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Authorised and notified according to Article 10 of the Council Directive of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products (89/106/EEC)

Deutsches Institut für Bautechnik DIBt

Mitglied der EOTA
Member of EOTA

European Technical Approval ETA-09/0339

English translation prepared by DIBt - Original version in German language

Handelsbezeichnung *Trade name*	Halfen Ankerschiene HTA *Halfen anchor channel HTA*
Zulassungsinhaber *Holder of approval*	HALFEN GmbH Liebigstraße 14 40764 Langenfeld DEUTSCHLAND
Zulassungsgegenstand und Verwendungszweck *Generic type and use of construction product*	Einbetonierte Ankerschienen *Cast-in anchor channels*
Geltungsdauer: vom / *Validity: from*	27 June 2013
bis / *to*	27 June 2018
Herstellwerk *Manufacturing plant*	Werk Langenfeld Liebigstraße 14 40764 Langenfeld

Diese Zulassung umfasst *This Approval contains*	37 Seiten einschließlich 27 Anhänge *37 pages including 27 annexes*
Diese Zulassung ersetzt *This Approval replaces*	ETA-09/0339 mit Geltungsdauer vom 28.02.2012 bis 15.02.2015 *ETA-09/0339 with validity from 28.02.2012 to 15.02.2015*

I LEGAL BASES AND GENERAL CONDITIONS

1 This European technical approval is issued by Deutsches Institut für Bautechnik in accordance with:

- Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products[1], modified by Council Directive 93/68/EEC[2] and Regulation (EC) N° 1882/2003 of the European Parliament and of the Council[3];
- *Gesetz über das In-Verkehr-Bringen von und den freien Warenverkehr mit Bauprodukten zur Umsetzung der Richtlinie 89/106/EWG des Rates vom 21. Dezember 1988 zur Angleichung der Rechts- und Verwaltungsvorschriften der Mitgliedstaaten über Bauprodukte und anderer Rechtsakte der Europäischen Gemeinschaften (Bauproduktengesetz - BauPG) vom 28. April 1998*[4]*, as amended by Article 2 of the law of 8 November 2011*[5]*;*
- Common Procedural Rules for Requesting, Preparing and the Granting of European technical approvals set out in the Annex to Commission Decision 94/23/EC[6].

2 Deutsches Institut für Bautechnik is authorized to check whether the provisions of this European technical approval are met. Checking may take place in the manufacturing plant. Nevertheless, the responsibility for the conformity of the products to the European technical approval and for their fitness for the intended use remains with the holder of the European technical approval.

3 This European technical approval is not to be transferred to manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those indicated on page 1 of this European technical approval.

4 This European technical approval may be withdrawn by Deutsches Institut für Bautechnik, in particular pursuant to information by the Commission according to Article 5(1) of Council Directive 89/106/EEC.

5 Reproduction of this European technical approval including transmission by electronic means shall be in full. However, partial reproduction can be made with the written consent of Deutsches Institut für Bautechnik. In this case partial reproduction has to be designated as such. Texts and drawings of advertising brochures shall not contradict or misuse the European technical approval.

6 The European technical approval is issued by the approval body in its official language. This version corresponds fully to the version circulated within EOTA. Translations into other languages have to be designated as such.

1 Official Journal of the European Communities L 40, 11 February 1989, p. 12
2 Official Journal of the European Communities L 220, 30 August 1993, p. 1
3 Official Journal of the European Union L 284, 31 October 2003, p. 25
4 *Bundesgesetzblatt Teil I 1998*, p. 812
5 *Bundesgesetzblatt Teil I 2011*, p. 2178
6 Official Journal of the European Communities L 17, 20 January 1994, p. 34

II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of product and intended use

1.1 Definition of the construction product

The Halfen anchor channel HTA is an anchor channel consisting of a C-shaped channel of hot-rolled or cold-formed steel and at least two metal anchors non-detachably fixed on the profile back.

The anchor channel is imbedded surface-flush in the concrete. Halfen-special screws (hammerhead or hooked) with appropriate hexagon nuts and washers will be fixed in the channel.

An illustration of the product and intended use is given in Annex 1.

1.2 Intended use

The anchor channel is intended to be used for anchorages for which requirements for mechanical resistance and stability and safety in use in the sense of the Essential Requirements 1 and 4 of Council Directive 89/106 EEC shall be fulfilled and failure of anchorages made with these products would cause risk to human life and/or lead to considerable economic consequences.

The anchor channel may be used for anchorages with requirements related to resistance to fire.

The anchor channel is to be used only for anchorages subject to static or quasi-static loading in reinforced or unreinforced normal weight concrete of strength classes C12/15 at minimum to C90/105 at most according to EN 206-1:2000-12. The anchor channel may be anchored in cracked and non-cracked concrete.

The anchor channel may be used for transmission of tensile loads, shear loads, or a combination of tensile and shear loads perpendicular to the longitudinal axis of the channel.

The anchor channels 40/22 and 52/34 in combination with special screws HS 40/22 and HS 50/30 according to Annex 21, Table 22 may also be used under fatigue tension loads.

The intended use of the anchor channel (channel profile, anchor, special screw, washer and nut) concerning corrosion is given in Annex 3, Table 1 depending on the chosen material.

The provisions made in this European technical approval are based on an assumed working life of the anchor channel of 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

2 Characteristics of the product and methods of verification

2.1 Characteristics of the product

The anchor channel corresponds to the drawings and information given in Annex 2 to 7. The characteristic material values, dimensions and tolerances of the anchor channel not indicated in the Annexes shall correspond to respective values laid down in the technical documentation[7] of this European technical approval.

Regarding the requirements concerning safety in case of fire it is assumed that the anchor channel meets the requirements of class A1 in relation to reaction to fire in accordance with the stipulations of the Commission decision 96/603/EC, amended by 2000/605/EC.

The characteristic values for the design of the anchorages for static or quasi-static loads are given in Annexes 8 to 17. The characteristic values for the design of the anchorages regarding resistance to fire are given in Annex 18 and 19. They are valid for use in a system that is required to provide a specific fire resistance class. The design values for the design of the anchorages for fatigue loads are given in Annexes 20 to 25.

The anchor channel shall be marked with the identifying mark of the producer, the type, the size and if applicable additionally with the type of stainless steel, e.g. Halfen 40/22 A4 according to Annex 2. The position of the anchor is marked for anchor channels with weld-on anchors by nail holes in the channel profile.

Each special screw is marked with the identifying mark of the producer and if applicable with the strength grade and if applicable with the type of stainless steel according to Annex 2.

2.2 Method of verification

2.2.1 General

The assessment of the fitness of the anchor channel for the intended use with regard to the requirements of mechanical resistance and stability as well as safety in use in the sense of the Essential Requirements 1 and 4 was performed based on the following verifications:

<u>Verifications for tension loads for</u>

1. Distribution of acting tension loads	
2. Steel failure - anchor	$N_{Rk,s,a}$
3. Steel failure - special screw	$N_{Rk,s,s}$
4. Steel failure - connection channel/ anchor	$N_{Rk,s,c}$
5. Steel failure - local flexure of channel lips	$N_{Rk,s,l}$
6. Steel failure - flexure resistance of channel	$M_{Rk,s,flex}$
7. Steel failure - transfer of setting torque into prestressing force	T_{inst}
8. Concrete failure - pullout	$N_{Rk,p}$
9. Concrete failure - concrete cone	$N_{Rk,c}$
10. Concrete failure - splitting due to installation	c_{min}, s_{min}, h_{min}
11. Concrete failure - splitting due to loading	$N_{Rk,sp}$

[7] The technical documentation of this European technical approval is deposited at Deutsches Institut für Bautechnik and, as far as it is relevant to the tasks of the approved body involved in the attestation of conformity procedure, is handed over to the approved bodies.

12.	Concrete failure - blow-out	$N_{Rk,cb}$
13.	Reinforcement	$N_{Rk,re}$, $N_{Rd,a}$
14.	Displacement under tension loads	δ_N

<u>Verifications for shear loads for</u>

1.	Distribution of acting shear loads	
2.	Steel failure without lever arm - special screw	$V_{Rk,s,s}$
3.	Steel failure without lever arm - flexure channel lips	$V_{Rk,sl}$
4.	Steel failure with lever arm	$M^0_{Rk,s}$
5.	Concrete failure - pry-out	$V_{Rk,cp}$
6.	Concrete failure - concrete edge	$V_{Rk,c}$
7.	Reinforcement	$V_{Rk,c,re}$
8.	Displacement under shear loads	δ_V

<u>Verification for fatigue tension loads for</u>

1.	Distribution of acting fatigue tension loads	
2.	Steel failure	$\Delta N_{Rd,s;0;n}$
3.	Concrete failure - pullout	$\Delta N_{Rd,p;0;n}$
4.	Concrete failure - concrete cone	$\Delta N_{Rd,c;0;n}$

The assessment of the anchor channel for the intended use in relation to the requirements for resistance to fire has been made in accordance with the Technical Report TR 020 "Evaluation of anchorages in concrete concerning resistance to fire".

In addition to the specific clauses relating to dangerous substances contained in this European Technical Approval, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Directive, these requirements need also to be complied with, when and where they apply.

3 Evaluation and attestation of conformity and CE-marking

3.1 System of attestation of conformity

According to the Decision 2000/273/EC of the European Commission[8] system 2(i) (referred to as system 1) of the attestation of conformity applies.

This system of attestation of conformity is defined as follows:

System 1: Certification of the conformity of the product by an approved certification body on the basis of:

(a) Tasks for the manufacturer:
- (1) factory production control;
- (2) further testing of samples taken at the factory by the manufacturer in accordance with a prescribed test plan;

(b) Tasks for the approved body:
- (3) initial type-testing of the product;
- (4) initial inspection of factory and of factory production control;
- (5) continuous surveillance, assessment and approval of factory production control.

Note: Approved bodies are also referred to as "notified bodies".

[8] Official Journal of the European Communities L 86 of 07.04.2000

3.2 Responsibilities

3.2.1 Tasks of the manufacturer

3.2.1.1 Factory production control

The manufacturer shall exercise permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures, including records of results performed. This production control system shall insure that the product is in conformity with this European technical approval.

The manufacturer may only use initial/raw/constituent materials stated in the technical documentation of this European technical approval.

The factory production control shall be in accordance with the control plan which is part of the technical documentation of this European technical approval. The control plan is laid down in the context of the factory production control system operated by the manufacturer and deposited with Deutsches Institut für Bautechnik.[9]

The results of factory production control shall be recorded and evaluated in accordance with the provisions of the control plan.

3.2.1.2 Other tasks for the manufacturer

The manufacturer shall, on the basis of a contract, involve a body which is approved for the tasks referred to in section 3.1 in the field of anchor channels in order to undertake the actions laid down in section 3.2.2. For this purpose, the control plan referred to in sections 3.2.1.1 and 3.2.2 shall be handed over by the manufacturer to the approved body involved.

The manufacturer shall make a declaration of conformity, stating that the construction product is in conformity with the provisions of this European technical approval.

3.2.2 Tasks of the approved bodies

The approved body shall perform the

- initial type-testing of the product,
- initial inspection of factory and of factory production control,
- continuous surveillance, assessment and approval of factory production control

in accordance with the provisions laid down in the control plan.

The approved body shall retain the essential points of its actions referred to above and state the results obtained and conclusions drawn in a written report.

The approved certification body involved by the manufacturer shall issue an EC certificate of conformity of the product stating the conformity with the provisions of this European technical approval.

In cases where the provisions of the European technical approval and its control plan are no longer fulfilled the certification body shall withdraw the certificate of conformity and inform Deutsches Institut für Bautechnik without delay.

[9] The control plan is a confidential part of the European technical approval and only handed over to the approved body involved in the procedure of attestation of conformity. See section 3.2.2.

