EUROPEAN TECHNICAL ASSESSMENT

ETA-17/0336

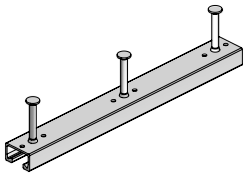
HILTI ANCHOR CHANNELS & BOLTS

A systematic approach to innovative anchoring

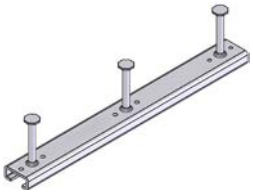
Hilti now offers a vast range of Anchor Channels for a variety of applications to the construction industry. Products have become an integrated part of the planning and calculation tools, software, engineering and delivery services with the aim to further increase efficiency from planning to completion. Hilti Anchor Channel Systems are designed to exceed expectations and are qualified to leading industry standards.

As of 2017 Hilti exclusively offers all three relevant production standards for Anchor Channel Profiles - Advanced TCRS (Temperature controlled Roll Shaping), hot-rolled and cold-formed. Now you have the choice between three different Anchor Channel Systems - depending on your applications.

HAC (TCRS) Anchor Channels



HAC-C hot-rolled Anchor Channels



HAC-C cold-formed Anchor Channels

GUARANTEED PRODUCT QUALITY

We produce high quality products which are certified according to the state-of-the-art European Technical Assessment (ETA) in our production facilities in Kaufering, Germany and Hilti (PEC Suzhou) Ltd. in China.

Consistent high quality products are the result of continous in-house testing and documentation. Third-party monitoring of production procedures is conducted as per relevant specifications.

Hilti Anchor Channels are available in hot-dip galvanized and stainless steel material up to high corrosion resistant category C4 as per (ISO 12944-2) and Hilti Anchor Channels are suitable for use in cracked and non-cracked concrete.
The design of all Anchor Channels is based on EOTA TR047 "Calculation Method for the Performance of Anchor Channels" or EN 1992-4.
Load bearing capacities and other relevant factors are taken from the respective assessment documents to design the Anchor Channels. This design method is integrated into in our user-friendly Hilti PROFIS Anchor Channel design software.

Inhouse tests are conducted & recorded

ESR-3520

ADVANTAGES OF HILTI ANCHOR CHANNELS

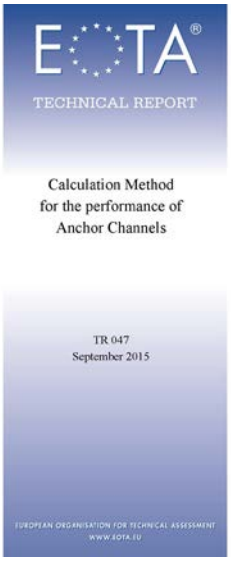
- Adjustable & Flexible System
- Easy assembly without complicated tools to minimize construction time
- Special foam filler protects Channel from concrete intrusion
- Pull-out strip allows easy, quick and complete removal of the foam
- Time-saving bolted connections rather than field welding
- No damage to existing reinforcement
- Suitable for post-tensioned concrete components
- Hilti PROFIS Anchor Channel design software and engineering support for various design conditions
- ETA for static design
- Suitable for most environmental conditions due to hot-dip galvanization and stainless steel material
- Reduces pre-planning construction effort considerably

No field welding needed

Environmentally friendly products

June, 1th 2017

NEW HAC ETA-17/0336 Assessment



EOTA TR047/EN 1992-4

NEW ERA FOR OUR ANCHOR CHANNELS

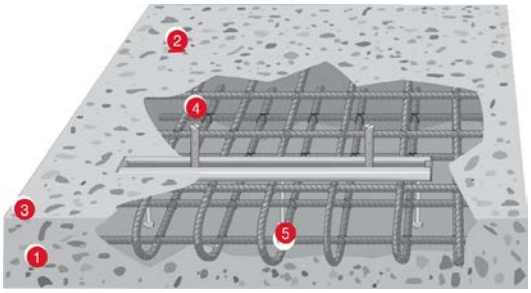
State-of-the-art Anchor Channel design with the latest product specifications ETA-17/0336 and ETA-11/0006

With the expiration of the current European Technical Approvals (in mid-2018), it is necessary to to adapt to the new Regime of European Technical Assessments and EC-2 based designs. Hilti leads this development with the publication of the ETA (Assessment) 11/0006, dated Feb. 01st, 2016, Hilti is the industry`s first producer to develop Anchor Channels that meet the new standard.

Customers benefit from reliable state-of-the-art testing and results, transparent assessment data and the application of EC-2 based design codes. In addition, the new provisions allow for complex designs, considering variable design conditions. This is strongly contrasting the regime of National Approvals (e.g. German abZ), which lack agreed international testing guidelines and design methods for Anchor Channels.

The new model allows better utilization of the materials involved and greater flexibility in designing the fastening. This leads to an optimized, more cost-efficient solution for the fastenings you are designing.

The following parameters are taken into account in the calculations:



1. Member thickness
2. Concrete grade, cracked / uncracked
3. Edge / corner distance
4. Load type / position
5. Supplementary reinforcement

UNIQUE MARKINGS FOR RELIABLE IDENTIFICATION

Markings on Hilti Anchor Channels & HBC Channel Bolts
Hilti Anchor Channels have distinct markings on the outside surface that allow correct identification before casting in concrete. The markings consist of the Hilti logo, the channel type designation and the type of corrosion protection. The channels bear a unique production number that indicates the production lot as well as the channel type, to aid identification.

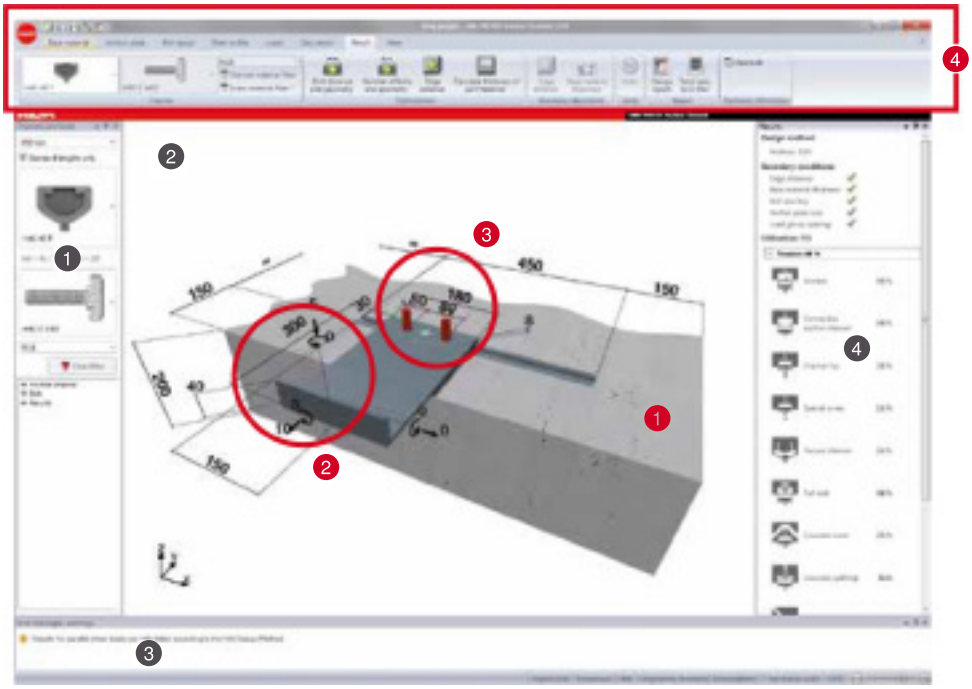
Hilti T-Bolts bear marks on the head indicating the bolt type, strength class, corrosion class and also include a manufacturing mark.

