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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-11/0006

English translation prepared by DIBt - Original version in German language

Handelsbezeichnung *Trade name*	Hilti Ankerschiene - HAC mit Spezialschraube - HBC *Hilti Anchor Channel - HAC with special screw - HBC*
Zulassungsinhaber *Holder of approval*	Hilti AG Feldkircherstraße 100 9494 Schaan FÜRSTENTUM LIECHTENSTEIN
Zulassungsgegenstand und Verwendungszweck *Generic type and use of construction product*	Einbetonierte Ankerschiene *Cast-in anchor channel*
Geltungsdauer: vom *Validity: from*	8 February 2011
bis *to*	8 February 2016
Herstellwerk *Manufacturing plant*	Hilti-Werk 6 Hilti-Werk 4828 Hilti-Werk 9223 Hilti-Werk 4345 Hilti-Werk 0199

Diese Zulassung umfasst *This Approval contains*	37 Seiten einschließlich 28 Anhänge *37 pages including 28 annexes*

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 law of 31 October 2006[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 2006*, p. 2407, 2416
[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 Hilti Anchor Channel - HAC with special screw - HBC is an anchor channel consisting of a C-shaped resp. V-shaped channel of 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. Hilti-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 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 in combination with special screws HBC-B and HBC-C according to Annex 22, Table 23 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 (ER 2) 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 predominantly 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 to 20. 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 21 to 26.

The anchor channel shall be marked with the identifying mark of the producer, the size and with the material finish, e.g. HAC-10 F 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, the special screw type, the strength grade and with the material finish 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	$N_{Rk,sp}$
12. Concrete failure - blow-out	$N_{Rk,cb}$
13. Reinforcement	$N_{Rk,re}$, $N_{Rd,a}$
14. Displacement under tension loads	δ_N

[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.

Verifications for shear loads for

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

Verification for fatigue tension loads for

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.

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.

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.

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 and 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 and 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 Predominantly 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 Annex 16 and 17.

The calculation of $\alpha_{h,v}$ (effect of the thickness of the structural component) for the verification of concrete edge failure is done according Annex 14, Table 16 exceptional to CEN/TS 1992-4-3:2009, section 6.3.5.6, formula (38).

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 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 9.

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

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.

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 23 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 24 and Annex 25 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 22 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 $n \geq 10^6$ load cycles. The design fatigue resistances $\Delta N_{Rd;E;\infty}$ may be calculated according Annex 22 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 26 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 $n \geq 10^6$ may be chosen.

The design fatigue resistances $\Delta N_{Rd;0;\infty}$ due to tension load without static pre-loading are given in Annex 26 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 to 20. 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 any manipulations, repositioning or exchanging of channel components.
- Cutting of anchor channels only if pieces according Annex 6, Table 6 are generated including end spacing and minimum channel length and only for use in dry internal conditions possible.
- Installation in accordance with the manufacturer's specifications given in Annex 27 and 28 and the design drawings.
- The anchor channels are fixed on the formwork, reinforcement or auxiliary construction 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 arprotected from penetration of concrete into the internal space of the channels.
- Size and spacing of special screws corresponding to the design drawings.
- Washer may be chosen according Annex 3 and provided separately by the user.
- 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).

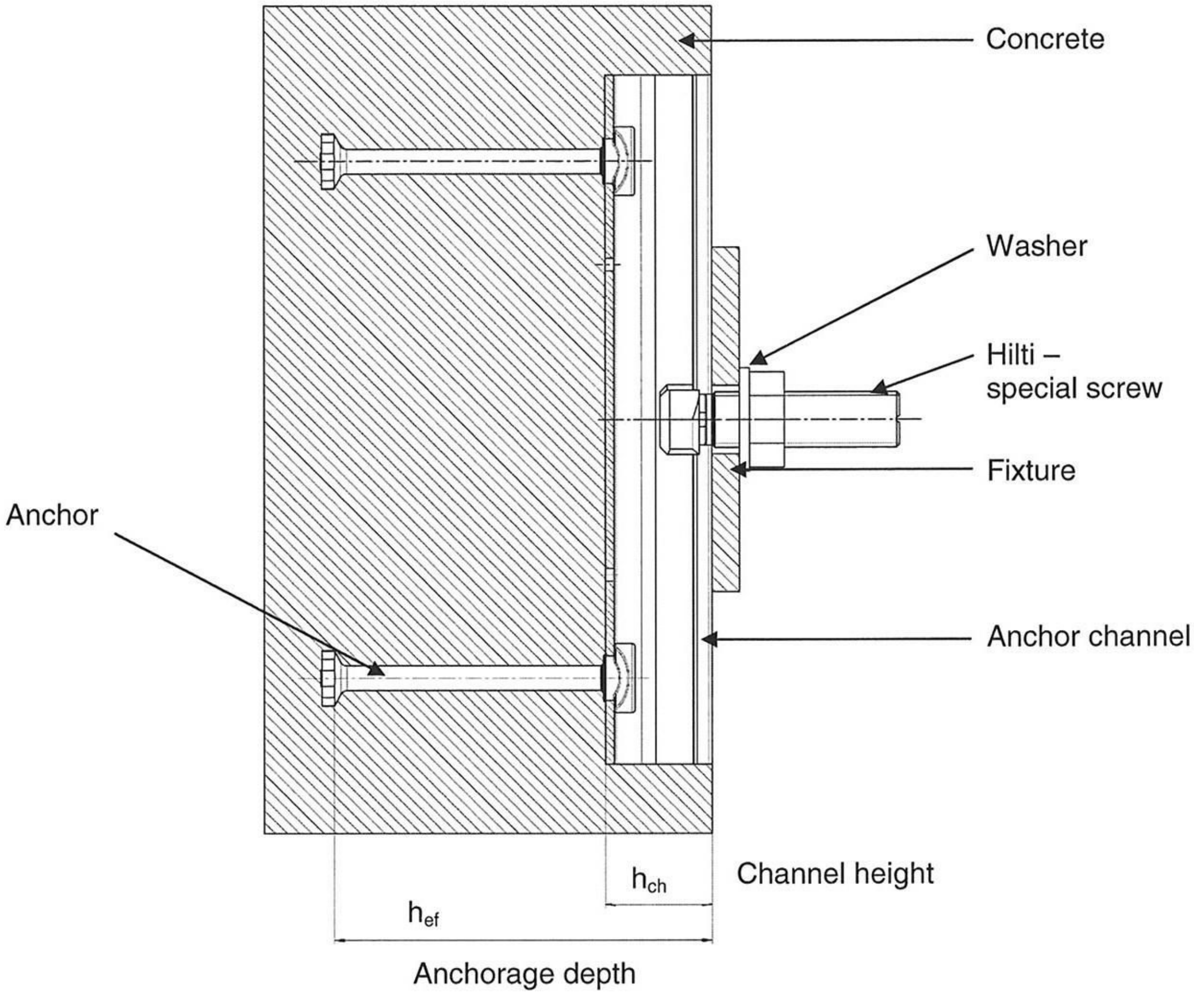
The minimum data required are:

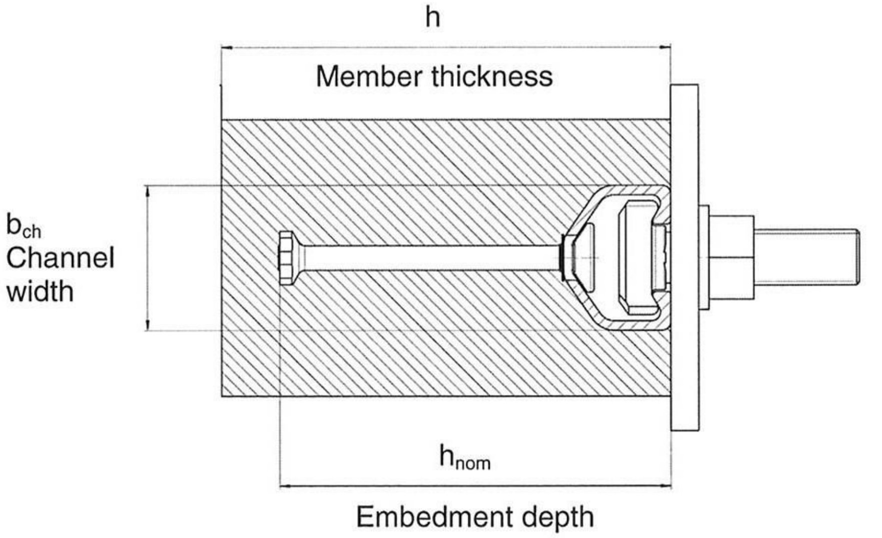
- dimensions of the anchor channel,
- mentioning of the matching screws,
- materials of the anchor channel (channel, anchor, screw , washer, nut)
- details on the installation procedure, preferably by using illustrations,
- maximum setting torque,
- identification of the manufacturing batch.

