Deutsches Institut für Bautechnik

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Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

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

European Technical Assessment ETA-16/0453 of 23 September 2016

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	Halfen Anchor Channel HTA 40/22P and 50/30P
Product family to which the construction product belongs	Anchor channels
Manufacturer	Halfen GmbH Liebigstraße 14 40764 Langenfeld DEUTSCHLAND
Manufacturing plant	
This European Technical Assessment contains	29 pages including 25 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

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Specific Part

1 Technical description of the product

The HALFEN Anchor Channel HTA 40/22P and 50/30P is 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. HALFEN channel bolts 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 C8
Characteristic resistances under fatigue cyclic loads	See Annex C10 to C12

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 C9

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

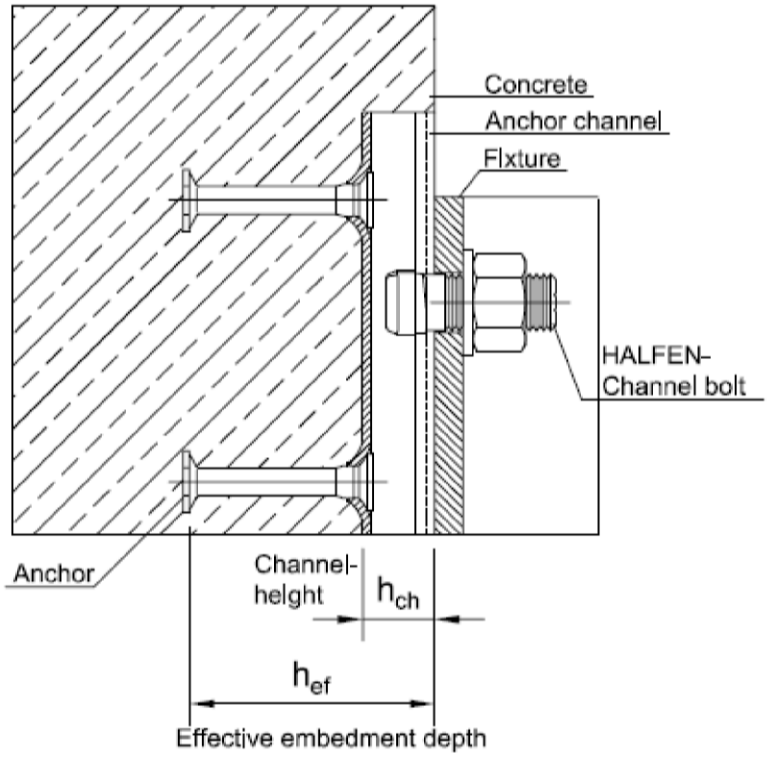
5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD

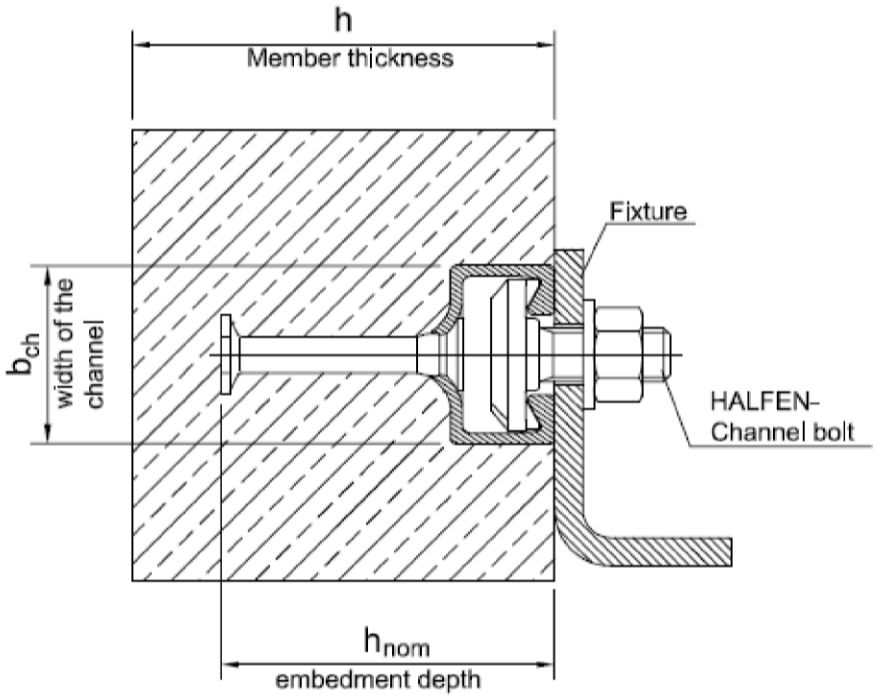
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

Issued in Berlin on 23 September 2016 by Deutsches Institut für Bautechnik

Andreas Kummerow
p. p. Head of Department

beglaubigt:
Müller





HALFEN Anchor Channel HTA 40/22P and HTA 50/30P	
Product description Installed condition	Annex A1

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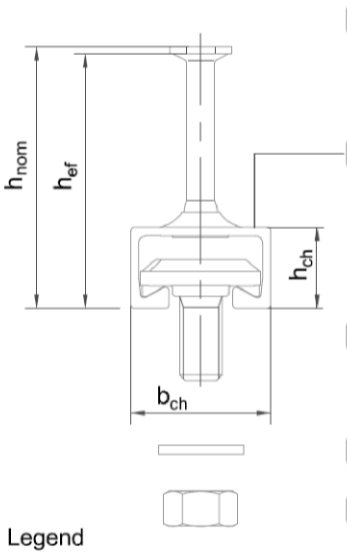
Anchor channel
hot-rolled profile



Legend
h_{ch} Channel height
b_{ch} Width of the channel
h_{ef} Effective embedment depth
h_{nom} Embedment depth

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

a) Stamped on back of channel

b) Printed on channel web

H or HALFEN	Identifying mark of the producer
TA	Type of anchor channel
40/22P	Size
A4	Material

Close to the anchor a nail hole is positioned.