HILTI PROFIS ANCHOR CHANNEL SOFTWARE

Design software for accurate and reliable planning

Easy to use, up-to-date software is essential for the efficient specification of Anchor Channels. Hilti PROFIS software meets these requirements admirably.
Design calculations are based on the latest international design provision e.g. Eurocode 2 / EOTA TR047, EOTA TR 050 and AC232. The software is kept up to date by a dedicated team of fastening and software experts.

1. Channel and bolt selector
2. 3D graphics with interactive input of loads and dimensions
3. Immediate messages and warnings guide user toward optimized design
4. Direct indication of the utilization rate in total and per specific failure mode allows optimization of the fastening point



1 Base material: Concrete

- C12/15 up to C90/105 or customized
- Cracked / uncracked Reinforcement
- Takes existing reinforcement into account
- Calculates supplementary reinforcement to enhance concrete loading capacity Concrete

2 Loading

- Static or fatigue loading, calculation of fatigue resistance takes number of load cycles and static pre-loading into account
- Characteristic or design loads
- Calculations for loads occurring in the event of fire

3 Fastening groups

- Up to 8 fastening groups with up to 4 bolts per fastening group
- Each fastening group with loads and moments in 3 directions (x,y and z-axis)
- Different types of base plates and predefined brackets
- Stand-off fastenings

4 Result

- Automated optimization of the fastening point in terms of reduced edge distance, bolt size, number of bolts and bolt spacing
- Automated correction in case edge distance and slab thickness exceed the minimum values
- PDF file containing the results in summarized or detailed form, detailed report for easy-to-follow verification including formulas

Hilti PROFIS Anchor Channel can be downloaded from your local Hilti online website or from www.hilti.com.

June, 1th 2017

Deutsches Institut für Bautechnik

Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

Member of EOTA
www.eota.eu

Designated according to Article 29 of Regulation (EU) No 305/2011 and member of EOTA (European Organisation for Technical Assessment)

European Technical Assessment

ETA-17/0336 of 11 July 2017

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	Anchor channels (HAC-C) with channel bolts (HBC)
Product family to which the construction product belongs	Anchor channels
Manufacturer	Hilti AG Feldkircherstraße 100 9494 Schaan FÜRSTENTUM LIECHTENSTEIN
Manufacturing plant	Hilti Werke
This European Technical Assessment contains	23 pages including 3 annexes which form an integral part of this assessment
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	European Assessment Document (EAD) 330008-02-0601

The European Technical Assessment is issued by the Technical Assessment Body in its official language. Translations of this European Technical Assessment in other languages shall fully correspond to the original issued document and shall be identified as such.

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Specific Part

1 Technical description of the product

The anchor channels (HAC-C) with channel bolts (HBC) are a system consisting of C-shaped channel profile of carbon steel or stainless steel and at least two metal anchors non-detachably fixed to the channel back and channel bolts.

The anchor channel is embedded surface-flush in the concrete. Channel bolts (HBC) with appropriate hexagon nuts and washers are fixed to the channel.

The product description is given in Annex A.

2 Specification of the intended use in accordance with the applicable European Assessment Document

The performances given in Section 3 are only valid if the anchor channel is used in compliance with the specifications and conditions given in Annex B.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the anchor channel of at least 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.

3 Performance of the product and references to the methods used for its assessment

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistances under static and quasi-static loads and displacements	See Annex C1 to C6

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Anchorages satisfy requirements for Class A1
Resistance to fire	See Annex C7

4 Assessment and verification of constancy of performance (AVCP) system applied, with reference to its legal base

In accordance with EAD No. 330008-02-0601, the applicable European legal act is: [2000/273/EC].

The system to be applied is: 1

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

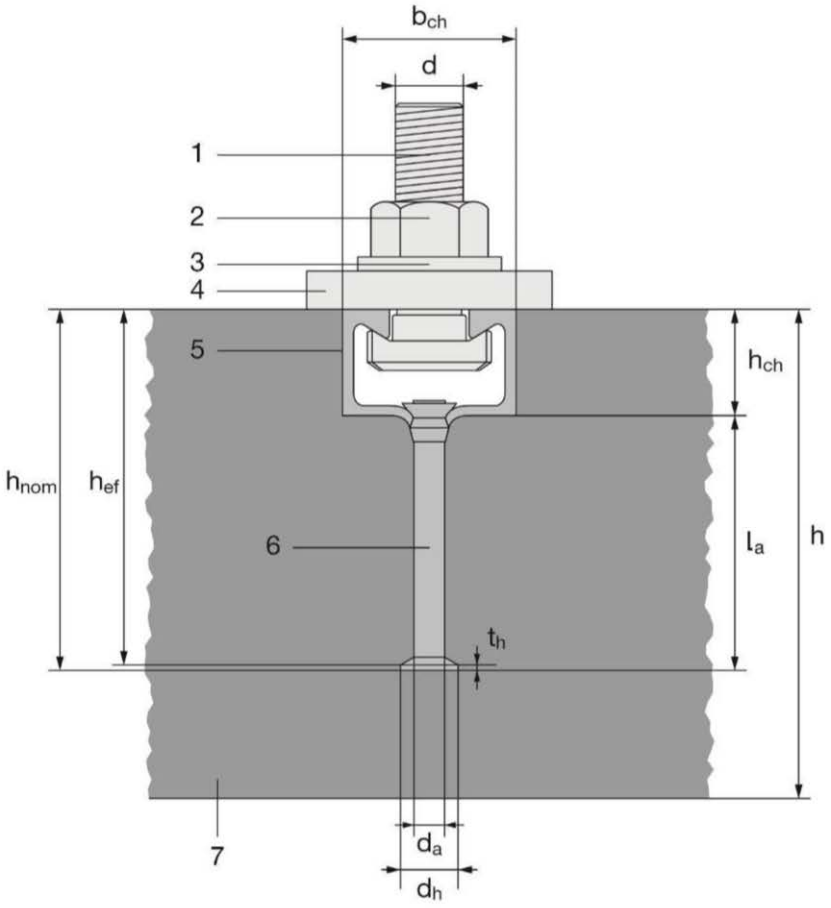
Issued in Berlin on 11 July 2017 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow
Head of Department

beglaubigt:
Müller

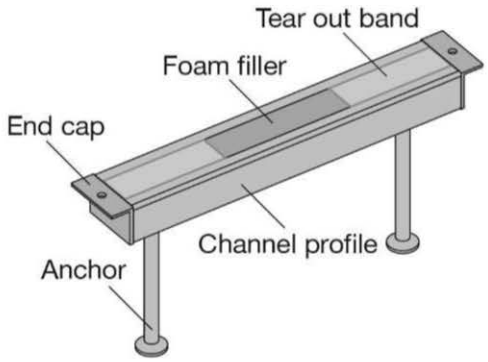
Deutsches Institut für Bautechnik

Product and installation condition

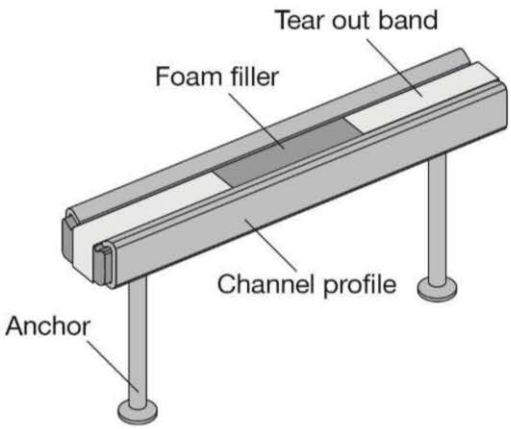


Key

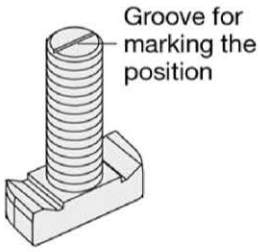
1 channel bolt
2 hexagonal nut
3 washer
4 fixture
5 channel profile
6 anchor
7 concrete member



