

HALFEN HAB H ANCHOR BOLT

Approval Z-21.5-1761



HALFEN HAB H ANCHOR BOLTS

General Note

Use of third-party products

This approval only applies to original HALFEN products. The specifications in this approval are not transferable to other products. Users are fully liable for personal injuries and material damage caused by third-party products used instead of HALFEN products.



Note: This translation of the original German version has not been verified by the Deutsches Institut für Bautechnik.

General Certificate of Approval

DIBt

German Institute of Construction Engineering
(*DIBt Deutsches Institut für Bautechnik*)

Approval Body for Construction Products and Methods
Inspection Board for Construction Technology
Member of the European Organisation for
Technical Approvals EOTA,
the European Union of Agrément UEAtc and the WFTAO

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Date: Ref no.:
6th December 2018 123-1.21.5-52/18

Approval no. Z-21.5-1761

Valid from: 24th October 2018

Valid until: 24th October 2023

Applicant:

Halfen GmbH

Liebigstraße 14,
40764 Langenfeld,
GERMANY

Object of this approval:

HALFEN HAB H Anchor bolt

The above-mentioned product is hereby granted general certificate of approval.
This general certificate of approval includes six pages and seven annexes.
This article was first General Building approved on the 16th January 2004

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I. GENERAL PROVISIONS

1. The general certificate of approval confirms the usability or fitness for use of the object of approval pertaining to building regulation issued by the German federal states.
2. The general certificate of approval does not replace the statutory approvals, permits and certificates required for construction projects.
3. The general certificate of approval is issued regardless of the rights of third parties, and in particular private proprietary rights.
4. The manufacturer and distributor of the construction product must make copies of the national technical approval available to the purchaser i.e. the end-user irrespective of further regulations as stated in the "Specific Provisions", and must give notice that the national technical approval for the product must be available at the point of application. Copies of the national technical approval must be made available to the respective authorities on request.
5. Reproduction of this national technical approval must be in full. Reproduction in excerpts requires the consent of the German Institute of Construction Engineering (DIBt *Deutsches Institut für Bautechnik*). Text and drawings used in advertising material must not contradict this national technical approval. Translations of the national technical approval must include a disclaimer as follows "This translation of the original German version has not been verified by the Deutsches Institut für Bautechnik" (*Vom Deutschen Institut für Bautechnik nicht geprüfte Übersetzung der deutschen Originalfassung*).
6. The general certificate of approval is issued subject to revocation. The provisions of the general certificate of approval can be extended and amended, as the current status of technical advancement requires.
7. This approval covers information and documents submitted by the applicant. Any change to the fundamentals is not covered by this approval and must be declared to the German Institute of Construction Engineering immediately.
8. The general type-approval covered by this document is also valid as a general building authority type approval.

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II. SPECIAL PROVISIONS

1. Object of approval and area of application

1.1 Object of Approval

The HALFEN HAB H Anchor bolt (hereafter referred to as 'Anchor bolt') is made from ribbed concrete reinforcing steel B500B, 16, 20, 25, 32 and 40 mm diameters, two hexagon nuts and two washers. A head is swage-fitted at one end of the Anchor bolt with a M16, M20, M24, M30 or M39 thread at the other end.

The anchor bolt is cast in concrete up to the embedment mark.

In annex 1 the Anchor bolt is shown in an installed state.

1.2 Area of application

The Anchor bolts may only be used for the connection of precast concrete columns with the respective HALFEN Column Shoes and steel/composite columns with appropriate foot-plates. The Anchor bolts may be anchored under predominantly static loads or quasi-static loads in reinforced or non-reinforced normal concrete with a strength class of at least C20/25 according to DIN EN 206: 2017-01. The Anchor bolts may be used in cracked and non-cracked concrete. To ensure that the Anchor bolts are protected from corrosion, the joint between the reinforced concrete precast column, and the installation recesses for the Anchor bolts in the Column shoe must be completely grouted after installation with a flush-finished, high-strength, low-shrinkage mortar or grouting concrete according to the specifications set by the German Committee for Structural Concrete (DAfStb *Deutscher Ausschuss für Stahlbeton*) "Production and use of cementitious, grouting concrete and grouting mortar".