Material of the channel:

Steel

No marking for	1.0038/1.0044

Stainless steel

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

Marking of the HALFEN channel bolts
e.g.: HALFEN A4-70

H or HALFEN	Identifying mark of the producer
A4	Material
70	Strength grade

Material of the channel bolts:

Steel

No marking

Stainless steel

A2	1.4301/1.4307/1.4567/1.4541
A4	1.4401/1.4404/1.4571/1.4578
L4	1.4362
F4, FA	1.4462
HCR	1.4529/1.4547

Strength grade of the channel bolts:

Steel

4.6, 8.8	Strength grade 4.6, 8.8

Stainless steel

50, 70	Strength grade 50, 70

HALFEN Anchor Channel HTA 40/22P and HTA 50/30P	Annex A2
Product description Marking and materials	

Table A1: Materials and intended use

Item no.	Specification	Intended use			
		1	2	3	4
		Dry internal conditions	**Internal conditions with usual humidity**	**Medium corrosion exposure**	**High corrosion exposure**
		Anchor channels may only be used in structures subject to dry internal conditions (e.g. accomodations, bureaus, schools, hospitals, shops, exceptional internal conditions with usual humidity acc. column 2)	Anchor channels may also be used in structures subject to internal conditions with usual humidity (e.g. kitchen, bath and laundry in residential buildings, exceptional permanent damp conditions and application under water)	Anchor channels may also be used in structures subject to external atmospheric exposure (incl. industrial and marine environment) or exposure in permanently damp internal conditions, if no particular aggressive conditions (e.g. permanent, alternating immersion in seawater etc. acc. column 4) exist.	Anchor channels may also be used in structures subject to exposure inparticular aggressive conditions (e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with chemical pollution (e.g. in de-sulphurization plants or road tunnels where de-icing materials are used)).
		Materials			
①	Channel profile	Steel 1.0038, 1.0044; EN 10025 hot-dip galv. ≥ 55 µm [6]	Steel 1.0038, 1.0044; EN 10025 hot-dip galv. ≥ 55 µm [6] Stainless steel 1.4301, 1.4307, 1.4567, 1.4541; EN 10088	Stainless steel 1.4401, 1.4404, 1.4571, 1.4062, 1.4162, 1.4362 EN 10088	Stainless steel 1.4462 [2], 1.4529, 1.4547 EN 10088
②	Anchor	Steel 1.0038, 1.0214, 1.0401, 1.1132, 1.5525; EN 10263, EN 10269 hot-dip galv. ≥ 55 µm [6]	Steel 1.0038, 1.0214, 1.0401, 1.1132, 1.5525; EN 10263, EN 10269 hot-dip galv. ≥ 55 µm [6] Stainless steel 1.4301, 1.4307, 1.4567, 1.4541; EN 10088	Stainless steel 1.4401, 1.4404, 1.4571, 1.4362, 1.4578 EN 10088 Steel 1.0038 [3]	
③	HALFEN channel bolts shaft and thread according EN ISO 4018	Steel, strength grade 4.6 / 8.8 EN ISO 898-1 electroplated ≥ 5 µm [4]	Steel, strength grade 4.6 / 8.8 EN ISO 898-1, hot-dip galv. ≥ 50 µm [1] [5] Stainless steel, strength grade 50, 70 1.4301, 1.4307, 1.4567, 1.4541 EN ISO 3506-1	Stainless steel strength grade 50, 70 1.4401, 1.4404, 1.4571, 1.4362, 1.4578 EN ISO 3506-1	Stainless steel strength grade 50, 70 1.4462 [2], 1.4529, 1.4547 EN ISO 3506-1
④	Washer [7] EN ISO 7089 and EN ISO 7093-1 production class A, 200 HV	Steel EN 10025 electroplated ≥ 5 µm [4]	Steel EN 10025 hot-dip galv. ≥ 50 µm [1] [5] Stainless steel steel grade A2, A3 EN ISO 3506-1	Stainless steel steel grade A4, A5 EN ISO 3506-1	Stainless steel 1.4462 [2],1.4529, 1.4547 EN ISO 3506-1
⑤	Hexagonal nuts EN ISO 4032	Steel strength grade 5/8 EN ISO 898-2 electroplated ≥ 5 µm [4]	Steel strength grade 5/8 EN ISO 898-2 hot-dip galv. ≥ 50 µm [1] [5] Stainless steel, strength grade 70, 80 steel grade A2, A3 EN ISO 3506-2	Stainless steel strength grade 70, 80 steel grade A4, A5 EN ISO 3506-2	Stainless steel strength grade 70, 80 1.4462 [2], 1.4529, 1.4547 EN ISO 3506-2

[1] or electroplated special coating ≥ 12µm
[2] 1.4462 not applicable for indoor swimming pools
[3] steel acc. EN 10025
[4] electroplated acc. to EN ISO 4042
[5] hot-dip galv. acc. to EN ISO 10684
[6] hot-dip galv. acc. to EN ISO 1461
[7] not included in scope of delivery

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Fig. 1
Hot-rolled Profile

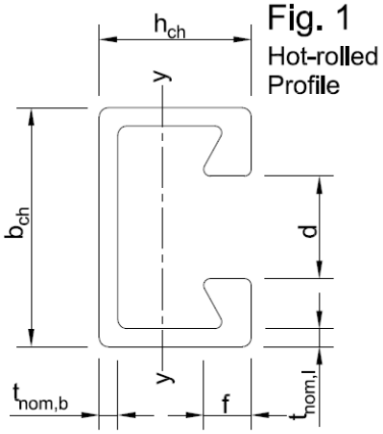
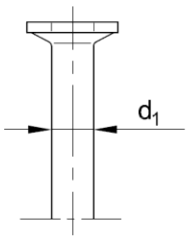


Table A2: Profile dimensions (steel and stainless steel)

Anchor channel	Figure	Dimensions						I_y
		b_{ch}	h_{ch}	$t_{nom,b}$	$t_{nom,l}$	d	f	
		[mm]						[mm^4]
40/22P	1	39.50	23.00	2.60	2.40	18.00	6.00	19859
50/30P	1	49.00	30.00	3.20	2.75	22.50	7.85	52575



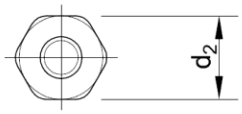


Table A3: Types of round anchors

Type	Shaft Ø d_1	Head Ø d_2	Anchor channel
	[mm]		
B6	10	20	40/22P
	12	25	50/30P

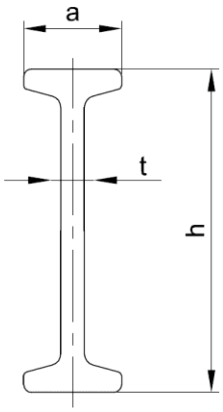


Table A4: Types of I-anchors

Type	Height h	Head width a	Web thickness t	Anchor channel
	[mm]			
I 128	128	17	6.0	40/22P, 50/30P
I 140	140	20	7.1	

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Figure 1

Round anchor
(B6-anchor)

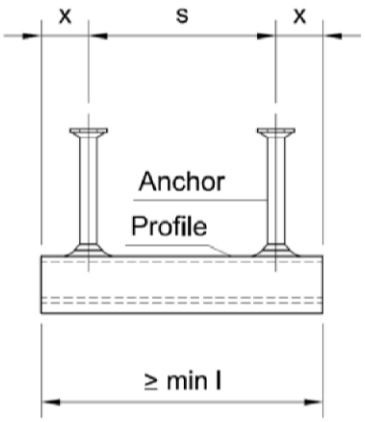

Figure 2

Weld- on anchor
(I-anchor)