3.3 CE marking

The CE marking shall be affixed on each packaging of the anchor channel. The letters "CE" shall be followed by the identification number of the approved certification body, where relevant, and be accompanied by the following additional information:

- the name and address of the producer (legal entity responsible for the manufacture),
- the last two digits of the year in which the CE marking was affixed,
- the number of the EC certificate of conformity for the product,
- the number of the European technical approval,
- trade name of the anchor channels and special screws.

4 Assumptions under which the fitness of the product for the intended use was favourably assessed

4.1 Manufacturing

The European technical approval is issued for the product on the basis of agreed data/information, deposited with Deutsches Institut für Bautechnik, which identifies the product that has been assessed and judged. Changes to the product or production process, which could result in this deposited data/information being incorrect, should be notified to Deutsches Institut für Bautechnik before the changes are introduced. Deutsches Institut für Bautechnik will decide whether or not such changes affect the approval and consequently the validity of the CE marking on the basis of the approval and if so whether further assessment or alterations to the approval shall be necessary.

4.2 Design of anchorages

4.2.1 Static load or quasi-static load

The fitness of the anchor channel for the intended use is given under the following condition:

The design of the anchorage is based on the CEN/TS 1992-4:2009 "Design of fastenings for use in concrete", part 1 and 3 under the responsibility of an engineer experienced in anchorages and concrete work.

The verification for shear load with supplementary reinforcement follows CEN/TS 1992-4-3:2009, section 6.3.6 and 6.3.7 or alternatively Annexes 16 and 17.

The reduction of the member cross section caused by the anchor channel is taken into account for the verification of the concrete member if necessary.

The member thickness is not less than h_{min} indicated in Annex 8, Table 8 and 9.

The edge distance of the anchors on the profile back of the channel is not less than c_{min} indicated in Annex 8, Table 8 and 9.

The spacing of the anchors is between the s_{min} and s_{max} given in Annex 6, Table 5.

The spacing of the special screws is not less than $s_{min,s}$ given in Annex 9, Table 10.

The effective anchorage depth is not less than min h_{ef} according to Annex 8, Table 8 and 9.

The characteristic resistances are calculated with the minimum effective anchorage depth.

Taking into account the loads to be anchored verifiable calculation notes and drawings are generated.

The position, the type, the size, the length, of the anchor channel, if applicable the spacing of the anchors, and if applicable the position as well as the size of the special screws are indicated on the design drawings. The material of the anchor channel and the special screw is given additionally on the drawings.

4.2.2 Fatigue tension load

The design for fatigue tension loads may be calculated according section 4.2.2.1 for known cycles n and known fatigue load ΔN_{Ed}, for unknown cycles and known fatigue load and for known cycles and unknown fatigue load.

It may be calculated according section 4.2.2.2 for unknown cycles and unknown fatigue load.

The partial safety factor for fatigue loads shall be chosen to $\gamma_{F,fat}$ = 1.0, if the there is a effective action collective with different level of actions and the anchor channel is verified with the maximum value of fatigue loads. It shall be chosen to $\gamma_{F,fat}$ = 1.2, if the effective action collective is actually a one level collective or converted to a collective of one level with an equivalent grade of damage.

4.2.2.1 Design method I for known fatigue load and/ or known load cycles

The verification may be done according Annex 22 if

(1) a definite allocation of all actions to a static or quasi-static part and a fatigue influenced part is possible and/or

(2) a upper limit of load cycles n during working life is known.

Three cases have to be divided:

Case 1: condition (1) and (2) is met,

Case 1.1: only condition (1) is met,

Case 1.2: only condition (2) is met.

The design fatigue resistances $\Delta N_{Rd;0;n}$ due to tension load without static pre-loading are given in Annex 23 and Annex 24 subject to the size of the anchor channel and number of cycles.

For case 1 the verification may be done with the design fatigue resistances $\Delta N_{Rd;E;n}$ due to tension load with static pre-loading and n load cycles. The design fatigue resistances $\Delta N_{Rd;E;n}$ may be calculated according Annex 21 for steel, concrete cone and pull-out failure.

For case 1.1 the verification may be done with the design fatigue resistances $\Delta N_{Rd;E;\infty}$ due to tension load with static pre-loading and $n \geq 10^7$ load cycles. The design fatigue resistances $\Delta N_{Rd;E;\infty}$ may be calculated according Annex 21 for steel, concrete cone and pull-out failure.

For case 1.2 the verification may be done with the total design action and the design fatigue resistances $\Delta N_{Rd;0;n}$ due to tension load without static pre-loading and n load cycles. The design fatigue resistances $\Delta N_{Rd;0;n}$ may be determined for steel, concrete cone and pull-out failure.

4.2.2.2 Design method II for unknown fatigue load and unknown load cycles

The verification may be done according Annex 25 if

(1) a definite allocation of all actions to a static or quasi-static part and a fatigue influenced part is not possible and

(2) a upper limit of load cycles n during working life is unknown.

All actions may be assumed to affect fatigue and load cycles $n \geq 10^7$ may be chosen.

The design fatigue resistances $\Delta N_{Rd;0;\infty}$ due to tension load without static pre-loading are given in Annex 25 subject to the size of the anchor channel.

Since pull-out failure is not decisive the design fatigue resistances $\Delta N_{Rd;0;\infty}$ may be determined for steel and concrete cone failure only.

4.2.3 Fire exposure

The design of anchorages under fire exposure has to consider the conditions given in the Technical Report TR 020 "Evaluation of anchorages in concrete concerning resistance to fire". The relevant characteristic values are given in Annex 18 and 19. The design method covers anchors with a fire attack from one side only. If the fire attack is from more than one side, the design method may be taken only, if the edge distance of the anchor is $c \geq 300$ mm.

4.3 Installation of the anchor channel

The fitness for use of the anchor channel can only be assumed, if the following installation conditions are observed:

- Installation by appropriately qualified personnel and under the supervision of the person responsible for technical matters on site.
- Use of the anchor channel only as supplied by the manufacturer without exchanging the components.
- Installation in accordance with the manufacturer's specifications given in Annexes 26 and 27 and the design drawings.
- The anchor channels are fixed on the formwork such that no movement of the channels will occur during the time of laying the reinforcement and of placing and compacting the concrete.
- The concrete under the head of the anchors are properly compacted. The channels are protected from penetration of concrete into the internal space of the channels.
- Size and spacing of special screws corresponding to the design drawings.
- Orientating the special screw (notch according Annex 7) rectangular to the channel axis.
- Observation of the prescribed values (e.g. T_{inst} according Annex 9) of installation.
- The setting torques given in Annex 9 must not be exceeded.

5 Responsibility of the manufacturer

It is in the responsibility of the manufacturer to ensure that the information on the specific conditions according to 1 and 2 including Annexes referred to and 4.2 and 4.3 is given to those who are concerned. This information may be made by reproduction of the respective parts of the European technical approval. In addition all installation data shall be shown clearly on the package and/or on an enclosed instruction sheet, preferably using illustration(s).

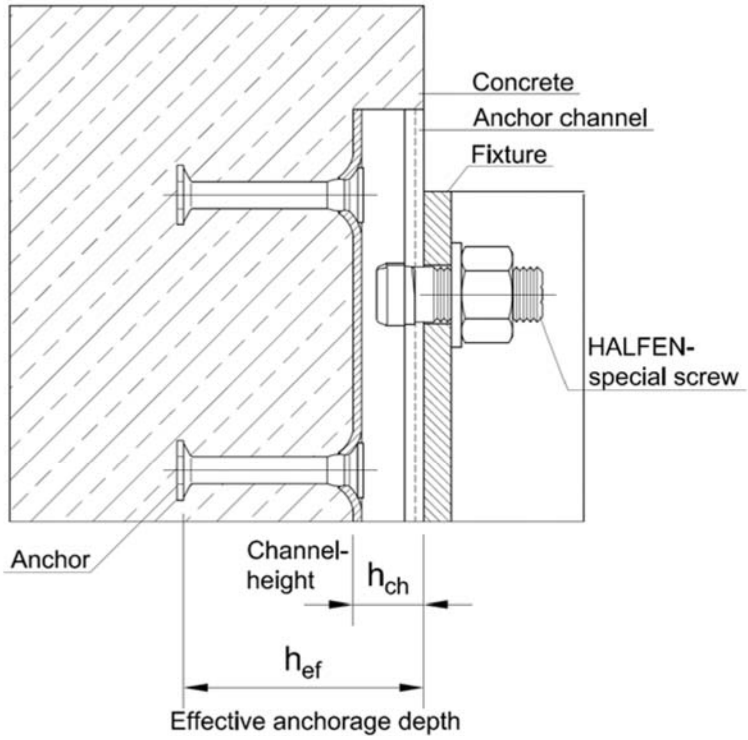
The minimum data required are:

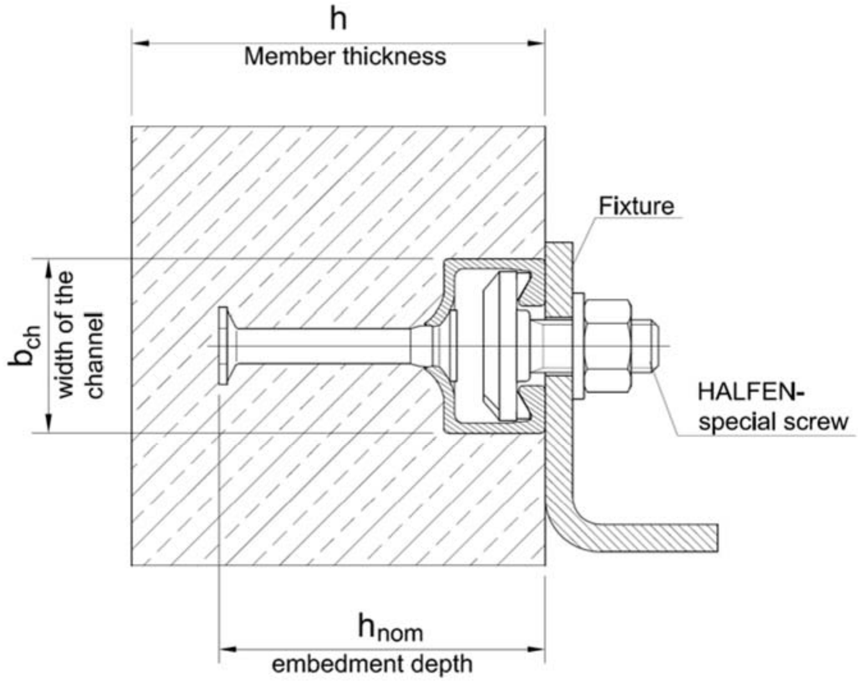
- dimensions of the anchor channel,
- mentioning of the matching screws,
- materials of the anchor channel (channel, anchor, screw , washer, nut)
- details on the installation procedure, preferably by using illustrations,
- maximum setting torque,
- identification of the manufacturing batch.

All data shall be presented in a clear and explicit form.