Ensure the concrete cover specified in DIN EN 1992-1-1 :2011-01 as well as DIN EN 1992-1-1/NA:2013-04 is met.

Anchor bolts used for connecting steel columns shall only be used in interior rooms, e.g. flats, apartments, offices, schools, hospitals, commercial projects – except for wet rooms.

2 Regulations for the construction product(s)

2.1 Properties and composition

The dimensions of the Anchor bolts must comply with the values listed in table 1 annex 2.

Any material properties, dimensions and tolerances of the Anchor bolts which are not specified in this general certificate of approval must comply with the specifications submitted to the DiBt, German Institute of Construction Engineering, the certification authority and the third-party auditor.

Ribbed, B500B concrete reinforcing steel according to DIN 488-1 :2009-01 with a 0.2% yield strength of 500 N/mm² and a minimum tensile strength of 550 N/mm² must be used for the 16, 20 and 25 mm Anchor bolts.

For Anchor bolts of 32 and 40 mm, ribbed B500B concrete-reinforcing steel in accordance with a general certificate of approval, with a 0.2% yield strength of 500 N/mm² and a minimum tensile strength of 550 N/mm² is used.

The Anchor bolt is made from class A, non-flammable construction material in accordance with DIN 4102-1:1998-05 "Fire Behaviour of Construction Materials and Structural Elements; Construction Materials, Terms, Requirements and Tests".

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2.2 Packaging, Storage and identification

2.2.1 Packaging and Storage

The Anchor bolts must only be packaged and supplied as one fixing unit.

2.2.2 Identification

The manufacturer must ensure the packaging, packaging-documents and delivery note display the conformity symbol (Ü) in accordance with the conformity regulations of the German federal states for said symbol.

The manufacturer's identification mark, the approval number and a full description of the Anchor bolts must also be included. The label may only be applied after the requirements according to Section 2.3 have been met.

The Anchor bolts must be labelled according to their type and thread diameter, e.g. HAB H 24.

Each Anchor bolt must be marked with the manufacturer's identification mark and thread diameter as shown in annex 2. The maximum anchorage depth is indicated by the end of the thread.

2.3 Verification of conformity

2.3.1 General information

Confirmation of compliance of the Anchor bolt with the provisions of this general certificate of approval must be confirmed for each manufacturing plant with a Certificate of Conformity based on factory production control and by a Certificate of Conformity from a recognized certification body as well as by regular third-party monitoring by a recognized monitoring body in compliance with the following provisions:

To gain issue of a Certificate of Conformity and for the purpose of third-party tests, which shall include the required product tests, the manufacturer of the anchor bolts is required to involve a recognized certification body and a recognized monitoring body.

The manufacture is required to label the product with the conformity Ü-Symbol (*Übereinstimmungszeichen*) with reference to its application to indicate that the product has been awarded a conformity certificate (*Übereinstimmungszertifikat*).

The certification body shall forward a copy of the awarded certificate of conformity to the German Institute of Construction Engineering for information.

2.3.2 Factory production control

Factory production control must be set up and carried out at each manufacturing plant. Factory production control is understood to mean a system of continual monitoring of the production process set up by the manufacturer to ensure that the manufactured construction products comply with the provisions of this general certificate of approval.

The extent, method and frequency of factory production control is determined by the test and inspection documents deposited with the German Institute of Construction Engineering and the third-party monitoring body.

The results of the factory production control must be documented and evaluated. The documents must contain at least the following details:

- Description of the construction product, i.e. the raw material, the individual components
- Method of control or test
- Date of manufacture and tests of the construction product, raw material, individual components
- Result of the control and tests and where appropriate, comparison with the specifications
- Signature of the person responsible for factory production control.

These records must be archived for at least five years and submitted to the auditor selected for third-party monitoring. On request, the documents must be made available to the German Institute of Construction Engineering and the responsible building control authority (*Bauaufsichtsbehörde*).