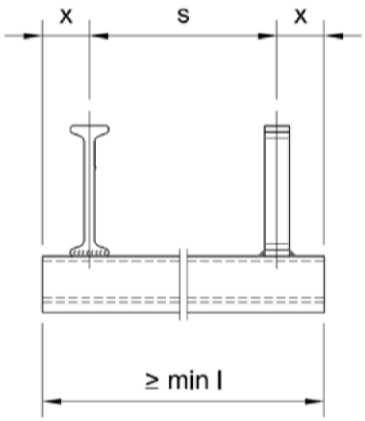

Figure 3

Weld- on anchor
round

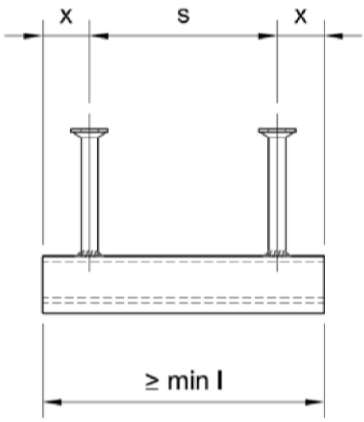

Table A5: Anchor positioning

Anchor channel	**Anchor spacing s**		**End spacing x** [1]		**Min. channel length l_{min}**	
	s_{min}	s_{max}	Round anchor Fig. 1	Welded anchor Fig. 2 and 3	Round anchor Fig. 1	Welded anchor Fig. 2 and 3
	[mm]					
40/22P 50/30P	100 (50)	250	25	25	100	150

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

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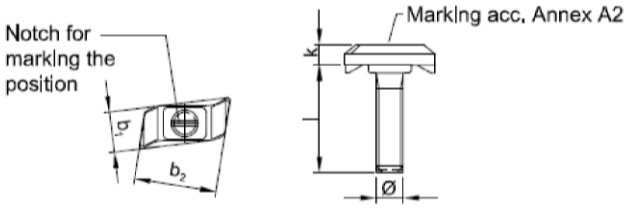
HALFEN channel bolt,
Hook-head geometry



alternative Hook-head geometry

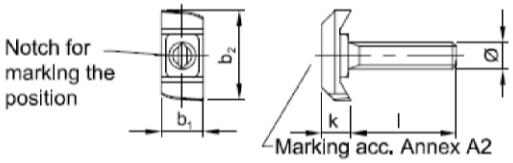


Table A6: Dimensions of HALFEN channel bolts

Head	HS	Thread Ø	Channel bolts - w ing shape			Channel bolts - alternative shape			Length l [mm]	Anchor channel
			Width b_1 [mm]	Length b_2 [mm]	Thickness k [mm]	Width b_1 [mm]	Length b_2 [mm]	Thickness k [mm]		
Hook-head	40/22	M10	15	30.8	7.2	-	-	-	20-100	40/22P
		M12	15	30.8	7.2	-	-	-	20-200	
		M16	17.4	30.3	8.2 (9.8)	-	-	-	30-300	
	50/30	M10	16.3	40.2	10	15	41.5	10	30-50	50/30P
		M12	16.3	40.2	10	15	41.5	10	30-200	
		M16	19.4	40.2	11	20	41.5	11	30-300	
		M20	21	39.5	12.5	21	41.5	12	35-300	

( ) Value applies for strength grade 8.8

Table A7: Strength grade

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

[1] Materials according Annex A2 and Annex A3, Tab.A1

HALFEN Anchor Channel HTA 40/22P and HTA 50/30P

Product description
HALFEN channel bolts, dimensions, strength grade

Annex A6

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Specifications for 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.
- Fatigue cyclic loads.
- Fire exposure for concrete class C20/25 to C50/60.

Base materials:

- Reinforced or unreinforced normal weight concrete according to EN 206.
- Strength classes C12/15 to C90/105 according to EN 206.
- 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 A3, Table A1, column 1 - 4)
- 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 A3, Table A1, column 2 - 4)
- Structures subject to external atmospheric exposure (incl. industrial and marine environment) or exposure to permanently damp internal conditions, if no particular aggressive conditions (e.g. permanent, alternating immersion in seawater etc.) exist.
  (anchor channels and channel bolts according to Annex A3, Table A1, column 3 - 4)
- Structures subject to exposure in particular aggressive conditions (e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used))
  (anchor channels and channel bolts according to Annex A3, Table A1, column 4)

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.
- For fatigue loading the anchor channels are designed in accordance with EOTA TR 050 “Calculation Method for the Performance of Anchor Channels under Fatigue Loading”.
- The characteristic resistances are calculated with the minimum effective embedment depth.

HALFEN Anchor Channel HTA 40/22P and HTA 50/30P	Annex B1
Intended use Specifications	

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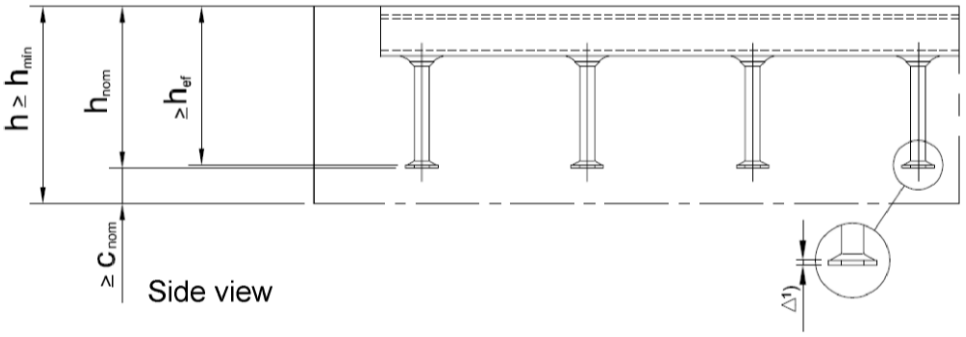
Installation:

- 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 A5, Table A5 are generated including end spacing and minimum channel length and only to be used in dry internal conditions (Annex A3, Table A1, column 1). For anchor channels made of stainless steel there are no restrictions regarding corrosion resistance when using cut channel pieces, if cutting is done professionally and contamination of cutting edges with corroding material is avoided.
- Installation in accordance with the manufacturer's specifications given in Annexes B6 and B7.
- The anchor channels are fixed on the formwork, reinforcement or auxiliary construction such that no movement of the anchor 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 is properly compacted. The anchor channels are protected from penetration of concrete into the internal space of the channel profiles.
- Washer may be chosen according to Annex A3 and provided separately by the user.
- Orientating the channel bolt (groove mark according to Annex B7) rectangular to the channel axis.
- The required installation torque given in Annex B4 must be applied and must not be exceeded.