Andreas Kummerow
p. p. Head of Department

beglaubigt:
Müller

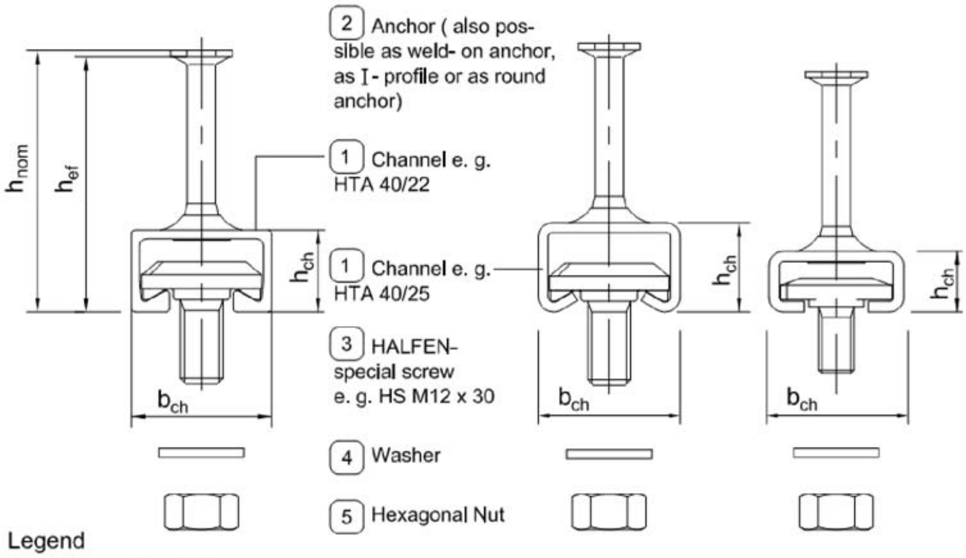




HALFEN Anchor Channel HTA	Annex 1
Product and intended use	

Deutsches Institut für Bautechnik DIBt

Anchor channel hot rolled profile — Anchor channel cold rolled profile — cold rolled C- profile

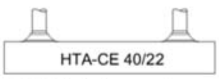


Legend

h_{ch} Channel height
b_{ch} Width of the channel
h_{ef} effective anchorage depth
h_{nom} embedment depth

Marking of the HALFEN anchor channel e.g.: HTA 40/22 A4

a) Stumped on back of channel



b) Printed on channel web

H or HALFEN	Identifying mark of the producer
TA	Type of anchor channel
40/22	size
A4	material

Close to the anchor a nail hole is positioned

Material of the channel:

<u>Steel</u>

No marking for 1.0038/1.0044

SV	1.0242+Z/1.0529+Z

<u>Stainless steel</u>

A2	1.4301/1.4307/1.4567/1.4541
A4	1.4401/1.4404/1.4571
L4, DX	1.4062/1.4162/1.4362
F4, FA	1.4462
HCR	1.4529/1.4547

Marking of the HALFEN special screw e.g.: HALFEN A4-70

H or HALFEN	Identifying mark of the producer
A4	material
70	strength grade

Material of the special screw:

<u>Steel</u>

No marking

<u>Stainless steel</u>

A2	1.4301/1.4307/1.4567/1.4541
A4	1.4401/1.4404/1.4571
L4	1.4362
F4, FA	1.4462
HCR	1.4529/1.4547

Strength grade of the special screw:

<u>Steel</u>

4.6, 8.8	Strength grade 4.6, 8.8

<u>Stainless steel</u>

50, 70	Strength grade 50, 70

HALFEN Anchor Channel HTA	Annex 2
Materials and intended use	

Table 1: Materials and intended use

Item no.	Specification	Intended use			
		1	**2**	**3**	**4**
		Dry internal conditions	**Internal conditions with usual humidity**	**Medium corrosion exposure**	**High corrosion exposure**
		Anchor channels may only be used in structures subject to dry internal conditions (e.g. accomodations, bureaus, schools, hospitals, shops, exceptional internal conditions with usual humidity acc. column 2)	Anchor channels may also be used in structures subject to internal conditions with usual humidity (e.g. kitchen, bath and laundry in residential buildings, exceptional permanent damp conditions and application under water)	Anchor channels may also be used in structures subject to external atmospheric exposure (incl. industrial and marine environment) or exposure in permanently damp internal conditions, if no particular aggressive conditions (e.g. permanent, alternating immersion in seawater etc. acc. column 4) exist.	Anchor channels may also be used in structures subject to exposure in particular aggressive conditions (e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with chemical pollution (e.g. in de-sulphurization plants or road tunnels where de-icing materials are used).
		Materials			
①	Channel profile	Steel 1.0038; 1.0044; EN 10025 hot-dip galv. ≥ 50 µm [6] Steel 1.0242+Z, 1.0529+Z EN 10346 hot-dip coated ≥ 15 µm	Steel 1.0038; 1.0044 EN 10025 hot-dip galv. ≥ 50 µm [6] Stainless steel 1.4301, 1.4307, 1.4567, 1.4541; EN 10088	Stainless steel 1.4401/ 1.4404/ 1.4571 1.4062/1.4162/1.4362 EN 10088	Stainless steel 1.4462 [2] ,1.4529/ 1.4547 EN 10088
②	Anchor	Steel 1.0038; 1.0214, 1.0401, 1.1132, 1.5525; EN 10263, EN 10269 hot-dip galv. ≥ 50 µm [6]	Steel 1.0038; 1.0214, 1.0401, 1.1132, 1.5525; EN 10263, EN 10269 hot-dip galv. ≥ 50 µm [6]) Stainless steel 1.4301, 1.4307, 1.4567, 1.4541; EN 10088	Stainless steel 1.4401/ 1.4404/ 1.4571 1.4362, 1.4578 EN 10088, 1.0038 [3]	
③	HALFEN special screws shaft and thread according EN ISO 4018	Steel, strength grade 4.6 / 8.8 EN ISO 898-1 electroplated ≥ 5 µm [4]	Steel, strength grade 4.6 / 8.8 EN ISO 898-1, hot-dip galv. ≥ 40 µm [1) 5)] Stainless steel 1.4301, 1.4307, 1.4567, 1.4541; EN ISO 3506-1	Stainless steel 1.4401/ 1.4404/ 1.4571 1.4362 EN ISO 3506-1	Stainless steel 1.4462 [2],1.4529/ 1.4547 EN ISO 3506-1
④	Washer, EN ISO 7089 and EN ISO 7093-1 production class A, 200 HV	Steel EN 10025 electroplated ≥ 5 µm [4]	Steel EN 10025 hot-dip galv. ≥ 40 µm [1) 5)] Stainless steel 1.4301, 1.4307, 1.4567, 1.4541; EN 10088	Stainless steel 1.4401/ 1.4404/ 1.4571 EN 10088	Stainless steel 1.4462 [2], 1.4529/ 1.4547 EN 10088
⑤	Hexagonal nuts EN ISO 4032	Steel strength grade 5/8 EN 20898-2 electroplated ≥ 5 µm [4]	Steel Strength grade 5/8 EN 20898-2 hot-dip galv. ≥ 40 µm [1) 5)] Stainless steel 1.4301, 1.4307, 1.4567, 1.4541; EN ISO 3506-2	Stainless steel 1.4401/ 1.4404/ 1.4571 EN ISO 3506-2	Stainless steel 1.4462 [2], 1.4529/ 1.4547 EN ISO 3506-2

[1)] or electroplated special coating ≥ 12µm
[2)] 1.4462 not applicable for indoor swimming pools
[3)] Steel acc. EN 10025, 1.0038 not for anchor channels 28/15 and 38/17
[4)] electroplated acc. EN ISO 4042
[5)] hot-dip galv. acc. to EN ISO 10684
[6)] hot-dip galv. on the basis of EN ISO 1461, but thickness ≥50µm

HALFEN Anchor Channel HTA

Materials and intended use

Annex 3

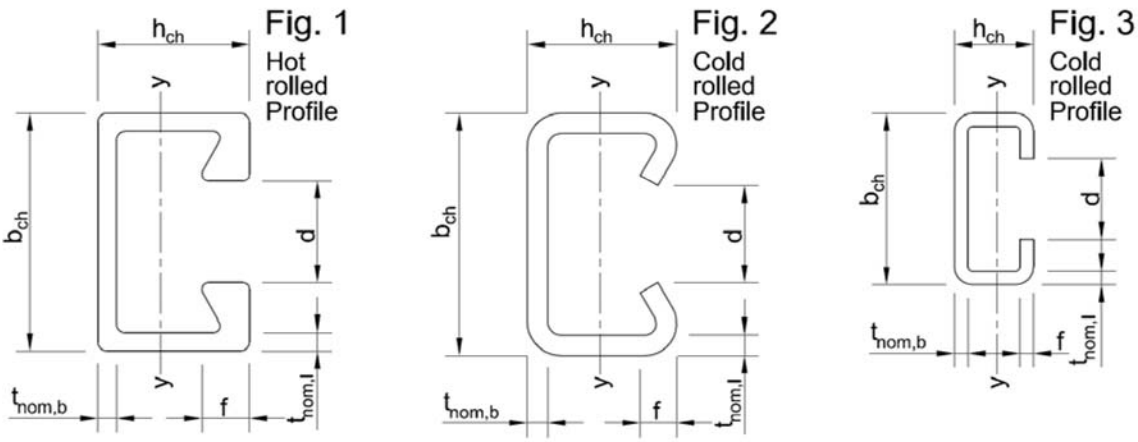


Table 2: Geometrical profile properties

Anchor channel	Figure	Dimensions						Material	I_y
		b_{ch}	h_{ch}	$t_{nom,b}$	$t_{nom,l}$	d	f		
		[mm]							[mm^4]
28/15	3	28.00	15.25	2.25	2.25	12.00	2.25	Steel	4060
38/17	3	38.00	17.50	3.00	3.00	18.00	3.00		8547
40/25	2	40.00	25.00	2.75	2.75	18.00	5.60		20570
49/30	2	50.00	30.00	3.00	3.00	22.00	7.39		41827
54/33	2	53.50	33.00	4.50	4.50	22.00	7.90		72079
72/49	2	72.00	49.00	6.00	6.00	33.00	9.90		293579
40/22	1	39.50	23.00	2.40	2.40	18.00	6.00		19703
50/30	1	49.00	30.00	3.00	2.75	22.50	7.85		51904
52/34	1	52.50	33.50	4.10	4.00	22.50	10.50		93262
55/42	1	54.50	42.00	5.00	5.00	26.00	12.90		187464
72/48	1	72.00	48.50	4.50	5.00	33.00	15.50		349721
28/15	3	28.00	15.25	2.25	2.25	12.00	2.25	Stainless steel	4060
38/17	3	38.00	17.50	3.00	3.00	18.00	3.00		8547
40/25	2	39.50	25.00	2.50	2.50	18.00	5.40		19097
49/30	2	50.00	30.00	3.00	3.00	22.00	7.39		41827
54/33	2	53.50	33.00	4.50	4.50	22.00	7.90		72079
72/49	2	72.00	49.00	6.00	6.00	33.00	9.90		293579
40/22	1	39.50	23.00	2.40	2.40	18.00	6.00		19759
50/30	1	49.00	30.00	3.00	2.75	22.50	7.85		51904
52/34	1	52.50	33.50	4.10	4.00	22.50	10.50		93262
72/48	1	72.00	48.50	4.50	5.00	33.00	15.50		349721

HALFEN Anchor Channel HTA	Annex 4
Geometrical profile properties	

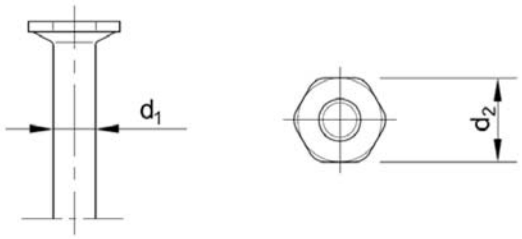


Table 3: Types of round anchors

Type	Shaft Ø d_1	Head Ø d_2
	[mm]	
B6	6	12
	8	16
	10	20
	12	25
	14	28
	16	32

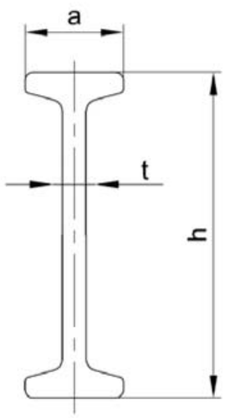


Table 4: Types of I-anchors

Type	Height h	Head width a	Web thickness t
	[mm]		
I 62	62	18	5.0
I 69	69	18	5.0
I 128	128	17	6.0
I 140	140	20	7.1

