		80×100×5	21.66	
4.0	5.4	260 ⁻¹⁵	350	Yes	21.0	15	246	294.5	25	25	215	31	5		60×80×3	9.46	
8.0	10.8			Yes	21.0	15	336	386.5	25	25	301	35	5		60×80×4	15.55	
12.0	16.2			Yes	1.0	16	386	436.5	25	25	351	35	5		80×100×5	21.73	

* max. acting force at the connection for the fixing

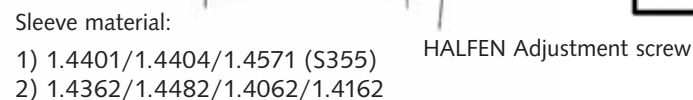
Load		a	b		c	d	r	s	M	min c1 (**)	min c2 (**)
Q	Q _i		(1.4401/ 1.4404/ 1.4571)	(1.4062/ 1.4162/ 1.4362/ 1.4482)							
[kN]	[kN]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
4.0	5.4	43	3	3	12.5	79.5	22	13	M10/ M12	20	1.1
8.0	10.8	46	5	3	16.5	85.5	25	17	M12/ M16	20	19.14
12.0	16.2	49	6	4	16.5	85.5	25	17	M16	20	29.05

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

1. For low loads ($Q_{z,vorh} < Q_d$) 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.
4. Bracket spacing is generally 25 cm, unless additional support angles are installed, then spacing distances are greater.
5. The bracket head including the diagonal adjustment bracket and the horizontal welding seam bracket head / bracket plate in section 1-1 or the resistance projection welded connection, bracket head / web plate, are not part of this type test, these are regulated in a separate building authority approval.

Note: This translation of the original German version has not been verified by the LGA.



Support structure: $\geq C20/25$

HALFEN Adjustment screw: stainless steel: A4-70 grade

Load		D_H	L_H	t_H	a_w	l_w	M	min sw	min c'
Q	Q_d								
[kN]	[kN]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
4.0	5.4	16	38	2.0	2.0	26	10	17.5	19
8.0	10.8	18	50	2.0	2.0	38	12	20.5	21
12.0	16.2	18	50	2.0	2.0	38	12	22.5	23

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

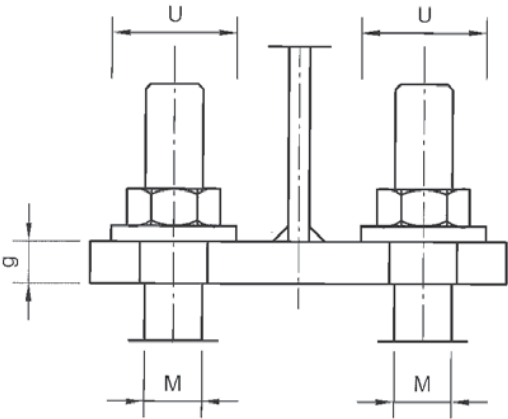


Brickwork support bracket HK5-U
alternative version of bracket plate, adjustment screw

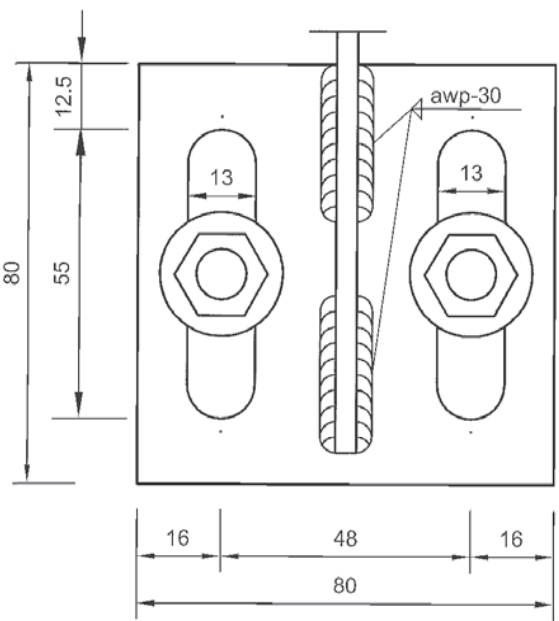
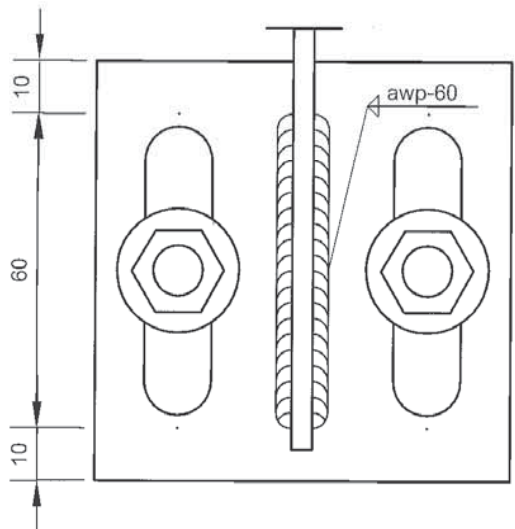
HALFEN GmbH
Liebigstr. 14, 40764 Langenfeld-Richrath
Tel. 02173 970-0, Fax. 02173 970-123

Alternative with HK5-S Support plate

Load		Mat. 1.4401/ 1.4404/1.4571		Mat. 1.4062/ 1.4162/1.4362/ 1.4482		M	U
Q	Q _d	g	awp	g	awp	[mm]	[mm]
[kN]	[kN]	[mm]	[mm]	[mm]	[mm]		
4.0	5.4	5	3	4	2	8 (10)	24 (30)
8.0	10.8	7	3	6	2	10 (12)	30 (24)
12.0	16.2	10	3	8	3	12	24



Version with alternative weld seam:



- Fixing method: Anchor bolts or anchor channels
Mat.no. 1.4401/1.4404/1.4571 or 1.4062/1.4162/1.4362/1.4462 or 1.4529/1.4547 acc. to Building Authority approval or ETA
- Cladding brickwork: according to DIN 1053 or DIN EN 1996-1-1
- Support structure $\geq$ C20/25
- Anchor material: Bracket head, adjustable slotted plate, U bracket:
Mat. no. 1.4401/1.4404/1.4571 S235 or 1.4062/1.4162/1.4362/1.4482
bracket plate, support plate, pressure plate: Mat. no. 1.4062/ 1.4162/ 1.4362/1.4482

Landesgewerbeanstalt Bayern.