Hot-rolled anchor channel



Cold-formed anchor channel



Channel bolt

Anchor channels (HAC-C) with channel bolts (HBC)	Annex A1
Product Description Installed condition	

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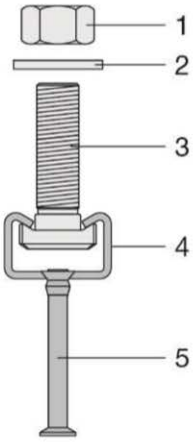
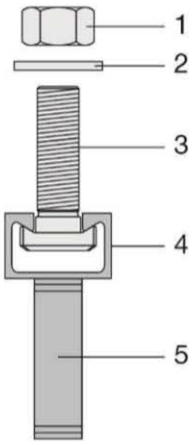
Anchor channel types

Cold-formed channel profiles

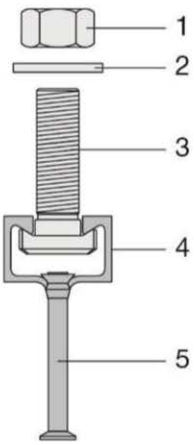


Round anchor

Hot-rolled channel profiles



I-anchor

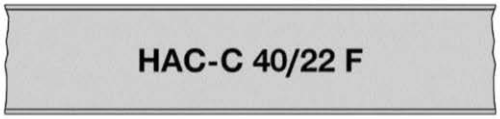


Round anchor

Key

1 hexagonal nut
2 washer
3 channel bolt
4 channel profile
5 anchor

Marking of the anchor channels:
HAC-C(-I) XZ

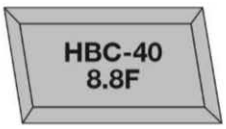


(e.g. HAC-C 40/22 F)

HAC-C	= Identifying mark of the manufacturer
I	= Additional marking for I-anchors (no marking in the case of round anchors)
X	= Size of the channel
Z	= Corrosion class / Material F = Hot-dip galvanized A4 = Stainless steel

40/22	= Anchor channel size 40/22
F	= Hot-dip galvanized

Marking of the channel bolt:
HBC-X YZ



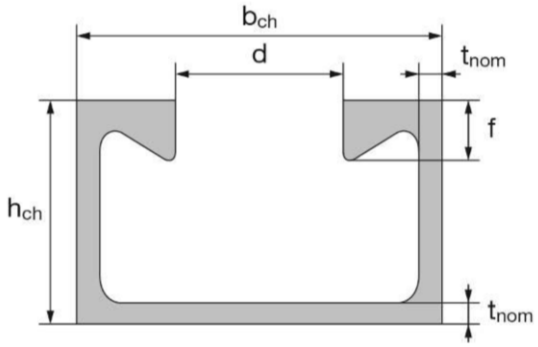
(e.g. HBC-40/22 8.8F)

HBC	= Identifying mark of the manufacturer
X	= Type of channel bolt
Y	= Steel grade (4.6, 8.8, 70)
Z	= Corrosion class / Material F = Hot-dip galvanized R = Stainless steel

40	= Channel bolt type in combination with HAC-C 40/22F
8.8	= Steel grade
F	= Hot-dip galvanized

Anchor channels (HAC-C) with channel bolts (HBC)	Annex A2
Product Description Anchor channel types and marking	

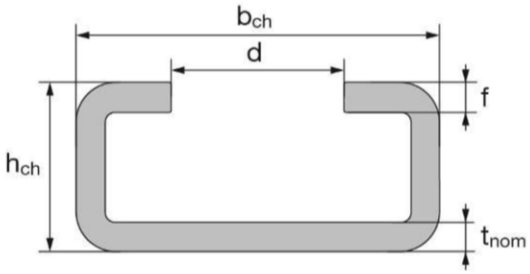
Channel profiles



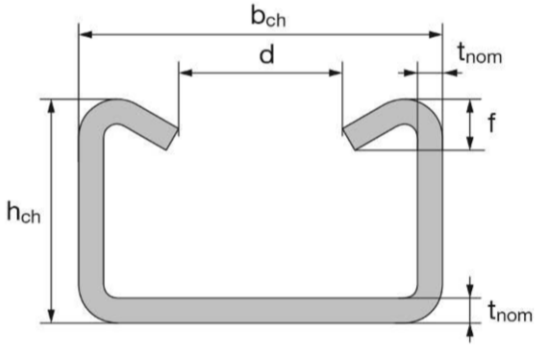
HAC-C 40/22, HAC-C 50/30, HAC-C 52/34

Table 1: Dimensions of hot-rolled channel profile

Anchor channel	b_{ch}	h_{ch}	t_{nom}	d	f	I_y
	[mm]					[mm⁴]
40/22	39,5	23,0	2,4	18,0	6,0	20087
50/30	49,0	30,0	2,75	22,5	8,1	53652
52/34	52,5	34,0	4,0	22,5	11,5	97606



HAC-C 28/15, HAC-C 38/17



HAC-C 40/25, HAC-C 49/30, HAC-C 54/33

Table 2: Dimensions of cold-formed channel profile

Anchor channel	b_{ch}	h_{ch}	t_{nom}	d	f	I_y
	[mm]					[mm⁴]
28/15	28,0	15,5	2,3	12,0	2,3	4277
38/17	38,0	17,25	3,0	18,0	3,0	8224
40/25	40,0	25,0	2,75	18,0	5,6	20122
49/30	50,0	30,0	3,25	22,0	7,4	43105
54/33	53,5	33,0	5,0	21,5	8,0	74706

Anchor channels (HAC-C) with channel bolts (HBC)

Product Description
Channel profiles (HAC-C)

Annex A3

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Anchors

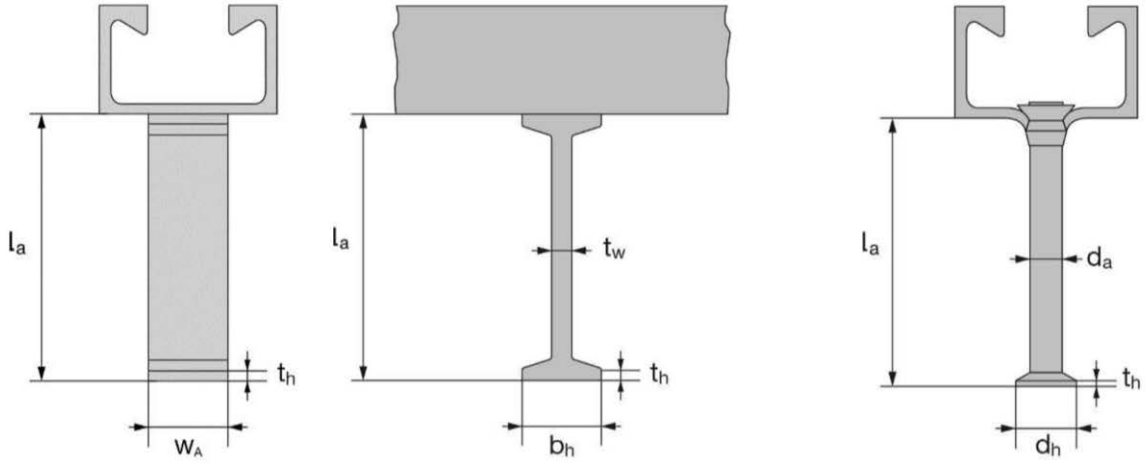

Table 3: Dimensions of anchor (welded I-anchor or round anchor)