HALFEN Anchor Channel HTA	Annex 5
Types of anchor	

Figure 1 — Round anchor (B6-anchor)

Figure 2 — Weld- on anchor (I-anchor)

Figure 3 — Weld- on anchor round

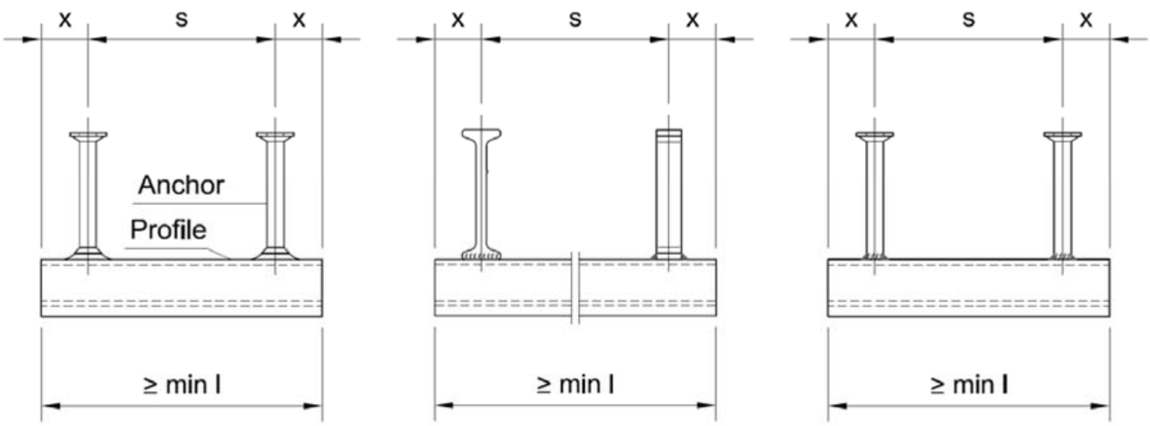


Table 5: Anchor positioning

Anchor channel	Anchor spacing		End spacing x [1]		min Channel lenght min l	
	s min	s max	Round anchor Fig. 1	Welded anchor Fig. 2 and 3	Round anchor Fig. 1	Welded anchor Fig. 2 and 3
	[mm]					
28/15 38/17	50	200	25	25	100	100
40/22 40/25 49/30 50/30	100 (50)	250	25	25	100	150
52/34 54/33	100 (80)	250	35	25	150	150
55/42	100 (80)	300	35	25 (35)	150	150
72/48 72/49	100 (80)	400	35	25 (35)	150	150

( ) valid for round anchor acc. Fig. 1 and welded anchors with 35 mm end spacing
[1] For channels with l=6070 mm, the end spacing x is always 35 mm

HALFEN Anchor Channel HTA	Annex 6
Anchor positioning, channel length	

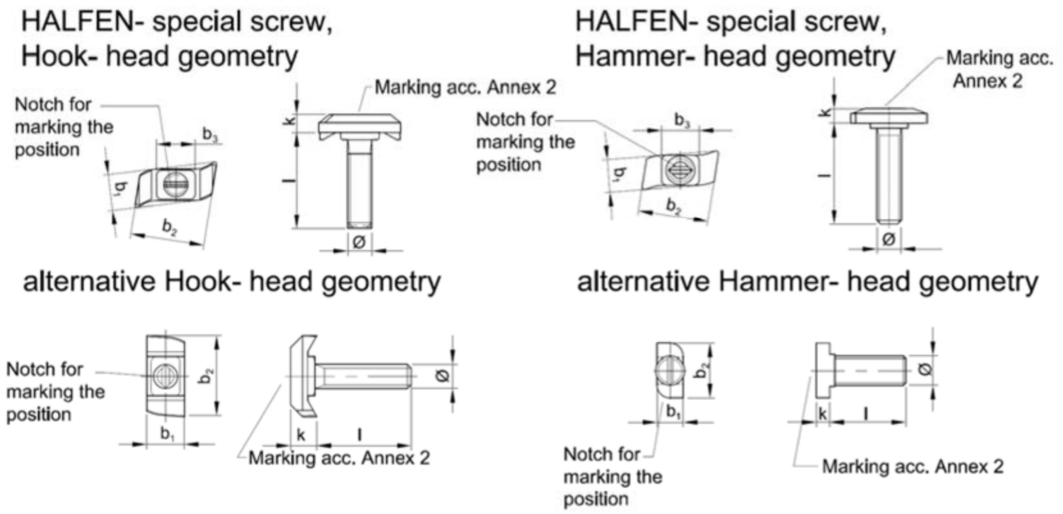


Table 6: Dimensions, special screw, Hook-head, Hammer-head

Head	HS	Thread Ø	Special screws Width b_1	Special screws Length b_2	Special screws b_3	Special screws Thickness k	Special screws alternative geometry Width b_1	Special screws alternative geometry Length b_2	Special screws alternative geometry Thickness k	Length l	Anchor channel
Hook-head	40/22	M 10	15.0	30.8	16.0	7.5	14 (13)	32.5	7	20-150	40/22
		M 12	15.0	30.8	16.0	7.5	14	32.5	7	20-250	40/25
		M 16	17.4	30.3	16.0	8.5	17	32.5	8	30-300	
	50/30	M 10	16.3	40.2	20.0	10.0	13	41	10	25-50	49/30
		M 12	16.3	40.2	20.0	10.0	13	41	10	30-200	50/30
		M 16	19.4	40.2	20.0	11.0	17	41	11	30-300	52/34
		M 20	21.0	39.5	20.0	12.5	21	41	12	35-300	54/33
											55/42
		M 24					24.5	41	18	40-300	55/42
	72/48	M 20					23	58	14	50-200	72/48
		M 24					25	58	16	50-250	72/49
		M 27					28	58	18	50-250	
		M 30					31	58	20	50-300	
Hammer-head	28/15	M 6	10.6	21.1	10.0	4.0	10.1	22.7 (22.2)	4.0	15-60	28/15
		M 8	10.6	21.1 (20.7)	10.0	4.5	10.1	22.7 (22.2)	4.0	15-150	
		M 10	10.9	20.2	10.0	5.0	10.1	22.7 (22.2)	5.0 (4.0)	15-200	
		M 12	10.8	20.1	-	6.5	10.1	22.7 (22.2)	5.5	20-200	
	38/17	M 10	13.6-14.1	29.0	15.5	6.0	13.0 (12.0)	30.5	6.0	20-175	38/17
		M 12	13.6-14.1	29.0	15.5	6.0	13.0 (12.0)	30.5	7.0 (6.0)	20-200	
		M 16	16.0	29.0	15.5	8.5	16.0	30.5	7.0	20-200	

[1)] Materials according Annex 2 and Annex 3, Tab.1
Marking of the screw head acc. to Annex 2

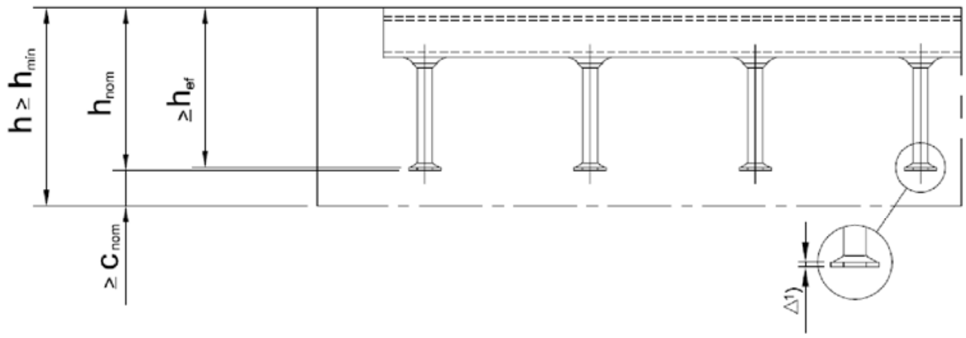
Table 7: Strength grade

	Steel [1)]		Stainless steel [1)]	
Strength grade	4.6	8.8	50	70
f_{uk} [N/mm²]	400	800	500	700
f_{yk} [N/mm²]	240	640	210	450
Finish	gv, fv		-	

HALFEN Anchor Channel HTA

Halfen-special screws,
dimensions, strength grade

Annex 7



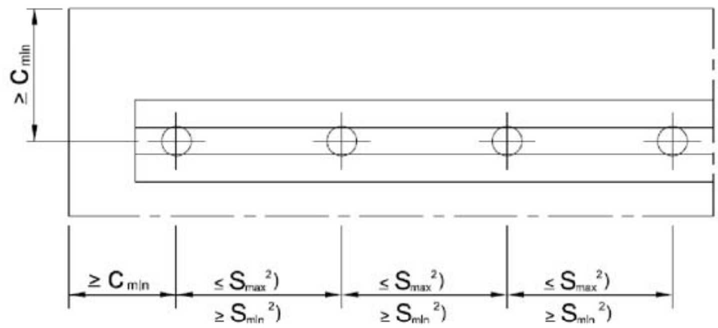


Table 8: Minimum anchorage depth, edge distance and member thickness for cold rolled profiles

Anchor channel			28/15	38/17	40/25	49/30	54/33	72/49
Min. anchorage depth	[mm]	min h_{ef}	45	76	79	94	155	179
Min. edge distance	[mm]	c_{min}	40	50	50	75	100	150
Min. member thickness	[mm]	h_{min}	$h_{ef} + \Delta^{1)} + c_{nom}{}^{3)}$					

Table 9: Minimum anchorage depth, edge distance and member thickness for hot rolled profiles

Anchor channel			40/22	50/30	52/34	55/42	72/48
Min. anchorage depth	[mm]	min h_{ef}	79	94	155	175	179
Min. edge distance	[mm]	c_{min}	50	75	100	100	150
Min. member thickness	[mm]	h_{min}	$h_{ef} + \Delta^{1)} + c_{nom}{}^{3)}$				

1) Δ = anchor head thickness
2) s_{min}, s_{max} acc. to Annex 6, Table 5
3) c_{nom} acc. EN 1992-1-1 and c_{nom} ≥ 15 mm

HALFEN Anchor Channel HTA

Installation parameters of
cold rolled and hot rolled anchor channels

Annex 8

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Table 10: Minimum spacing and setting torque of HALFEN – special screws

Anchor channel	**Special screw** ∅	Min. spacing $s_{min,s}$ 4) of the special screws	**Setting Torque T_{inst} 5)**				
			General 2)	Steel – steel contact 3)			
			Steel 4.6; 8.8 Stainless steel 50; 70 1)	Steel 4.6	Stainless steel 50 1)	Steel 8.8	Stainless steel 70 1)
	[mm]	[mm]	[Nm]				
28/15	6	30	-	3	3	-	
	8	40	8	8	8	20	15
	10	50	13	15	15	40	30
	12	60	15	25	25	70	50
38/17	10	50	15	15	15	40	30
	12	60	25	25	25	70	50
	16	80	40	65	60	180	130
40/22 40/25	10	50	15	15	15	40	30
	12	60	25	25	25	70	50
	16	80	45	65	60	180	130
49/30 50/30	10	50	15	15	15	40	30
	12	60	25	25	25	70	50
	16	80	60	65	60	180	130
	20	100	75	130	120	360	250
52/34 54/33	10	50	15	15	15	40	30
	12	60	25	25	25	70	50
	16	80	60	65	60	180	130
	20	100	120	130	120	360	250
55/42	10	50	15	15	15	40	30
	12	60	25	25	25	70	50
	16	80	60	65	60	180	130
	20	100	120	130	120	360	250
	24	120	200	230	200	620	440
72/48 72/49	20	100	120	130	120	360	250
	24	120	200	230	200	620	440
	27	135	300	340	300	900	650
	30	150	380	460	400	1200	850

1) Materials according to Annex 2 and Annex 3, Tab. 1
2) Acc. to Annex 10, Fig. 1
3) Acc. to Annex 10, Fig. 2
4) See Annex 11, Fig. 1
5) T_{inst} must not be exceeded

HALFEN Anchor Channel HTA	Annex 9
Installation parameters of HALFEN – special screw	

General

The fixture is braced to concrete or to the anchor channel respectively braced to concrete and anchor channel. The setting torques according to Annex 9, Table 11 shall be applied and must not be exceeded.