If the test results are unsatisfactory, the manufacturer must take the necessary action immediately to eliminate the problem. Construction products that do not meet the specification must be handled so as to prevent them from being confused in any way with parts which do conform. After the defect has been resolved, the relevant test must be repeated without delay, where this is technically feasible and necessary to ensure the defect has been rectified.

2.3.3 Third-party auditing

Factory production control at each manufacturing location must be evaluated by an third-party auditor on a regular basis, at least once a year. The inspection and supervision plan on record at the German Institute of Construction Engineering and the external auditor are authoritative for the scope, type and frequency of the external auditing.

The certification and external auditing results must be archived for at least five years. They must be submitted on request by the certification body or auditor to the German Institute of Construction Engineering and the responsible building control authority (*Bauaufsichtsbehörde*).

3 Specifications for planning, calculation and application

3.1 Planning

3.1.1 General information

The Anchor bolt connections must be designed according to standard engineering principles. Taking the expected anchor loads into consideration, verifiable calculations and design drawings shall be prepared which contain the position of the anchorages including possible (dimensional) tolerances.

3.1.2 Minimal axial spacing and edge distances

The minimum centre and edge distances specified in annex 3, table 3 must be observed.

3.1.3 Minimal thickness for the building component

The minimum component thickness h_{min} is derived from the anchoring depth and the required concrete cover according to DIN EN 1992-1-1:2011-01 as well as DIN EN 1992-1-1/NA:2013-04:

$$h_{min} = h_{ef} + t_h + c_{nom} \quad [mm] \quad (3.1)$$

h_{ef} = Anchorage depth for the anchor bolts according to annex 3, table 3

t_h = Thickness of the anchor bolt head according to annex 2, table 1

c_{nom} = Nominal dimension of the concrete cover according to DIN EN 1992-1-1 :2011-01 as well as DIN EN 1992-1-1/NA:2013-04

3.2 Design

3.2.1 General information

Anchor design is according to DIN SPEC 1021-4:2009-08 "Design of fastenings for use in concrete", part 1 and 2. The corresponding characteristic values are provided in annex 4 and 5.

Verification of the immediate, local load transfer into the concrete is provided.

Transfer of the anchored loads into the building member must be verified.

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Loads that may occur in the anchorage or in connected components caused by constrained deformation (for example from temperature fluctuation) must be considered.
In addition to table 1 of DIN SPEC 1021-4:2009-08, part 1, section 5.2.3.1, table 3.1 of this approval must be observed.

Table 3.1

Anchor bolts HAB H Thread diameter	16	20	24	30	39
Diameter of the clearance holes in the fixture [mm]	18	22	26	33	42

3.2.2 Displacement behaviour

Displacement caused by tensile loads are in annex 4, table 5.
Displacement caused by shear loads are in annex 5, table 7.

3.3 Application

3.3.1 Installation of the anchor bolt and fixing the column

The anchors must be installed as shown in the mandatory design drawings. These design drawings must include the exact position and design details (position, size and lengths of the anchor bolts) of the anchorages. The manufacturer's installation instructions must be followed, see annex 6 and 7.

The anchors must be securely fixed to the formwork to ensure they are not displaced when the reinforcement is installed and when the concrete is poured and compacted.

When pouring the concrete, ensure the concrete is properly compacted, especially under the heads of the anchor bolts.

When connecting precast reinforced concrete columns with the corresponding column shoes, the connection joint between the concrete member and the column shoe as well as the recesses for the nuts must be subsequently completely sealed with a flush-finished, high-strength, low-shrinkage mortar or grouting concrete according to the specifications in the German Committee for Structural Concrete (DAfStb) guideline "Production and use of cementitious, grouting concrete and grouting mortar".

The maximum torque T_{inst} at installation according to table 3, annex 3, must be met.
It is not required to apply a specific torque for the anchor bolts' load capacity. for the load capacity of the anchor bolt.

3.3.2 Checking installation

The contractor entrusted with the anchoring of anchor bolts or the site manager appointed by him, or a competent representative of the site manager must be present on site when the anchorage(s) is installed. He must ensure that installation is carried out properly. In particular, he is responsible for checking the execution and position of the anchorage(s) as well as any reinforcement that may be required.