HALFEN Anchor Channel HTA 40/22P and HTA 50/30P	Annex B2
Intended use Specifications	



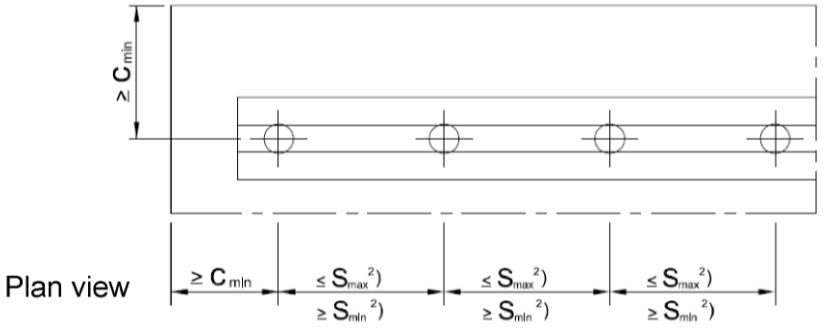


Table B1: Minimum anchorage depth, edge distance and member thickness

Anchor channel			**40/22P**	**50/30P**
Min. anchorage depth	[mm]	$h_{ef,min}$	91	106
Min. edge distance		c_{min}	50	75
Min. member thickness		h_{min}	$h_{nom} + c_{nom}$ 3)	

1) Δ = anchor head thickness
2) s_{min}, s_{max} acc. Annex A5, Table A5
3) c_{nom} acc. EN 1992-1-1 and $c_{nom} \geq 10$ mm

HALFEN Anchor Channel HTA 40/22P and HTA 50/30P

Intended use
Installation parameters of anchor channels

Annex B3

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Table B2: Minimum spacing and setting torque of HALFEN channel bolts

Anchor channel	**Channel bolts** Ø	**Min. spacing $s_{min,cbo}$ [4] of the channel bolts**	**Setting Torque T_{inst} [5]**				
			General [2]	Steel – steel contact [3]			
			Steel 4.6; 8.8 Stainless steel 50; 70 [1]	Steel 4.6	Stainless steel 50 [1]	Steel 8.8	Stainless steel 70 [1]
	[mm]	[mm]	[Nm]				
40/22P	10	50	15	15	15	40	30
	12	60	25	25	25	70	50
	16	80	45	65	60	180	130
50/30P	10	50	15	15	15	40	30
	12	60	25	25	25	70	50
	16	80	60	65	60	180	130
	20	100	75	130	120	360	250

[1] Materials according to Annex A2 and Annex A3, Tab. A1
[2] Acc. to Annex B5, Fig. 1
[3] Acc. to Annex B5, Fig. 2
[4] See Annex C1, Fig. 1
[5] T_{inst} must not be exceeded

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General

The fixture is braced to concrete or to the anchor channel respectively braced to concrete and anchor channel. The setting torques according to Annex B4, Table B2 shall be applied and must not be exceeded.

Steel to steel contact

The fixture is braced to the anchor channel by suitable washer. The setting torques according to Annex B4, Table B2 shall be applied and must not be exceeded.

Fig. 1

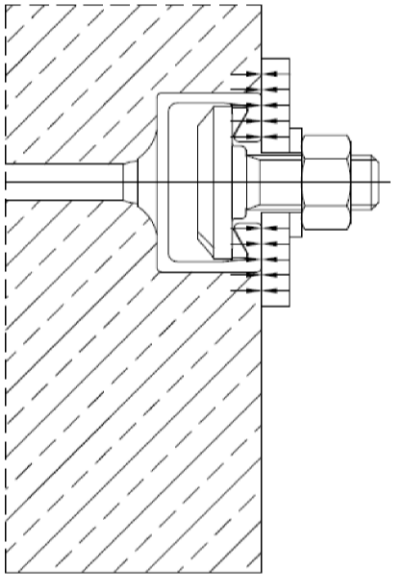
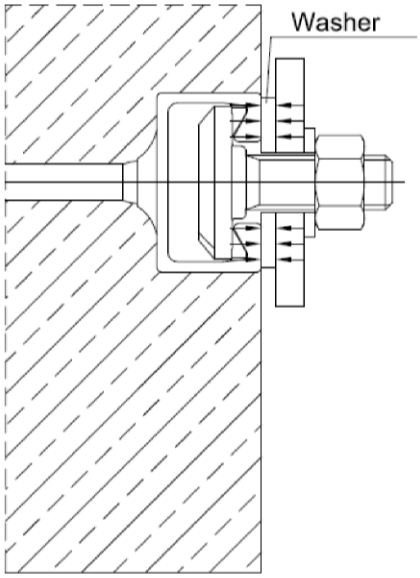


Fig. 2



HALFEN Anchor Channel HTA 40/22P and HTA 50/30P	Annex B5
Intended use Positions of the fixture	

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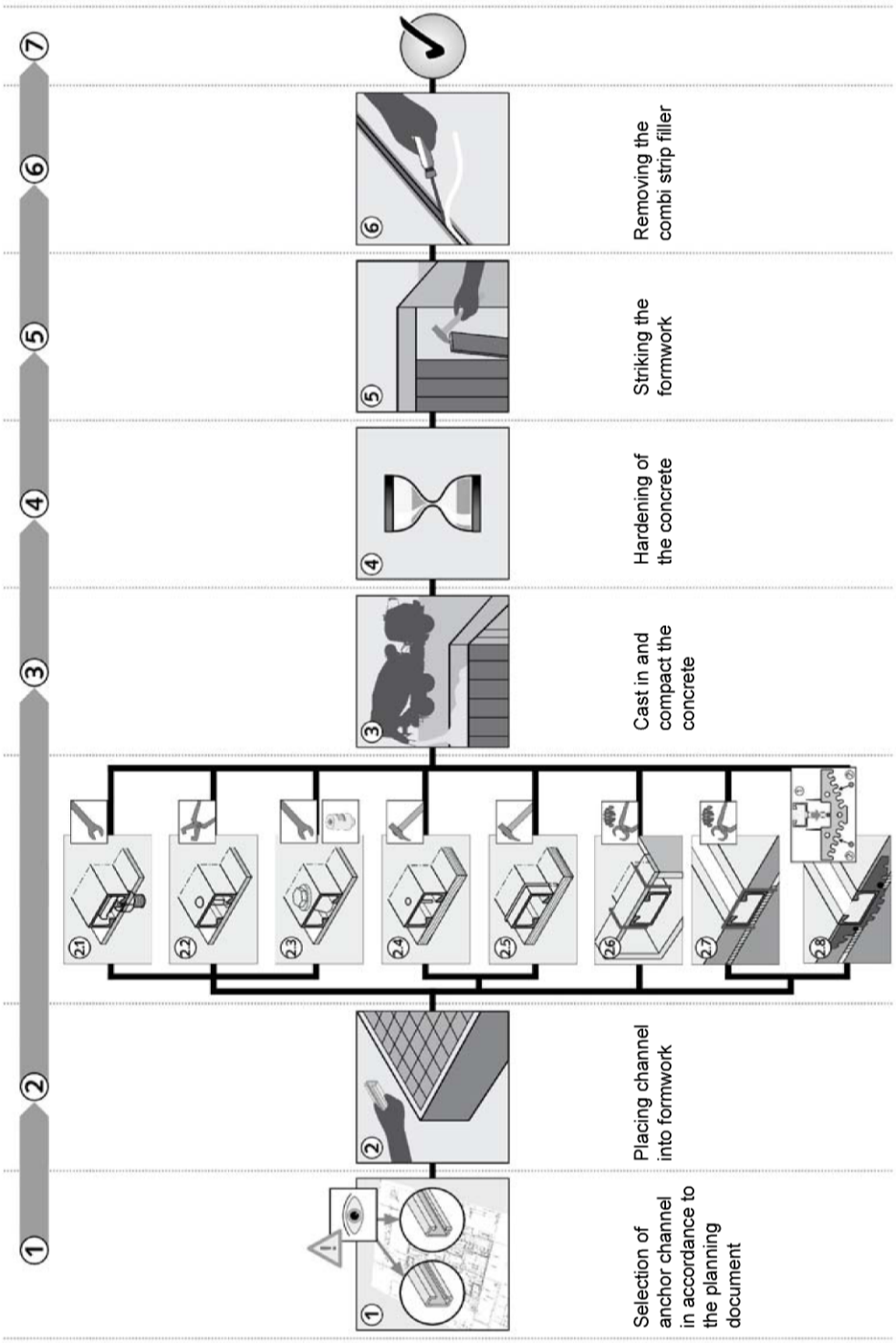
Installation of HALFEN anchor channel