Steel- steel contact

The fixture is braced to the anchor channel by suitable washer. The setting torques according to Annex 9, Table 11 shall be applied and must not be exceeded.

Fig. 1

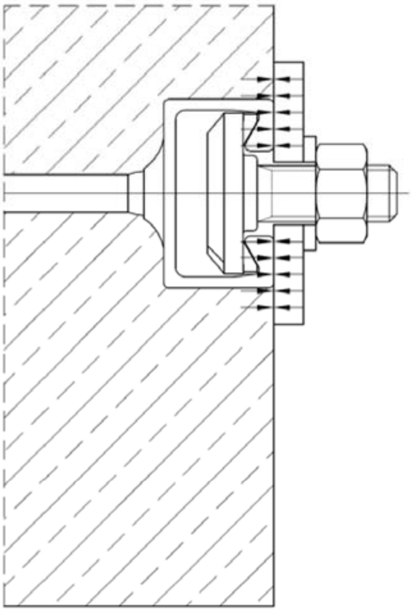
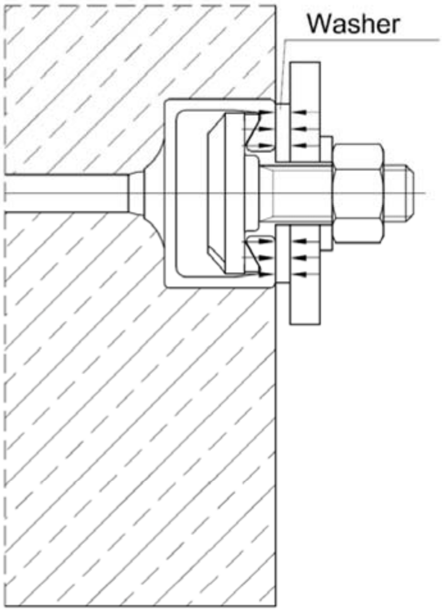


Fig. 2



HALFEN Anchor Channel HTA

Positions of the fixture

Annex 10

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Table 11: Characteristic values for tension loads - steel failure anchor channel

Anchor channel			28/15	38/17	40/25	49/30	54/33	55/42	72/48
					40/22	50/30	52/34		72/49
Steel failure, anchor									
Characteristic resistance	$N_{Rk,s,a}$	[kN]	not relevant						
Partial safety factor	γ_{Ms} [1])		1.8						
Steel failure, connection channel anchor									
Characteristic resistance	$N_{Rk,s,c}$	[kN]	9	18	20	31	55	80	100
Partial safety factor	$\gamma_{Ms,ca}$ [1)]		1.8						
Steel failure, local flexure of channel lips for $s_s \geq s_{slb}$									
Spacing of special screws for NRk,s,l	s_{slb}	[mm]	42	52	65	81	88	109	129
Characteristic resistance	$N_{Rk,s,l}$	[kN]	9	18	20	31	55	80	100
					35	36	65		
Partial safety factor	$\gamma_{Ms,l}$ [1])		1.8						
Steel failure, local flexure of channel lips for $s_{slb} \geq s_s \geq s_{min,s}$ [2)]									
Characteristic resistance	$N_{Rk,s,l}$	[kN]	$0.5\ (1+s_s/s_{slb})\ N_{Rk,s,l} \leq N_{Rk,s,l}$						
Partial safety factor	$\gamma_{Ms,l}$ [1)]		1.8						

[1]) in absence of other national regulations
[2]) $s_{min,s}$ acc. to Table 11, Annex 9

Fig. 1

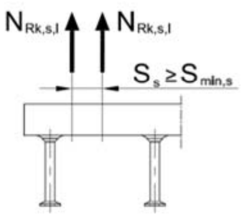


Fig. 2: Assumption of system

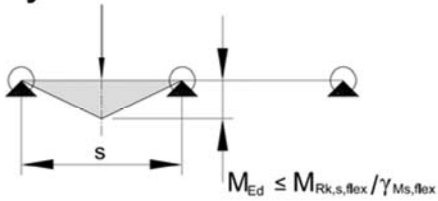


Table 12: Flexure resistance of channel

Anchor channel				28/15	38/17	40/25	49/30	54/33	72/49	40/22	50/30	52/34	55/42	72/48
Characteristic flexure resistance of channel	$M_{Rk,s,flex}$	[Nm]	Steel	317	580	1099	1673	2984	8617	1076	2038	3373	6447	8593
			Stainless steel	324	593	1071	1708	2984	8617	1080	2081	3445	-	8775
Partial safety factor	$\gamma_{Ms,flex}$ [1)]			1.15										

[1)] in absence of other national regulations

Deutsches Institut für Bautechnik

Table 13: Characteristic values for tension load - steel failure of HALFEN-special screws

Special Screw ∅				**M 6**	**M 8**	**M 10**	**M 12**	**M 16**	**M 20**	**M 24**	**M 27**	**M 30**
Steel failure												
Characteristic resistance	$N_{Rk,s,s}$ [2]	[kN]	4.6	8.0	14.6	23.2	33.7	62.8	98.0	141.2	183.6	224.4
			8.8	16.1	29.3	46.4	67.4	125.6	196.0	282.4	367.2	448.8
			50 [1]	10.1	18.3	29.0	42.2	78.5	122.5	176.5	229.5	280.5
			70 [1]	14.1	25.6	40.6	59.0	109.9	171.5	247.1	321.3	392.7
Partial safety factor	$\gamma_{Ms,s}$ [3]		4.6	2.00								
			8.8	1.50								
			50 [1]	2.86								
			70 [1]	1.87								

[1] Materials according Annex 2 and Annex 3, Table 1
[2] In conformity to EN ISO 898-1: 1999
[3] in absence of other national regulations

HALFEN Anchor Channel HTA

Characteristic values for tension loads - steel failure special screws

Annex 12

Deutsches Institut für Bautechnik DIBt

Table 14: Characteristic values for tension loads – concrete failure

Anchor channel				**28/15**	**38/17**	**40/25 40/22**	**49/30 50/30**	**54/33 52/34**	**55/42**	**72/49 72/48**
Pullout failure										
Characteristic resistance in cracked concrete C12/15	Round anchors	$N_{Rk,p}$	[kN]	7.6	13.5	13.5	21.1	33.9	41.5	54.3
	Welded anchors			11.7	11.7	14.0	21.1	25.7	37.2	46.4
Increasing factor for $N_{Rk,p}$	C20/25	Ψ_c	[-]	1.67						
	C25/30			2.00						
	C30/37			2.47						
	C35/45			3.00						
	C40/50			3.33						
	C45/55			3.67						
	≥C50/60			4.00						
		$\Psi_{ucr,N}$		1.4						
Partial safety factor		$\gamma_{Mp} = \gamma_{Mc}$ [1)]		1.5						
Concrete cone failure $N^0_{Rk,c}$ see CEN/TS 1992-4-3 section 6.2.5										
		α_{ch}		0.81	0.88	0.88	0.91	0.98	1.00	1.00
Effective anchorage depth		h_{ef}	[mm]	45	76	79	94	155	175	179
Characteristic edge distance		$c_{cr,N}$		111	171	176	199	260	269	270
Characteristic spacing		$s_{cr,N}$		223	342	352	399	521	538	540
		$\Psi_{ucr,N}$		1.4						
Partial safety factor		γ_{Mc} [1)]		1.5						
Splitting										
				Verification of splitting is not relevant						

[1]) in absence of other national regulations

Table 15: Displacements under tension loads

Anchor channel			**28/15**	**38/17**	**40/25 40/22**	**49/30 50/30**	**54/33 52/34**	**55/42**	**72/49 72/48**
Tension load	N_{Ek}	[kN]	3.6	7.1	8.3	12.3	21.8	31.7	39.7
Short time displacement	δ_{N0}	[mm]	0.3	0.3	0.4	0.4	0.5	0.5	0.5
Long time displacement	δ_N	[mm]	1.2	1.2	1.2	1.2	1.2	1.2	1.2

HALFEN Anchor Channel HTA

Characteristic values for tension loads - concrete failure and displacements

Annex 13

Table 16: Characteristic values for shear loads

Anchor channel				**28/15**	**38/17**	**40/25**	**49/30**	**54/33**	**55/42**	**72/49**
						40/22	**50/30**	**52/34**		**72/48**
Steel failure, local flexure of channel lips										
Characteristic resistance		$V_{Rk,s,l}$	[kN]	9	18	20	31	55	104	100
						26	40.3	71.5		130
Partial safety factor		$\gamma_{Ms,l}$ [1]		1.8						
Pry out failure										
Factor in equation (31) of CEN/TS 1992-4-3		k_5 [3]		2.0						
Partial safety factor		γ_{Mc} [1]		1.5						
Concrete edge failure										
Product of factor α_p and $\Psi_{re,V}$	Cracked concrete without edge reinforcement or stirrups	$\alpha_p \cdot \Psi_{re,V}$		2.5	3.5	4.0	4.0	4.0	4.0	4.0
	Cracked concrete with straight edge reinforcement (≥Ø 12 mm)	$\alpha_p \cdot \Psi_{re,V}$		3.0	4.1	4.7	4.7	4.7	4.7	4.7
	Non-cracked concrete [2] or cracked concrete with edge reinforce-ment and stirrups with a spacing $a \leq 100$mm and $a \leq 2c_1$	$\alpha_p \cdot \Psi_{re,V}$		3.5	4.7	5.3	5.3	5.3	5.3	5.3
Effect of the thickness of the structural component		$\alpha_{h,V}$		$(h/h_{cr,V})^{0.5}$						
Characteristic height		$h_{cr,V}$		$2c_1 + 2h_{ch}$						
Characteristic edge distance		$c_{cr,V}$		$2c_1 + b_{ch}$						
Characteristic spacing		$s_{cr,V}$		$4c_1 + 2b_{ch}$						
Partial safety factor		γ_{Mc} [1]		1.5						

[1] in absence of other national regulations

[2] Proof acc. to CEN/TS 1992-4-1: 2009, section 5

[3] Without supplementary reinforcement. In case of supplementary reinforcement the factor k_5 should be multiplied with 0.75

HALFEN Anchor Channel HTA	Annex 14
Characteristic values for shear loads	

Deutsches Institut für Bautechnik DIBt

Table 17: Characteristic values for shear load - steel failure of HALFEN-special screws

Special Screw ∅				**M 6**	**M 8**	**M 10**	**M 12**	**M 16**	**M 20**	**M 24**	**M 27**	**M 30**
Steel failure [2)]												
Char. resistance	$V_{Rk,s,s}$ [2)]	[kN]	4.6	4.8	8.8	13.9	20.2	37.7	58.8	84.7	110.2	134.6
			8.8	8.0	14.6	23.2	33.7	62.8	98.0	141.2	183.6	224.4
			50 [1)]	6.0	11.0	17.4	25.3	47.1	73.5	105.9	137.7	168.3
			70 [1)]	8.4	15.4	24.4	35.4	65.9	102.9	148.3	192.8	235.6
Char. flexure resistance	$M^0_{Rk,s}$	[Nm]	4.6	6.3	15.0	29.9	52.4	133.2	259.6	449.0	665.8	899.6
			8.8	12.2	30.0	59.8	104.8	266.4	519.3	898.0	1331.5	1799.2
			50 [1)]	7.6	18.7	37.4	65.5	166.5	324.5	561.3	832.2	1124.5
			70 [1)]	10.7	26.2	52.3	91.7	233.1	454.4	785.8	1165.1	1574.3
Partial safety factor	$\gamma_{Ms,s}$ [3)]		4.6	1.67								
			8.8	1.25								
			50 [1)]	2.38								
			70 [1)]	1.56								