Prüfamt für Standsicherheit der Zweigstelle Würzburg

Certified according to DIN EN ISO 9001/14001

Dreikronenstraße 31 B, D-97082 Würzburg, Germany

Tel.: +49 931 4196-113 | Fax: +49 931 4196-200

Email: wuerzburg@lga.de | www.lga.de

Date

30th September 2016

Ref no.:

Frick / gr

**Type Test
Test report no.2**

Approval number: S-WUE/150438

Object: Type test HALFEN HK5-F Brickwork support bracket

Type test applicant: HALFEN GmbH
Liebigstraße 14, 40764 Langenfeld

Static documents prepared by: HALFEN GmbH
Liebigstraße 14, 40764 Langenfeld

Valid until: 31st January 2021

The bracket anchors HK5-U and HK5-S Brickwork support bracket 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: 91 pages (page 1 to 91)

1.1.2 Design drawings: 7 drawings (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 22nd April 2014; 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.

1.2.3 General building authority approval issued by the German Centre of Competence for Construction (Allgemeine bauaufsichtliche Zulassung des Deutschen Instituts für Bautechnik, Berlin), for "HALFEN HTA-ES und HTR-ES Cast-in channels for precast lintels", Approval number Z-21.4-1989 from 25th October 2013; Applicant: HALFEN GmbH, Liebigstraße 14, 40764 Langenfeld.

1.2.4 Technical report compiled by Dynardo GmbH, Steubenstraße 25, 99423 Weimar regarding the derivation of design models for HALFEN masonry support brackets type HK5-F with realistic distribution of masonry compression from 11th May 2016, Doc.-no. K16-HALFEN-01 .AP2_Rev.1.docx.

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/NA:2013-04	National annex to EC 2
DIN EN 1992-1-1/NA Ber. 1:2012-06	with amendment
DIN 18800 - 1	Steel structures - Part 1 : Calculation and construction, November 2008
DIN 18800-2	Steel structures - Part 2: Stability criteria, buckling of struts and framework structures, November 2008
DIN EN 1996	Calculation and construction of masonry structures, published 2013-02

2 Component description:

The HALFEN HK5-F Support system for supporting brickwork cladding consists of two brackets and a steel support angle. The steel support angle is directly subjected to load from the 11.5 cm thick masonry; these loads are transferred as a single-span beams with 2 cantilever arms to the brackets. The consoles each consist of a bracket head, a bracket plate and a pressure plate. The bracket plate is designed with a diagonal tension strut running from the bottom left to top right and a horizontal compression strut.

The brackets are designed for service loads of 4.0 kN, 8.0 kN or 12.0 kN and for ventilation gap thicknesses of up to 260 mm. The load is introduced into the building at the top of the bracket head, which is connected with anchor bolts or cast-in anchor channels and at the bottom via a pressure plate.

A tolerance of 15 mm in the thickness of the ventilation gap and a vertical height adjustability of the K4 bracket head of ± 35 mm, or ± 20 mm when using a K5, K5C or K5D bracket head are taken into account.

The HALFEN HK5-F Brickwork support bracket is made of Duplex material 1.4062, 1.4162, 1.4362 or 1.4482 in accordance with approval no. Z-30.3-23 issued by the German Centre of Competence for Construction (Deutsches Institut für Bautechnik, Berlin) or made of stainless steels, strength class S 235, material 1.4401, 1.4404 or 1.4571, in accordance with the Building authority approval no. Z-30-6 for building components made of stainless steels.

In addition, static analyses of the support angles were carried out taking the suspended rowlock bricks layers into account. If the rowlock or soldier layers are suspended, the maximum load weight from the masonry must be reduced accordingly.

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, 8.0 kN and 12.0 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 235 Stainless steel; material number 1.4401, 1.4404 or 1.4571 and

5 Test test results:

- 5.1** The documents listed under item 1.1 were checked for stability, but not for other building regulation requirements or other official requirements. They comply with currently valid technical building regulations.

The transfer of the dead weight loads in the masonry as a (diaphragm) panel was statically verified by HALFEN, analogous to the specifications in issue 240 of the German Committee for Structural Concrete. These static verifications were checked.

To confirm the calculation model, DYNARDO GMBH, Weimar, carried out calculations of the overall structure of masonry with the steel angle including the brickwork support bracket. Using the finite element method on a 3D overall model, the position and size of the masonry pressures occurring in the support areas on the steel angle of the brickwork support bracket was determined. (see item 1.2.4).

The static documents are in compliance with the currently valid technical building regulations.

- 5.2** The bracket head plate with width **a**, including the horizontal weld at its lower end, is not part of the type calculation. The bracket head plate including the slotted adjustment bracket and the bolt are regulated in an approval granted by the German Institute for Building Technology, Berlin.
- 5.3** The type calculation includes only the load transfer of the vertical loads specified under items 3.1 and 3.2. Additional anchors are required for any additional horizontal loads that may occur, for example from wind.
- 5.4** From a structural design point of view there are no objections to bracket design in accordance with the tested documents. The substructure under the pressure plate must be concrete of at least quality class C20/25 and sufficiently reinforced for the transverse tensile forces occurring in the load distribution area.
- 5.5** The verification of the masonry channel with regard to the suspension of rowlock or soldier courses with a corresponding reduction of the standard loads refers exclusively to the stresses on the masonry channel. All other static proofs with regard to the suspension of the rowlock layers must still be provided in individual cases.
- 5.6** The tension and compression struts of the bracket anchors are in some cases subject to very high loads. To avoid inadmissible stress concentration, abrupt sharp corners must be rounded.
- 5.7** The HALFEN Brickwork support brackets type K210, K270 and K350 were additionally designed as complete systems for load category 1.35*12.0 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 capacities of these systems are not exceeded.

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 Specific documents required for individual building applications.

- 7.1** The available test report no. 2, S-WUE/150438, and the design plans for the corresponding type in accordance with item 1.1.2
- 7.2** General construction plans