2.1 Steel formwork: Fixing with HALFEN channel bolts through formwork penetration
2.2 Steel formwork: Fixing with rivets
2.3 Steel formwork: Fixing with HALFEN Fixing cone
2.4 Timber formwork: Fixing with nails
2.5 Timber formwork: Fixing with staples
2.6 Fixing in the top surface of concrete: Fixing by using auxiliary construction
2.7 Fixing in the top surface of concrete: Fixing from above directly to the reinforcement
2.8 Fixing in the top surface of concrete: Fixing from above to the reinforcement, using the HALFEN ChanClip

HALFEN Anchor Channel HTA 40/22P and HTA 50/30P	
Intended use Installation instruction – HALFEN anchor channel	Annex B6

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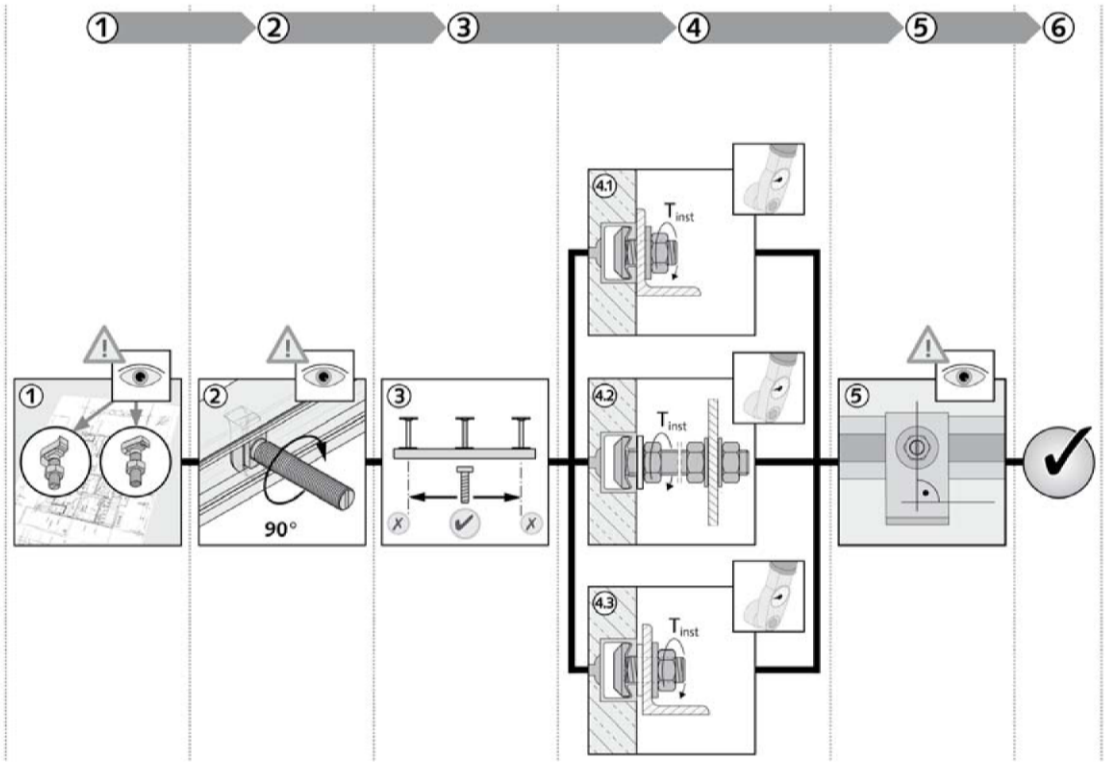
Installation of HALFEN channel bolts



1	2	3	4	5
Selection of the HALFEN channel bolts in accordance with the planning document.	Insert the HALFEN channel bolts into the channel slot. After a 90° turn clockwise the HALFEN screw locks into position (check whether the groove mark is perpendicular to the channel longitudinal axis).	Positioning of the HALFEN channel bolts: At the channel ends a minimum clearance must be maintained, which corresponds with the overhang beyond the last anchor acc. to Annex A5.	Tighten the hexagonal nut to the setting torque (T_{inst}) acc. table stated below. T_{inst} must not be exceeded. 4.1: general application, 4.2 and 4.3: steel to steel contact.	After tightening the nut check if the groove mark on the HALFEN channel bolt is perpendicular to the channel longitudinal axis. If it is not perpendicular the screw must be completely loosened, re-inserted and tightened again.

Table B4: Setting torques

Pos. of fixture acc. Annex B5	Material strength grade		Anchor channel	T_{inst} [Nm] [1]			
				M10	M12	M16	M20
General	Steel 4.6 / 8.8 and Stainless steel 50 / 70		40/22P	15	25	45	-
			50/30P	15	25	60	75
Steel to steel contact	Steel	4.6	40/22P and 50/30P	15	25	65	130
		8.8		40	70	180	360
	Stainless steel	50		15	25	60	120
		70		30	50	130	250

[1] T_{inst} must not be exceeded

HALFEN Anchor Channel HTA 40/22P and HTA 50/30P

Intended use
Installation instruction – HALFEN channel bolts

Annex B7

Table C1: Character. resistances under tension load - steel failure anchor channel

Anchor channel			**40/22P**	**50/30P**
Steel failure, anchor				
Characteristic resistance	$N_{Rk,s,a}$	[kN]	31	56
Partial safety factor	γ_{Ms} [1)]		1.8	
Steel failure, connection channel/anchor				
Characteristic resistance	$N_{Rk,s,c}$	[kN]	29	39
Partial safety factor	$\gamma_{Ms,ca}$ [1)]		1.8	
Steel failure, local flexure of channel lips				
Spacing of channel bolts for $N_{Rk,s,l}$	$s_{l,N}$	[mm]	79	98
Characteristic resistance	$N^0_{Rk,s,l}$	[kN]	35	39
Partial safety factor	$\gamma_{Ms,l}$ [1)]		1.8	