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

Georg Feistel
Head of Department

beglaubigt:
Müller

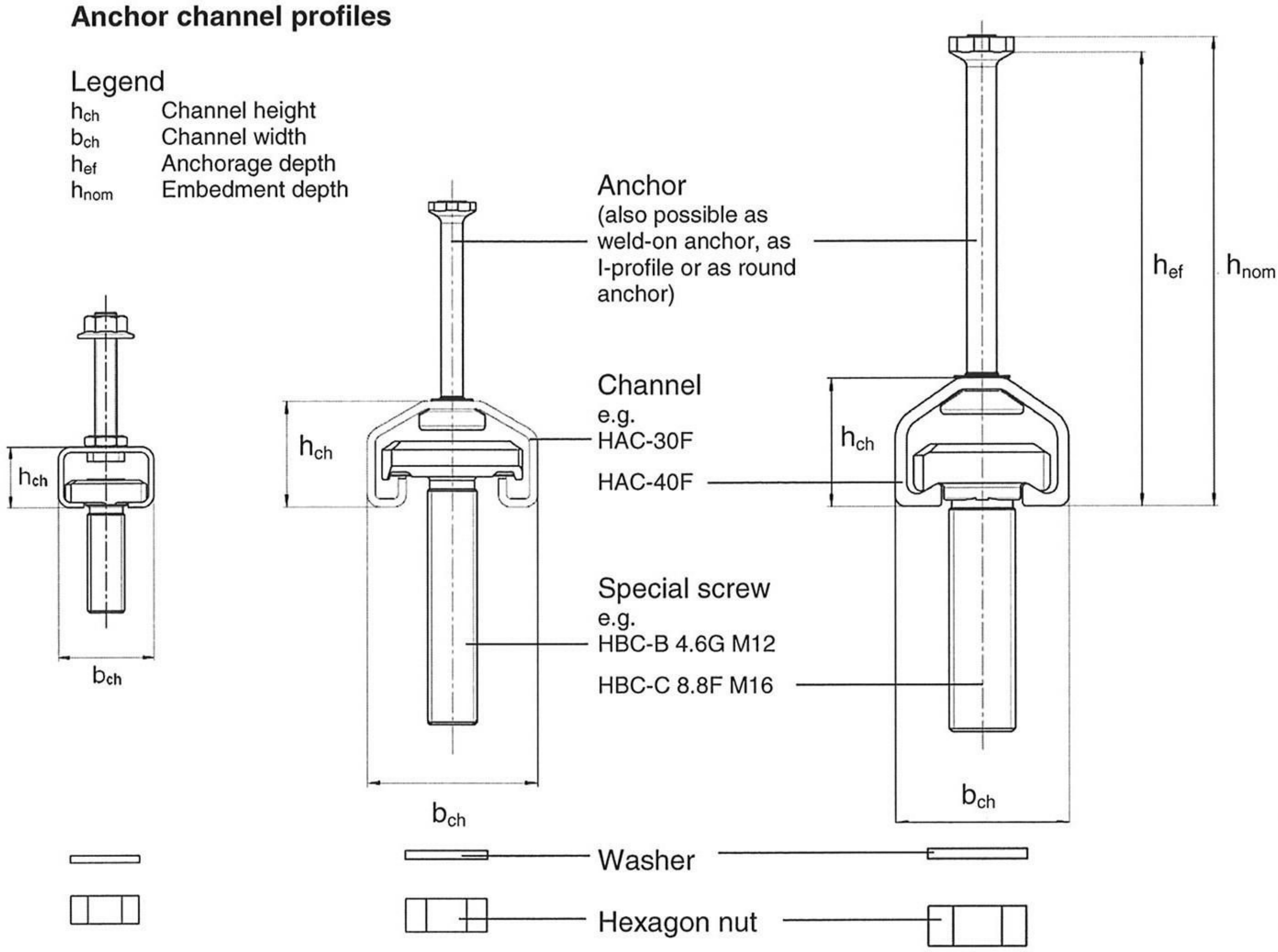




Hilti Anchor Channel - HAC	**Annex 1**
Product and intended use	of European technical approval ETA – 11/0006

Anchor channel profiles

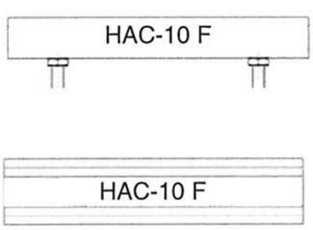
Legend
h_{ch} Channel height
b_{ch} Channel width
h_{ef} Anchorage depth
h_{nom} Embedment depth



Marking of the Hilti – anchor channel: e.g.: HAC-10 F

HAC = Identifying mark of the manufacturer **H**ilti **A**nchor **C**hannel
10 = Size
F = Material finish = hot-dip galvanized

Close to the anchors a nail hole is positioned



Stamped on channel side

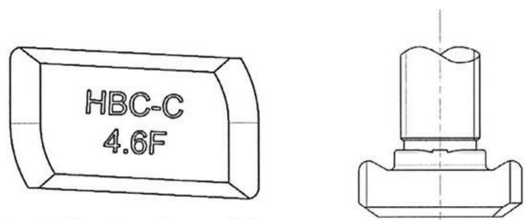
and / or

Stamped inside the channel bottom

Material channels:
see Annex 3

Marking of the Hilti – special screw: e.g.: HBC-C 4.6F

HBC = Identifying mark of the manufacturer **H**ilti **B**olt **C**hannel
C = Special screw type
4.6F = Strength grade / material finish



Material/Steel grade special screw
4.6 = Steel grade 4.6
8.8 = Steel grade 8.8
A4-50 = Stainless steel acc. Annex 3

Material finish:
G = Electroplated
F = Hot-dip galvanized
R = Stainless steel

Hilti Anchor Channel - HAC	Annex 2
Product and marking	of European technical approval ETA – 11/0006

Table 1: Materials and intended use

Item no.	Specification	Intended use		
		1	2	3
		Dry internal condition	**Internal conditions with usual humidity**	**Medium corrosion exposure**
		Anchor channels may only be used in structures subject to dry internal conditions (e.g. accommodations, 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 be used in structures subject to external atmospheric conditions (including industrial and marine environment) or exposure in permanently damp internal conditions , if no 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. desulphurization plants or road tunnels where deicing materials are used) exist.
		Materials		
1	Channel profile	Carbon steel acc. EN 10149-2, EN 10051 hot-dip galv. ≥ 55 µm [2], (HAC-10 and HAC-20) or acc. EN 10025-2, hot-dip galv. ≥ 55 µm [2] (HAC-30 to HAC-50) or acc. EN 10025-2, hot-dip galv. ≥ 70 µm [2] (HAC-60 and HAC-70)		-
2	Rivet	Carbon steel, hot-dip galv. ≥ 45 µm [3]		-
3	Anchor	Carbon steel, hot-dip galv. ≥ 45 µm [3]		-
4	HILTI special screw shaft and thread according to EN ISO 4018	Carbon steel, steel grade 4.6 / 8.8 in dependence on EN ISO 898-1 [4] electroplated ≥ 8 µm [1]	Carbon steel, steel grade 4.6 / 8.8 in dependence on EN ISO 898-1 [4] hot-dip galv. ≥ 45 µm [3]	Stainless steel steel grade 50 1.4401/ 1.4404/ 1.4571 1.4362/ 1.4578/ 1.4439 EN ISO 3506-1 EN10088-2
5	Washer EN ISO 7089 and EN ISO 7093-1 production class A, 200 HV	Carbon steel, EN 10025-2 electroplated ≥ 5 µm [1]	Carbon steel, EN 10025-2 hot-dip galv. ≥ 45 µm [3]	Stainless steel 1.4401/ 1.4404/ 1.4571 1.4362/ 1.4578/ 1.4439 EN 10088
6	Hexagonal nuts DIN 934 [5] EN ISO 4032	Carbon steel, class 5 / 8 EN 20898-2 electroplated ≥ 8 µm [1]	Carbon steel, class 5 / 8 EN 20898-2 hot-dip galv. ≥ 45 µm [3]	Stainless steel class 70 1.4401/ 1.4404/ 1.4571 1.4362/ 1.4578/ 1.4439 EN ISO 3506-2 EN 10088-2

[1] Electroplated according to EN ISO 4042, A3K
[2] Hot-dip galv. according to EN ISO 1461:2009-10 (Mean coating thickness (minimum))
[3] Hot-dip galv. according to ISO 1461:1999 (Mean coating thickness (minimum))
[4] Properties according to EN ISO 898-1 only in threaded part of screw
[5] DIN 934 only for special screw grade 4.6 and stainless steel

Hilti Anchor Channel - HAC	Annex 3
Materials and intended use	of European technical approval ETA – 11/0006

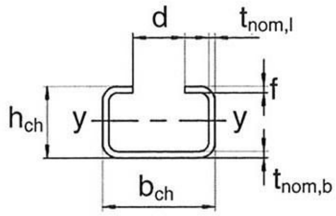


Fig. 1

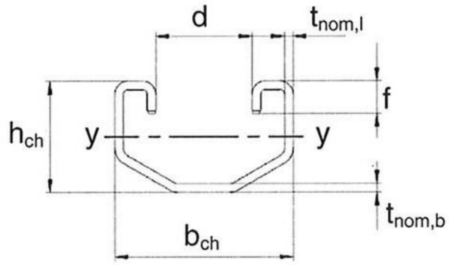


Fig. 2

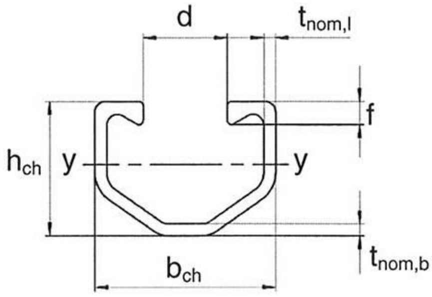


Fig. 3

Marking of the channel according to Annex 2

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]							[mm⁴]
HAC-10	1	26.2	16.7	1.60	1.60	12.0	1.60	Steel	3643
HAC-20		27.5	18.0	2.25	2.25	12.0	2.25		5775
HAC-30	2	41.3	25.6	2.00	2.00	22.3	7.50		15349
HAC-40	3	40.9	28.0	2.25	2.25	19.5	4.50		21452
HAC-50		41.9	31.0	2.75	2.75	19.5	5.30		33125
HAC-60		43.4	35.5	3.50	3.50	19.5	6.30		57930
HAC-70		45.4	40.0	4.50	4.50	19.5	7.40		96736

Table 3: Types of round anchors

Channel	Shaft Ø d_1	Head Ø d_2	Length min l
	[mm]		
HAC-10 [1]	5.35	10.0	33.3
HAC-20 [1]	7.19	13.0	64.5
HAC-30	5.35	11.5	44.4
HAC-40	7.19	13.5	66.0
HAC-50	7.19	15.5	78.5
HAC-60	9.03	19.5	117.0
HAC-70	10.86	23.0	140.0