8 General provisions

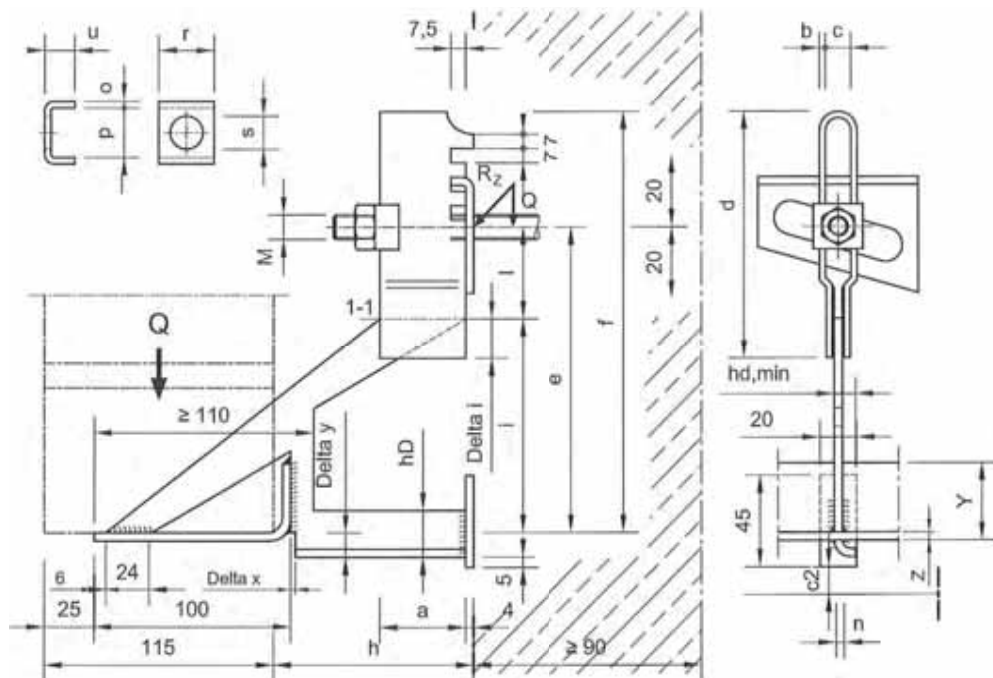
- 8.1** The static type test does not release the client from the obligation to obtain a building permit for each building project, unless the applicable building regulations or other legal provisions specifically exempts him from this.
- 8.2** The type test may save the building supervisory authority 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 structural engineering findings,
The testing authority will make a decision on further procedure.

Der Bearbeiter:(Responsible engineer)

Der Leiter: (Head of Division)

Dipl.-Ing. Wolfgang Frick

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



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

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

2. The following torques must be applied when installing the fixing bolts:
M10 > 15 Nm, M12 > 25 Nm, M16 > 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.
4. For brick weights greater than 20 kN/m³, angles may be used without further verification whose section modulus is greater by a factor of brick weight:- [kN/m³] 1 20 kN/m³, than provided in the tables, with equivalent or greater material thickness.
5. To avoid large deflections of the support angles during assembly, these should remain supported during on-going masonry work until sufficient mortar strength has been reached and a (shear) panel effect is ensured.
6. The bracket head including the adjustable slotted plate and the horizontal weld seam at the bracket head / web plate in section 1-1 or the resistance projection welded connection of the bracket head / web plate are not included in this type test; they are regulated in a separate building authority approval.
7. Details and installation situations are shown in annex 7

Load Q [kN]	Q _d [kN]	Ventilation gap h [mm]	Cantilever K [mm]	Compression strut with angled edge [-]	Delta i	Delta x	Delta y	e	f	hD	hdmin	i	l	n	*
					[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	max Rzd [kN]
4.0	5.4	<= 120° ¹⁵	<= 210	Yes	19.5	1.0	10	150	206.5	23	12	105	45	3	9.65
8.0	10.8			No	15.5	/	/	200	260.5	32	/	151	49	4	16.32
12.0	16.2			No	17.5	/	/	264	325.5	36	/	201	63	4	20.98
4.0	5.4	120° ¹⁵ < h <= 160° ¹⁵	210 < K <= 250	Yes	19.5	1.0	13	175	231.5	21	21	130	45	4	9.61
8.0	10.8			Yes	15.5	1.0	13	250	310.5	21	21	201	49	4	15.26
12.0	16.2			Yes	17.5	1.0	14	314	375.5	25	21	251	63	4	20.55
4.0	5.4	180° ¹⁵	270	Yes	19.5	1.0	13	180	236.5	21	21	135	45	4	9.96
8.0	10.8			Yes	15.5	1.0	13	270	330.5	21	21	221	49	4	15.26
12.0	16.2			Yes	17.5	1.0	14	334	395.5	25	21	271	63	4	20.69
4.0	5.4	200° ¹⁵	290	Yes	19.5	1.0	13	200	256.5	21	21	155	45	4	9.69
8.0	10.8			Yes	15.5	1.0	13	290	350.5	21	21	241	49	4	15.26
12.0	16.2			Yes	17.5	1.0	16	354	415.5	25	25	291	63	5	20.76
4.0	5.4	220° ¹⁵	310	Yes	19.5	1.0	13	220	276.5	21	21	175	45	4	9.47
8.0	10.8			Yes	15.5	1.0	13	310	370.5	21	21	261	49	4	15.26
12.0	16.2			Yes	17.5	1.0	16	374	435.5	25	25	311	63	5	20.87
4.0	5.4	240° ¹⁵	330	Yes	19.5	1.0	15	240	296.5	25	25	195	45	5	9.24
8.0	10.8			Yes	15.5	1.0	15	330	390.5	25	25	281	49	5	15.21
12.0	16.2			Yes	17.5	1.0	16	394	455.5	25	25	331	63	5	20.97
4.0	5.4	260° ¹⁵	350	Yes	19.5	1.0	15	260	316.5	25	25	215	45	5	9.10
8.0	10.8			Yes	15.5	1.0	15	350	410.5	25	25	301	49	5	15.22
12.0	16.2			Yes	17.5	1.0	16	414	475.5	25	25	351	63	5	21.07

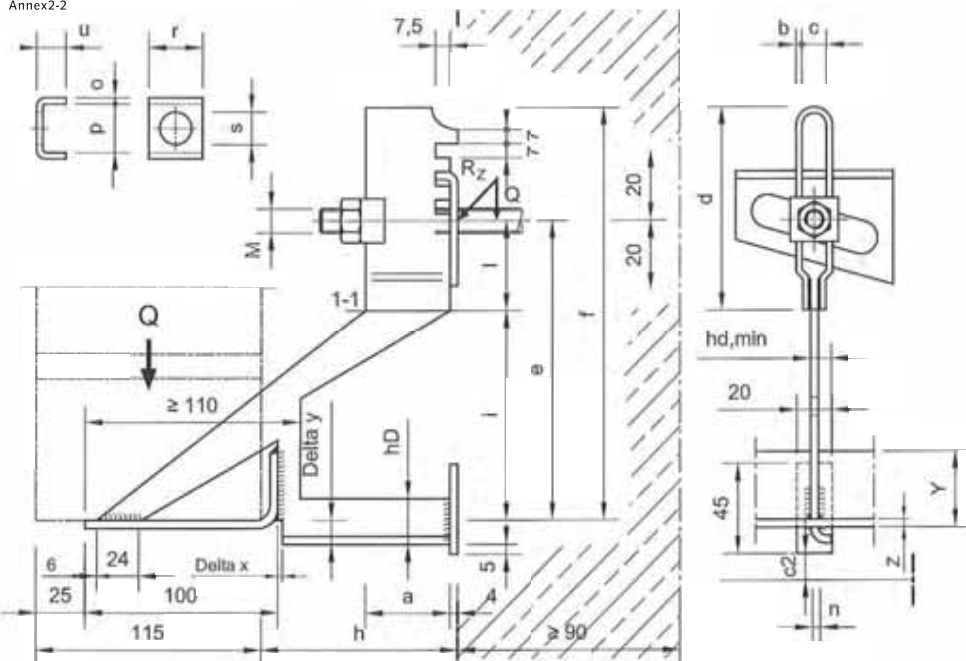
* max. acting force at the connection for the fixing