Anchor channel	I-anchor						Round anchor				
	min l_a	t_w	b_h	t_h	w_A	A_h	min l_a	d_a	d_h	t_h	A_h
	[mm]					[mm²]	[mm]				[mm²]
28/15	-						31,0	6,0	12,0	1,3	85
38/17	-						60,8	8,0	16,0	2,0	151
40/25	-						56,0				
40/22	62,0	5,0	20,0	5,0	20,0	300	58,0				
49/30	-						66,0	10,0	20,0	2,2	236
50/30	69,0	5,0	20,0	5,0	25,0	375					
54/33	-						124,5	11,0	24,3	2,5	369
52/34	125,0	6,0	25,0	5,0	40,0	760	123,5				

Anchor channels (HAC-C) with channel bolts (HBC)

Product Description
Anchors

Annex A4

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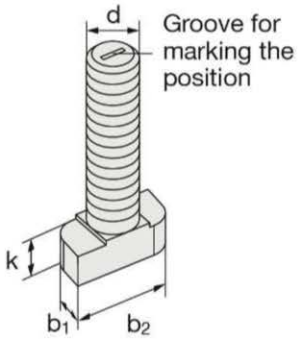
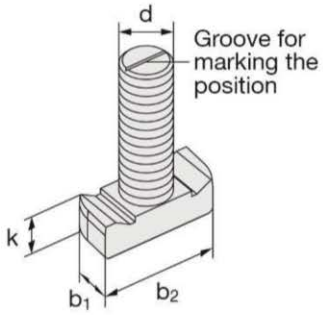
Channel bolts



HBC-28/15, HBC-38/17



HBC-40/22, HBC-50/30

Table 4: Dimensions of channel bolt

Anchor channel	Channel bolt type	Dimensions			
		b_1	b_2	k	d
		[mm]			
HAC-C 28/15	HBC-28/15	10,1	22,2	5,0	8
					10
		11,0		6,0	12
HAC-C 38/17	HBC-38/17	13,0	30,5	6,0	10
				7,0	12
		16,0			16
HAC-C 40/22 HAC-C 40/25	HBC-40/22	14,0	33,0	10,5	10
				11,5	12
		17,0			16
HAC-C 49/30 HAC-C 50/30 HAC-C 52/34 HAC-C 54/33	HBC-50/30	17,0	42,0	14,5	12
				15,5	16
		21,0			20

Table 5: Steel grade and corrosion class

Channel Bolt	Carbon steel [1]		Stainless steel [1]	
Steel grade	4.6	8.8	A4-50	A4-70
f_{uk} [N/mm²]	400	800 / 830 [2]	500	700
f_{yk} [N/mm²]	240	640 / 660 [2]	210	450
Corrosion class	G [3] F [4]		R [5]	

[1] Material properties according to Annex A6
[2] Material properties according to EN ISO 898-1
[3] Electroplated
[4] Hot-dip galvanized
[5] Stainless steel

Anchor channels (HAC-C) with channel bolts (HBC)

Product Description
Channel bolts (HBC)

Annex A5

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Table 6: Materials

Component	Carbon steel			Stainless steel
	Mechanical properties	Coating		Mechanical properties
1	2a	2b	2c	3
Channel Profile	1.0038, 1.0044, 1.0045 according to EN 10025: 2005 1.0976, 1.0979 according to EN 10149: 2013	Hot dip galvanized ≥ 50 µm according to EN ISO 10684: 2004/AC: 2009		1.4362, 1.4401 1.4404, 1.4571, 1.4578 according to EN 10088: 2005
Anchor	1.0038, 1.0213, 1.0214 according to EN 10025: 2005 1.5523, 1.5535 according to EN 10263: 2002-02			
Channel bolt	Steel grade 4.6 and 8.8 according to EN ISO 898-1: 2013	Electroplated according to EN ISO 4042: 1999	Hot dip galvanized ≥ 50 µm according to EN ISO 10684: 2004/ AC: 2009	Grade 50 or 70 according to EN ISO 3506: 2009
Plain washer [1] according to ISO 7089: 2000 and ISO 7093-1: 2000	Hardness class A ≥ 200 HV	Electroplated according to EN ISO 4042: 1999	Hot dip galvanized ≥ 50 µm according to EN ISO 10684: 2004/ AC: 2009	1.4401, 1.4404 1.4571, 1.4578 according to EN 10088: 2005
Hexagonal nut according to ISO 4032: 2012 or DIN 934: 1987-10 [2]	Property class 5 or 8 according to EN ISO 898-2: 2012	Electroplated according to EN ISO 4042: 1999	Hot dip galvanized ≥ 50 µm according to EN ISO 10684: 2004/ AC: 2009	Property class 50, 70 or 80 according to EN ISO 3506: 2009

[1] Not in the scope of delivery

[2] Hexagonal nuts according to DIN 934 for channel bolts made from carbon steel (4.6) and stainless steel

Deutsches Institut für Bautechnik DIBt

Specifications of intended use

Anchor channels and channel bolts subject to:

- Static and quasi-static loads in tension and shear perpendicular to the longitudinal axis of the channel.
- Fire exposure: only for concrete class C20/25 to C50/60.

Base materials:

- Reinforced or unreinforced normal weight concrete according to EN 206: 2000.
- Strength classes C12/15 to C90/105 according to EN 206: 2000.
- Cracked or uncracked concrete.

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions (e.g. accommodations, bureaus, schools, hospitals, shops, exceptional internal conditions with usual humidity)
  (anchor channels and channel bolts according to Annex A6, Table 6, column 2 and 3).
- 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 and channel bolts according to Annex A6, Table 6, column 2c and 3).
- The stainless steel anchor channels (HAC-C) and channel bolts (HBC), washers and nuts 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 de-icing materials are used) exist
  (anchor channels and channel bolts according to Annex A6, Table 6, column 3).

Design:

- Anchor channels are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor channel and channel bolts are indicated on the design drawings (e.g. position of the anchor channel relative to the reinforcement or to supports).
- For static and quasi-static loading as well as fire exposure the anchor channels are designed in accordance with EOTA TR 047 “Calculation Method for the Performance of Anchor Channels” or EN 1992-4: 2016.
- The characteristic resistances are calculated with the minimum effective embedment depth.

Anchor channels (HAC-C) with channel bolts (HBC)	Annex B1
Intended Use Specifications	

Installation:

- The installation of anchor channels is carried out by appropriately qualified personnel under the supervision of the person responsible for the technical matters on site.
- Use of the anchor channels only as supplied by the manufacturer - without any manipulations, repositioning or exchanging of channel components.
- Cutting of anchor channels is allowed only if pieces according to Annex B3, Table 7 are generated including end spacing and minimum channel length and in case of hot-dip galvanised anchor channels only to be used in dry internal conditions.
- Installation in accordance with the manufacturer's specifications given in Annexes B5 and B6
- 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 around the head of the anchors are properly compacted. The channels are protected from penetration of concrete into the internal space of the channels.
- Washer may be chosen according to Annex A6 and provided separately by the user.
- Orientating the channel bolt (groove according to Annex B6) rectangular to the channel axis.
- The required installation torques given in Annex B4 must be applied and must not be exceeded.

