HALFEN HTA-CE CAST-IN CHANNELS
TECHNICAL PRODUCT INFORMATION

HALFEN CAST-IN CHANNELS

CONCRETE

HTA-CE 11-E

NEW!

European Technical Approval
ETA - 09/0339

HALFEN
YOUR BEST CONNECTIONS

European Technical Approval ETA

ETA - 09 / 0339
432-CPD-8394-01

In 2010 the European Technical Approval ETA- 09/0339 was granted by the Deutsches Institut für Bautechnik (DIBt) for the HALFEN HTA-CE Cast-in channel. This new approval is valid unrestrictedly in 30 states of Europe.
The dimensioning of the anchor channels that are governed in this ETA is carried out according to the new European standards series CEN/TS 1992-4 "Design of fastenings for use in concrete". This standards series summarises the current state of technology in the dimensioning of fastenings in concrete and takes into consideration the insights of research in the field of anchoring systems (→ see also pages 3 and 5).

Advantages of the HALFEN HTA-CE Cast-in channels

- It is possible to consider various concrete strength classes, geometric boundary conditions and any load combinations. As a result, the planner works in conformity with the approval in all application situations, this thereby increasing the legal certainty and reducing the risk of technical or legal discussion with building authorities, test engineers or consultants.

- The planning engineer has numerous options for influencing the result and can therefore work out the most effective solution economically and technically. Thus, for example, the load bearing capacity of the overall system can be positively influenced with different reinforcement models.

- A comprehensive and sophisticated test program is needed to achieve an ETA. Furthermore, all further approval criteria must be satisfied. Thus, planners and users can rest assured that the HALFEN HTA-CE Cast-in channels offer all assured properties. In addition, the properties of different products are comparable, as these are determined with a clearly defined and identical test program.

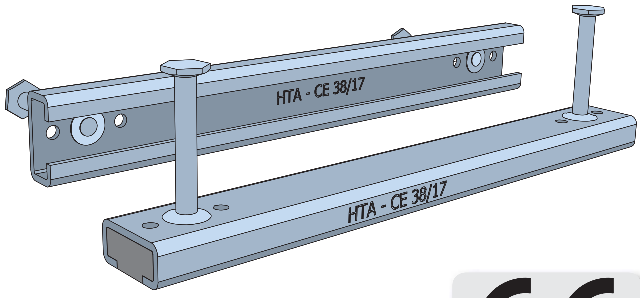
- If planners and users utilise HALFEN HTA-CE Cast-in channels compliant with the European Technical Approval, they therefore take into consideration the national construction regulations in 30 countries of the European Union. Moreover, the CE mark verifies that all criteria of the ETA are fulfilled. The anchor channels approved in this way may be used beyond national boundaries. Consequently, planners have maximum planning certainty for international projects. This also applies, in particular, for prefabricated concrete parts which are very frequently CE marked as complete components.

- As the ETA also makes detailed specifications on internal and external quality control of the current production, the user can rest assured that HALFEN HTA-CE Cast-in channels always correspond to the same high quality as the samples tested in the approval procedure.

European standard CEN/TS 1992-4

Optimised planning certainty for the entire European Union

- The new European standard CEN/TS 1992-4 was published in 2009 and governs the calculation method for “Design of fastenings for use in concrete”.
- This standards series therefore represents the state of the art and may be used.
- To be able to apply the new European calculation method, product specific values such as load bearing capacities or form coefficients are necessary. These and further special regulations for the dimensioning are the content of the ETA-09/0339 (European Technical Approval).
- This new calculation method is supported by a comprehensive and user-oriented and clear dimensioning software.
- The two parallel product series HALFEN HTA Cast-in channels according to the German Building Supervisory Approval as well as the HALFEN HTA-CE Cast-in channels according to the European Technical Approval guarantee the highest planning certainty, as the user can deliberately opt for one of the two dimensioning models. The relevant channels belonging to the dimensioning concept are then tendered, supplied and installed.