Load Q [kN]	Q _d [kN]	a [mm]	b [mm]		c [mm]	d [mm]	o [mm]	p [mm]	r [mm]	s [mm]	u [mm]	M [mm]	min c2 [mm]
			(1.4401 / 1.4404 / 1.4571)	(1.4062 / 1.4162 / 1.4362 / 1.4482)									
4.0	5.4	43	3	3	12.5	121	2.5	20	22	13	12	M10/ M12	0
8.0	10.8	46	5	3	16.5	125	3	27.2	25	17	11	M12/ M16	13.8
12.0	16.2	49	6	4	16.5	142	3	27.2	25	17	11	M16	19.9

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

- Fixing method: Anchor bolts or anchor channel
Mat. no. 1.4401/1.4404/1.4571 or 1.4062/1.4162/1.4362/1.4462 or 1.4529/1.4547 acc. to building authority approval or ETA
- Cladding brickwork: according to DIN 1053 or DIN EN 1996-1-1
- Support structure ≥ C20/25
- Anchor material: Bracket head, adjustable slotted plate, U bracket:
Mat. no. 1.4401/1.4404/1.4571 S235 or. 1.4062/1.4162/1.4362/1.4482
web plate, support plate, pressure plate:
Mat. no. 1.4062/ 1.4162/ 1.4362/1.4482

Annex2-2



- 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.
- For brick weights greater than 20 kN/m³, angles may be used without further verification whose section modulus is greater by a factor of brick weight:- [kN/m³] 1 20 kN/m³, than provided in the tables, with equivalent or greater material thickness.
- To avoid large deflections of the support angles during assembly, these should remain supported during on-going masonry work until sufficient mortar strength has been reached and a (shear) panel effect is ensured.
- The bracket head including the adjustable slotted plate and the horizontal weld seam at the bracket head / web plate in section 1-1 or the resistance projection welded connection of the bracket head / web plate are not included in this type test; they are regulated in a separate building authority approval.
- Details and installation situations are shown in annex 7

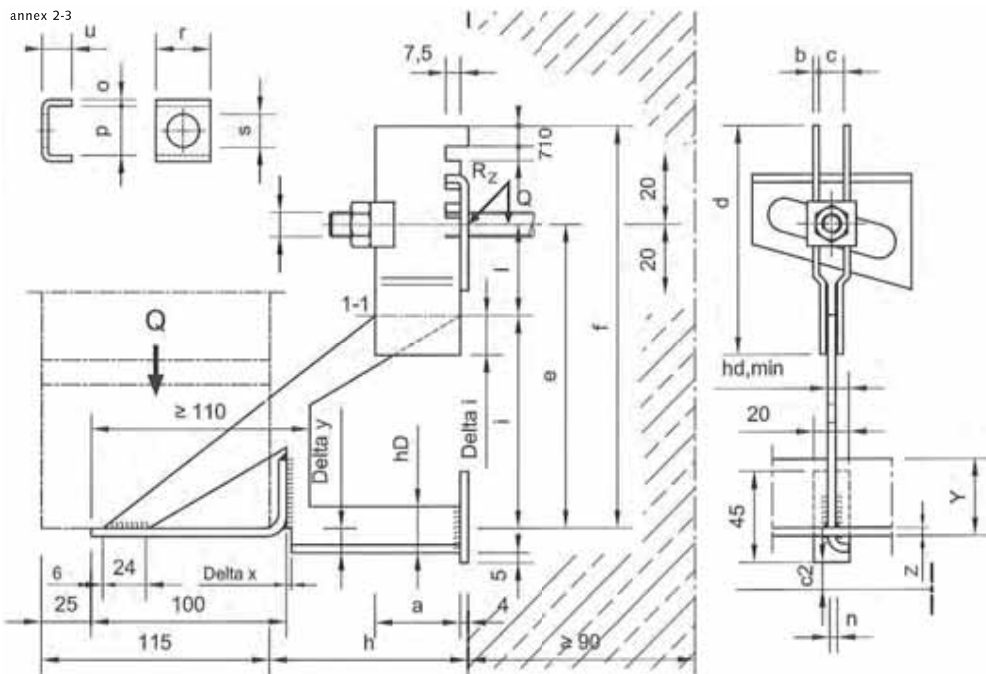
Load		Ventilation gap	Cantilever	Compression strut with angled edge	Delta x	Delta y	e	f	hD	hDmin	i	l	n	*
Q [kN]	Q ₂ [kN]	h [mm]	K [mm]	-]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	max Rz [kN]
4.0	5.4	<= 120 ⁻¹⁵	<= 210	Yes	1.0	10	150	206.5	23	12	105	45	3	9.65
8.0	10.8			No	/	/	200	260.5	32	/	151	49	4	16.32
12.0	16.2			No	/	/	264	325.5	36	/	201	63	4	20.98
4.0	5.4	120 ⁻¹⁵ <= 160 ⁻¹⁵	210<K<= 250	Yes	1.0	13	175	231.5	21	21	130	45	4	9.61
8.0	10.8			Yes	1.0	13	250	310.5	21	21	201	49	4	15.26
12.0	16.2			Yes	1.0	14	314	375.5	25	21	251	63	4	20.55
4.0	5.4	180 ⁻¹⁵	270	Yes	1.0	13	180	236.5	21	21	135	45	4	9.96
8.0	10.8			Yes	1.0	13	270	330.5	21	21	221	49	4	15.26
12.0	16.2			Yes	1.0	14	334	395.5	25	21	271	63	4	20.69
4.0	5.4	200 ⁻¹⁵	290	Yes	1.0	13	200	256.5	21	21	155	45	4	9.69
8.0	10.8			Yes	1.0	13	290	350.5	21	21	241	49	4	15.26
12.0	16.2			Yes	1.0	16	354	415.5	25	25	291	63	5	20.76
4.0	5.4	220 ⁻¹⁵	310	Yes	1.0	13	220	276.5	21	21	175	45	4	9.47
8.0	10.8			Yes	1.0	13	310	370.5	21	21	261	49	4	15.26
12.0	16.2			Yes	1.0	16	374	435.5	25	25	311	63	5	20.87
4.0	5.4	240 ⁻¹⁵	330	Yes	1.0	15	240	296.5	25	25	195	45	5	9.24
8.0	10.8			Yes	1.0	15	330	390.5	25	25	281	49	5	15.21
12.0	16.2			Yes	1.0	16	394	455.5	25	25	331	63	5	20.97
4.0	5.4	260 ⁻¹⁵	350	Yes	1.0	15	260	316.5	25	25	215	45	5	9.10
8.0	10.8			Yes	1.0	15	350	410.5	25	25	301	49	5	15.22
12.0	16.2			Yes	1.0	16	414	475.5	25	25	351	63	5	21.07