The respective documentation must be kept on site during the period of construction and on request must be available for inspection by the responsible engineer. These documents must be kept by the contractor, with the delivery documents for at least 5 years after work is completed.

Beatrix Wittstock
Head of division (*Referatsleiterin*)

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Figure 1 Reinforced precast concrete column (B)

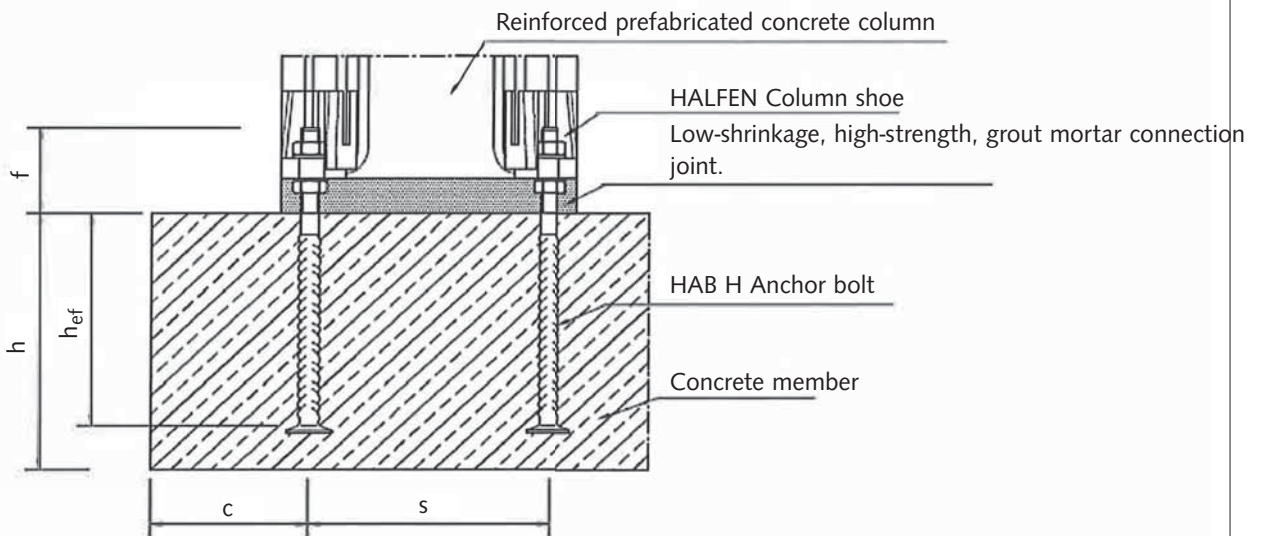


Figure 2 Steel/concrete composite column, with grout connection (B)