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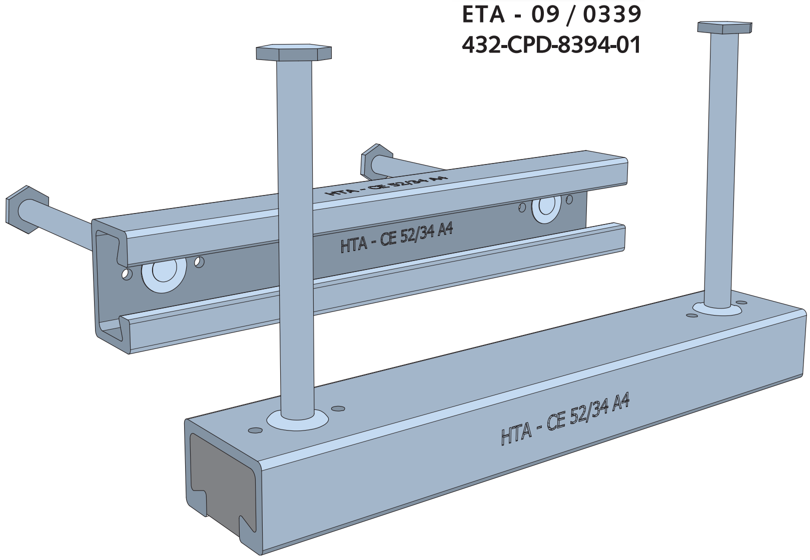


Background to CEN/TS 1992-4

A European CEN standard was created with the aim of standardising the dimensioning of fastenings in concrete on a common basis. Both cast-in fasteners such as anchor channels and headed fasteners as well as post-installed anchors are regulated in this standard.

The standards committee CEN/TC 250/ SC 2/WG 2 “Design of fastenings for use in concrete” was founded in 2000 with members from nine European nations. In 2009, the set of regulations was published as CEN/ TS 1992-4, “TS” standing for “Technical Specification”. This is a preliminary standard with the aim of transferring this to a European standard. With its publication, this preliminary standard represents the state of the art and may be used in practice. It consists of five parts: “General”, “Headed Fasteners”, “Anchor Channels”, “Post-Installed Fasteners – Mechanical Systems” and “Post-Installed Fasteners – Chemical Systems”.

European standard CEN/TS 1992-4

With the transfer to a standard, this technical specification will become part of the European Concrete Standard EN1992. Even today, the future way ahead is being paved with the publication of the ETA, the publication of all resources and documents as well as personal consultation.

CEN/TS 1992-4 may only be used if a technical specification is available for the fasteners, which confirms the suitability of the product and which contains the characteristic values necessary for dimensioning a fastening. In the case of building products, this document is represented by a European Technical Approval, in short ETA. This approval for the Halfen HTA-CE Cast-in channels is the ETA-09/0339.

The European Technical Approval is a verification of the usability of a building product as defined by the Construction Products Directive (CPD). The ETA is based on tests, inspections and a technical evaluation by bodies that have been appointed for this by the member states of the EU. It comprises all product characteristics which can be significant for compliance with statutory requirements in the member states, whereby the relevant requisite performance level can be different nationally and depending on the intended purpose.

The transmission of the loads applied locally into the channel must be verified. For this purpose, Part 3 of the CEN/TS 1992-4 provides a method for calculating the resultant anchor loads.

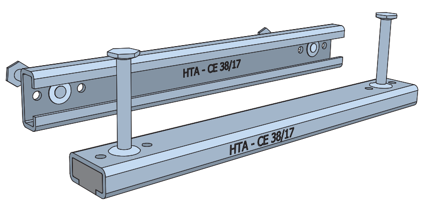
The resistances to steel failure are listed in the European Technical Approval. The load bearing capacities are provided with dimensioning equations. All influences on the load bearing capacity of the anchor channel are taken into consideration here. The HALFEN Cast-in channel may be used in all concrete strength classes from C12/15 to C90/105. The planned strength is incorporated in the verifications.

The flexible dimensioning concept allows for the development in reinforced concrete construction towards using ever lower component thicknesses with higher concrete strengths. The resistance to concrete failure is e.g. 55% higher in a concrete of strength class C50/60 than in one of strength class C20/25. It is therefore possible to compensate lower edge distances through a higher concrete strength.