[1)] In absence of other national regulations

Fig. 1

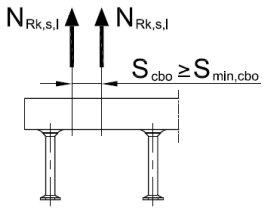
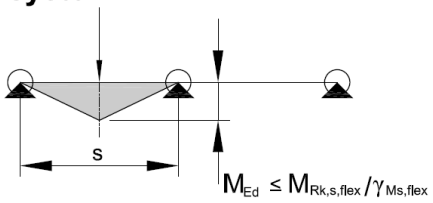


Fig. 2: Assumption of system



• $s_{min,cbo}$ acc. to Table B2, Annex B4

Table C2: Characteristic flexure resistance of channel

Anchor channel				**40/22P**	**50/30P**
Characteristic flexure resistance of channel	$M_{Rk,s,flex}$	[Nm]	Steel	1389	2803
			Stainless steel	1562	3154
Partial safety factor	$\gamma_{Ms,flex}$ [1)]			1.15	

[1)] In absence of other national regulations

HALFEN Anchor Channel HTA 40/22P and HTA 50/30P

Performances
Characteristic resistances under tension load – steel failure anchor channel

Annex C1

Table C3: Char. resistances under tension load - steel failure of HALFEN channel bolts

Channel bolts ∅				**M10**	**M12**	**M16**	**M20**
Steel failure							
Characteristic resistance	$N_{Rk,s}$ [2]	[kN]	4.6	23.2	33.7	62.8	98.0
			8.8	46.4	67.4	125.6	196.0
			50 [1]	29.0	42.2	78.5	122.5
			70 [1]	40.6	59.0	109.9	171.5
Partial safety factor	γ_{Ms} [3]		4.6	2.00			
			8.8	1.50			
			50 [1]	2.86			
			70 [1]	1.87			

[1] Materials according Annex A2 and A3
[2] In conformity to EN ISO 898-1:1999
[3] In absence of other national regulations

HALFEN Anchor Channel HTA 40/22P and HTA 50/30P	Annex C2
Performances Characteristic resistances under tension load – steel failure channel bolts	

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Table C4: Characteristic resistances under tension load - concrete failure

Anchor channel				**40/22P**	**50/30P**
Pull-out failure					
Characteristic resistance in cracked concrete C12/15	Round anchors	$N_{Rk,p}$	[kN]	21.2	34.0
	Welded anchors			17.8	23.8
Characteristic resistance in uncracked concrete C12/15	Round anchors	$N_{Rk,p}$	[kN]	29.7	47.6
	Welded anchors			24.9	33.3
Increasing factor for $N_{Rk,p}$	C20/25	Ψ_c	[-]	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		$k_{cr,N}$		8.0	8.2
		$k_{ucr,N}$		11.5	11.7
Characteristic edge distance		$c_{cr,N}$	[mm]	195	216
Characteristic spacing		$s_{cr,N}$		$2.0\ c_{cr,N}$	
Partial safety factor		γ_{Mc} [1)]		1.5	
Splitting failure					
Characteristic edge distance		$c_{cr,sp}$	[mm]	273	318
Characteristic spacing		$s_{cr,sp}$		$2.0\ c_{cr,sp}$	
Partial safety factor		γ_{Msp} [1)]		1.5	

[1)] In absence of other national regulations

Table C5: Displacements under tension load

Anchor channel			**40/22P**	**50/30P**
Tension load	N_{Ek}	[kN]	11.5	15.5
Short time displacement	δ_{N0}	[mm]	0.4	0.5
Long time displacement	$\delta_{N\infty}$	[mm]	0.8	1.0

HALFEN Anchor Channel HTA 40/22P and HTA 50/30P

Performances
Characteristic resistances under tension load – concrete failure and displacements

Annex C3

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Table C6: Characteristic resistances under shear load

Anchor channel				**40/22P**	**50/30P**
Steel failure, anchor					
Characteristic resistance		$V_{Rk,s,a}$	[kN]	31	56
Partial safety factor		γ_{Ms} [1]		1.5	
Steel failure, connection channel/anchor					
Characteristic resistance		$V_{Rk,s,c}$	[kN]	29	39
Partial safety factor		$\gamma_{Ms,ca}$ [1]		1.8	
Steel failure, local flexure of channel lips					
Spacing of channel bolts for $V_{Rk,s,l}$		$s_{l,V}$	[mm]	79	98
Characteristic resistance		$V^0_{Rk,s,l}$	[kN]	35	40.3
Partial safety factor		$\gamma_{Ms,l}$ [1]		1.8	
Pry-out failure					
Product factor		k_8 [2]		2.0	
Partial safety factor		γ_{Mc} [1]		1.5	
Concrete edge failure					
Product factor k_{12}	cracked concrete	$k_{cr,V}$		7.5	7.5
	uncracked concrete	$k_{ucr,V}$		10.5	10.5
Partial safety factor		γ_{Mc} [1]		1.5	

[1] In absence of other national regulations

[2] Without supplementary reinforcement. In case of supplementary reinforcement the factor k_8 should be multiplied with 0.75.

Table C7: Displacements under shear load

Anchor channel			**40/22P**	**50/30P**
Shear load	V_{Ek}	[kN]	11.5	15.5
Short time displacement	δ_{V0}	[mm]	0.6	0.6
Long time displacement	$\delta_{V\infty}$	[mm]	0.9	0.9

Table C8: Charact. resistances under shear load - steel failure of HALFEN channel bolts

Channel bolts Ø				**M10**	**M12**	**M16**	**M20**
Steel failure							
Characteristic resistance	$V_{Rk,s}$ [2]	[kN]	4.6	13.9	20.2	37.7	58.8
			8.8	23.2	33.7	62.8	98.0
			50 [1]	17.4	25.3	47.1	73.5
			70 [1]	24.4	35.4	65.9	102.9
Characteristic flexure resistance	$M^0_{Rk,s}$	[Nm]	4.6	29.9	52.4	133.2	259.6
			8.8	59.8	104.8	266.4	519.3
			50 [1]	37.4	65.5	166.5	324.5
			70 [1]	52.3	91.7	233.1	454.4
Partial safety factor	γ_{Ms} [3]		4.6	1.67			
			8.8	1.25			
			50 [1]	2.38			
			70 [1]	1.56			

[1] Materials according Annex A2 and A3
[2] In conformity to DIN EN 898-1:1999
[3] In absence of other national regulations

HALFEN Anchor Channel HTA 40/22P and HTA 50/30P

Performances
Characteristic resistances under shear load – steel failure channel bolts

Annex C5

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Table C9: Characteristic resistances under combined tension and shear load

Anchor channel		**40/22P**	**50/30P**
Steel failure: Local failure by flexure of channel lips and failure by flexure of channel			
Product factor	k_{13}	2.0	1.0 [1)]
Steel failure: Failure of anchor and connection between anchor and channel			
Product factor	k_{14}	2.0	