[1)] Materials according Annex 3, Table 1
[2)] In conformity to DIN EN 898-1: 1999
[3)] in absence of other national regulations

Table 18: Displacements under shear loads

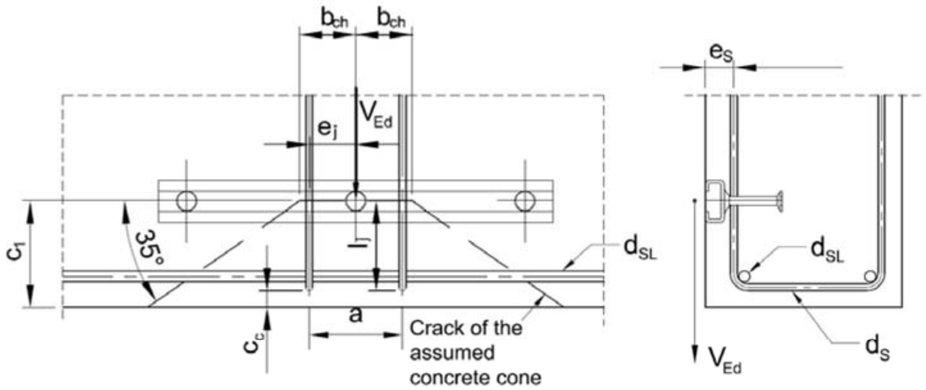
Anchor channel			**28/15**	**38/17**	**40/25 40/22**	**49/30 50/30**	**54/33 52/34**	**55/42**	**72/49 72/48**
Shear load	V_{Ek}	[kN]	3.6	7.1	8.3	12.3	21.8	31.7	39.7
Short time displacement	δ_{V0}	[mm]	0.6	0.6	0.6	0.6	1.2	1.2	1.2
Long time displacement	$\delta_{V\infty}$	[mm]	0.9	0.9	0.9	0.9	1.8	1.8	1.8

HALFEN Anchor Channel HTA

Characteristic values for shear loads -
Steel failure special screws and displacements

Annex 15

Verification for anchor channels for shear loads with reinforcement
(only for loading perpendicular to the edge)



$$V_{Ed} \leq V_{Rd,re} = V_{Rk,re}/\gamma_{Mc} \qquad V_{Ed} = \max\left[V_{Ed}; V_{Ed}^{a}\right] \tag{1}$$

$$V_{Rk,re} = V_{Rk,c,re}/x \tag{2}$$

$$V_{Rk,c,re} = V_{Rk,c,hook} + V_{Rk,c,bond} \quad \leq V_{Rk,c,re,max} \quad \leq \sum_{m+n} A_s \cdot f_{y,k} \tag{3}$$

$$V_{Rk,c,hook} = \sum_{j=1}^{m}\left(\psi_1 \cdot \psi_3 \cdot \psi_4 \cdot A_s \cdot f_{y,k} \cdot \left(\frac{f_{ck}}{30}\right)^{0,1}\right) + \sum_{j=1}^{n}\left(\psi_2 \cdot \psi_3 \cdot \psi_4 \cdot A_s \cdot f_{y,k} \cdot \left(\frac{f_{ck}}{30}\right)^{0,1}\right) \tag{4}$$

$$V_{Rk,c,bond} = \sum_{j=1}^{m+n}\left(\pi \cdot d_s \cdot l_j \cdot f_{b,k}\right) \tag{5}$$

$$V_{Rk,c,re,max} = 4{,}2 \cdot c_1^{-0,12} \cdot V_{Rk,c} \tag{6}$$

$$V_{Rk,c} = V_{Rk,c}^{0} \cdot \alpha_{s,V} \cdot \alpha_{c,V} \cdot \alpha_{h,V} \tag{7}$$

<u>Reinforcement requirements</u>

$$50\,\text{mm} \leq a \leq \begin{cases} s \\ 150\,\text{mm} \\ (c_1 - c_c + 0{,}7 \cdot b_{ch} - 4 \cdot d_s)/0{,}35 \\ c_1 - c_c \end{cases} \tag{8}$$

$$6\,\text{mm} \leq d_s \leq 20\,\text{mm} \tag{9}$$

HALFEN Anchor Channel HTA	Annex 16
Verification for shear loads with reinforcement	

Ψ_1 = 0.67, effectiveness factor

- for stirrups directly besides a shear load ①
- for a stirrup at the location of a shear load ③
- for a stirrup between 2 shear loads acting on an anchor channel (distance between the loads $p \leq s_{cr,V}$ according to Table 17 ②

Ψ_2 = 0.11, effectiveness factor for other stirrups in the concrete cone ④

Ψ_3 = $(d_{s,L}/d_s)^{2/3}$

d_s = diameter of stirrup [mm]

$d_{s,L}$ = diameter of edge bars [mm]

$$\Psi_4 = \left(\frac{l_j}{c_1}\right)^{0,4} \cdot \left(\frac{10}{d_s}\right)^{0,25}$$

l_j = anchorage length of a stirrup leg in the concrete cone [mm]

= c_1-c_c-0.7·(e_j-b_{ch}) [mm] for stirrups crossed diagonally by the assumed crack

= c_1-c_c [mm] for stirrups directly under the load or for stirrups crossed orthogonally by the assumed crack

≥ $4 \cdot d_s$

c_1 = edge distance [mm]

c_c = concrete cover [mm]

e_j = distance of the stirrup leg to the point of load action [mm]

b_{ch} = width of the anchor channel [mm] (acc. to Table 2)

A_s = cross section of one leg of the stirrup [mm²]

$f_{y,k}$ = characteristic yield strength of the reinforcement [N/mm²]

f_{ck} = char. concrete strength measured on cubes with a side length of 150 mm [N/mm²]

f_{bk} = characteristic bond strength [N/mm²]

m = number of stirrups in the assumed concrete cone with Ψ_1

n = number of stirrups in the assumed concrete cone with Ψ_2 ;

a = spacing of stirrups

x = $e_s/z+1$ [-]
factor taking into account eccentricity between reinforcement force and load

e_s = distance between reinforcement and shear force acting on the anchor channel according to CEN/TS 1992-4-3 section 5.3.4

z = internal lever arm

≈ 0.85d [mm] ; $d = \min(2 \cdot h_{ef} / 2 \cdot c_1)$

$V^0_{Rk,c}$ = acc. CEN/TS 1992-4-3: 2009, section 6.3.5.3

V^a_{Ed} = acc. CEN/TS 1992-4-1: 2009, section 3.2.2

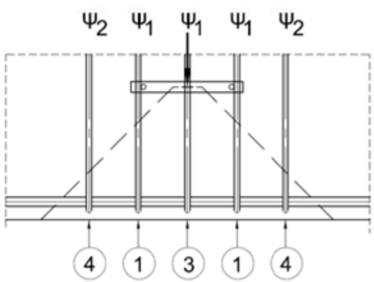


Fig. 1: Effectiveness factor for one load

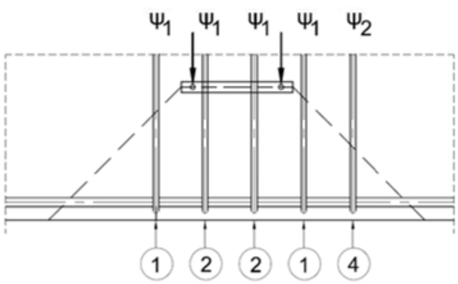


Fig. 2: Effectiveness factor for two loads

HALFEN Anchor Channel HTA	Annex 17
Model for reinforcement under shear loading towards the edge	

Tabelle 19: Characteristic values for tension loads under fire exposure

Anchor channel				28/15	38/17	40/25 40/22	49/30 50/30	54/33 52/34	55/42	72/49 72/48
Special screw			≥ [mm]	M 12	M 16	M 16	M 16	M 16	M 24	M 24
Steel failure: Anchor, Connection channel/anchor, Local flexure of channel lip										
Characteristic resistance	R 90	$N_{Rk,s,fi}$	[kN]	0.7	1.4	2.0	2.5	2.5	7.3	7.3
	R 120			0.5	1.0	1.2	2.1	2.1	5.4	5.4
Partial safety factor [3)]		$\gamma_{Ms,fi}$	[-]	1.0						
Pull-out										
Characteristic resistance	R 90	$N_{Rk,p,fi}$	[kN]	$N_{Rk,p,fi}(90) = 0.25 \cdot N_{Rk,p}$						
	R 120	$N_{Rk,p,fi}$		$N_{Rk,p,fi}(120) = 0.20 \cdot N_{Rk,p}$						
Partial safety factor [3)]		$\gamma_{Mc,fi}$	[-]	1.0						
Concrete cone failure										
Characteristic resistance	R 90	$N_{Rk,c,fi}$	[kN]	$N^0_{Rk,c,fi}(90) = h_{ef}/200 \cdot N^0_{Rk,c} \le N^0_{Rk,c}$						
	R 120	$N_{Rk,c,fi}$		$N^0_{Rk,c,fi}(120) = 0.8 \cdot h_{ef}/200 \cdot N^0_{Rk,c} \le N^0_{Rk,c}$						
Partial safety factor [3)]		$\gamma_{Mc,fi}$	[-]	1.0						
Edge distance		$c_{cr,N,fi}$	[mm]	$2 \cdot h_{ef} \ge c_{cr,N}$						
		$c_{min,fi}$		$2 \cdot h_{ef}$ [1)]; max($2 \cdot h_{ef}$; 300 mm) [2)]						
Characteristic spacing		$s_{cr,N,fi}$	[mm]	$4 \cdot h_{ef} \ge s_{cr,N}$						
		$s_{min,fi}$		acc. to Table 6, Annex 6						
Axial spacing of reinforcement [4)]										
Min. axial spacing	R 90	a	[mm]	45	45	45	45	50	50	50
	R 120	a		60	60	60	60	65	70	70

[1)] Fire exposure from one side only.
[2)] Fire exposure from more than one side.
[3)] In absence of other national regulations
[4)] The reinforced concrete has to be designed acc. to EN 1992. The fire resistance class of the concrete member is not part of this ETA.