Fig. 4

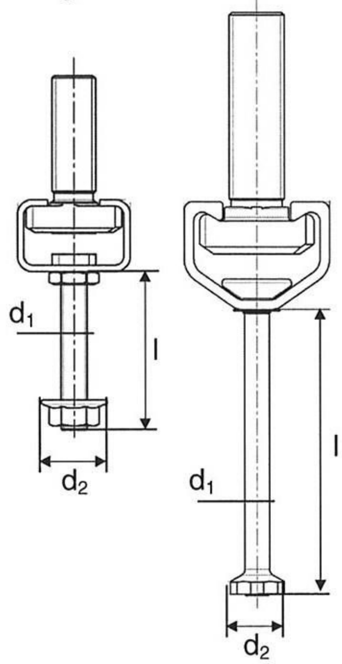


Table 4: Types of weld-on round anchors (headed studs) [1]

Channel	Shaft Ø d_1	Shaft Ø d_2	Length min l
	[mm]		
HAC-10	6	13	35
HAC-20	10	19	75
HAC-30		19	50

Fig. 5a

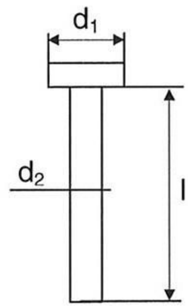


Table 5: Types of weld-onT-anchors [1]

Channel	Head width a	Web thickness t	Length min l
	[mm]		
HAC-40	13	5	70
HAC-50	14	5	80
HAC-60	16	5	120
HAC-70	17	6	135

[1] Not valid for fatigue load

Fig. 5b

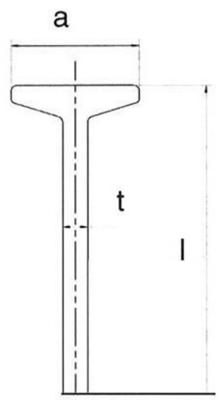


Fig. 6

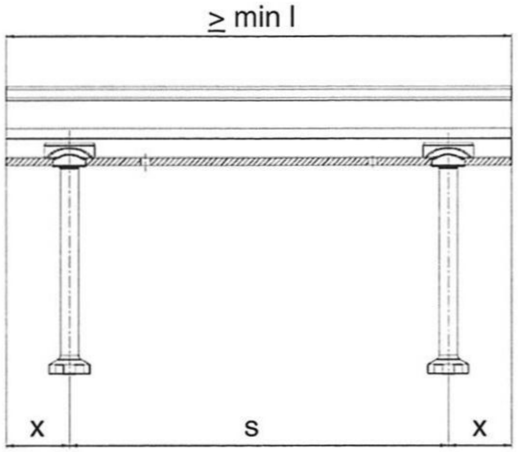


Fig. 7

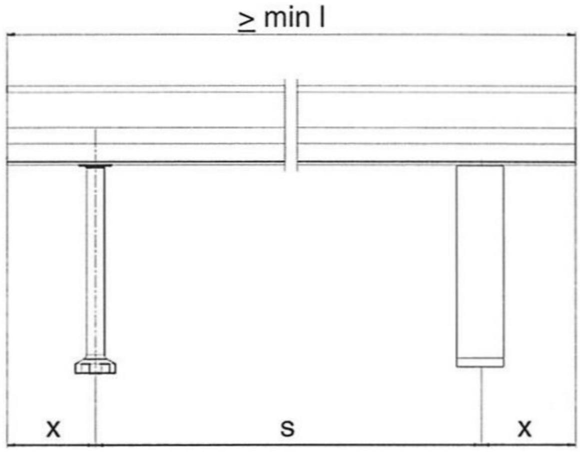


Table 6: Anchor positioning

<table>
<tr><th rowspan="3">Anchor channel</th><th colspan="2">Anchor spacing</th><th colspan="2">End spacing x</th><th colspan="2">Min. channel length min l</th></tr>
<tr><th>s_{min}</th><th>s_{max}</th><th>Round anchor Fig. 6</th><th>Welded anchor Fig. 7</th><th>Round anchor Fig.6</th><th>Welded anchor Fig. 7</th></tr>
<tr><th colspan="6">[mm]</th></tr>
<tr><td>HAC-10</td><td rowspan="3">50</td><td rowspan="2">200</td><td rowspan="7" colspan="2">25</td><td rowspan="3" colspan="2">100</td></tr>
<tr><td>HAC-20</td></tr>
<tr><td>HAC-30</td><td rowspan="5">250</td></tr>
<tr><td>HAC-40</td><td rowspan="4">100</td><td rowspan="4" colspan="2">150</td></tr>
<tr><td>HAC-50</td></tr>
<tr><td>HAC-60</td></tr>
<tr><td>HAC-70</td></tr>
</table>

Table 7: Dimensions of special screw

Anchor channel	Figure	Special screw type	Special screw dimensions b_1 [mm]	b_2 [mm]	k [mm]	Ø [mm]	Length l [mm]
HAC-10 HAC-20	8	HBC-A	11.0	22.0	5.0	8	15-100
					6.0	10	15-175
					7.0	12	20-200
HAC-30	9	HBC-B	18.0	34.0	7.0	8	15-150
						10	15-175
			19.0	34.0	9.2	12	20-200
HAC-40 HAC-50 HAC-60 HAC-70	10	HBC-C	14.0	33.0	8.5	10	20-200
						12	20-200
			18.5		9.5	16	20-300
					12.0	20	20-300
HAC-40 HAC-50	11	HBC-C-E	14.0	33.0	8.5	12	20-200
			17.0		11.5	16	20-300
HAC-40 HAC-50 HAC-60 HAC-70	12	HBC-C-N	18.5	33.0	9.5	16	20-200
					13.0	20	20-300

Table 8: Steel grade

Special screws	Carbon steel [1)]		Stainless steel [1)]
property class	4.6	8.8	A4-50
f_{uk} [N/mm^2]	400	800	500
f_{yk} [N/mm^2]	240	640	210
Coating	G [2)] F [3)]		-

[1)] Materials according to Annex 3, Table 1
[2)] Electroplated
[3)] Hot-dip galvanized

Fig. 8: HBC-A

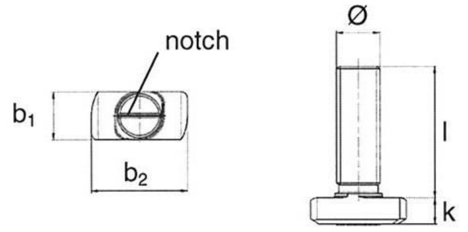


Fig. 9: HBC-B

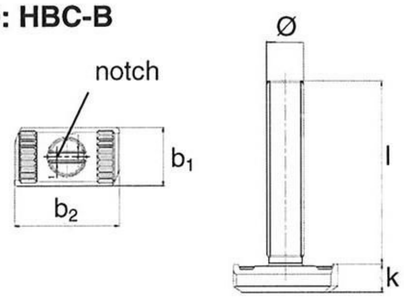


Fig. 10: HBC-C

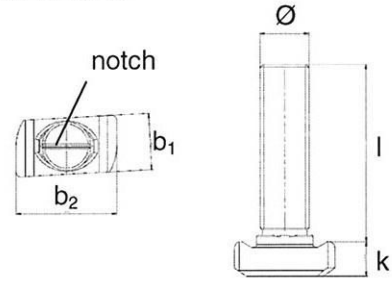


Fig. 11: HBC-C-E

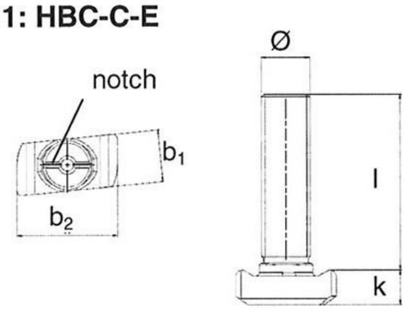
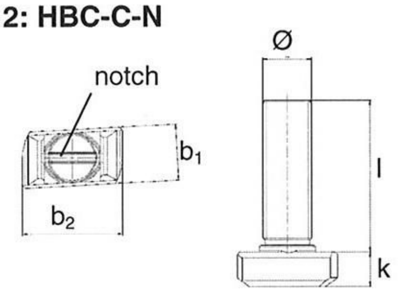