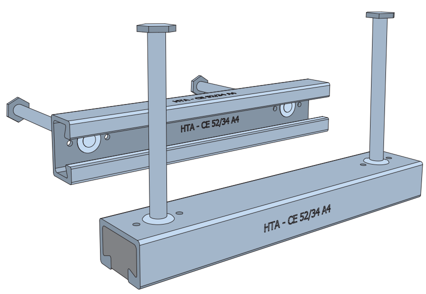
Identification

The HALFEN HTA-CE Cast-in channels receive the CE mark with the European Technical Approval. This enables the user to have "regulated" access to the European market. The CE mark is the external sign that a product corresponds to the requirements of the European Community imposed on the manufacturer. It may only be applied if a directive applies for the product which envisages the CE mark.
With the CE mark, HALFEN confirms that the specified method for verifying the conformity of the product with the approval has been carried out.

ETA - 09 / 0339
432-CPD-8394-01



Halfen HTA-CE Cast-In Channels
cold rolled



Halfen HTA-CE Cast-In Channels
hot rolled

Verification method according to CEN/TS 1992-4

The dimensioning method for anchor channels contained in Part 3 of the standards series has been completely newly developed. The verifications required there against splitting failure when loaded and blow-out failure are not necessary for the HTA-CE according to ETA-09/0339. The requisite verifications are shown in the following table:

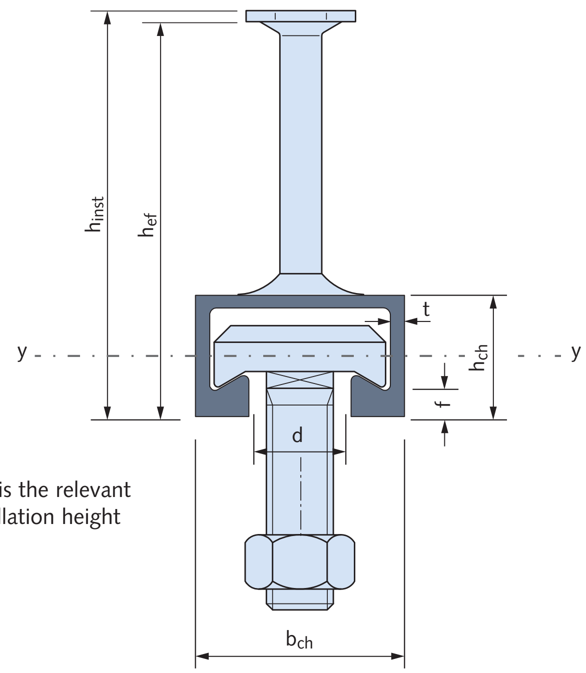
Verifications according to CEN/TS 1992-4

Tension loading			**Loading in shear**		
Failure type			Failure type		
Steel failure	Anchor	$N^a_{Ed} \leq N_{Rd,s,a}$	Steel failure	Anchor	$V^a_{Ed} \leq V_{Rd,s,a}$
	Connection between anchor and channel	$N^a_{Ed} \leq N_{Rd,s,c}$		Connection between anchor and channel	$V^a_{Ed} \leq V_{Rd,s,c}$
	Local flexure of channel lip	$N_{Ed} \leq N_{Rd,s,l}$		Local flexure of channel lip	$V_{Ed} \leq V_{Rd,s,l}$
	Bolt	$N_{Ed} \leq N_{Rd,s,s}$		Bolt	$V_{Ed} \leq V_{Rd,s,s}$
	Flexure of channel	$M_{Ed} \leq M_{Rd,s,flex}$	Pry-out failure		$V^a_{Ed} \leq V_{Rd,cp}$
Pull-out failure		$N^a_{Ed} \leq N_{Rd,p}$	Concrete edge failure		$V^a_{Ed} \leq V_{Rd,c}$
Concrete cone failure		$N^a_{Ed} \leq N_{Rd,c}$			

Here N_{Ed} and V_{Ed} stand for the tensile load or load in shear which act on the bolt, while N^a_{Ed} and V^a_{Ed} are the anchor loads resulting from the load on the channel. CEN/TS 1992-4 also governs the allowance for supplementary reinforcement. Other verifications must then be provided for this.