Anchor channels (HAC-C) with channel bolts (HBC)	Annex B2
Intended Use Specifications	

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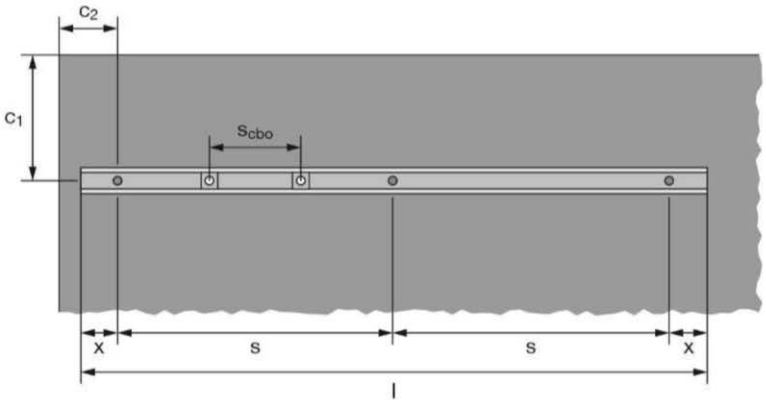
Table 7: Installation parameters for anchor channel

Anchor channel HAC-C			**28/15**	**38/17**	**40/25**	**40/22**	**49/30**	**50/30**	**54/33**	**52/34**
Minimum effective embedment depth	$h_{ef,min}$	[mm]	45	76	79		94		155	
Minimum spacing	s_{min}		50	100						
Maximum spacing	s_{max}		200	250						
End spacing	x		25 [1]							35 [2]
Minimum channel length	l_{min}		100	150						170 [3]
Minimum edge distance	c_{min}		40	50			75		100	
Minimum thickness of concrete member	h_{min}		70	100			120		180	

[1] The end spacing may be increased from 25 mm to 35 mm
[2] x = 25 mm for welded I-anchors
[3] l_{min} = 150 mm for welded I-anchors



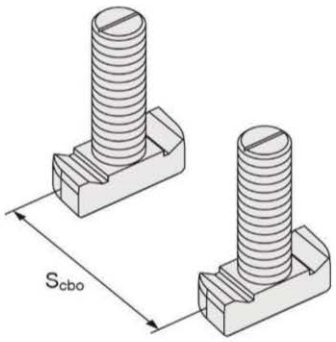


Table 8: Minimum spacing for channel bolts

Channel bolt			**M8**	**M10**	**M12**	**M16**	**M20**
Minimum spacing between channel bolts	$s_{cbo,min}$	[mm]	40	50	60	80	100

s_{cbo} = center to center spacing between channel bolts ($s_{cbo,min}$ = 5d)

Anchor channels (HAC-C) with channel bolts (HBC)	Annex B3
Intended Use Installation parameters for anchor channels (HAC-C)	

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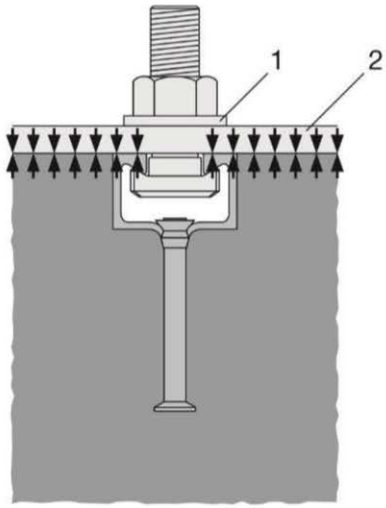
Table 9: Required installation torque T_{inst}

Channel bolt		T_{inst} [1] [Nm]				
		General	Steel - steel contact			
		4.6, 8.8, A4-50, A4-70	4.6	8.8	A4-50	A4-70
28/15	M8	7	-	20	7	15
	M10	10		40	-	30
	M12	13		60		50
38/17	M10	15	13	-		22
	M12	25	-	45		50
	M16	40		100		90
40/22	M10	15	13	-	-	22
	M12	25	-	45		50
	M16	30		100		90
50/30	M12	25	-	45		50
	M16	60		100		130
	M20	75		360		250

[1] T_{inst} must not be exceeded

General: The fixture is in contact with the channel profile and the concrete surface.



Key

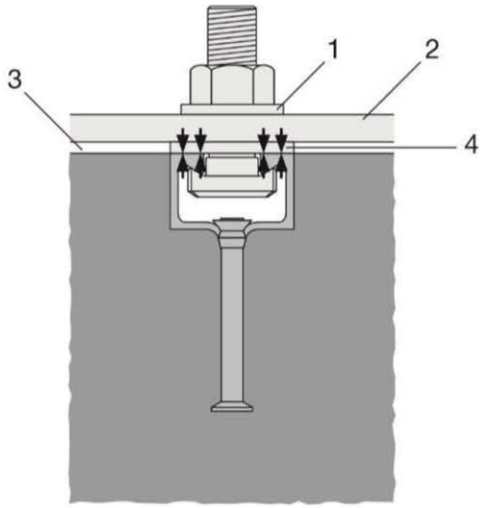
1 washer

2 fixture

3 gap

4 suitable steel part

Steel-steel contact: The fixture is fastened to the anchor channel by suitable steel part (e.g. washer). Fixture is in contact with the channel profile only.



Anchor channels (HAC-C) with channel bolts (HBC)

Intended Use
Installation parameters for channel bolts (HBC)

Annex B4

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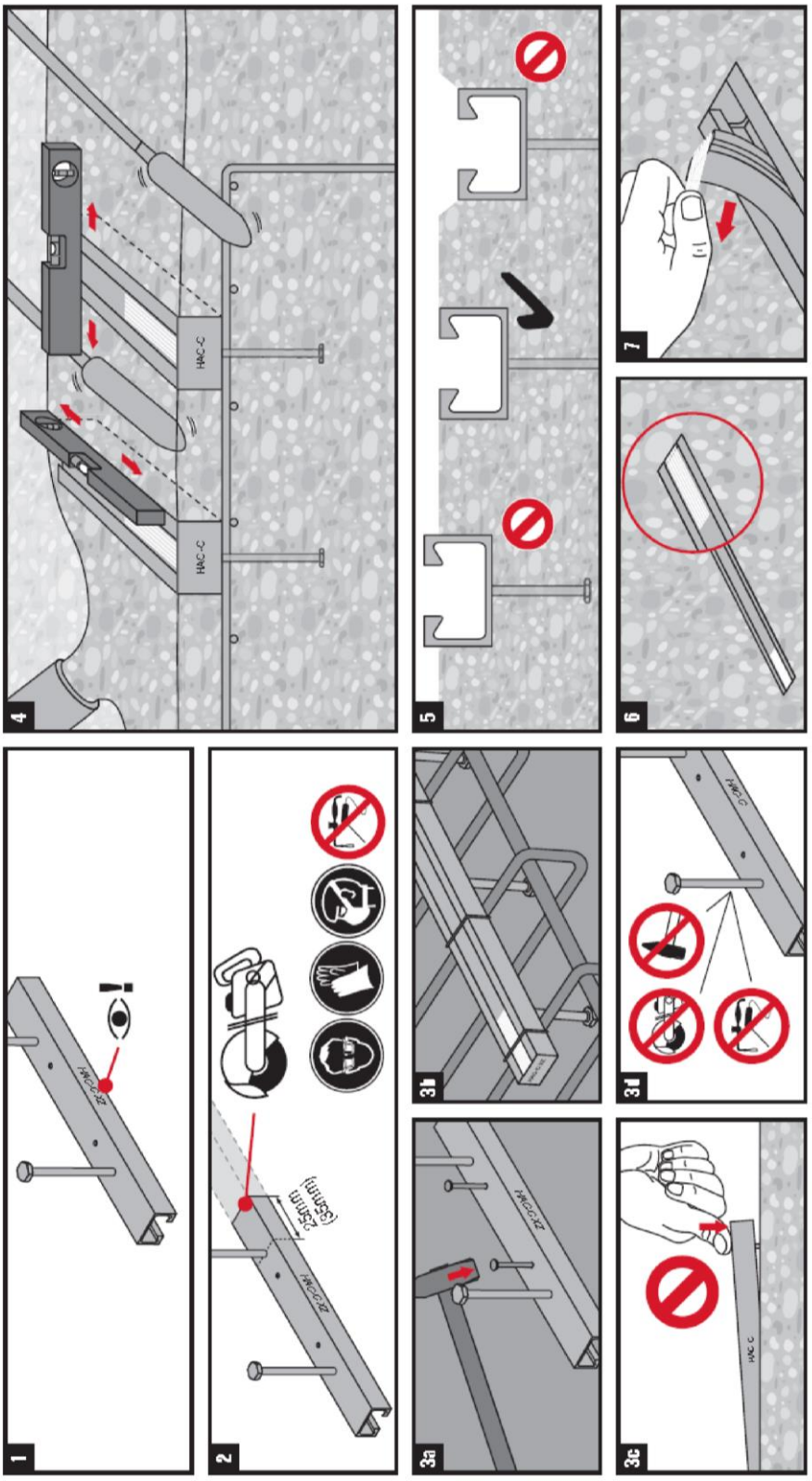