Fig. 12: HBC-C-N



Marking of the special screw according to Annex 2

Fig. 13

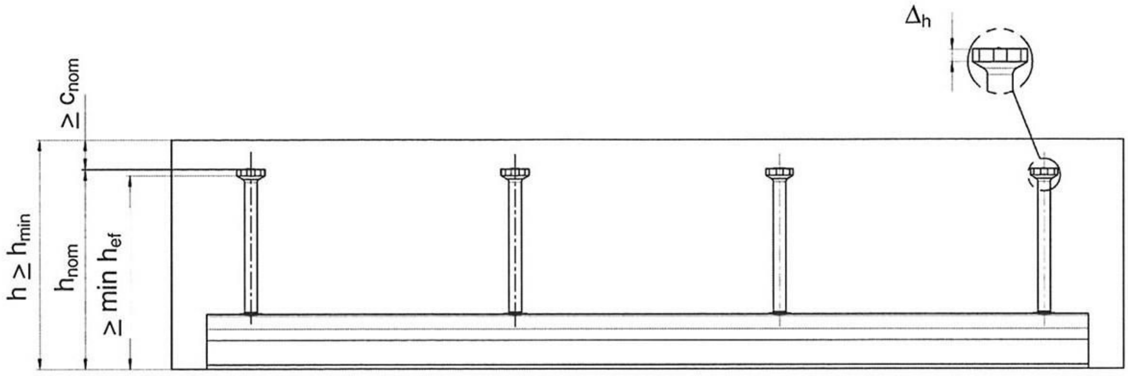


Fig. 14

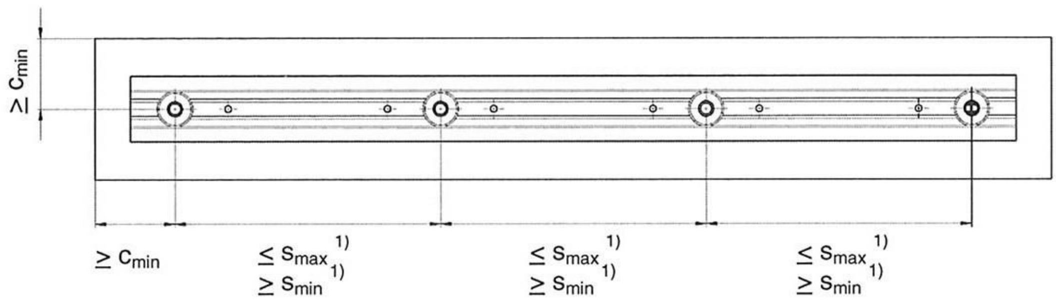


Table 9: Minimum anchorage depth, edge distance and member thickness

Anchor channel			HAC-10	HAC-20	HAC-30	HAC-40	HAC-50	HAC-60	HAC-70
Min. anchorage depth	min h_{ef}	[mm]	45	76	68	91	106	148	175
Min. edge distance	c_{min}		40	50			75	100	
Anchor head thickness	Δ_h		5	6.5	2	3	3.5	4.5	5
Min. member thickness	h_{min} 2)		$h_{ef} + \Delta h + c_{nom}$ 2)						

1) s_{min}, s_{max} acc. to Table 5 Annex 6
2) $c_{nom} \geq 10$ mm and acc. to EN 1992-1-1:2005

Table 10: Installation parameter of Hilti special screws

Anchor channel	Special screw type	Special screw Ø	Min spacing [5] $s_{min,s}$ of the special screw	Setting torque T_{inst} [1) 4)]		
				General [2)]	Steel – steel contact [3)]	
				4.6; 8.8; A4-50 [1)]	4.6 A4-50 [1)]	8.8 [1)]
		[mm]	[mm]	[Nm]		
HAC-10	HBC-A	8	40	8	8	-
		10	50	15	15	-
		12	60	15	25	-
HAC-20		8	40	8	8	-
		10	50	15	15	-
		12	60	25	25	-
HAC-30	HBC-B	8	40	8	8	-
		10	50	15	15	-
		12	60	30	25	-
HAC-40	HBC-C HBC-C-E HBC-C-N	10	50	15	15	48
		12	60	25	25	70
		16	80	60	60	200
		20	100	75	120	400
HAC-50		10	50	15	15	48
		12	60	25	25	70
		16	80	60	60	200
		20	100	120	120	400
HAC-60		10	50	15	15	48
		12	60	25	25	70
		16	80	60	60	200
		20	100	120	120	400
HAC-70		10	50	15	15	48
		12	60	25	25	70
		16	80	60	60	200
		20	100	120	120	400

1) Materials according to Tab. 1, Annex 3
2) Acc. to figure 15, Annex 10
3) Acc. to figure 16, Annex 10
4) T_{inst} must not be exceeded
5) See Annex 11, Fig. 17

General:

The fixture is fastened to the concrete or to the anchor channel respectively fastened to concrete and anchor channel.
The setting torques acc. to Annex 9, Table 10 shall be applied and must not be exceeded.

Steel to steel contact:

The fixture is fastened to the anchor channel by suitable washer.
The setting torques acc. to Annex 9, Table 10 shall be applied and must not be exceeded.

Fig. 15

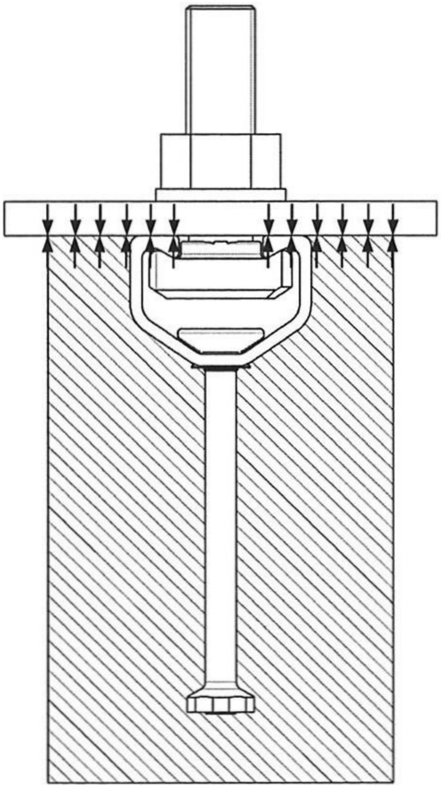


Fig. 16

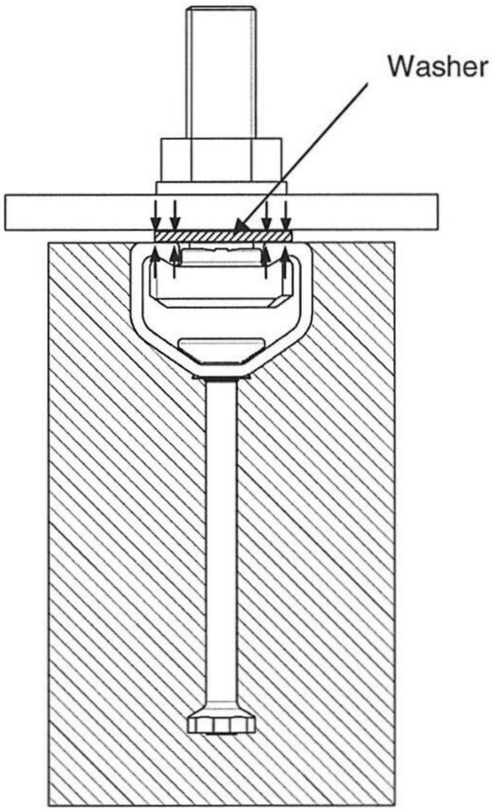


Table 11: Characteristic values for tension loads – steel failure channel

Anchor channel			HAC-10	HAC-20	HAC-30	HAC-40	HAC-50	HAC-60	HAC-70
Steel failure, Anchor									
Characteristic resistance	$N_{Rk,s,a}$	[kN]	13	29	18	33	33	52	76
Partial safety factor	γ_{Ms} [1]		1.8						
Steel failure, Connection channel/ anchor									
Characteristic resistance	$N_{Rk,s,c}$	[kN]	9	18	18	25	33	52	73
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 screw for $N_{Rk,s,l}$	s_{slb}	[mm]	45	47	71	75	81	90	99
Characteristic resistance	$N_{Rk,s,l}$	[kN]	9	18	20	25	35	52	73
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]	$0.5\ (1+s_s/s_{slb})\ N_{Rk,s,l} \leq N_{Rk,s,c}$						
Partial safety factor	γ_{Ms} [1]		1.8						

[1] In absence of other national regulations
[2] $s_{min,s}$ acc. to Table 10, Annex 9

Fig. 17: Spacing of special screw

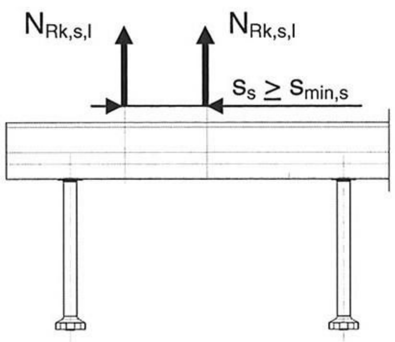


Fig. 18: Assumption of system

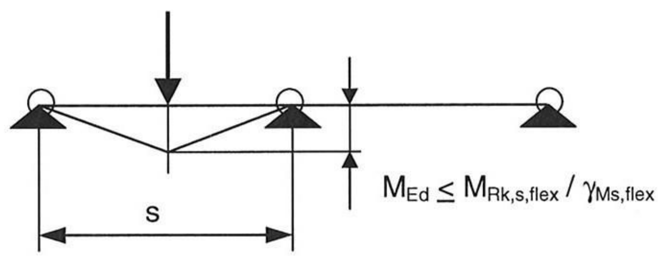


Table 12: Characteristic flexure resistance of channel

Anchor channel			HAC-10	HAC-20	HAC-30	HAC-40	HAC-50	HAC-60	HAC-70
Characteristic flexure resistance of channel	$M_{Rk,s,flex}$	[Nm]	292	584	708	944	1364	2077	3239
Partial safety factor	$\gamma_{Ms,flex}$ [1]		1.15						

[1] In absence of other national regulations

Table 13: Characteristic values for tension load – Steel failure Hilti-special screw type HBC-A, HBC-B, HBC-C, HBC-C-E and HBC-C-N

Special screw Ø					M8	M10	M12	M16	M20
Steel failure									
Characteristic resistance	$N_{Rk,s,s}$ [2]	[kN]	HBC-A	4.6	14.6	23.2	33.7	-	-
				A4-50 [1]	18.3	29.0	42.2	-	-
			HBC-B	4.6	14.6	23.2	33.7	-	-
				A4-50 [1]	18.3	29.0	42.2	-	-
			HBC-C HBC-C-E HBC-C-N	4.6	-	23.2	33.7	62.8	98.0
				8.8	-	46.4	67.4	125.6	196.0
				A4-50 [1]	-	29.0	42.2	78.5	122.5
Partial safety factor	γ_{Ms} [3]			4.6	2.00				
				8.8	1.50				
				A4-50 [1]	2.86				