Detailed information on CEN/TS 1992-4, Part 1 and 3 and the requisite verifications for anchor channels can be found in the brochure “Dimensioning of Anchor Channels“ authored by the German VBBF association in collaboration with HALFEN. It is available for download free of charge from *www.halfen.de*.

Overview of HALFEN HTA-CE Cast-in channels

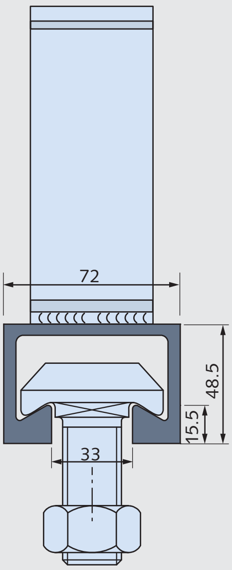
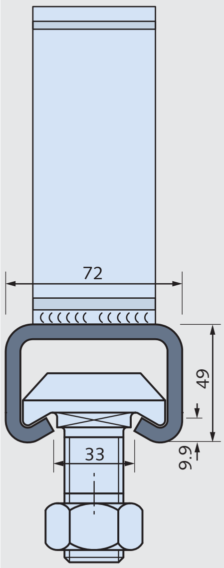
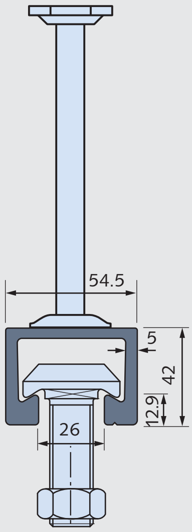
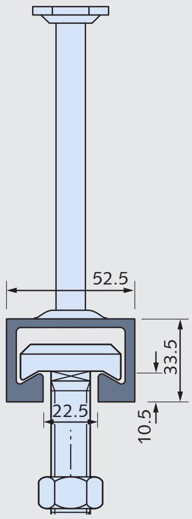
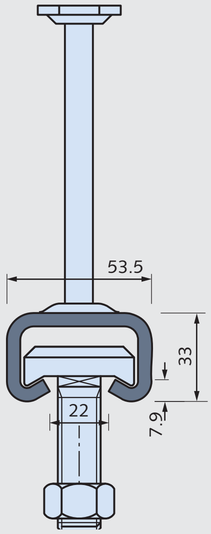


h_{inst} is the relevant installation height

Geometry of HALFEN HTA-CE Cast-in channels

HALFEN HTA-CE CAST-IN CHANNELS

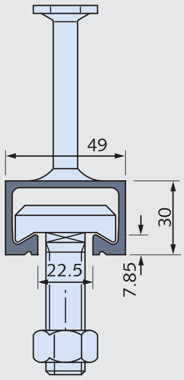
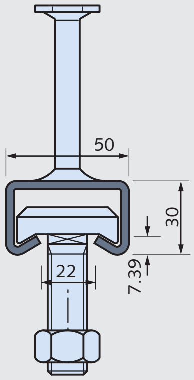
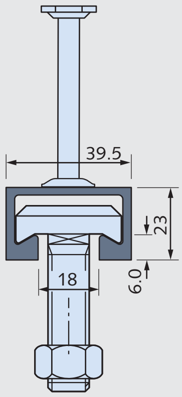
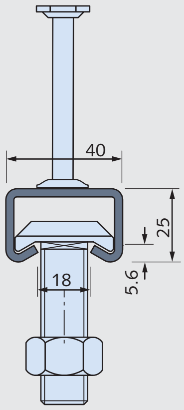
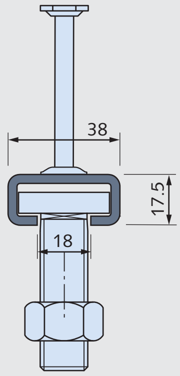
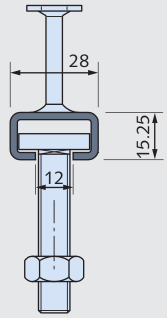
Overview of HALFEN HTA-CE Cast-in channels