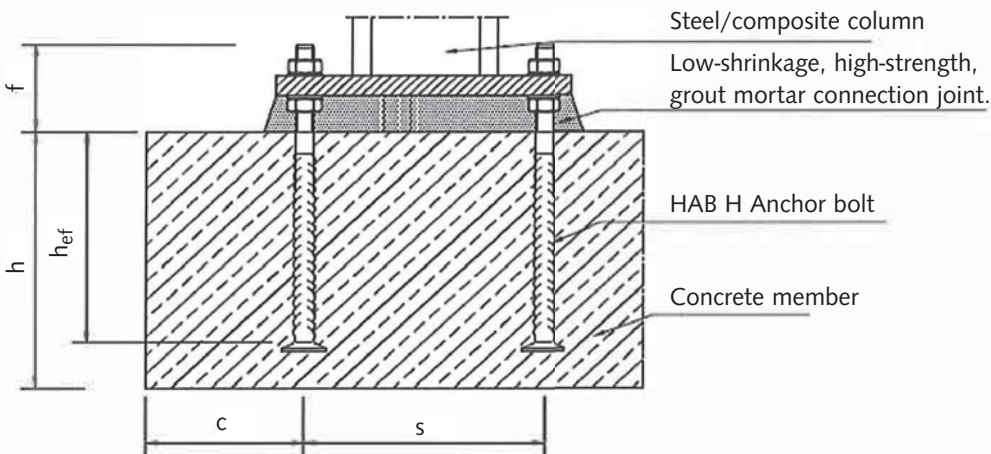
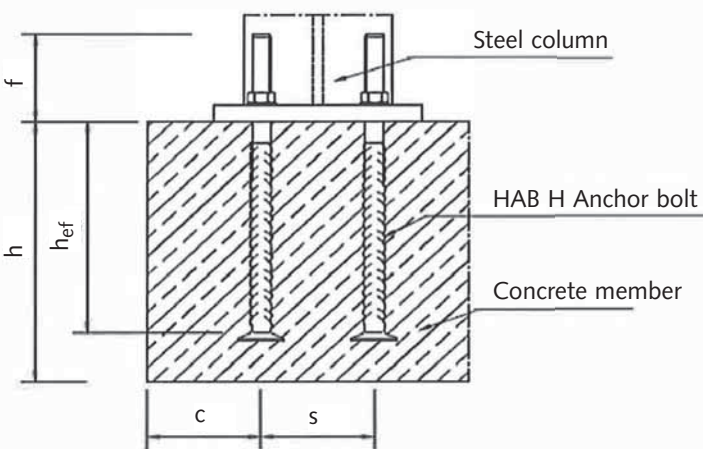


Figure 3 Steel column, without grout (A)



- h - thickness of concrete member
- h_{ef} - effective embedment depth
- c - edge distance
- s - axial spacing
- f - anchor protrusion

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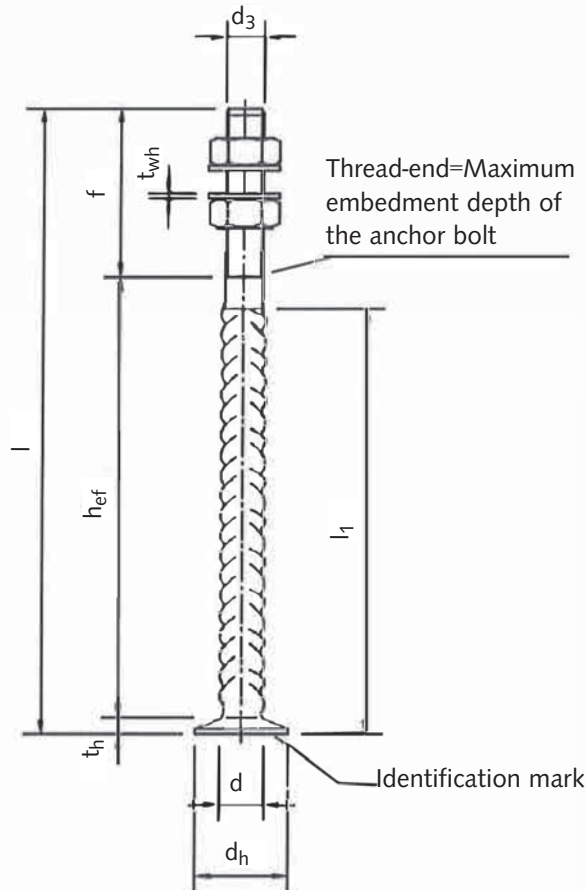


HALFEN Anchor bolt HAB H
Annex 1
Installed condition

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Part 1: Anchor bolts

Identification markings on the anchor bolt (example for HAB H16)



Part 2: Washer



Part 3: Nut

Dimensions according to DIN EN ISO 4032: 2013-04



Table1: Dimension [mm]

Component part	1 - Anchor bolt									2 - Washer			3 - Nut ¹⁾
	d	dh	d3	f	hef	th	l	l1	d2	d1	twh		
Type		≥						≥					
HAB H16	16	38	16	105	165	10	280	140	18	38	18	5	M16
HAB H20	20	46	20	115	223	12	350	210	22	46	22	6	M20
HAB H24	25	55	24	130	287	13	430	260	25	55	25	6	M24
HAB H30	32	70	30	150	335	15	500	310	31	65	31	8	M30
HAB H39	40	90	39	165	517	18	700	490	41	90	41	10	M39