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

Fig. 19

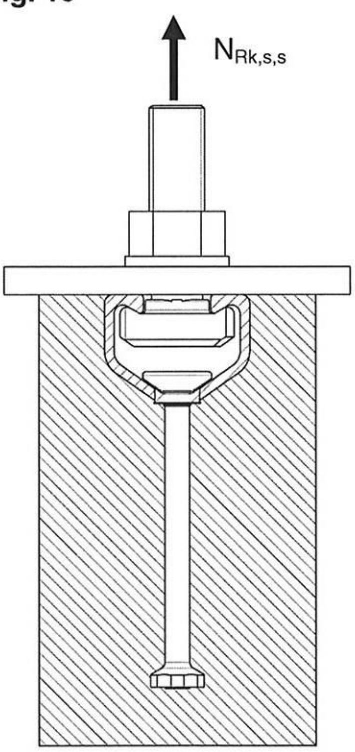


Table 14: Characteristic values for tension load – Concrete failure

Anchor channel				HAC-10	HAC-20	HAC-30	HAC-40	HAC-50	HAC-60	HAC-70
Pullout failure										
Characteristic resistance in cracked concrete C12/15		$N_{Rk,p}$	[kN]	5.0	8.3	7.3	9.2	13.3	21.1	29.1
Amplification factor of $N_{Rk,p}$	C16/20	Ψ_c	[-]	1.33						
	C20/25			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						
		$\Psi_{ucr,N}$ 2)		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: 2009, section 6.2.5										
		α_{ch}		0.812	0.879	0.864	0.903	0.924	0.971	0.989
Effective anchorage depth		h_{ef}	[mm]	45	76	68	91	106	148	175
Characteristic edge distance		$c_{cr,N}$	[mm]	111	171	157	195	216	256	269
Characteristic spacing		$s_{cr,N}$	[mm]	222	342	314	390	432	512	538
		$\Psi_{ucr,N}$ 2)		1.4						
Partial safety factor		γ_{Mc} 1)		1.5						
Splitting										
				Verification of splitting is not relevant						

1) In absence of other national regulations
2) Amplification factor for uncracked concrete

Table 15: Displacements under tension load

Anchor channel			HAC-10	HAC-20	HAC-30	HAC-40	HAC-50	HAC-60	HAC-70
Tension load	N_{Ek}	[kN]	3.6	7.1	8.3	9.9	13.9	20.6	28.9
Short time displacement 1)	δ_{N0}	[mm]	0.7	1.1	1.5				
Long time displacement 1)	$\delta_{N\infty}$	[mm]	1.1	1.7	2.25				

1) Displacements in midspan of the anchor channel, including channel lip deformation, bending of the channel and slip of the anchor channel in concrete.

Table 16: Characteristic values for shear load

Anchor channel				**HAC-10**	**HAC-20**	**HAC-30**	**HAC-40**	**HAC-50**	**HAC-60**	**HAC-70**
Steel failure, local flexure of channel lip										
Characteristic resistance		$V_{Rk,s,l}$	[kN]	12	18	19	35	51	67	79
Partial safety factor		$\gamma_{Ms,l}$ [1]		1.8						
Pry out failure										
Factor k 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 factor $\psi_{re,V}$	Cracked concrete without edge reinforcement or stirrups	$\alpha_p\ \psi_{re,V}$		3.0	4.0	3.5	4.0 (3.5) [4]	4.0 (3.5) [4]	4.0	4.0
	Cracked concrete with straight edge reinforcement (≥ Ø 12mm)	$\alpha_p\ \psi_{re,V}$		3.6	4.8	4.2	4.8 (4.2) [4]	4.8 (4,2) [4]	4.8	4.8
	Non-cracked concrete [2] or cracked concrete with edge reinforcement and stirrups with a spacing $a \leq 100$mm and $a \leq 2c_1$	$\alpha_p\ \psi_{re,V}$		4.2	5.6	4.9	5.6 (4.9) [4]	5.6 (4.9) [4]	5.6	5.6
Effect of thickness of the structural component		$\alpha_{h,V}$		$(h/h_{cr,V})^{2/3}$		$(h/h_{cr,V})^{1/2}$				
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] Verification acc. to CEN/TS 1992-4-3 : 2009
[3] Without supplementary reinforcement. In case of supplementary reinforcement the factor k_5 should be multiplied with 0.75
[4] Bracket values are valid for channel/screw combination with the Hilti - special screw HBC-C-E

Table 17: Characteristic values for shear load – Steel failure Hilti special screw

Special screw Ø					M8	M10	M12	M16	M20
Steel failure									
Characteristic resistance	$V_{Rk,s}$ 2)	[kN]	HBC-A	4.6	7.3	11.6	16.8	-	-
				A4-50 1)	9.2	14.5	21.1	-	-
			HBC-B	4.6	7.3	11.6	20.2	-	-
				A4-50 1)	9.2	14.5	24.0	-	-
			HBC-C HBC-C-E HBC-C-N	4.6	-	13.9	20.2	37.6	58.8
				8.8	-	23.2	33.7	62.7	97.9
				A4-50 1)	-	17.4	25.3	47.0	73.4
Characteristic flexure resistance	$M^0_{Rk,s}$	[Nm]	HBC-A	4.6	15	29.9	52.4	-	-
				A4-50 1)	18.7	37.4	65.5	-	-
			HBC-B	4.6	15	29.9	52.4	-	-
				A4-50 1)	18.7	37.4	65.5	-	-
			HBC-C HBC-C-E HBC-C-N	4.6	-	29.9	52.4	133.2	259.6
				8.8	-	59.8	104.8	266.4	519.3
				A4-50 1)	-	37.4	65.5	166.5	324.5
Partial safety factor	γ_{Ms} 3)			4.6	1.67				
				8.8	1.25				
				A4-50 1)	2.38				

1) Materials according to Table 1, Annex 3
2) In conformity with EN ISO 898-1
3) In absence of other national regulations

Table 18: Displacements under shear loads

Anchor channel			HAC-10	HAC-20	HAC-30	HAC-40	HAC-50	HAC-60	HAC-70
Shear load	V_{Ek}	[kN]	4.7	7.1	7.5	13.9	20.2	26.6	31.3
Short time displacement 1)	δ_{V0}	[mm]	0.3	0.7	1.0				
Long time displacement 1)	$\delta_{V\infty}$	[mm]	0.4	1.0	1.5				

1) Displacements in midspan of the anchor channel, including channel lip deformation and slip of the anchor channel in concrete.

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

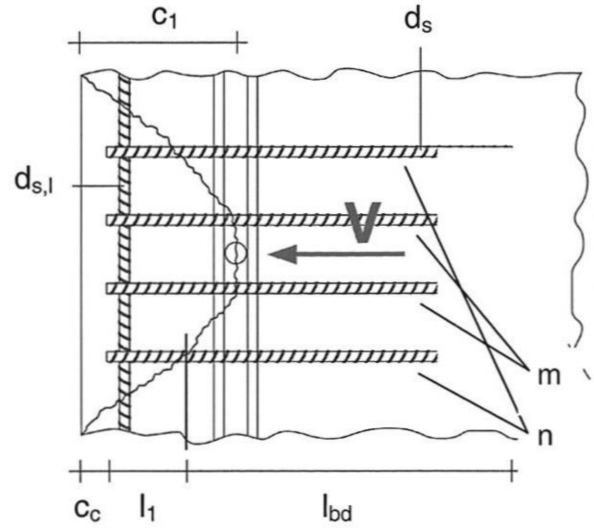


Fig. 20

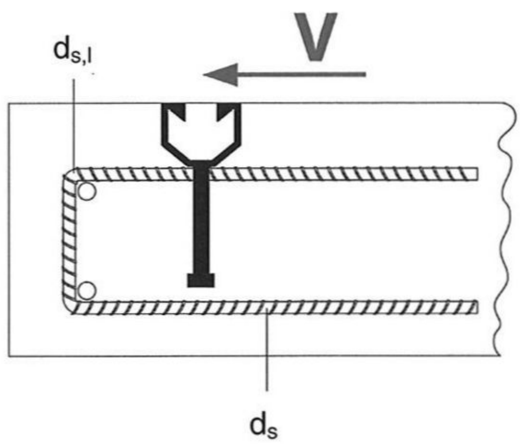


Fig. 21

$V_{Ed} \le V_{Rd,re} = V_{Rk,re}/\gamma_M$ $\quad V_{Ed} = \max(V_{Ed}; V^a_{Ed})$ (1)

$V_{Rk,re} = V_{Rk,c,re}/x$ (2)

$V_{Rk,c,re} = V_{Rk,c,hook} + V_{Rk,c,bond}$ $\quad \le V_{Rk,c,re,max}$ (3)

$$\le \sum_{m+n} A_s \cdot f_{y,k}$$

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

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

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

$$V_{Rk,c} = V^0_{Rk,c} \cdot \alpha_{s,V} \cdot \alpha_{c,V} \cdot \alpha_{h,V} \quad (7)$$

Reinforcement requirements

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

$$6\text{mm} \le d_s \le 20\text{mm} \quad (9)$$

ψ_1 = effectiveness factor → 0.67 for stirrups:
- For stirrups at the location of a shear load
- For stirrups between 2 shear loads acting on an anchor channel (distance between the loads $p \leq s_{cr,v}$ according to Table 16)

ψ_2 = effectiveness factor → 0.11 for other stirrups in the concrete cone
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 to the stirrup leg to the point of load action [mm]
b_{ch} = width of anchor channel [mm] (according 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} = characteristic 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
z ≈ 0.85d [mm]
internal lever arm of the concrete member
d = $\min(2h_{ef}, 2c_1)$
$V^0_{Rk,c}$ = according to CEN/TS 1992-4-3:2009, section 6.3.5.3
V^a_{Ed} = according to CEN/TS 1992-4-1:2009, section 3.2.2

Fig 22: Crack pattern of the decisive anchor B, if the anchor shear load $V_{Ed,A}$ and $V_{Ed,C}$ are smaller than 0.8 $V_{Ed,B}$