Characteristic values of HTA-CE						
Profile		HTA-CE 72/48	HTA-CE 72/49	HTA-CE 55/42	HTA-CE 52/34	HTA-CE 54/33
		Hot rolled	Cold rolled	Hot rolled	Hot rolled	Cold rolled
Version						
Material	steel	■		■	■	■
	A4	■	■		■	■
	HCR					
Bolts		HS 72/48	HS 72/48	HS 50/30	HS 50/30	HS 50/30
Thread		M 20 - M 30	M 20 - M 30	M 10 - M 24	M 10 - M 20	M 10 - M 20
s_{slb} [mm]		129	129	109	88	88
Load bearing capacity of the profile						
$N_{Rd,s,l} = N_{Rd,s,c}$ [kN]		55.6	55.6	44.4	30.6	30.6
$V_{Rd,s,l}$ [kN]		72.2		57.8	39.7	
$M_{Rd,s,flex}$ [Nm]	steel	7472	-	5606	2933	2595
	NR	7630	7493	-	2996	2595
Geometry						
h_{inst} [mm]		(191)	(192)	182 (185)	161 (164)	161 (164)
b_{ch} [mm]		72	72	54.5	52.5	53.5
h_{ch} [mm]		48.5	49	42	33.5	33
I_y [mm⁴]	steel	349721	293579	187464	93262	72079
	NR					
h_{ef} [mm]		179	179	175	155	155
c_{min} [mm]		150	150	100	100	100

( ) Values in brackets with I – weld-on anchor

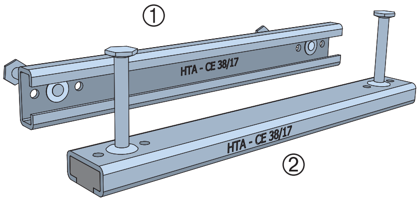
HALFEN HTA-CE CAST-IN CHANNELS

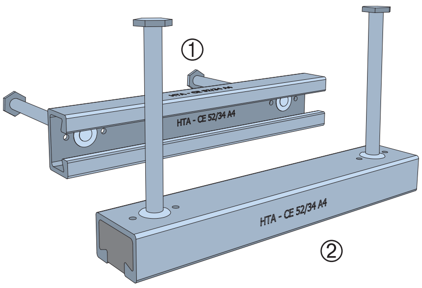
Overview of HALFEN HTA-CE Cast-in channels

	HTA-CE 50/30	HTA-CE 49/30	HTA-CE 40/22	HTA-CE 40/25	HTA-CE 38/17	HTA-CE 28/15
	Hot rolled	Cold rolled	Hot rolled	Cold rolled	Cold rolled	Cold rolled
						
	■	■	■	■	■	■
	■	■	■	■	■	■
		☒			☒	☒
	HS 50/30	HS 50/30	HS 40/22	HS 40/22	HS 38/17	HS 28/15
	M 10 - M 20	M 10 - M 20	M 10 - M 16	M 10 - M 16	M 10 - M 16	M 6 - M 12
	81	81	65	65	52	42
	17.2	17.2	11.1	11.1	10.0	5.0
	22.4		14.4			
	1772	1455	936	956	504	276
	1810	1485	939	931	516	282
	100 (161)	100 (161)	87 (87)	89 (89)	81 (82)	50 (79)
	49	50	39.5	40	38	28.0
	30	30	23	25	17.5	15.25
	51904	41827	19703	20570	8547	4060
			19759	19097		
	94	94	79	79	76	45
	75	75	50	50	50	40

Product range

Identification





Channel material	Type identification
1.0038 / 1.0044	HTA-CE 38/17
A4: 1.4401/1.4404/1.4571	HTA-CE 38/17 - A4
HCR: 1.4529 / 1.4547	HTA-CE 38/17 - HCR

Type identification:
① On profile back, inside.
② Additionally on profile side for all types with full-foam filling.

Supplied lengths and number of anchors

The standard product range of the HALFEN Cast-in channel with European Technical Approval is listed in the adjacent table. Other lengths and anchor numbers are available on request.