¹⁾ according to DIN EN ISO 4032: 2013-04

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	<p>HALFEN Anchor bolt HAB H</p> <p>Annex 2 Dimensions</p>	<p>HALFEN GmbH Liebigstr. 14 D - 40764 Langenfeld Phone: +49-2173-970-0 Fax: +49-2173-970-123</p>
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Table 2: Materials

Anchor bolts	Diameters 16-40 B500B according to DIN 488-2:2009-8
Washers	S355J0 according to DIN EN 10025-2:2005-04
6 KT Nuts	Hexagonal nuts according to DIN EN ISO 4032:2013-04 Strength class 8 according to DIN EN ISO 898-2:2012-08

Table 3: Installation parameters for the Anchor bolts

Anchor bolt type			HAB H				
			16	20	24	30	39
Effective embedment depth	h_{ef}	[mm]	165	223	287	335	517
Minimum axial spacing	s_{min}	[mm]	80	100	100	130	150
Minimum edge distance	c_{min}	[mm]	50	70	70	100	130
Protusion of the anchor bolts above the concrete surface	f	[mm]	105	115	130	150	165
Thickness of the concrete member	h_{min}	[mm]	$h_{ef} + t_h + c_{nom}^{1)}$				
max. installation torque; general (A) ²⁾	$T_{inst,A}$	[Nm]	35	70	110	230	530
max. installation torque; steel-steel (B) ³⁾	$T_{inst,B}$	[Nm]	100	250	400	800	1800

¹⁾ Nominal dimension of the concrete cover according to DIN EN 1992-1-1 :2011-01 as well as DIN EN 1992-1-1/NA:2013-04

²⁾ Connected component has contact with concrete surface (See annex 1, figure 3)

³⁾ Connected component is clamped between the two nuts (See annex 1, figure 1 and 2)

Minimum reinforcement

Reinforcement, which limits the crack width to $w_k \leq 0.3$ mm, must be installed to absorb splitting tensile forces.

See DIN SPEC 1021-4-2:2009-08, part 6.2.6.2

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HALFEN Anchor bolt HAB H
Annex 3
Materials and installation parameters for the Anchor bolts

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Table 4: Characteristic resistances under tensile load

Anchor bolt type			HAB H				
			16	20	24	30	39
Steel failure							
Characteristic resistance to steel failure	$N_{Rk,s}$	[kN]	86	134	194	308	537
Partial safety factor	γ_{Ms}	[-]	1.4				
Pullout failure							
Characteristic tensile resistance to pull-out failure for concrete strength class C20/25	$N_{Rk,p}$	[kN]	140	202	282	456	766
Partial safety factor	γ_{Mp}	[-]	1.5				
Concrete failure							
Effective embedment depth	h_{ef}	[mm]	165	223	287	335	517
Characteristic axial spacing	$s_{cr,N}$	[mm]	3 * h_{ef}				
Characteristic edge distance	$c_{cr,N}$	[mm]	1.5 * h_{ef}				
Partial safety factor	γ_{Mc}	[-]	1.5				
Factor to take into account the influence of load transfer mechanism							
in cracked concrete	k_{cr}	[-]	8.5				
in non-cracked concrete	k_{ucr}	[-]	11.5				
Splitting failure							
Reinforcement, which limits the crack width to $w_k \leq 0.3$ mm, must be installed to absorb splitting tensile forces. See DIN SPEC 1021-4-2:2009-08, part 6.2.6.2							
Localized concrete (Blowout) failure							
Partial safety factor	γ_{Mcb}	[-]	1.5				

Table 5: Displacement under tensile load

Anchor bolt type			HAB H				
			16	20	24	30	39
The short-term effect of the following tensile loads may cause displacements of up to 0.9 mm ¹⁾		[kN]	41	64	92	147	256

¹⁾ under continuous load, displacements may increase by up to 1.8 mm.