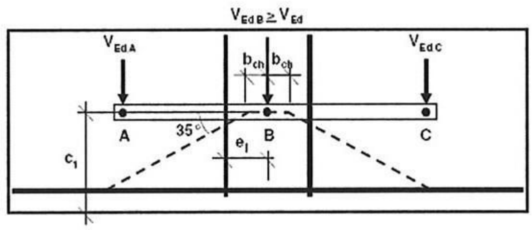


Fig 23: Crack pattern of the decisive anchor B, if the anchor shear load $V_{Ed,c}$ is $\geq$ 0.8 $V_{Ed,B}$ and $V_{Ed,A}$ is < 0.8 $V_{Ed,B}$

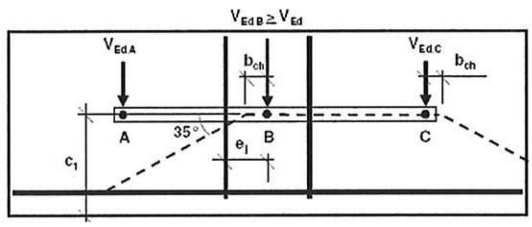


Fig 24: Crack pattern of the decisive anchor B, if the anchor shear load $V_{Ed,A}$ and $V_{Ed,C}$ are equal or higher than the decisive anchor shear load 0.8 $V_{Ed,B}$

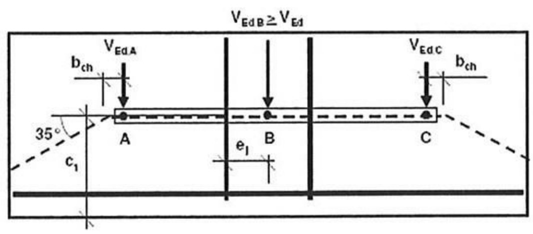


Table 19: Characteristic tension resistance in cracked concrete C20/25 under fire exposure

Anchor channel				HAC-10	HAC-20	HAC-30	HAC-40	HAC-50	HAC-60	HAC-70
Steel failure, Anchor, Connection channel/ anchor, Local flexure of channel lip										
Characteristic resistance [1)]	R30	$N_{Rk,s,fi}$	[kN]	0.9	1.4	2.5	2.8	5.7		
	R60	$N_{Rk,s,fi}$	[kN]	0.7	1.1	1.8	2.3	4.0		
	R90	$N_{Rk,s,fi}$	[kN]	0.5	0.7	1.1	1.7	2.3		
Partial safety factor		$\gamma_{Ms,fi}$ [4)]	[-]	1.0						
Concrete pullout failure										
Characteristic resistance	R30 R60 R90	$N_{Rk,p,fi}$	[kN]	1.5	3.1	3.1	3.9	5.6	8.8	12.1
Partial safety factor		$\gamma_{Mc,fi}$ [4)]	[-]	1.0						
Concrete cone failure										
Characteristic resistance	R30 R60 R90	$N_{Rk,c,fi}$	[kN]	1.4	6.8	5.0	12.8	20.8	49.6	67.6
Partial safety factor		$\gamma_{Mc,fi}$ [4)]	[-]	1.0						
Edge distance		$c_{cr,N,fi}$	[mm]	$2 \cdot h_{ef}$						
		$c_{min,fi}$	[mm]	$2 \cdot h_{ef}$ [2)] max($2 \cdot h_{ef}$; 300mm) [3)]						
Anchor spacing		$s_{cr,N,fi}$	[mm]	$4 \cdot h_{ef}$						
		$s_{min,fi}$	[mm]	according to Table 6, Annex 6						
Axial spacing	R30 R60	u	[mm]	35				50		
	R90		[mm]	45				50		

[1)] Max. resistance in conjunction of biggest Hilti special screw HBC
[2)] Fire exposure from 1 side only
[3)] Fire exposure from more than one side
[4)] In absence of other national regulations the safety factor $\gamma_{Mc,fi}$ = 1.0 under fire exposure is recommended

Fig. 25

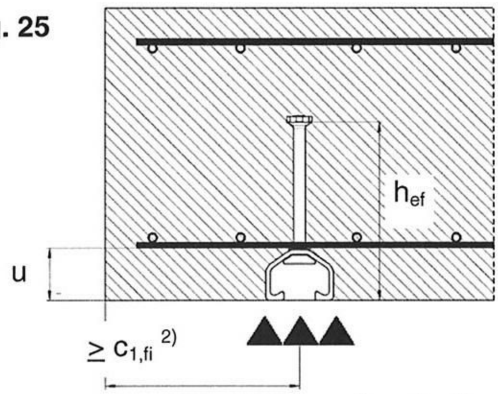
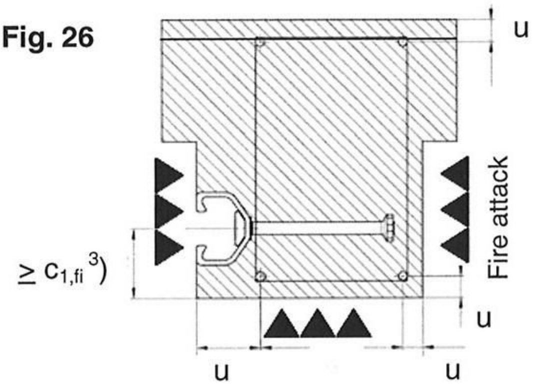


Fig. 26



A reduction of the fire resistance class of the concrete member due to the anchor channel is not evaluated in this ETA.

Table 20: Characteristic tension resistance of special screw under fire exposure

Special screw Ø					**M8**	**M10**	**M12**	**M16**	**M20**
Steel failure									
Characteristic resistance	HBC-A	R30	$N_{Rk,s,s,fi}$	[kN]	0.6	1.3	1.4	-	-
		R60			0.5	1.0	1.1	-	-
		R90			0.3	0.6	0.7	-	-
	HBC-B	R30	$N_{Rk,s,s,fi}$	[kN]	1.0	1.7	2.5	-	-
		R60			0.8	1.3	1.8	-	-
		R90			0.6	0.9	1.1	-	-
	HBC-C	R30	$N_{Rk,s,s,fi}$	[kN]	-	2.5	3.1	5.7	
		R60			-	1.9	2.5	4.0	
		R90			-	1.3	1.9	2.3	
Partial safety factor			$\gamma_{Ms,fi}$ [1)]	[-]	1.0				

[1)] In absence of other national regulations the safety factor $\gamma_{Mc,fi}$ = 1.0 under fire exposure is recommended

Table 21: Characteristic shear resistance in cracked concrete C20/25 under fire exposure

Anchor channel				HAC-10	HAC-20	HAC-30	HAC-40	HAC-50	HAC-60	HAC-70
Steel failure. Local flexure of channel lip										
Characteristic resistance [1]	R30	$V_{Rk,s,l,fi}$	[kN]	0.9	1.4	2.5	2.8	5.7		
	R60			0.7	1.1	1.8	2.3	4.0		
	R90			0.5	0.7	1.1	1.7	2.3		
Partial safety factor		$\gamma_{Ms,fi}$ [2]	[-]	1.0						
Concrete pry-out failure										
Factor k in equation (D.6) of CEN/TS 1992-4-1		k_5	[-]	2.0						
Partial safety factor		$\gamma_{Mc,fi}$ [2]	[-]	1.0						
Concrete edge failure										
The initial value $V^0_{Rk,c,fi}$ of the characteristic resistance in concrete C20/25 under fire exposure may be determined by: $V^0_{Rk,c,fi} = 0.25 \cdot V^0_{Rk,c}$ ($\leq$ R90) With $V^0_{Rk,c}$ initial value of the characteristic resistance in cracked concrete C20/25 under normal temperature.										
Partial safety factor		$\gamma_{Mc,fi}$ [2]	[-]	1.0						

Table 22: Characteristic shear resistance of special screw

Special screw Ø					M8	M10	M12	M16	M20
Steel failure without lever arm									
Characteristic resistance	HBC-A	R30	$V_{Rk,s,fi}$	[kN]	0.6	1.3	1.4	-	-
		R60			0.5	1.0	1.1	-	-
		R90			0.3	0.6	0.7	-	-
	HBC-B	R30	$V_{Rk,s,fi}$	[kN]	1.0	1.7	2.5	-	-
		R60			0.8	1.3	1.8	-	-
		R90			0.6	0.9	1.1	-	-
	HBC-C	R30	$V_{Rk,s,fi}$	[kN]	-	2.5	3.1	5.7	
		R60			-	1.9	2.5	4.0	
		R90			-	1.3	1.9	2.3	
Partial safety factor			$\gamma_{Ms,fi}$ [2]	[-]	1.0				

[1] Max. resistance in conjunction of biggest Hilti special screw HBC

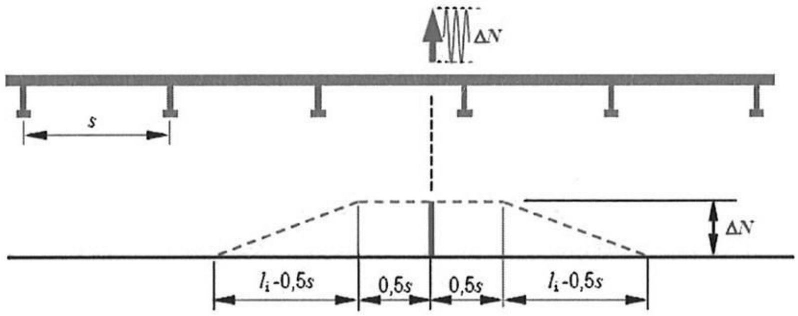
[2] In absence of other national regulations the safety factor $\gamma_{Mc,fi} = 1.0$ under fire exposure is recommended

Fatigue design of anchor channels

Determining the fatigue-relevant loadings

The existing provisions in accordance to CEN/TS 1992-4-3:2009 are used to take the static load into account.