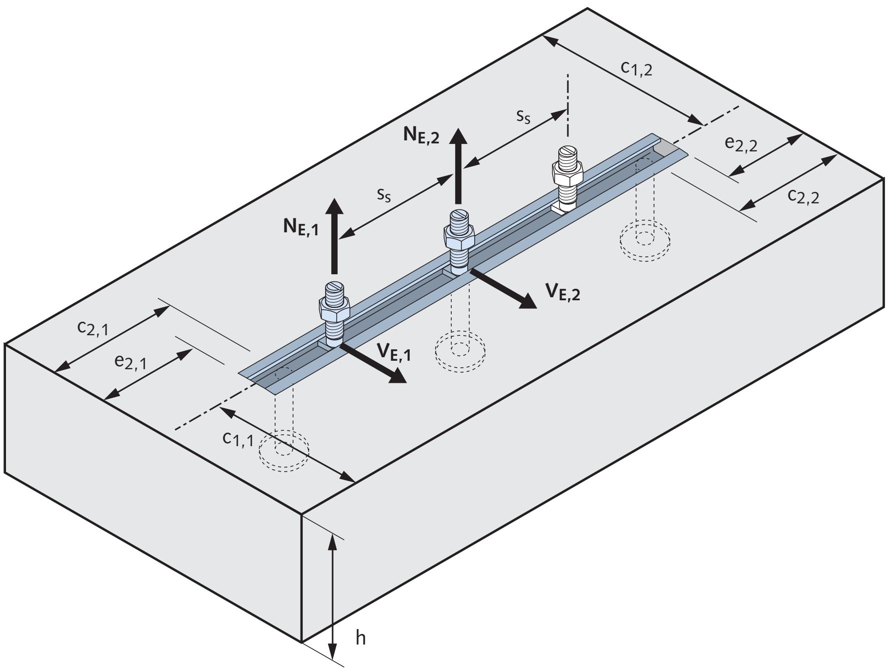
Standard product range					
Length [mm] / Number of anchors					
HTA-CE 72/48	HTA-CE 72/49	HTA-CE 55/42	HTA-CE 40/25, 50/30, 49/30, 52/34, 54/33	HTA-CE 40/22	HTA-CE 28/15, 38/17
150/2	150/2	150/2	150/2	150/2	100/2
200/2	200/2	200/2	200/2	200/2	150/2
250/2	250/2	250/2	250/2	250/2	200/2
300/2	300/2	300/2	300/2	300/2	250/2
350/2	350/2	350/2	350/3	350/3	300/3
450/3	450/3	450/3	400/3	400/3	350/3
650/3	650/3	650/3	550/3	550/3	450/3
950/4	950/4	950/4	800/4	800/4 ②	550/4
6070/21		6070/21	1050/5	1050/5	850/5
			3030/13 ①	1300/6 ②	1050/6
			6070/25	1550/7 ②	3030/16
				1800/8 ②	6070/31
				2050/9 ②	
				2300/10 ②	
				2550/11 ②	
				3030/13 ②	
				6070/25	
Anchor distance ≤ 300 mm			Anchor distance ≤ 250 mm		Anchor distance ≤ 200 mm

① does not apply for HTA-CE 52/34, HTA-CE 54/33
② does not apply for HTA-CE 40/22 - A4

Standard fixed lengths – Production order specific											
HTA-CE 28/15, HTA-CE 38/17 Length [mm] / Number of anchors				HTA-CE 40/22, 40/25, 49/30, 50/30, 52/34, 54/33 Length [mm] / Number of anchors				HTA-CE 55/42, HTA-CE 72/48 Length [mm] / Number of anchors			
1250/7	**1450**/8	**1650**/9	**1850**/10	**1050**/5	**1300**/6	**1550**/7	**1800**/8	**1250**/5	**1550**/6	**1850**/7	**2150**/8
2050/11	**2250**/12	**2450**/13	**2650**/14	**2050**/9	**2300**/10	**2550**/11	**2800**/12	**2450**/9	**2750**/10	**3030**/11	**3350**/12
2850/15	**3030**/16	**3250**/17	**3450**/18	**3030**/13	**3300**/14	**3550**/15	**3800**/16	**3650**/13	**3950**/14	**4250**/15	**4550**/16
3650/19	**3850**/20	**4050**/21	**4250**/22	**4050**/17	**4300**/18	**4550**/19	**4800**/20	**4850**/17	**5150**/18	**5450**/19	**5750**/20
4450/23	**4650**/24	**4850**/25	**5050**/26	**5050**/21	**5300**/22	**5550**/23	**5800**/24	-	-	-	-
5250/27	**5450**/28	**5650**/29	**5850**/30	-	-	-	-	-	-	-	-
Anchor spacing ≤ 200 mm				Anchor spacing ≤ 250 mm				Anchor spacing ≤ 300 mm			

Minimum edge distances and minimum bolt distances

Depending on the profile used and thread size of the associated HALFEN T-head bolt, definite minimum edge distances of the anchors to component edges must be complied with. The bolt distance s_s amongst one another may not be below the value $5 \cdot d_s$ according to the ETA.