Anchor channels (HAC-C) with channel bolts (HBC)

Intended Use
Installation instructions for anchor channels (HAC-C)

Annex B5

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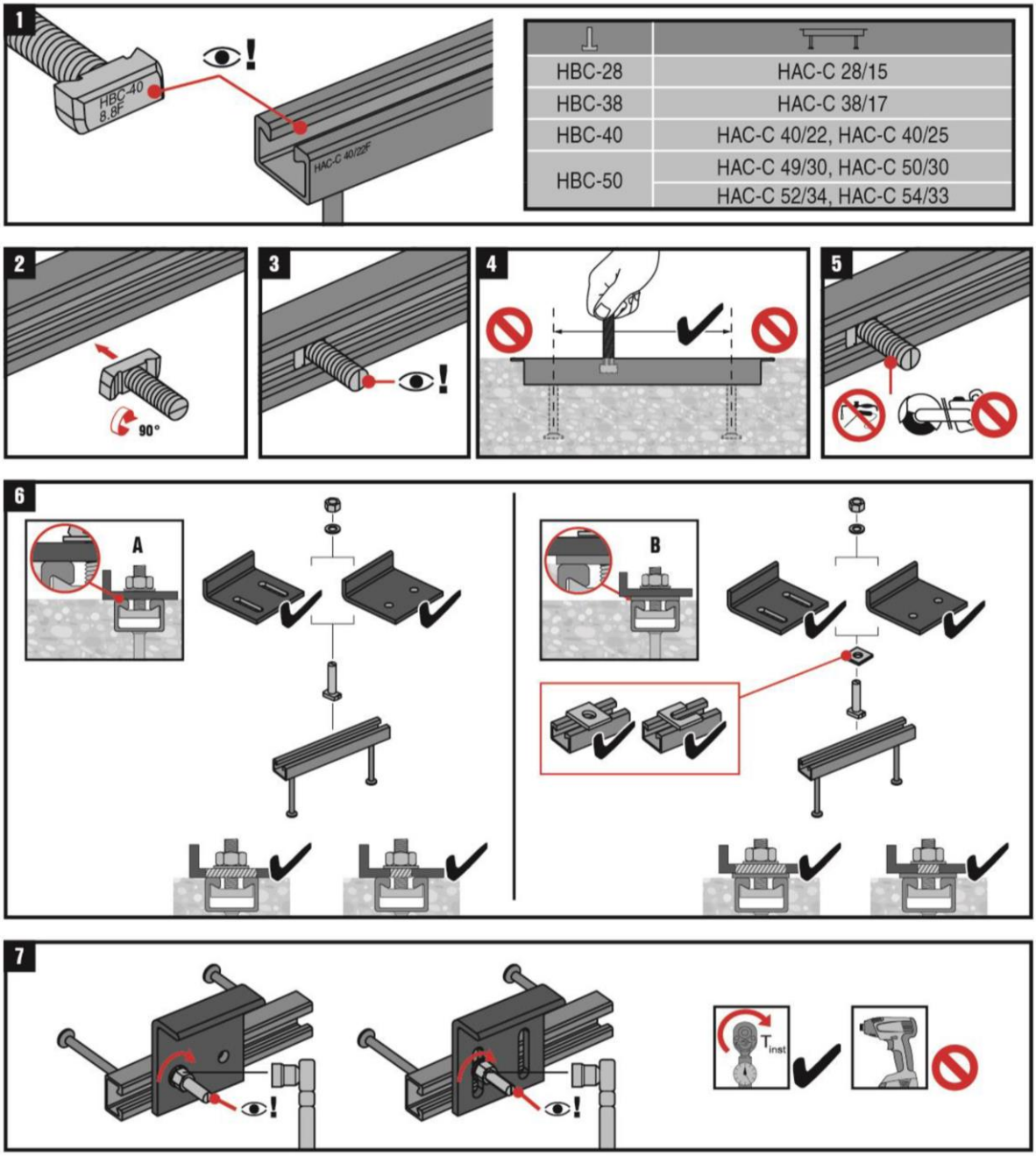


HBC-28	HAC-C 28/15
HBC-38	HAC-C 38/17
HBC-40	HAC-C 40/22, HAC-C 40/25
HBC-50	HAC-C 49/30, HAC-C 50/30
	HAC-C 52/34, HAC-C 54/33

Anchor channels (HAC-C) with channel bolts (HBC)

Intended Use
Installation instructions for channel bolts (HBC)

Annex B6

Deutsches Institut für Bautechnik DIBt

Table 10: Characteristic resistances under tension load – steel failure of anchor channel

Anchor channel HAC-C			**28/15**	**38/17**	**40/25**	**40/22**	**49/30**	**50/30**	**54/33**	**52/34**
Steel failure: Failure of anchor										
Characteristic resistance	$N_{Rk,s,a}$	[kN]	9	18	20		31		55	
Partial safety factor	γ_{Ms} [1)]	[-]	1,8							
Steel failure: Failure of connection between anchor and channel										
Characteristic resistance	$N_{Rk,s,c}$	[kN]	9	18	20		31		55	
Partial safety factor	$\gamma_{Ms,ca}$ [1)]	[-]	1,8							
Steel failure: Local failure by flexure of channel lips										
Characteristic spacing of the channel bolts for $N_{Rk,s,l}$	$s_{l,N}$	[mm]	56	76	80	79	100	98	107	105
Characteristic resistance	$N^0_{Rk,s,l}$	[kN]	9	18	20	35	31	36	55	65
Partial safety factor	$\gamma_{Ms,l}$ [1)]	[-]	1,8							

[1)] In absence of other national regulations

Table 11: Characteristic flexural resistance of channel under tension load

Anchor channel HAC-C				**28/15**	**38/17**	**40/25**	**40/22**	**49/30**	**50/30**	**54/33**	**52/34**
Steel failure: Failure by flexure of channel											
Characteristic flexural resistance of channel	carbon steel	$M_{Rk,s,flex}$	[Nm]	316	538	979	1013	1669	2084	2929	3435
	stainless steel				527			1702		2832	
Partial safety factor		$\gamma_{Ms,flex}$ [1)]	[-]	1,15							