Fig. 1

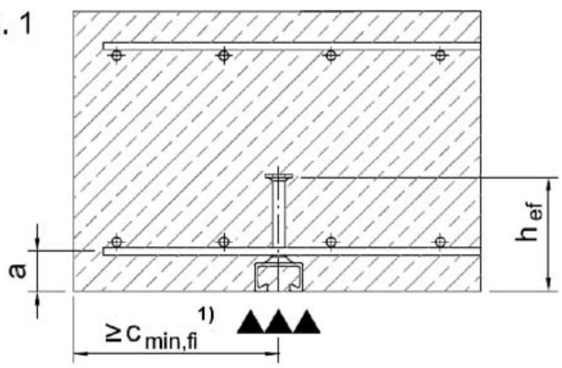
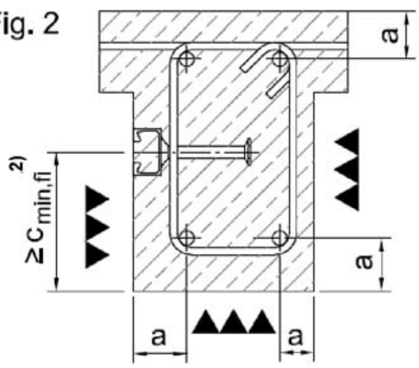


Fig. 2



HALFEN Anchor Channel HTA	Annex 18
Characteristic values for tension loads under fire exposure Axial spacing of reinforcement	

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Table 20: Characteristic values for shear loads under fire exposure

Anchor channel				28/15	38/17	40/25 40/22	49/30 50/30	54/33 52/34	55/42	72/49 72/48
Special screw			≥ [mm]	M 12	M 16	M 16	M 16	M 16	M 24	M 24
Steel failure: Anchor, Connection channel/anchor, Local flexure of channel lip										
Characteristic resistance	R 90	$V_{Rk,s,fi}$	[kN]	0.7	1.4	2.0	2.5	2.5	7.3	7.3
	R 120			0.5	1.0	1.2	2.1	2.1	5.4	5.4
Partial safety factor [1)]		$\gamma_{Ms,fi}$	[-]	1.0						
Pry out										
Characteristic resistance	R 90	$V_{Rk,p,fi}$	[kN]	$V_{Rk,cp,fi}(90) = k_5 \cdot N_{Rk,c,fi}(90)$						
	R 120	$V_{Rk,p,fi}$		$V_{Rk,cp,fi}(120) = k_5 \cdot N_{Rk,c,fi}(120)$						
		k_5	[-]	2.0						
Partial safety factor [1)]		$\gamma_{Mc,fi}$	[-]	1.0						
Concrete edge failure										
Characteristic resistance	R 90	$V_{Rk,c,fi}$	[kN]	$V^0_{Rk,c,fi}(90) = 0.25 \cdot V^0_{Rk,c}$						
	R 120	$V_{Rk,c,fi}$		$V^0_{Rk,c,fi}(120) = 0.20 \cdot V^0_{Rk,c}$						
Partial safety factor [1)]		$\gamma_{Mc,fi}$	[-]	1.0						

[1)] In absence of other national regulations

HALFEN Anchor Channel HTA	Annex 19
Characteristic values for shear loads under fire exposure	

Design method for fatigue loads

The tension forces in the anchors due to static and cyclic loads acting on the channel are calculated according to CEN/TS 1992-4-3:2009, 5.2.2.
The distribution of static actions and the range of influence is determined acc. to Fig. 1. For cyclic loading Fig. 2 has to be taken into account.

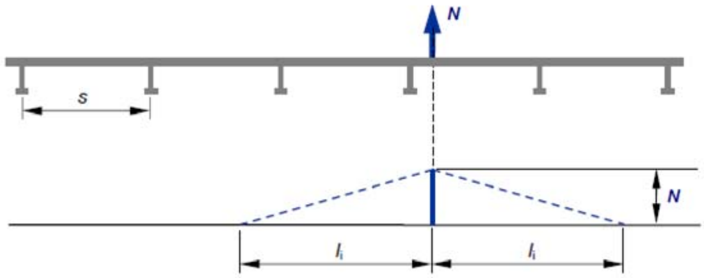


Fig. 1: Range of influence of a static load.

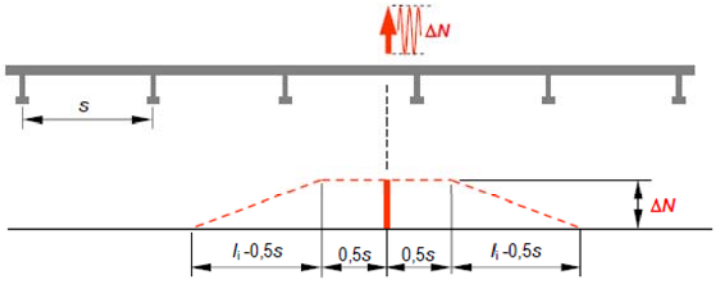


Fig. 2: Range of influence of a cyclic load

The combination of static and fatigue-inducing actions is illustrated in Fig. 3. It may be assumed that the equivalent static load $N_{Ed,eq}$ and the equivalent cyclic load $\Delta N_{Ed,eq}$ act at the same position.

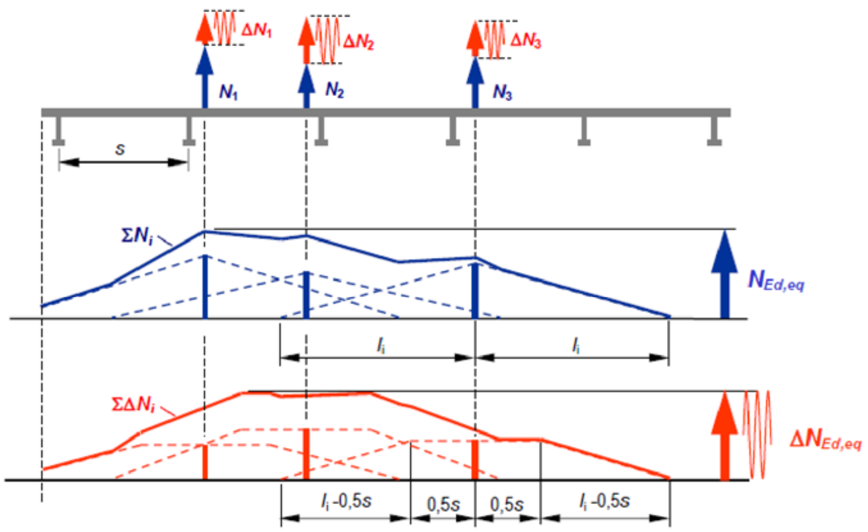


Fig. 3: Consideration of multiple static and cyclic loads.

HALFEN Anchor Channel HTA	Annex 20
Fatigue design - actions	

Table 21: Combinations of anchor channels and special screws for fatigue tensile loads

Anchor channel				Special screw			
Anchor channel	Anchor	d_1 [mm]	Material	Special Screw	Thread Ø [mm]	Grade	Material
HTA 40/22	B6	8	Steel hot-dip galv.	HS 40/22	M12	8.8	Steel, electroplated, hot-dip galv.
					M16	4.6	
						8.8	
HTA 52/34	B6	12		HS 50/30	M16	8.8	
					M20		

Design methods

Conditions:
(1) definite distinction between static loads N_{Ed} and fatigue loads ΔN_{Ed}
(2) known number of load cycles n during service life

Table 22: Design methods, applicable design value of action and design resistance

Design method		Conditions met	Action ΔN_{Ed}		Resistance ΔN_{Rd}	
Design method I	Case 1	(1) and (2)	ΔN_{Ed}	fatigue load	$\Delta N_{Rd;E;n}$	fatigue resistance with known static load after n load cycles
	Case 1.1	(1)	ΔN_{Ed}	fatigue load	$\Delta N_{Rd;E;\infty}$	fatigue resistance with known static load after unlimited load cycles
	Case 1.2	(2)	$\Delta N_{Ed,tot}$	static preload+ fatigue load	$\Delta N_{Rd;0;n}$	fatigue resistance without static load after n load cycles (Tab. 23 and 24)
Design method II	Case 2	none	$\Delta N_{Ed,tot}$	static preload+ fatigue load	$\Delta N_{Rd;0;\infty}$	fatigue resistance without static load after unlimited load cycles (Tab. 25 and 26)

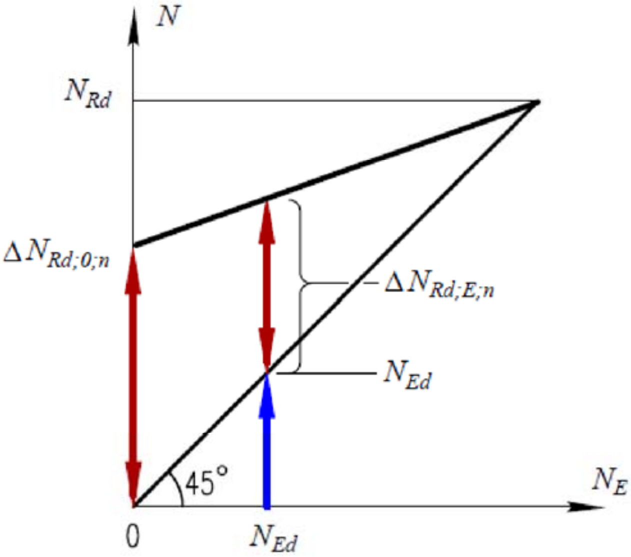
Design method I

Calculation of fatigue resistance $\Delta N_{Rd;E;n}$

$\Delta N_{Rd;E;n} = \Delta N_{Rd;0;n} \cdot (1 - N_{Ed}/N_{Rd})$

respectively

$\Delta N_{Rd;E;\infty} = \Delta N_{Rd;0;\infty} \cdot (1 - N_{Ed}/N_{Rd})$



with

N_{Ed}	design value of static load
N_{Rd}	design value of static resistance
$\Delta N_{Rd;0;n}$	design value of fatigue resistance without static preload for n load cycles (Table 23, 24)
$\Delta N_{Rd;E;n}$	design value of fatigue resistance static with static preload N_{Ed} for n load cycles
$\Delta N_{Rd;0;\infty}$	design value of fatigue limit resistance without static preload (Table 25, Table 26)
$\Delta N_{Rd;E;\infty}$	design value of fatigue limit resistance without static preload (Table 25, Table 26)

Required verifications

<u>Case 1:</u>

Steel failure: $\Delta N_{Ed} \leq \Delta N_{Rd,s;E;n}$

Pullout failure: $\Delta N_{Ed} \leq \Delta N_{Rd,p;E;n}$

Concrete cone failue: $\Delta N_{Ed} \leq \Delta N_{Rd,c;E;n}$

<u>Case 1.1:</u>

Steel failure: $\Delta N_{Ed} \leq \Delta N_{Rd,s;E;\infty}$

Pullout failure: $\Delta N_{Ed} \leq \Delta N_{Rd,p;E;\infty}$

Concrete cone failue: $\Delta N_{Ed} \leq \Delta N_{Rd,c;E;\infty}$

<u>Case 1.2:</u>

Steel failure: $\Delta N_{Ed,tot} \leq \Delta N_{Rd,s;0;n}$

Pullout failure: $\Delta N_{Ed,tot} \leq \Delta N_{Rd,p;0;n}$

Concrete cone failue: $\Delta N_{Ed,tot} \leq \Delta N_{Rd,c;0;n}$

HALFEN Anchor Channel HTA	Annex 22
Fatigue design - Design method I	

Table 23: Design fatigue resistances after n load cycles without static preload (N_{Ed} = 0 kN) - Steel failure

Anchor channel HTA	Load cycles n	40/22	52/34
		$\Delta N_{Rd,s;0;n}$ [kN]	
Design fatigue resistance without static preload	≤ 10	11.1	30.5
	≤ 100	11.0	29.3
	≤ 300	10.7	27.9
	≤ 10^3	10.2	25.3
	≤ $3 \cdot 10^3$	9.3	21.9
	≤ 10^4	7.9	17.4
	≤ $3 \cdot 10^4$	6.2	13.4
	≤ 10^5	4.5	9.8
	≤ $3 \cdot 10^5$	3.4	7.6
	≤ 10^6	2.8	6.4
	≤ $2 \cdot 10^6$	2.7	6.1
	> 10^7	2.7	5.9

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Table 24: Design fatigue resistances after n load cycles without static preload (N_{Ed} = 0 kN) - Concrete failure

Pullout failure:

Anchor channel HTA	Load cycles n	40/22	52/34
		$\Delta N_{Rd,p;0;n}$(C12/15) [kN]	
Design fatigue resistance without static preload $\Delta N_{Rd,p;0;n} = \Delta N_{Rd,p;0;n}(C12/15) \cdot \psi_c \cdot \psi_{ucr,N}$ [1)]	≤ 10	9.0	22.6
	≤ 100	8.3	20.9
	≤ 300	8.0	20.1
	≤ 10^3	7.7	19.2
	≤ $3 \cdot 10^3$	7.4	18.5
	≤ 10^4	7.1	17.7
	≤ $3 \cdot 10^4$	6.8	17.1
	≤ 10^5	6.5	16.4
	≤ $3 \cdot 10^5$	6.3	15.7
	> 10^6	6.0	15.1