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HALFEN Anchor bolt HAB H
Annex 4
Characteristic resistance and displacement under tensile load

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Table 6: Characteristic resistances under shear load

Anchor bolt type			HAB H				
			16	20	24	30	39
Steel failure without cantilever							
Characteristic resistance to steel failure	$V_{Rk,s}^0$	[kN]	42	66	95	151	265
Partial safety factor	γ_{Ms}	[-]	1.5				
Steel failure with cantilever							
Characteristic bending resistance of a single fastener	$M_{Rk,s}^0$	[kN]	183	357	618	1237	2778
Partial safety factor	γ_{Mp}	[-]	1.5				
Concrete failure (Pryout failure)							
Factor for calculation according to DIN SPEC 1021-4-2:2009-08, Gl. (32)	k_3 ¹⁾	[-]	2.0				
Partial safety factor	γ_{Mcp}	[-]	1.5				
Concrete edge failure							
Effective anchor bolt length	$l_f = h_{ef}$	[mm]	165	223	287	335	517
Thread diameter of the anchor bolt	$d_{nom} = d_3$	[mm]	16	20	24	30	39
Partial safety factor	γ_{Mc}	[-]	1.5				

¹⁾ If additional reinforcement is used, factor k_3 is multiplied by 0.75.

Table 7: Displacement under shear load

Anchor bolt type			HAB H				
			16	20	24	30	39
The short-term effect of the following shear loads may cause displacements of up to 1.5 mm ¹⁾	[kN]		18	25	41	66	115

¹⁾ under continuous load, displacements may increase by up to 2.0 mm.

Combined tensile and shear loads

Factor according to DIN SPEC 1021-4-2:2009-08, part 6.4.1.3: $k_7 = 2/3$

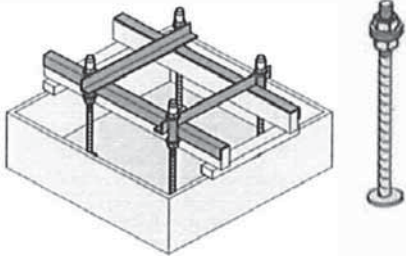
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HALFEN Anchor bolt HAB H
Annex 5
Characteristic resistance and displacement under shear load

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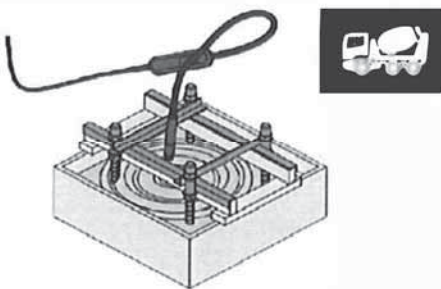
1: Position the anchors



Scope of delivery: Pre-assembled anchor bolts each with 2 hexagon nuts and custom washers

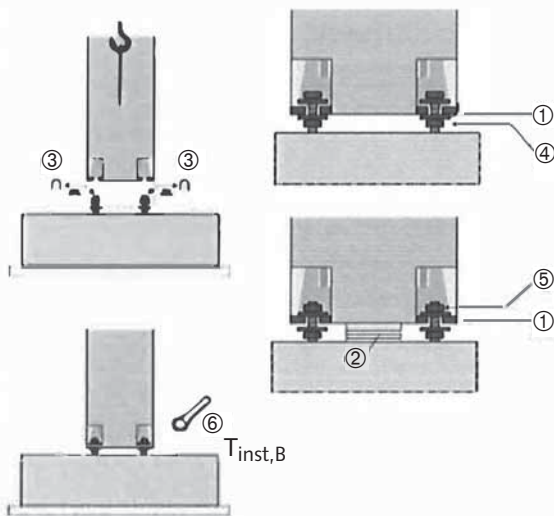
- Position the installation frame (reusable)
- Fit bolts to installation frame
- Position the bolts and any necessary, additional reinforcement according to the structural engineer's specifications and reinforcement plans
- The anchor bolts must be correctly positioned and fixed in the specified axes and planes.