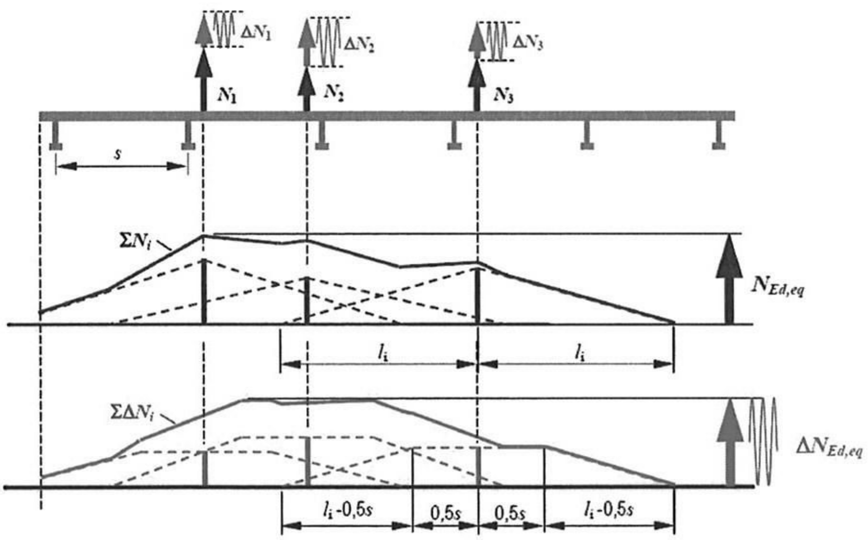
The fatigue loads are distributed in accordance to CEN/TS 1992-4-3:2009 as illustrated in fig. 27.



$l_i = 13 \cdot I_y^{0,05} \cdot s^{0,5} \geq s$ [mm]

Fig. 27: Distribution of fatigue actions

As an example, fig. 28 illustrates the effects to be taken into account as a result of multiple fatigue loadings combined with static loads.
For the sake of simplicity, the max. equivalent static load $N_{Ed,eq}$ and the max. equivalent fatigue load $\Delta N_{Ed,eq}$ act at each point of the anchor channel within the sphere of the actions.



$l_i = 13 \cdot I_y^{0,05} \cdot s^{0,5} \geq s$ [mm]

Fig. 28: Addition of the effects of multiple static and fatigue action

The effects of multiple fatigue and static loadings are superimposed as illustrated in fig. 28 and the above mentioned provisions.

Table 23: Possible channel / special screw combination under fatigue load

Anchor channel [3]	Special screw type	Ø	steel grade	corrosion class
HAC-30	HBC-B	M10	4.6	G [1] F [2]
		M12		
HAC-40	HBC-C	M12	4.6 8.8	
		M16		
		M20		
HAC-50		M16	4.6 8.8	
		M20		
HAC-60		M16	4.6 8.8	
		M20		
HAC-70		M20	4.6 8.8	

[1] Electroplated
[2] Hot-dip galvanized
[3] Only with round anchors screwed to the channel according Annex 5, Table 3 resp. Fig. 4

Design procedure I

General

Verification is provided by the following provisions:

(1) total loads can be clearly divided into a static load N_{Ed} and a fatigue load ΔN_{Ed} and (or)

(2) an upper limit to the number of stress cycles ***n*** over the working life is known.

<u>Case 1</u> → the condition (1) and (2) is met:

$\Delta N_{Rd;E;n}$ — design value of fatigue resistance under fatigue loading with a known static load N_{Ed} after n loading cycles

<u>Case 1.1</u> → only condition (1) is met:

$\Delta N_{Rd;E;n} = \Delta N_{Rd;E;\infty}$ — characteristic value of fatigue resistance under fatigue loading with a known static load N_{Ed}

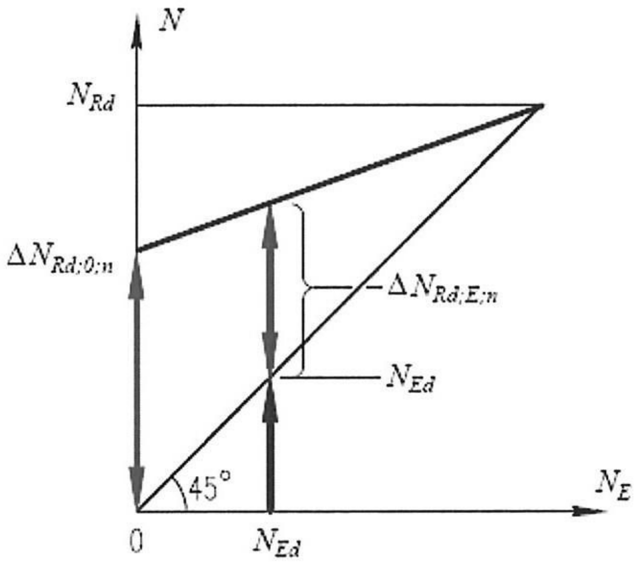
<u>Case 1.2</u> → only condition (2) is met:

$\Delta N_{Ed} = \Delta N_{Ed,tot}$ — design value of the total load

$\Delta N_{Rd;E;n} = \Delta N_{Rd;0;n}$ — design value of fatigue resistance without static preload and n loading cycles

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

Fatigue loading with static preload ($N_{Ed} \geq 0$)



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

respectively

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

with

N_{Ed}	design value of static load
N_{Rd}	design value of static resistance (in Tab. 24, 25 and 26 values with $n \leq 10$)
$\Delta N_{Rd;0;n}$	design value of fatigue resistance without static preload and n load cycles (Tab. 24, 25 and 26)
$\Delta N_{Rd;E;n}$	design value of fatigue resistance under combined influence of static N_{Ed} and fatigue ΔN_{Ed} action and n load cycles
$\Delta N_{Rd;0;\infty}$	design value of continuous fatigue resistance without static preload (in tab. 24, 25 and 26, values with $n > 10^6$ load cycles)
$\Delta N_{Rd;E;\infty}$	design value of continuous fatigue under combined influence of static N_{Ed} and fatigue ΔN_{Ed} action and $n > 10^6$ load cycles

Design procedure I – the required verification

	For case 1:	For case 1.1:	For case 1.2:
Steel failure:	$\Delta N_{Ed} / \Delta N_{Rd,s;E;n} \leq 1.0$	$\Delta N_{Rd,E,n} = \Delta N_{Rd,E,\infty}$	$\Delta N_{Rd,E,n} = \Delta N_{Rd,0,n}$
Pull-out:	$\Delta N_{Ed} / \Delta N_{Rd,p;E;n} \leq 1.0$		
Concrete cone failure:	$\Delta N_{Ed} / \Delta N_{Rd,c;E;n} \leq 1.0$		

Table 24: Design fatigue resistance with n load cycles without static preload ($N_{Ed} = 0$)

Anchor channel		HAC-30	HAC-40	HAC-50	HAC-60	HAC-70
Steel failure	n	$\Delta N_{Rd,s;0;n}$ [kN]				
Fatigue design resistance without static preload	$\leq 10^1$	9.80	12.60	18.30	28.00	39.20
	$\leq 10^2$	9.30	12.33	17.34	27.38	37.23
	$\leq 3 \cdot 10^2$	8.70	11.84	16.09	26.17	34.53
	$\leq 10^3$	7.67	10.74	13.84	23.38	29.57
	$\leq 3 \cdot 10^3$	6.39	9.09	11.08	19.14	23.41
	$\leq 10^4$	4.82	6.68	7.75	13.11	16.09
	$\leq 3 \cdot 10^4$	3.46	4.37	5.09	7.85	10.47
	$\leq 10^5$	2.31	2.42	3.15	4.17	6.68
	$\leq 3 \cdot 10^5$	1.67	1.49	2.29	2.90	5.22
	$\leq 10^6$	1.34	1.16	1.97	2.62	4.77
	$> 10^6$	1.20	1.10	1.90	2.60	4.70

Table 25: Reduction factor $\eta_{c.fat}$ with n load cycles without static preload ($N_{Ed} = 0$)

Anchor channel		HAC-30	HAC-40	HAC-50	HAC-60	HAC-70
Concrete cone failure	n	$\eta_{c,fat}$ [-]				
Fatigue design resistance without static preload: $\Delta N_{Rd,c;0;n} = \eta_{c,fat} \cdot N_{Rd,c}$ [1)]	$\leq 10^1$	1.000				
	$\leq 10^2$	0.923				
	$\leq 3 \cdot 10^2$	0.888				
	$\leq 10^3$	0.851				
	$\leq 3 \cdot 10^3$	0.819				
	$\leq 10^4$	0.785				
	$\leq 3 \cdot 10^4$	0.755				
	$\leq 10^5$	0.723				
	$\leq 3 \cdot 10^5$	0.696				
	$\leq 10^6$	0.667				
	$> 10^6$	0.667				

[1)] $N_{Rd,c}$ Static design resistance according CEN TS 1992-4-3:2009

Hilti Anchor Channel - HAC	Annex 24
Design fatigue resistance for tension load	of European technical approval ETA – 11/0006

Table 26: Design fatigue resistance with n load cycles without static preload (N_{Ed} = 0)

Anchor channel			HAC-30	HAC-40	HAC-50	HAC-60	HAC-70
Pullout failure		n	$\Delta N_{Rd,p;0;n}$ [kN]				
Pullout fatigue design resistance without static preload		$\leq 10^1$	4.9	6.1	8.9	14.1	19.4
		$\leq 10^2$	4.5	5.7	8.2	13.0	17.9
		$\leq 3 \cdot 10^2$	4.3	5.4	7.9	12.5	17.2
		$\leq 10^3$	4.1	5.2	7.5	12.0	16.5
		$\leq 3 \cdot 10^3$	4.0	5.0	7.3	11.5	15.9
		$\leq 10^4$	3.8	4.8	7.0	11.0	15.2
		$\leq 3 \cdot 10^4$	3.7	4.6	6.7	10.6	14.6
		$\leq 10^5$	3.5	4.4	6.4	10.2	14.0
		$\leq 3 \cdot 10^5$	3.4	4.3	6.2	9.8	13.5
		$\leq 10^6$	3.2	4.1	5.9	9.4	12.9
		$> 10^6$	3.2	4.1	5.9	9.4	12.9
Amplification factor of $\Delta N_{Rd,p;0;n}$	C16/20	ψ_c	1.33				
	C20/25		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				

Design procedure II

General

Verification is provided in the following provisions:

(1) total loads can NOT be divided into a static load N_{Ed} and a fatigue load ΔN_{Ed} and

(2) NO upper limit to the number of stress cycles ***n*** over the working life is known.