[1)] k_{13} can be taken as 2.0 if $V_{Rd,s,l}$ is limited to $N_{Rd,s,l}$

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

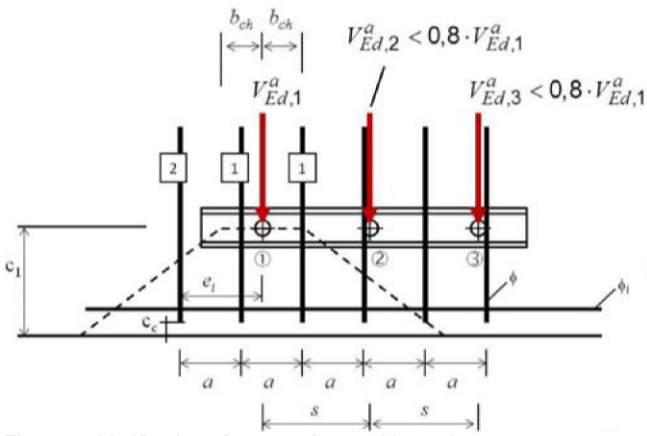

Fig. 1: Verification of most unfavourable anchor 1, $V^a_{Ed,2} < 0{,}8 \cdot V^a_{Ed,1}$. Crack formation independent of anchor spacing s.

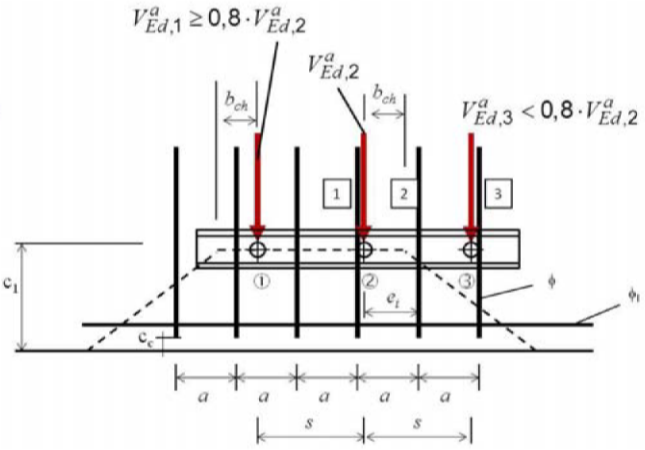

Fig. 2: Verification of most unfavourable anchor 2, $V^a_{Ed,1} \geq 0{,}8 \cdot V^a_{Ed,2}$ and $V^a_{Ed,3} < 0{,}8 \cdot V^a_{Ed,2}$ and $s < s_{cr,V}$.

Verifications according to EOTA TR 047, Tab. 7.2:

$$N^a_{Ed,re} \leq N_{Rd,re} \quad (1) \quad \text{and}$$
$$N^a_{Ed,re} \leq N_{Rd,a} \quad (2)$$

with $N^a_{Ed,re}$ according to EOTA TR 047, Eq. (6.6)

$$N_{Rd,re} = N_{Rk,re} / \gamma_{Ms} \quad (3)$$
$$N_{Rd,a} = N_{Rk,a} / \gamma_{Mc} \quad (4)$$

$N_{Rk,a}$ = characteristic tension resistance of the stirrups effective for the anchor to be verified for bond failure acc. to Equation (7)

$N_{Rk,re}$ = characteristic tension resistance of the stirrups effective for the anchor to be verified in case of steel failure acc. to Equation (5)

$$N_{Rk,re} = (m+n) \cdot A_s \cdot f_{yk} \quad (5)$$

$$V_{Rk,re,max} = k_{ch} \cdot V_{Rk,c} \quad (6)$$

k_{ch} = 2,50 if $h_{ch} > 17$mm
= 1,25 if $h_{ch} \leq 17$mm

$V_{Rk,c}$ according to EOTA TR047, Eq. 7.30

The characteristic resistance of the supplementary reinforcement for one anchor is:

$$N_{Rk,a} = \sum_{m+n} N_{Rk,a,i} \quad (7)$$

m = number of stirrups in the assumed concrete break-out body with $\psi_1 = 0{,}67$

n = number of stirrups in the assumed concrete break-out body with $\psi_1 = 0{,}11$

HALFEN Anchor Channel HTA 40/22P and HTA 50/30P	Annex C7
Performances Design method for reinforcement under shear loading	

The characteristic tension resistance $N_{Rk,a,i}$ of one stirrup is:

$$N_{Rk,a,i} = \psi_{cr} \cdot (N_{Rk,hook,i} + N_{Rk,bond,i}) \le A_{s,i} \cdot f_{yk} \quad (8)$$

with

$$N_{Rk,hook,i} = \psi_1 \cdot \psi_2 \cdot \psi_3 \cdot A_{s,i} \cdot f_{yk} \cdot (f_{ck}/25)^{0,1} \quad (9)$$

$$N_{Rk,bond,i} = \pi \cdot \phi \cdot l'_{1,i} \cdot f_{bk} \quad (10)$$

ψ_1 = 0.67, effectiveness factor for stirrups crossing the assumed break-out crack under an angle of 90° (stirrups 1 in Fig. 1 and Fig. 2) or stirrups inclined to the assumed break-out crack but closest to the anchor under consideration (stirrups 2 in Fig. 1 and Fig. 2)

= 0.11, effectiveness factor for stirrups other than considered for ψ_1 = 0,67 (stirrups 3 in Fig. 2)

ψ_2 = $\left(\frac{l_1}{c_1}\right)^{0,4} \cdot \left(\frac{10}{\phi}\right)^{0,25}$

ψ_3 = $(\phi_l / \phi)^{2/3} \le 1,15$

ψ_{cr} = 1,0 for fastening in uncracked concrete

= 0,7 to account for cracks along the longitudinal axis of the stirrups

ϕ = diameter of stirrups [mm]

ϕ_l = diameter of edge reinforcement [mm]

$l'_{1,i}$ = $l_{1,i}$ - 3 ϕ [mm]

$l_{1,i}$ = anchorage length of a stirrup i in the assumed break-out body [mm]

= $c_1 - c_c - 0.7 \cdot (e_i - b_{ch}) \ge 4\,\phi$, for stirrups crossing the assumed failure crack under an angle < 90°

= $c_1 - c_c \ge 4\,\phi$, for stirrups crossing the assumed failure crack under an angle of 90°

c_1 = edge distance [mm]

c_c = concrete cover of stirrups in direction to the edge (see Fig. 1 and 2) [mm]

e_i = distance of the stirrup leg from the anchor under consideration [mm]

b_{ch} = width of the anchor channel [mm]

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

f_{yk} = characteristic yield strength of the reinforcement [N/mm²]

f_{ck} = characteristic compressive cylinder strength of the concrete [N/mm²]

f_{bk} = characteristic bond strength = $\gamma_c \cdot f_{bd}$ [N/mm²]

f_{bd} = design bond strength according to EN 1992-1 [N/mm²]

a = spacing of stirrups [mm]