2: Pour the concrete



- Ensure the concrete is properly compacted around the anchor heads
- Ensure the anchor bolts do not move or are damaged
- Protect the thread of the anchor bolts against concrete or dirt
- The anchor bolts must only be subjected to load after minimum concrete strength has been reached

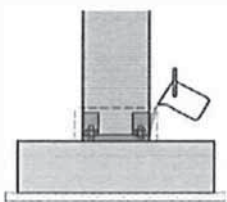
3: Place and adjust the column



- Adjust and fix the bottom nuts and washers of the anchor bolts to the required height. ①. Keep the column connected to the crane during lifting and positioning
- Ensure the protection caps ③ are on the threads
- Screw on the top nuts and adjust the column using the bottom nuts ④
- Use stacked steel shims ② for heavy columns; In this case fix the bottom nuts 5 mm lower. Lower the column on to the steel shims and adjust using the top nuts ⑤.
- Use ring slogging spanners ⑥ according to DIN 7444 and open-end slogging spanners ⑥ according to DIN 133
- The maximal installation torque $T_{inst,B}$ as specified in annex 3 must not be exceeded

Anchor bolt type		HAB H				
		16	20	24	30	39
Max. installation torque; steel-steel	$T_{inst,B}$ [Nm]	100	250	400	800	1800

4: Seal the connection joint



- Use a free-flowing low-shrinkage grouting mortar to fill the joint and the recesses in the column
- The mortar strength must be at least the same strength as the concrete used for the column concrete
- Full load capacity is only achieved after the mortar has fully cured

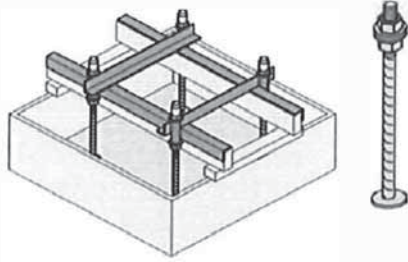
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HALFEN Anchor bolt HAB H
Annex 6
Installation instructions for precast concrete columns

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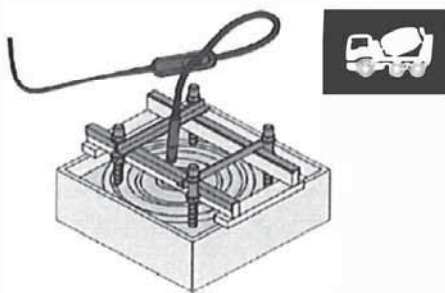
1: Position the anchors



Scope of delivery: Pre-assembled anchor bolts each with 2 hexagon nuts and custom washers

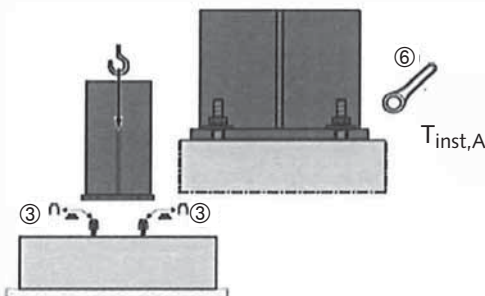
- Position the installation frame (reusable)
- Fit bolts to installation frame
- Position the bolts and any necessary, additional reinforcement according to the structural engineer's specifications and reinforcement plans
- The anchor bolts must be correctly positioned and fixed in the specified axes and planes

2: Pour the concrete



- Ensure the concrete is properly compacted around the anchor heads
- Ensure the anchor bolts do not move or are damaged
- Protect the thread of the anchor bolts against concrete or dirt
- The anchor bolts must only be subjected to load after minimum concrete strength has been reached

3: Install the column



- Position the column, keeping it connected to the crane
- Ensure the protection caps^③ are on the threads
- Screw on the top nuts
- Use ring slogging spanners^⑥ according to DIN 7444 and open-end slogging spanners^⑥ according to DIN 133
- The maximal installation torque $T_{inst,A}$ as specified in annex 3 must not be exceeded

Anchor bolt type		HAB H				
		16	20	24	30	39
max. installation torque; general	$T_{inst,A}$ [Nm]	35	70	110	230	530

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HALFEN Anchor bolt HAB H
Annex 7
Assembly instructions for steel columns

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For more information on the products featured here, please contact Leviat:

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