[1)] In absence of other national regulations

Anchor channels (HAC-C) with channel bolts (HBC)

Performance Data
Characteristic resistances of anchor channels under tension load

Annex C1

Deutsches Institut für Bautechnik DIBt

Table 12: Characteristic resistances under tension load – concrete failure

Anchor channel HAC-C				**28/15**	**38/17**	**40/25**	**40/22**		**49/30**	**50/30**		**54/33**	**52/34**	
Type of anchor				**R**	**R**	**R**	**I**	**R**	**R**	**I**	**R**	**R**	**I**	**R**
Pullout failure														
Characteristic resistance in cracked concrete C12/15		$N_{Rk,p}$	[kN]	7,6	13,6		27,0	13,6	21,2	33,8	21,2	33,2	68,4	33,2
Characteristic resistance in uncracked concrete C12/15				10,7	19,0		37,8	19,0	29,7	47,3	29,7	46,5	95,8	46,5
Amplification factor of $N_{Rk,p}$	C16/20	ψ_c	[-]	1,33										
	C20/25			1,67										
	C25/30			2,08										
	C30/37			2,50										
	C35/45			2,92										
	C40/50			3,33										
	C45/55			3,75										
	C50/60			4,17										
	C55/67			4,58										
	≥ C60/75			5,00										
Partial safety factor		$\gamma_{Mp} = \gamma_{Mc}$ [1]	[-]	1,5										
Concrete cone failure														
Product factor k_1	cracked concrete	$k_{cr,N}$	[-]	7,2	7,8	7,9			8,1			8,7		
	uncracked concrete	$k_{ucr,N}$	[-]	10,3	11,2	11,2			11,6			12,4		
Partial safety factor		γ_{Mc} [1]	[-]	1,5										
Splitting														
Characteristic edge distance		$c_{cr,sp}$	[mm]	135	228	237			282			465		
Partial safety factor		$\gamma_{Msp} = \gamma_{Mc}$ [1]	[-]	1,5										

[1] In absence of other national regulations

Table 13: Displacements under tension load

Anchor channel HAC-C			**28/15**	**38/17**	**40/25**	**40/22**	**49/30**	**50/30**	**54/33**	**52/34**
Tension load	N	[kN]	3,6	7,1	7,9	13,9	12,3	14,3	21,8	25,8
Short-term displacement [1]	δ_{N0}	[mm]	0,6	1,3	1,4	2,3	1,4	2,2	1,6	1,4
Long-term displacement [1]	$\delta_{N\infty}$	[mm]	1,2	2,6	2,8	4,6	2,8	4,4	3,2	2,8

[1] Displacements in midspan of the anchor channel, including slip of channel bolt, deformation of channel lips, bending of the channel and slip of the anchor channel in concrete

Anchor channels (HAC-C) with channel bolts (HBC)

Performance Data
Characteristic resistances of anchor channels and displacements under tension load

Annex C2

Deutsches Institut für Bautechnik DIBt

Table 14: Characteristic resistances under shear load – steel failure of anchor channel

Anchor channel HAC-C			**28/15**	**38/17**	**40/25**	**40/22**	**49/30**	**50/30**	**54/33**	**52/34**
Steel failure: Failure of anchor										
Characteristic resistance	$V_{Rk,s,a}$	[kN]	9,0	18,0	20,0	26,0	31,0	40,3	55,0	71,5
Partial safety factor	γ_{Ms} [1)]	[-]	1,5							
Steel failure: Failure of connection between anchor and channel										
Characteristic resistance	$V_{Rk,s,c}$	[kN]	9,0	18,0	20,0	26,0	31,0	40,3	55,0	71,5
Partial safety factor	$\gamma_{Ms,ca}$ [1)]	[-]	1,8							
Steel failure: Local failure by flexure of channel lips										
Characteristic spacing of channel bolts for $V_{Rk,s,l}$	$s_{l,V}$	[mm]	56	76	80	79	100	98	107	105
Characteristic resistance	$V^0_{Rk,s,l}$	[kN]	9,0	18,0	20,0	26,0	31,0	40,3	55,0	71,5
Partial safety factor	$\gamma_{Ms,l}$ [1)]	[-]	1,8							

[1)] In absence of other national regulations

Anchor channels (HAC-C) with channel bolts (HBC)

Performance Data
Characteristic resistances of anchor channels under shear load

Annex C3

Deutsches Institut für Bautechnik DIBt

Table 15: Characteristic resistances under shear load – concrete failure

Anchor channel HAC-C				**28/15**	**38/17**	**40/25**	**40/22**	**49/30**	**50/30**	**54/33**	**52/34**
Pry out failure											
Product factor		k_8	[-]	1,0	2,0						
Partial safety factor		γ_{Mc} [1]	[-]	1,5							
Concrete edge failure											
Product factor k_{12}	cracked concrete	$k_{cr,V}$	[-]	6,9		7,5					
	uncracked concrete	$k_{ucr,V}$	[-]	9,6		10,5					
Partial safety factor		γ_{Mc} [1]	[-]	1,5							

[1] In absence of other national regulations

Table 16: Displacements under shear load

Anchor channel HAC-C			**28/15**	**38/17**	**40/25**	**40/22**	**49/30**	**50/30**	**54/33**	**52/34**
Shear load	V	[kN]	3,6	7,1	7,9	10,3	12,3	16,0	21,8	28,4
Short-term displacement [1]	δ_{V0}	[mm]	0,6	1,3	1,4	2,1	1,4	2,6	1,6	3,7
Long-term displacement [1]	$\delta_{V\infty}$	[mm]	0,9	2,0	2,1	3,1	2,1	3,9	2,4	5,5

[1] Displacements in midspan of the anchor channel, including slip of channel bolt, deformation of channel lips and slip of the anchor channel in concrete

Table 17: Characteristic resistances under combined tension and shear load

Anchor channel HAC-C			**28/15**	**38/17**	**40/25**	**40/22**	**49/30**	**50/30**	**54/33**	**52/34**
Steel failure: Local failure by flexure of channel lips and failure by flexure of channel										
Product factor	k_{13}	[-]	1,0 [1]							
Steel failure: Failure of anchor and connection between anchor and channel										
Product factor	k_{14}	[-]	1,0 [2]							

[1] k_{13} can be taken as 2,0 if $V_{Rd,s,l}$ is limited to $N_{Rd,s,l}$

[2] k_{14} can be taken as 2,0 if $\max(V_{Rd,s,a}; V_{Rd,s,c})$ is limited to $\min(N_{Rd,s,a}; N_{Rd,s,c})$

Anchor channels (HAC-C) with channel bolts (HBC)

Performance Data
Characteristic resistances of anchor channels and displacements under shear load
Characteristic resistances under combined tension and shear load

Annex C4

Deutsches Institut für Bautechnik DIBt

Table 18: Characteristic resistances under tension and shear load – steel failure of channel bolts