* max. acting force at the connection for the fixing

Load		a	b		c	d	o	p	r	s	u	M	min c2 (**)
Q	Q _d		(1.4401/ 1.4404/ 1.4571)	(1.4062/ 1.4162/ 1.4362/ 1.4482)									
[kN]	[kN]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
4.0	5.4	43	3	3	12.5	101.5	2.5	20	22	13	12	M10/ M12	0
8.0	10.8	46	5	3	16.5	109.5	3	27.2	25	17	11	M12/ M16	13.8
12.0	16.2	49	6	4	16.5	124.5	3	27.2	25	17	11	M16	19.9

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

Fixing method:	Anchor bolts or anchor channel Mat.no. 1.4401/1.4404/1.4571 or 1.4062/1.4162/1.4362/1.4462 or 1.4529/1.4547 acc. to Building authority approval or ETA
Cladding brickwork:	according to DIN 1053 or DIN EN 1996-1-1
Support structure	≥ C20/25
Anchor material:	Bracket head, adjustable slotted plate, U bracket: Mat. no. 1.4401/1.4404/1.4571 S235 or. 1.4062/1.4162/1.4362/1.4482 web plate, support plate, pressure plate: Mat. no. 1.4062/ 1.4162/ 1.4362/1.4482



- 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.
- For brick weights greater than 20 kN/m³, angles may be used without further verification whose section modulus is greater by a factor of brick weight:- [kN/m³] 1 20 kN/m³, than provided in the tables, with equivalent or greater material thickness.
- To avoid large deflections of the support angles during assembly, these should remain supported during on-going masonry work until sufficient mortar strength has been reached and a (shear) panel effect is ensured.
- The bracket head including the adjustable slotted plate and the horizontal weld seam at the bracket head / web plate in section 1-1 or the resistance projection welded connection of the bracket head / web plate are not included in this type test; they are regulated in a separate building authority approval.
- Details and installation situations are shown in annex 7

Load		Ventilation gap	Cantilever	Compression strut with angled edge												*
Q	Q _d	h	K		Delta i	Delta x	Delta y	e	f	hD	hDmin	i	l	n		max Rz
[kN]	[kN]	[mm]	[mm]	[-]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[kN]
4.0	5.4	<= 120° ¹⁵	<= 210	Yes	19.5	1.0	10	150	198.5	23	12	105	45	3		9.65
8.0	10.8			No	15.5	/	/	200	250.5	32	/	151	49	4		16.32
12.0	16.2			No	17.5	/	/	264	314.5	36	/	201	63	4		20.98
4.0	5.4	120° ¹⁵ <h<= 160° ¹⁵	210<K<= 250	Yes	19.5	1.0	13	175	223.5	21	21	130	45	4		9.61
8.0	10.8			Yes	15.5	1.0	13	250	300.5	21	21	201	49	4		15.26
12.0	16.2			Yes	17.5	1.0	14	314	364.5	25	21	251	63	4		20.55
4.0	5.4	180° ¹⁵	270	Yes	19.5	1.0	13	180	228.5	21	21	135	45	4		9.96
8.0	10.8			Yes	15.5	1.0	13	270	320.5	21	21	221	49	4		15.26
12.0	16.2			Yes	17.5	1.0	14	334	384.5	25	21	271	63	4		20.69
4.0	5.4	200° ¹⁵	290	Yes	19.5	1.0	13	200	248.5	21	21	155	45	4		9.69
8.0	10.8			Yes	15.5	1.0	13	290	340.5	21	21	241	49	4		15.26
12.0	16.2			Yes	17.5	1.0	16	354	404.5	25	25	291	63	5		20.76
4.0	5.4	220° ¹⁵	310	Yes	19.5	1.0	13	220	268.5	21	21	175	45	4		9.47
8.0	10.8			Yes	15.5	1.0	13	310	360.5	21	21	261	49	4		15.26
12.0	16.2			Yes	17.5	1.0	16	374	424.5	25	25	311	63	5		20.87
4.0	5.4	240° ¹⁵	330	Yes	19.5	1.0	15	240	288.5	25	25	195	45	5		9.24
8.0	10.8			Yes	15.5	1.0	15	330	380.5	25	25	281	49	5		15.21
12.0	16.2			Yes	17.5	1.0	16	394	444.5	25	25	331	63	5		20.97
4.0	5.4	260° ¹⁵	350	Yes	19.5	1.0	15	260	308.5	25	25	215	45	5		9.10
8.0	10.8			Yes	15.5	1.0	15	350	400.5	25	25	301	49	5		15.22
12.0	16.2			Yes	17.5	1.0	16	414	464.5	25	25	351	63	5		21.07

* max. acting force at the connection for the fixing

Load		a	b		c	d	o	p	r	s	u	M	min c2 (**)
Q	Q _d		(1.4401/ 1.4404/ 1.4571)	(1.4062/ 1.4162/ 1.4362/ 1.4482)									
[kN]	[kN]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
4.0	5.4	43	3	3	12.5	113	2.5	20	22	13	12	M10/ M12	0
8.0	10.8	46	5	3	16.5	115	3	27.2	25	17	11	M12/ M16	13.8
12.0	16.2	49	6	4	16.5	131	3	27.2	25	17	11	M16	19.9

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

- Fixing method: Anchor bolts or anchor channel
Mat.no. 1.4401/1.4404/1.4571 or 1.4062/1.4162/1.4362/1.4462 or 1.4529/1.4547 acc. to Building authority approval or ETA
- Cladding brickwork: according to DIN 1053 or DIN EN 1996-1-1
- Support structure $\geq$ C20/25
- Anchor material: Bracket head, adjustable slotted plate, U bracket:
Mat. no. 1.4401/1.4404/1.4571 S235 or 1.4062/1.4162/1.4362/1.4482
web plate, support plate, pressure plate:
Mat. no. 1.4062/ 1.4162/ 1.4362/1.4482

- 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 $\geq$ 15 Nm, M12 $\geq$ 25 Nm, M16 $\geq$ 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.
4. For brick weights greater than 20 kN/m³, angles may be used without further verification whose section modulus is greater by a factor of brick weight:- [kN/m³] 1 20 kN/m³, than provided in the tables, with equivalent or greater material thickness.
5. To avoid large deflections of the support angles during assembly, these should remain supported during on-going masonry work until sufficient mortar strength has been reached and a (shear) panel effect is ensured.
6. The bracket head including the adjustable slotted plate and the horizontal weld seam at the bracket head / web plate in section 1-1 or the resistance projection welded connection at the bracket head / web plate are not included in this type test; they are regulated in a separate building authority approval.
7. Details and installation situations are shown in annex 7