Reinforcement requirements

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

$$6\,mm \le \phi \le 16\,mm$$

- $\phi_l \ge \phi$
- every stirrup (m+n) with the same diameter

HALFEN Anchor Channel HTA 40/22P and HTA 50/30P	Annex C8
Performances Design method for reinforcement under shear loading	

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Table C10: Characteristic resistances under tension and shear load under fire exposure

Anchor channel				**40/22P**	**50/30P**
Channel bolts			≥ [mm]	M16	M16
Steel failure: Anchor, Connection channel/anchor, Local flexure of channel lips					
Characteristic resistance	R90	$N_{Rk,s,fi}$ = $V_{Rk,s,fi}$	[kN]	2.0	2.5
	R120			1.2	2.1
Partial safety factor		$\gamma_{Ms,fi}$ [3]	[-]	1.0	
Concrete cone failure					
Characteristic edge distance		$c_{cr,N,fi}$	[mm]	$2 \cdot h_{ef} \geq c_{cr,N}$	
		$c_{min,fi}$		$2 \cdot h_{ef}$ [1]; $\max(2 \cdot h_{ef}; 300\ mm)$ [2]	
Characteristic spacing		$s_{cr,N,fi}$	[mm]	$4 \cdot h_{ef} \geq s_{cr,N}$	
		$s_{min,fi}$		acc. to Table A5, Annex A5	
Axial spacing of reinforcement [4]					
Min. axial spacing	R90	a	[mm]	45	45
	R120	a		60	60

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

Fig. 1

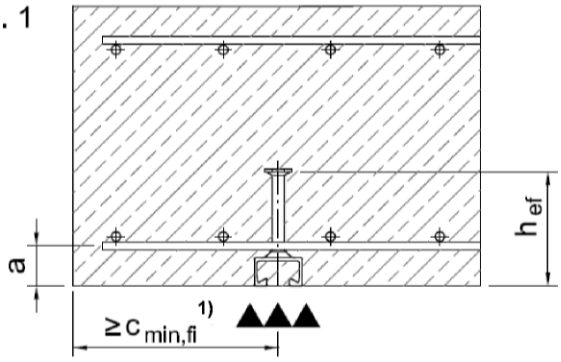

Fig. 2

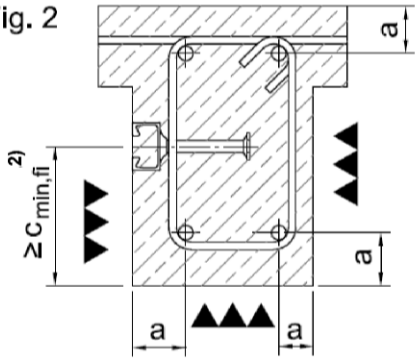

Table C11: Combinations of anchor channels and channel bolts under fatigue tension load

Anchor channel				Channel bolts			
Profile	Anchor	d_1 [mm]	Material	Channel bolt	Thread Ø [mm]	Grade	Material
40/22P	B6	10	Steel hot-dip galv.	HS 40/22	M12	8.8	Steel electroplated, hot-dip galv.
					M16	4.6	
						8.8	
50/30P	B6	12		HS 50/30	M16	4.6	
					M20	8.8	

Design method I

Table C12: Characteristic resistances under fatigue tension load after n load cycles without static preload (N_{Ed} = 0) - Steel failure

Anchor channel	Load cycles n	**40/22P**	**50/30P**
		$\Delta N_{Rk,s;0;n}$ [kN]	
Characteristic resistances under fatigue tension load without static preload	≤ 10^4	12.8	16.5
	≤ 10^5	7.7	9.8
	≤ 10^6	4.7	5.8
	≤ $2 \cdot 10^6$	4.0	4.9
	≤ $5 \cdot 10^6$	3.3	4.0
	≤ 10^8	1.7	

Table C13: Characteristic resistances under fatigue tension load after n load cycles without static preload (N_{Ed} = 0) - Concrete failure

Pullout failure:

Characteristic resistances without static preload (N_{Ed} = 0) in concrete C12/15

Anchor channel	Load cycles n	**40/22P**	**50/30P**
		$\Delta N_{Rk,p;0;n}$(C12/15) [kN]	
Characteristic resistances under fatigue tension load in cracked concrete without static preload $\Delta N_{Rk,p;0;n} = \Delta N_{Rk,p;0;n}(C12/15) \cdot \Psi_c$ [1)]	≤ 10^4	15.6	25.0
	≤ 10^5	14.1	22.6
	≤ 10^6	12.7	20.4
	≤ $2 \cdot 10^6$	12.3	19.8
	≤ $5 \cdot 10^6$	11.9	19.0
	≤ 10^8	10.6	17.0
Characteristic resistances under fatigue tension load in uncracked concrete without static preload	$\Delta N_{Rk,p;0;n}$	$\Delta N_{Rk,p;0;n}$(cracked concrete) · 1.4	

[1)] Consideration of different concrete strengths by increasing factor Ψ_c acc. Annex C3.

Concrete cone failure:

Reduction factor for concrete cone failure without static preload (N_{Ed} = 0)

	Load cycles n	$\eta_{c,fat}$ [-]
Reduction factor for $\Delta N_{Rk,c;0;n} = \eta_{c,fat} \cdot N_{Rk,c}$ [1)]	≤ 10^4	0.736
	≤ 10^5	0.665
	≤ 10^6	0.600
	≤ $2 \cdot 10^6$	0.582
	≤ $5 \cdot 10^6$	0.559
	≤ 10^8	0.500

[1)] $N_{Rk,c}$ static resistance according Annex C3 and EOTA TR 047 or EN 1992-4

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Design method II

Table C14: Characteristic limit resistances under fatigue tension load
Steel failure

Anchor channel	**40/22P**	**50/30P**
Characteristic resistances under fatigue tension load	$\Delta N_{Rk,s;0;\infty}$ [kN]	
	1.7	4.0

Table C15: Characteristic limit resistances under fatigue tension load
Concrete cone and pullout failure

Characteristic resistances under fatigue tension load	$\eta_{c,fat}$ [-]
$\Delta N_{Rk,c;0;\infty} = \eta_{c,fat} \cdot N_{Rk,c}$ [1)] $\Delta N_{Rk,p;0;\infty} = \eta_{c,fat} \cdot N_{Rk,p}$ [2)]	0.5

[1)] $N_{Rk,c}$ static resistance according Annex C3 and EOTA TR 047 or EN 1992-4
[2)] $N_{Rk,p}$ static resistance according Annex C3

In absence of other national regulations the following safety factors $\gamma_{M,fat}$ are recommended for design method I and II (Tables C12 to C15) according to EOTA TR 050:

$\gamma_{M,fat}$ = 1,35 (steel)
$\gamma_{M,fat}$ = 1,5 (concrete)