Case 2 → the condition (1) and (2) is met:

$\Delta N_{Ed} = N_{Ed,tot}$	design value for the total load
$\Delta N_{Rd} = \Delta N_{Rd;0;\infty}$	characteristic value of fatigue resistance without static preload (tab. 27)

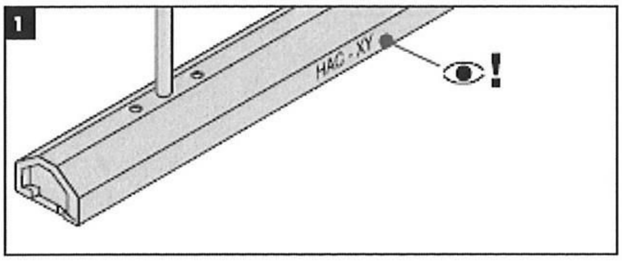
Design procedure II – the required verification

Steel failure:	$\Delta N_{Ed,tot} / \Delta N_{Rd,s;0;\infty} \leq 1.0$
Pull-out:	**not required as this is not decisive**
Concrete cone failure:	$\Delta N_{Ed,tot} / \Delta N_{Rd,c;0;\infty} \leq 1.0$

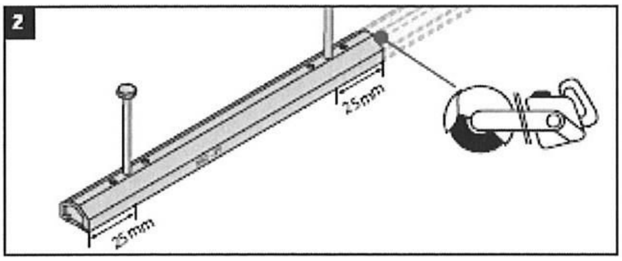
Table 27: Design fatigue resistance with n→∞ load cycles without static preload (N_{Ed} = 0)

Anchor channel		**HAC-30**	**HAC-40**	**HAC-50**	**HAC-60**	**HAC-70**
Steel failure						
$\Delta N_{Rd,s;0;\infty}$	[kN]	1.2	1.1	1.9	2.6	4.7
Concrete cone failure						
$\Delta N_{Rd,c;0;\infty} = \eta_{c,fat} \cdot N_{Rd,c}$ [1)]	[-]	0.667				

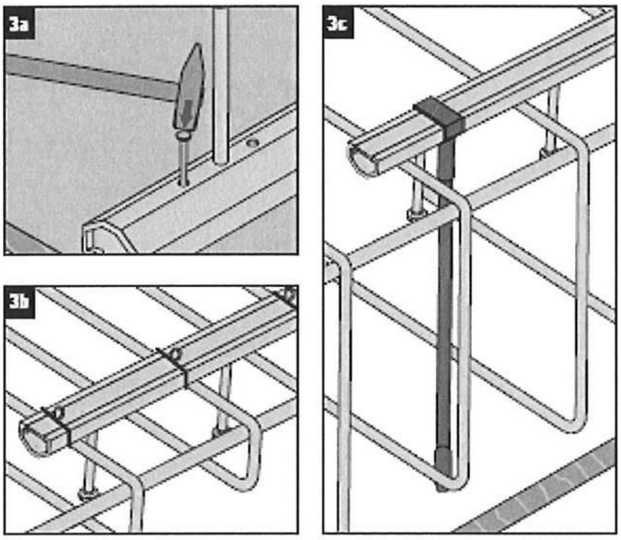
[1)] $N_{Rd,c}$ Static design resistance according CEN TS 1992-4-3:2009



Selection of anchor channel in accordance to the design specification.

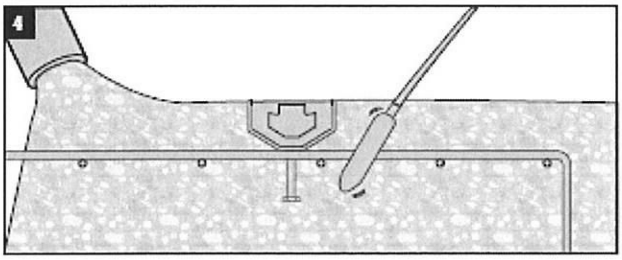


Min. end spacing for cutting anchor channels according Annex 6.
Cut anchor channels only for use in dry internal conditions.

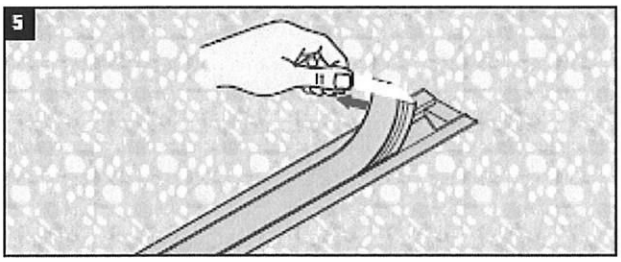


Placing anchor channel into formwork and fixing as follows:

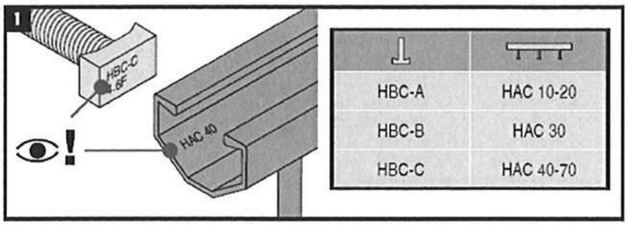
- Fixing to the wood formwork with nails or staples (fig. 3a).
- Fixing to the steel formwork with rivets or Hilti special screw.
- Fixing directly to the reinforcement in the case of positioning top of slab (fig. 3b).
- Fixing directly to the formwork with the Hilti support system (fig. 3c).



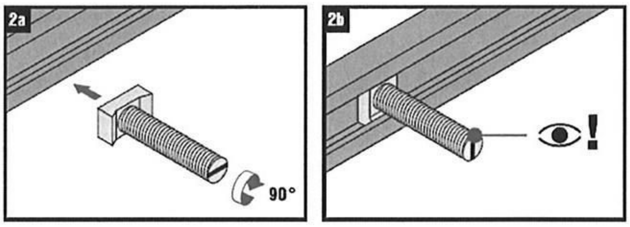
Cast in and compact the concrete.



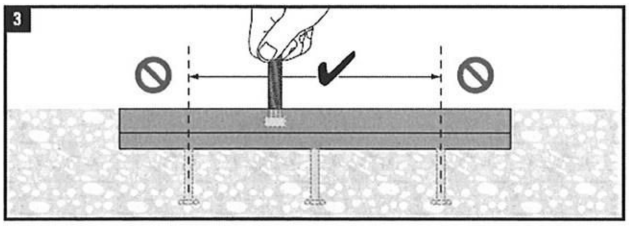
Removing the foam filler after hardening of concrete and striking the formwork.



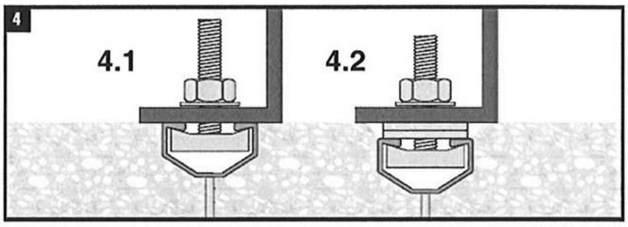
Selecting of the Hilti special screws in accordance with the design specification.



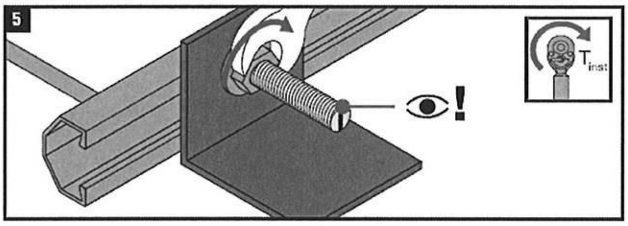
Setting the special screw into the channel: After a 90° turn clockwise, the special screw locks into the channel. Checking the position of the screw with the notch.



Positioning of the special screw: Clearance at channel ends: Special screw must be fixed between two anchors or maximum on position of last anchor



4.1: General setting
4.2: Setting with steel to steel contact



Tightening the hexagonal nut to the setting torque acc. Tab. 28. T_{inst} must not be exceeded.
After fixing check that the screw is positioned correctly.

Table 28: Setting torque

Position of fixture	Strength class	Anchor channel	T_{inst} [Nm] [1]				
			M8	M10	M12	M16	M20
General (acc. Fig. 4.1)	4.6 8.8 A4-50	HAC-10	8	15	15	-	-
		HAC-20	8	15	25		
		HAC-30			30		
		HAC-40	-	15	25	60	75
		HAC-50					120
		HAC-60					
		HAC-70					
Steel to steel contact (acc. Fig. 4.2)	4.6 A4-50	all anchor channels	8	15	25	60	120
	8.8		20 [2]	48 [2]	70 [2]	200	400

1) T_{inst} must not be exceeded
2) Values must not be taken for HAC 10, HAC 20 and HAC 30

Hilti Anchor Channel - HAC	Annex 28
Manufacturer's specification of special screw	of European technical approval ETA – 11/0006