Load		Ventilation gap	Cantilever	Compression strut with angled edge												*
Q	Q _g	h	K	[-]	Delta x	Delta y	e	f	hD	hDmin	i	l	n		max Rz	
[kN]	[kN]	[mm]	[mm]		[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]		[kN]	
4.0	5.4	<= 120 ⁻¹⁵	<= 210	Yes	1.0	10	150	198.5	23	12	105	45	3	9.65		
8.0	10.8			No	/	/	200	250.5	32	/	151	49	4	16.32		
12.0	16.2			No	/	/	264	314.5	36	/	201	63	4	20.98		
4.0	5.4	120 ⁻¹⁵ <h<= 160 ⁻¹⁵	210<K<= 250	Yes	1.0	13	175	223.5	21	21	130	45	4	9.61		
8.0	10.8			Yes	1.0	13	250	300.5	21	21	201	49	4	15.26		
12.0	16.2			Yes	1.0	14	314	364.5	25	21	251	63	4	20.55		
4.0	5.4	180 ⁻¹⁵	270	Yes	1.0	13	180	228.5	21	21	135	45	4	9.96		
8.0	10.8			Yes	1.0	13	270	320.5	21	21	221	49	4	15.26		
12.0	16.2			Yes	1.0	14	334	384.5	25	21	271	63	4	20.69		
4.0	5.4	200 ⁻¹⁵	290	Yes	1.0	13	200	248.5	21	21	155	45	4	9.69		
8.0	10.8			Yes	1.0	13	290	340.5	21	21	241	49	4	15.26		
12.0	16.2			Yes	1.0	16	354	404.5	25	25	291	63	5	20.76		
4.0	5.4	220 ⁻¹⁵	310	Yes	1.0	13	220	268.5	21	21	175	45	4	9.47		
8.0	10.8			Yes	1.0	13	310	360.5	21	21	261	49	4	15.26		
12.0	16.2			Yes	1.0	16	374	424.5	25	25	311	63	5	20.87		
4.0	5.4	240 ⁻¹⁵	330	Yes	1.0	15	240	288.5	25	25	195	45	5	9.24		
8.0	10.8			Yes	1.0	15	330	380.5	25	25	281	49	5	15.21		
12.0	16.2			Yes	1.0	16	394	444.5	25	25	331	63	5	20.97		
4.0	5.4	260 ⁻¹⁵	350	Yes	1.0	15	260	308.5	25	25	215	45	5	9.10		
8.0	10.8			Yes	1.0	15	350	400.5	25	25	301	49	5	15.22		
12.0	16.2			Yes	1.0	16	414	464.5	25	25	351	63	5	21.07		

Load		a	b		c	d	o	p	r	s	u	M	min c2 (**)
Q	Q _d		(1.4401/ 1.4404/ 1.4571)	(1.4062/ 1.4162/ 1.4362/ 1.4482)									
[kN]	[kN]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
4.0	5.4	43	3	3	12.5	93.5	2.5	20	22	13	12	M10/ M12	0
8.0	10.8	46	5	3	16.5	99.5	3	27.2	25	17	11	M12/ M16	13.8
12.0	16.2	49	6	4	16.5	113.5	3	27.2	25	17	11	M16	19.9

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

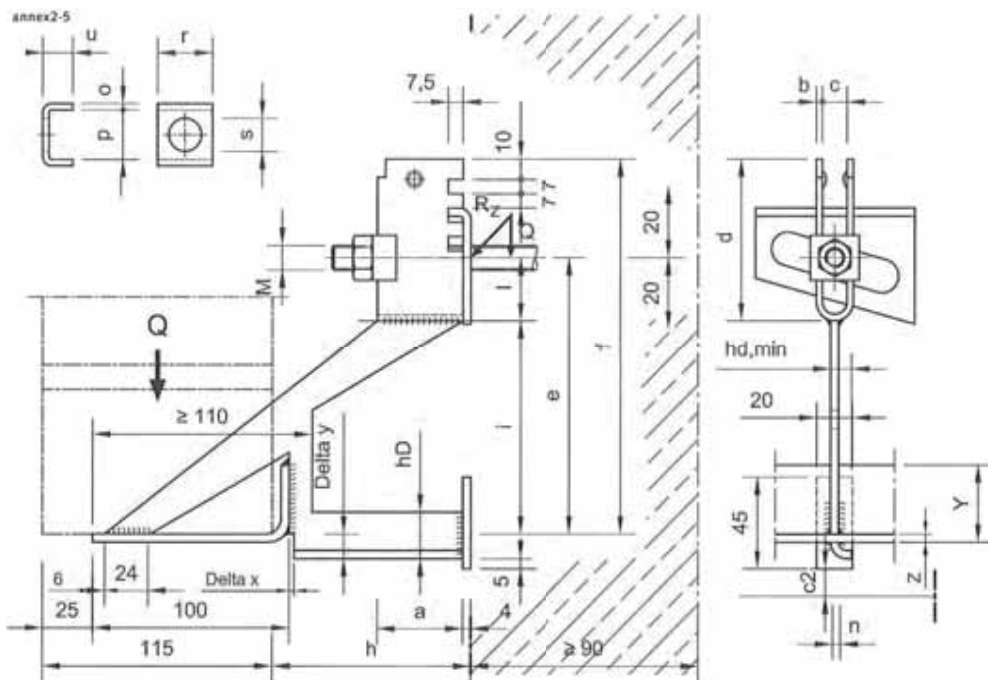
Fixing method:	Anchor bolts or anchor channel Mat.no. 1.4401/1.4404/1.4571 or 1.4062/1.4162/1.4362/1.4462 or 1.4529/1.4547 acc. to Building authority approval or ETA
Cladding brickwork:	according to DIN 1053 or DIN EN 1996-1-1
Support structure	≥ C20/25
Anchor material:	Bracket head, adjustable slotted plate, U bracket: Mat. no. 1.4401/1.4404/1.4571 S235 or. 1.4062/1.4162/1.4362/1.4482 web plate, support plate, pressure plate: Mat. no. 1.4062/ 1.4162/ 1.4362/1.4482

ANNEX 4

Type Test S-WUE/150438

**Brickwork support bracket HK5-F
with bracket head K5D
(Welded seam)**

HALFEN GmbH
Liebigstr. 14, 40764 Langenfeld-Richrath
Tel. 02173 970-0, Fax. 02173 970-123