Channel bolt					M8	M10	M12	M16	M20
Steel failure									
Characteristic tension resistance	$N_{Rk,s}$ [1]	[kN]	HBC-28/15	4.6	-				
				8.8	22,4	35,4	44,3	-	
				A4-50 [2]	17,2	-			
				A4-70 [2]	25,6	38,9	51,3	-	
			HBC-38/17	4.6	-	23,2	-		
				8.8		-	35,4	55,8	-
				A4-70 [2]		20,5	47,2	53,0	
			HBC-40/22	4.6		23,2	-		
				8.8		-	35,4	55,8	-
				A4-70 [2]		20,5	58,6	91,0	
			HBC-50/30	4.6		-			
				8.8			35,4	55,8	183,1
				A4-70 [2]			58,6	109,0	129,0
Partial safety factor	γ_{Ms} [3]	[-]	HBC-28/15 HBC-38/17 HBC-40/22 HBC-50/30	4.6	2,00				
				8.8	1,50				
				A4-50 [2]	2,86				
				A4-70 [2]	1,87				
Characteristic shear resistance	$V_{Rk,s}$ [1]	[kN]	HBC-28/15	4.6	-				
				8.8	14,6	23,2	33,7	-	
				A4-50 [2]	11,0	-			
				A4-70	15,4	24,4	35,4	-	
			HBC-38/17	4.6	-	13,9	-		
				8.8		-	33,7	62,8	-
				A4-70 [2]		24,4	35,4	65,9	
			HBC-40/22	4.6		13,9	-		
				8.8		-	33,7	62,8	-
				A4-70 [2]		24,4	35,4	65,9	
			HBC-50/30	4.6		-			
				8.8			33,7	62,8	98,0
				A4-70 [2]			35,4	65,9	102,9
Partial safety factor	γ_{Ms} [3]	[-]	HBC-28/15 HBC-38/17 HBC-40/22 HBC-50/30	4.6	1,67				
				8.8	1,25				
				A4-50 [2]	2,38				
				A4-70	1,56				

[1] In conformity to EN ISO 898-1:1999
[2] Materials according to Table 6, Annex A6
[3] In absence of other national regulations

Anchor channels (HAC-C) with channel bolts (HBC)

Performance Data
Characteristic resistances of channel bolts under tension and shear load

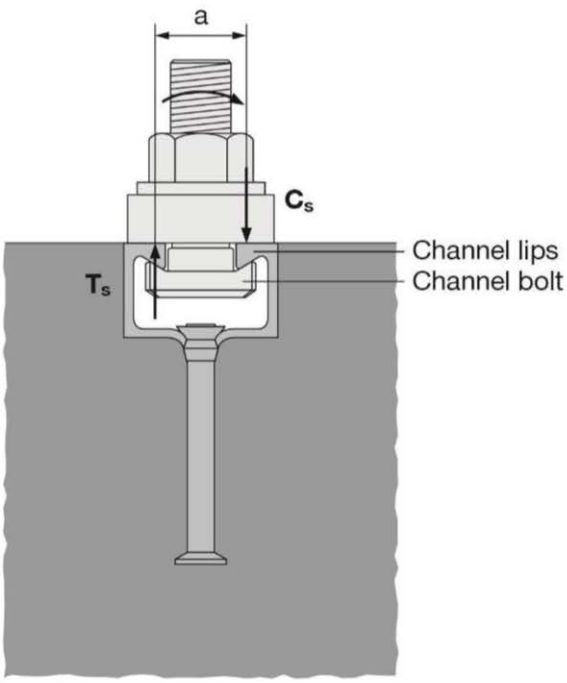
Annex C5

Deutsches Institut für Bautechnik DIBt

Table 19: Characteristic resistances under shear load with lever arm – steel failure of channel bolts

Channel bolt[1]					**M8**	**M10**	**M12**	**M16**	**M20**
Steel failure									
Characteristic flexural resistance	$M^0_{Rk,s}$	[Nm]	HBC-28/15 HBC-38/17 HBC-40/22 HBC-50/30	4.6	-	29,9 [3]	-		
				8.8	30,0	59,8	104,8	266,4	519,3
				A4-50 [2]	18,7	-			
				A4-70 [2]	26,2	52,3	91,7	233,1	454,4
Partial safety factor	γ_{Ms} [1]	[-]	HBC-28/15 HBC-38/17 HBC-40/22 HBC-50/30	4.6	1,67				
				8.8	1,25				
				A4-50 [2]	2,38				
				A4-70 [2]	1,56				
Internal lever arm	a	[mm]	HBC-28/15	28/15	17,3	18,7	20,0	-	
			HBC-38/17	38/17	-	23,0	24,3	26,3	-
			HBC-40/22	40/22		24,3	25,7	27,3	
			HBC-50/30	50/30		-	29,9	31,7	33,9

[1] In absence of other national regulations
[2] Materials according to Table 6, Annex A6
[3] Not applicable for HBC-28/15 and HBC-50/30



[3] The characteristic flexure resistance according to Table 19 is limited as follows:

$M^0_{Rk,s} \leq 0{,}5 \cdot N_{Rk,s,l} \cdot a$ ($N_{Rk,s,l}$ according to Table 10)

$M^0_{Rk,s} \leq 0{,}5 \cdot N_{Rk,s} \cdot a$ ($N_{Rk,s}$ according to Table 18)

a = internal lever arm according to Table 19

T_s = tension force acting on the channel lips

C_s = compression force acting on the channel lips

Anchor channels (HAC-C) with channel bolts (HBC)

Performance Data
Characteristic flexural resistances of channel bolts under shear load

Annex C6

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Table 20: Characteristic resistance $F_{Rd,s,fi}$ [kN] of anchor channels under fire exposure

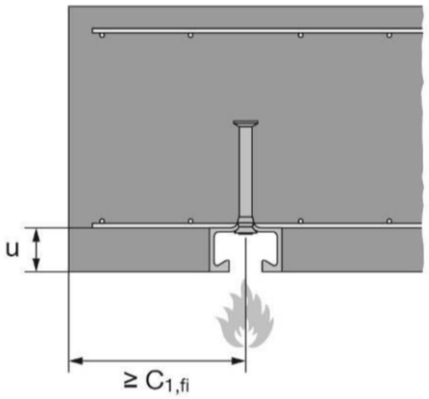
Channel bolt					**M10**	**M12**	**≥ M16**
Steel failure of anchor, connection between anchor and channel, local flexure of channel lip							
Characteristic resistance in cracked concrete C20/25	HAC-C 28/15	R60	$N_{Rk,s,fi}$ = $V_{Rk,s,fi}$	[kN]	0,8		-
		R90			0,6		
		R120			0,5		
	HAC-C 38/17	R60			-		1,9
		R90			-		1,3
		R120			-		1,0
	HAC-C 40/25 HAC-C 40/22	R60			1,7	3,5	
		R90			1,2	2,2	
		R120			0,9	1,5	
	HAC-C 49/30 HAC-C 50/30 HAC-C 52/34	R60			-	3,8	3,9
		R90				2,5	2,9
		R120				1,9	2,4
Partial safety factor			$\gamma_{Ms,fi}$ [1]	[-]	1,0		

[1] In absence of other national regulations

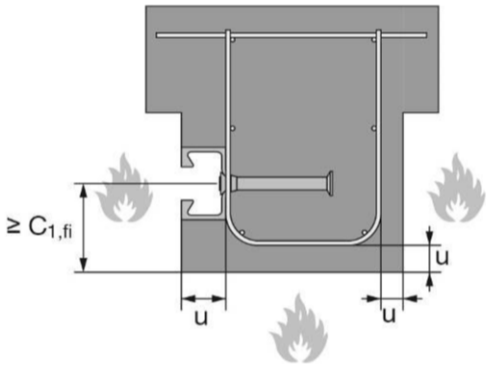
Table 21: Minimum concrete cover

Anchor channel HAC-C				**28/15**	**38/17**	**40/25**	**40/22**	**49/30**	**50/30**	**54/33**	**52/34**
Concrete cover	R60	u	[mm]	35				50	50	50	50
	R90			45							
	R120			55							

Fire exposure from one side only



Fire exposure from more than one side



Anchor channels (HAC-C) with channel bolts (HBC)

Performance Data
Characteristic resistances of anchor channels and channel bolts under fire exposure

Annex C7

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