[1)] Consideration of different concrete strength by factor ψ_c acc. Annex 13
Consideration of the position of the anchor channel by factor $\psi_{ucr,N}$ acc. Annex 13

Concrete cone failure:

	Load cycles N	$\eta_{c,fat}$ [-]
Design fatigue resistance without static preload $\Delta N_{Rd,c:0;n} = \eta_{c,fat} \cdot N_{Rd,c}$ [1)]	≤ 10	1.000
	≤ 100	0.923
	≤ 300	0.888
	≤ 10^3	0.851
	≤ $3 \cdot 10^3$	0.819
	≤ 10^4	0.785
	≤ $3 \cdot 10^4$	0.755
	≤ 10^5	0.723
	≤ $3 \cdot 10^5$	0.696
	> 10^6	0.667

[1)] $N_{Rd,c}$ static resistance according Annex 13 and CEN/TS 1992-4-3:2009

HALFEN Anchor Channel HTA	Annex 24
Fatigue design – Design fatigue resistances for concrete failure	

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Design method II

Conditions:
(1) no definite distinction between static loads N_{Ed} and fatigue loads ΔN_{Ed}
(2) unknown number of load cycles n during service life

Required verifications

Case 2:

Steel failure:	$\Delta N_{Ed,tot} \leq \Delta N_{Rd,s;0;\infty}$	acc. Table 25
Pullout failure:	not required	
Concrete cone failure:	$\Delta N_{Ed,tot} \leq \Delta N_{Rd,c;0;\infty}$	acc. Table 26

Table 25: Design fatigue limit resistances – Steel failure

Anchor channel HTA		40/22	52/34
Design faigue resistance		$\Delta N_{Rd,s;0;\infty}$ [kN]	
		2.7	5.9

Table 26: Design fatigue limit resistances – Concrete cone failure

Design fatigue resistance	$\eta_{c,fat}$ [-]
$\Delta N_{Rd,c:0;\infty} = \eta_{c,fat} \cdot N_{Rd,c}$ [1)]	0.667

[1)] $N_{Rd,c}$ static resistance according Annex 13 and CEN/TS 1992-4-3:2009

English translation prepared by DIBt

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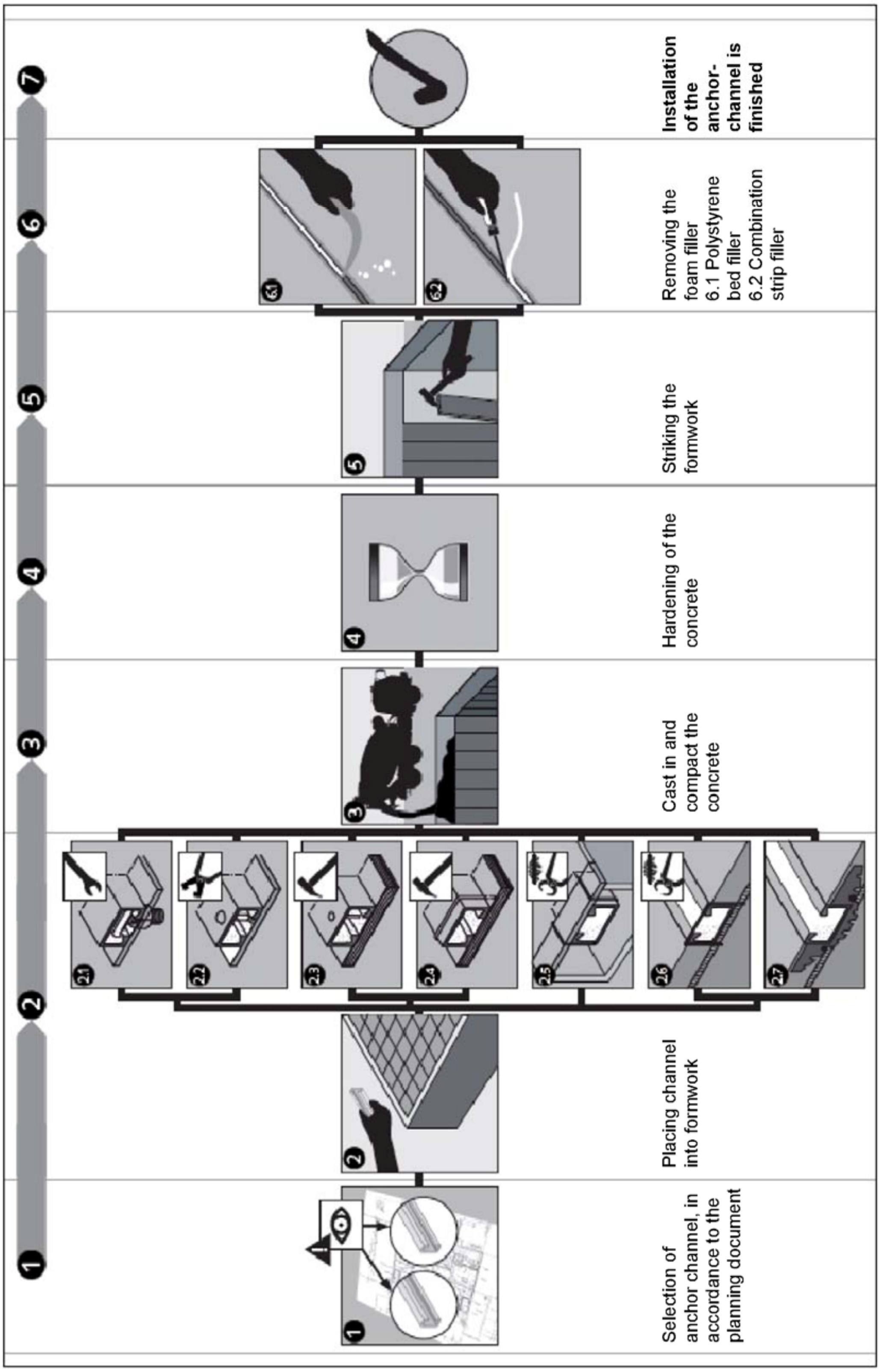
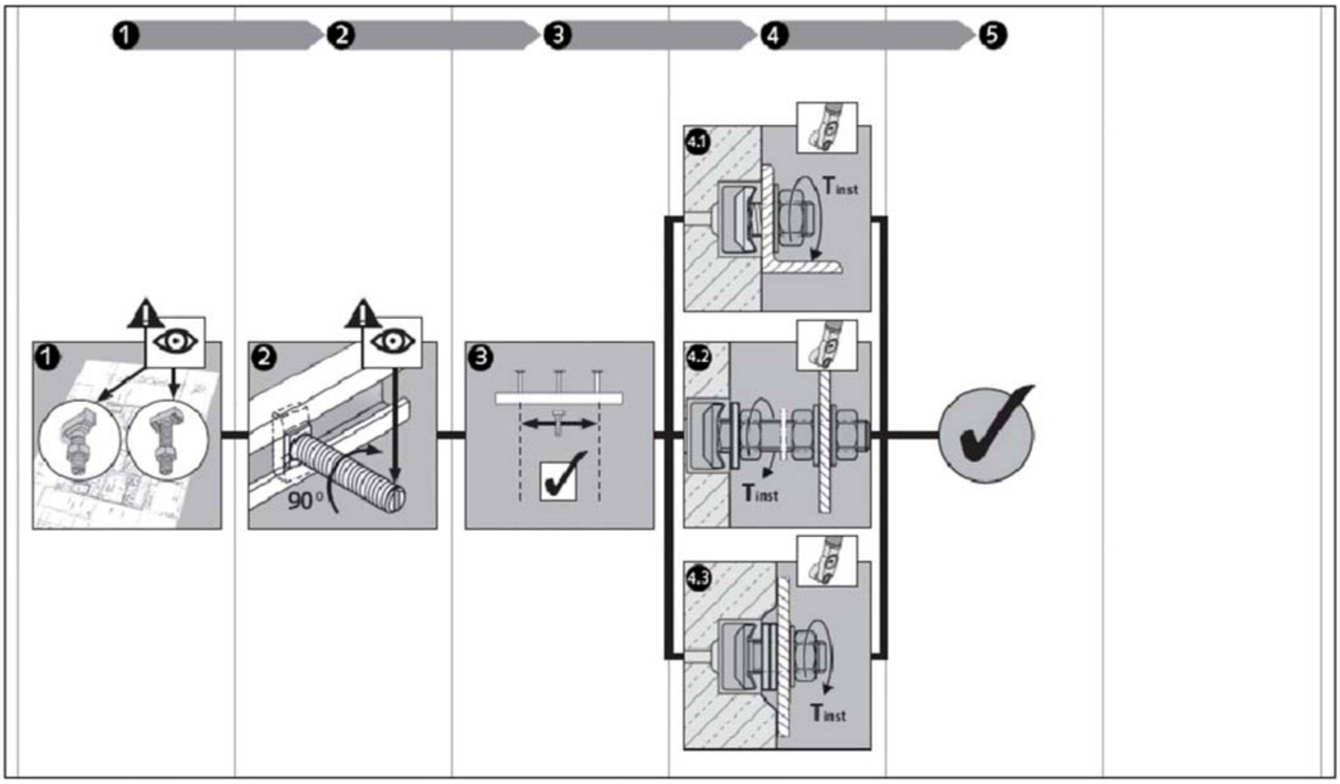


2.1 steel formwork: Fixing with HALFEN special screws through the form
2.2 steel formwork: Fixing with rivets
2.3 wood formwork: Fixing with nails
2.4 wood formwork: Fixing with staples
2.5 fixing in the top surface of concrete: Fixing by using auxiliary construction
2.6 fixing in the top surface of concrete: Fixing from above directly to the reinforcement
2.7 fixing in the top surface of concrete: Fixing to the reinforcement, using the HALFEN ChanClip

HALFEN Anchor Channel HTA	Annex 26
Manufacturer's specification HALFEN nchor channel	

Installation of HALFEN special screws



1. Selection of the HALFEN special screws in accordance with the planning document
2. Insert the special screw into the channel. After a 90° turn clockwise, the special screw locks into the channel. (Check of the position of the screw by notch)
3. Positioning of the special screw: At the channel ends a minimum clearance must be maintained, which corresponds with the overhang beyond the last anchor acc. Annex 6.
4. Tighten the hexagonal nut to the setting torque (Tinst) acc.Table 27. Tinst must not be exceeded. 4.1: general 4.2 and 4.3: steel to steel contact
5. After fixing the nuts: check the correct position of the screw: If the notch is not perpendicular to the channel length axis, the special screw must be released completely, inserted and tightened again.

Fixing is completed

Table 27: Setting torques

Position of fixture acc. Ann.10	Material Strength grade		Anchor channel	T inst [Nm] [1]								
				M6	M8	M10	M12	M16	M20	M24	M27	M30
General	steel 4.6 / 8.8 stainless steel 50 / 70		28/15	3	8	13	15	-	-	-	-	-
			38/17	-	-	15	25	40	-	-	-	-
			40/25, 40/22	-	-	15	25	45	-	-	-	-
			49/30, 50/30	-	-	15	25	60	75	-	-	-
			54/33, 53/34	-	-	15	25	60	120	-	-	-
			55/42	-	-	15	25	60	120	200	-	-
			72/49, 72/48	-	-	-	-	-	120	200	300	380
Steel to steel contact	steel	4.6	all anchor channels	3	8	15	25	65	130	230	340	460
		8.8		-	20	40	70	180	360	620	900	1200
	stainless steel	50		-	8	15	25	60	120	200	300	400
		70		-	15	30	50	130	250	440	650	850

[1] Tinst must not be exceeded

HALFEN Anchor Channel HTA

Manufacturer's specification
HALFEN special screw

Annex 27