- 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.
- For brick weights greater than 20 kN/m³, angles may be used without further verification whose section modulus is greater by a factor of brick weight:- [kN/m³] 1 20 kN/m³, than provided in the tables, with equivalent or greater material thickness.
- To avoid large deflections of the support angles during assembly, these should remain supported during on-going masonry work until sufficient mortar strength has been reached and a (shear) panel effect is ensured.
- The bracket head including the adjustable slotted plate and the horizontal weld seam at the bracket head / web plate in section 1-1 or the resistance projection welded connection of the bracket head / web plate are not included in this type test; they are regulated in a separate building authority approval.
- Details and installation situations are shown in annex 7

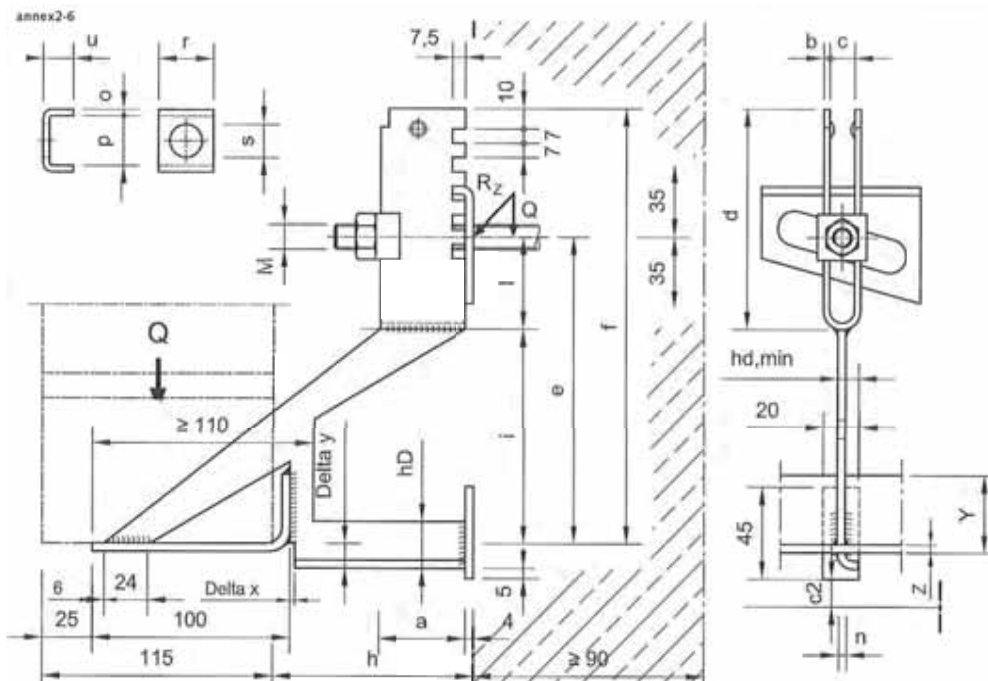
Load		Ventilation gap	Cantilever	Compression strut with angled edge												*
Q [kN]	Q ₂ [kN]	h [mm]	K [mm]	[-]	Delta x [mm]	Delta y [mm]	e [mm]	f [mm]	hD [mm]	hdmin [mm]	i [mm]	l [mm]	n		max Rz [kN]	
4.0	5.4	<= 120 ⁻¹⁵	<= 210	Yes	1.0	10	136	184.5	23	12	105	31	3		10.46	
8.0	10.8			No	/	/	186	236.5	32	/	151	35	4		17.15	
12.0	16.2			No	/	/	236	386.5	36	/	201	35	4		22.17	
4.0	5.4	120 ⁻¹⁵ ch<= 160 ⁻¹⁵	210<K<= 250	Yes	1.0	13	161	209.5	21	21	130	31	4		10.26	
8.0	10.8			Yes	1.0	13	236	286.5	21	21	201	35	4		15.75	
12.0	16.2			Yes	1.0	14	286	336.5	25	21	251	35	4		21.38	
4.0	5.4	180 ⁻¹⁵	270	Yes	1.0	13	166	214.5	21	21	135	31	4		10.63	
8.0	10.8			Yes	1.0	13	256	306.5	21	21	221	35	4		15.71	
12.0	16.2			Yes	1.0	14	306	356.5	25	21	271	35	4		21.48	
4.0	5.4	200 ⁻¹⁵	290	Yes	1.0	13	186	234.5	21	21	155	31	4		10.25	
8.0	10.8			Yes	1.0	13	276	326.5	21	21	241	35	4		15.68	
12.0	16.2			Yes	1.0	16	326	376.5	25	25	291	35	5		21.51	
4.0	5.4	220 ⁻¹⁵	310	Yes	1.0	13	206	254.5	21	21	175	31	4		9.95	
8.0	10.8			Yes	1.0	13	396	346.5	21	21	261	35	4		15.65	
12.0	16.2			Yes	1.0	16	346	396.5	25	25	311	35	5		21.59	
4.0	5.4	240 ⁻¹⁵	330	Yes	1.0	15	226	274.5	25	25	195	31	5		9.65	
8.0	10.8			Yes	1.0	15	316	366.5	25	25	281	35	5		15.57	
12.0	16.2			Yes	1.0	16	366	416.5	25	25	331	35	5		21.66	
4.0	5.4	260 ⁻¹⁵	350	Yes	1.0	15	246	294.5	25	25	215	31	5		9.46	
8.0	10.8			Yes	1.0	15	336	386.5	25	25	301	35	5		15.55	
12.0	16.2			Yes	1.0	16	386	436.5	25	25	351	35	5		21.73	

* max. acting force at the connection for the fixing

Load		a	b		c	d	o	p	r	s	u	M	min c2 (**)
Q	Q _d		(1.4401/ 1.4404/ 1.4571)	(1.4062/ 1.4162/ 1.4362/ 1.4482)									
[kN]	[kN]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
4.0	5.4	43	3	3	12.5	79.5	2.5	20	22	13	12	M10/ M12	1,1
8.0	10.8	46	5	3	16.5	85.5	3	27.2	25	17	11	M12/ M16	19.1
12.0	16.2	49	6	4	16.5	85.5	3	27.2	25	17	11	M16	29.1

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

Fixing method:	Anchor bolts or anchor channel Mat.no. 1.4401/1.4404/1.4571 or 1.4062/1.4162/1.4362/1.4462 or 1.4529/1.4547 acc. to Building authority approval or ETA
Cladding brickwork:	according to DIN 1053 or DIN EN 1996-1-1
Support structure	≥ C20/25
Anchor material:	Bracket head, adjustable slotted plate, U bracket: Mat. no. 1.4401/1.4404/1.4571 S235 or. 1.4062/1.4162/1.4362/1.4482 bracket plate, support plate, pressure plate: Mat. no. 1.4062/ 1.4162/ 1.4362/1.4482



- 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.
- For brick weights greater than 20 kN/m³, angles may be used without further verification whose section modulus is greater by a factor of brick weight:- [kN/m³] 1 20 kN/m³, than provided in the tables, with equivalent or greater material thickness.
- To avoid large deflections of the support angles during assembly, these should remain supported during on-going masonry work until sufficient mortar strength has been reached and a (shear) panel effect is ensured.
- The bracket head including the adjustable slotted plate and the horizontal weld seam at the bracket head / web plate in section 1-1 or the resistance projection welded connection of the bracket head / web plate are not included in this type test; they are regulated in a separate building supervisory approval.
- Details and installation situations are shown in annex 7

Load		Ventilation gap	Cantilever	Compression strut with angled edge	Delta x	Delta y	e	f	hD	hDmin	i	l	n	*
Q [kN]	Q _e [kN]	h [mm]	K [mm]	-]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	max Rzd [kN]
4.0	5.4	<= 120 ⁻¹⁵	<= 210	Yes	1.0	10	150	212.5	23	12	105	45	3	10.53
8.0	10.8			No	/	/	200	264.5	32	/	151	49	4	17.22
12.0	16.2			No	/	/	250	314.5	36	/	201	49	4	22.22
4.0	5.4	120 ⁻¹⁵ <h<= 160 ⁻¹⁵	210<K<= 250	Yes	1.0	13	175	237.5	21	21	130	45	4	10.31
8.0	10.8			Yes	1.0	13	250	314.5	21	21	201	49	4	15.79
12.0	16.2			Yes	1.0	14	300	364.5	25	21	251	49	4	21.41
4.0	5.4	180 ⁻¹⁵	270	Yes	1.0	13	180	242.5	21	21	135	45	4	10.68
8.0	10.8			Yes	1.0	13	270	334.5	21	21	221	49	4	15.75
12.0	16.2			Yes	1.0	14	320	384.5	25	21	271	49	4	21.51
4.0	5.4	200 ⁻¹⁵	290	Yes	1.0	13	200	262.5	21	21	155	45	4	10.29
8.0	10.8			Yes	1.0	13	290	354.5	21	21	241	49	4	15.71
12.0	16.2			Yes	1.0	16	340	404.5	25	25	291	49	5	21.54
4.0	5.4	220 ⁻¹⁵	310	Yes	1.0	13	220	282.5	21	21	175	45	4	9.99
8.0	10.8			Yes	1.0	13	310	374.5	21	21	261	49	4	15.68
12.0	16.2			Yes	1.0	16	360	424.5	25	25	311	49	5	21.62
4.0	5.4	240 ⁻¹⁵	330	Yes	1.0	15	240	302.5	25	25	195	45	5	9.68
8.0	10.8			Yes	1.0	15	330	394.5	25	25	281	49	5	15.60
12.0	16.2			Yes	1.0	16	380	444.5	25	25	331	49	5	21.69
4.0	5.4	260 ⁻¹⁵	350	Yes	1.0	15	260	322.5	25	25	215	45	5	9.49
8.0	10.8			Yes	1.0	15	350	414.5	25	25	301	49	5	15.58
12.0	16.2			Yes	1.0	16	400	464.5	25	25	351	49	5	21.75

* max. acting force at the connection for the fixing

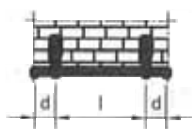
Load		a	b		c	d	o	p	r	s	u	M	min c2 **)
Q	Q _d		(1.4401 / 1.4404 / 1.4571)	(1.4062 / 1.4162 / 1.4362 / 1.4482)									
[kN]	[kN]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
4.0	5.4	43	3	3	12.5	107.5	2.5	20	22	13	12	M10/ M12	1.3
8.0	10.8	46	5	3	16.5	113.5	3	27.2	25	17	11	M12/ M16	19.6
12.0	16.2	49	6	4	16.5	113.5	3	27.2	25	17	11	M16	29.5

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

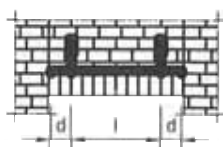
Fixing method:	Anchor bolts or anchor channel Mat.no. 1.4401/1.4404/1.4571 or 1.4062/1.4162/1.4362/1.4462 or 1.4529/1.4547 acc. to building authority approval or ETA
Cladding brickwork:	according to DIN 1053 or DIN EN 1996-1-1
Support structure	≥ C20/25
Anchor material:	Bracket head, adjustable slotted plate, U bracket: Mat. no. 1.4401/1.4404/1.4571 S235 or. 1.4062/1.4162/1.4362/1.4482 web plate, support plate, pressure plate: Mat. no. 1.4062/ 1.4162/ 1.4362/1.4482

Installation examples:

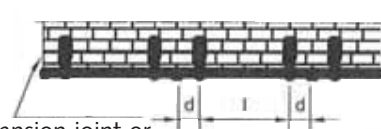
Column



Expansion joint



Wall



Expansion joint or
Building edge

Span distance [mm/mm/mm] d / l / d	Mortar class	Mat. 1.4062 / 1.4162 / 1.4362 / 1.4482 angle x / y / z [mm / mm / mm] for load class [kN]		
		4.0	8.0	12.0
245 / 500 / 245	≥ II ¹⁾	100 / 40 / 3	100 / 40 / 3	100 / 40 / 3
245 / 750 / 245		100/40/3	100 / 40 / 3	100 / 40 / 3
245 / 1000 / 245		100/40 / 3	100 / 40/ 3	100 / 40 / 3
250 / 1250 / 245		100 / 40 / 4	100 / 40 / 4	100 / 40 / 4
120 / 500 / 120	≥ II ¹⁾	100 / 40 / 3	100 / 40 / 3	100 / 40 / 3
120 / 750 / 120		100 / 40 / 3	100 / 40 / 3	100 / 40 / 3
120 / 1000 / 120		100 / 40 / 4	100 / 40 / 4	100 / 40 / 4

1) Offset value > Brick height, otherwise mortar class IIa

Fixing method:

anchor bolts or anchor channel
Mat.no. 1.4401/1.4404/1.4571 or 1.4062/1.4162/1.4362/1.4462 or
1.4529/1.4547 acc. to Building Authority Approval or ETA

Cladding brickwork:

according to DIN 1053 or DIN EN 1996-1-1

Support structure

≥ C20/25

Anchor material:

Bracket head, adjustable slotted plate, U bracket:
Mat. no. 1.4401/1.4404/1.4571 S235 or. 1.4062/1.4162/1.4362/1.4482
web plate, support plate, pressure plate:
Mat. no. 1.4062/ 1.4162/ 1.4362/1.4482

Detail 1:

HK5-F-4.0, HKA5-F-8.0 and HK5-F-12.0