Minimum edge and bolt distances

Edge and bolt distances [mm]				
HTA-CE profiles	M	$s_{s,min}$	c_{min}	e_{min}
28/15	6	30	40	15
	8	40	40	15
	10	50	50	25
	12	60	60	35
38/17	10	50	50	25
	12	60	60	35
	16	80	80	55
40/25 40/22	10	50	50	25
	12	60	60	35
	16	80	80	55
49/30 50/30	10	50	75	50
	12	60	75	50
	16	80	80	55
	20	100	100	75
54/33 52/34	10	50	100	65
	12	60	100	65
	16	80	100	65
	20	100	100	65
55/42	10	100	100	65
	12	60	100	65
	16	80	100	65
	20	100	100	65
	24	120	120	85
72/49 72/48	20	100	150	115
	24	120	150	115
	27	135	150	115
	30	150	150	115

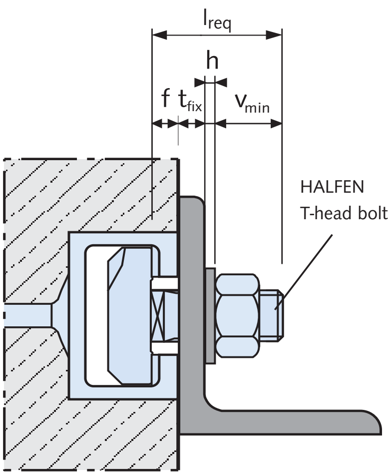
Bolt characteristic values

The dimensioning resistances of the HALFEN T-head bolts in the various thread sizes, materials and strength classes are shown below. $N_{Rd,s,s}$ is the resistance to tension loading, $V_{Rd,s,s}$ the resistance to loading in shear and $M^0_{Rd,s,s}$ the flexural resistance of the bolt at a load through a shear force with a lever arm.

Dimensioning resistances

Material		M 6	M 8	M 10	M 12	M 16	M 20	M 24	M 27	M 30
4.6	N_{Rd}	4.0	7.3	11.6	16.9	31.4	49.0	70.6	91.8	112.2
	V_{Rd}	2.9	5.3	8.3	12.1	22.6	35.2	50.7	66.0	80.6
	M_{Rd}	3.8	9.0	17.9	31.4	79.8	155.4	268.9	398.7	538.7
8.8	N_{Rd}	10.7	19.5	30.9	44.9	83.7	130.7	188.3	244.8	299.2
	V_{Rd}	6.4	11.7	18.6	27.0	50.2	78.4	113.0	146.9	179.5
	M_{Rd}	9.8	24.0	47.8	83.8	213.1	415.4	718.4	1065.2	1439.4
A4-50	N_{Rd}	3.5	6.4	10.1	14.8	27.4	42.8	61.7	80.2	98.1
	V_{Rd}	2.5	4.6	7.3	10.6	19.8	30.9	44.5	57.9	70.7
	M_{Rd}	3.2	7.9	15.7	27.5	70.0	136.3	235.8	349.7	472.5
A4-70	N_{Rd}	7.5	13.7	21.7	31.6	58.8	91.7	132.1	171.8	210.0
	V_{Rd}	5.4	9.9	15.6	22.7	42.2	66.0	95.1	123.6	151.0
	M_{Rd}	6.9	16.8	33.5	58.8	149.4	291.3	503.7	746.9	1009.2

Determination of the bolt length l_{erf} for HALFEN T-head bolts



l_{req} = Required bolt length

t_{fix} = Clamping thickness of add-on part

f = Profile lip height

h = Washer thickness

v_{min} = Nut height EN ISO 4032 + overhang approx. 5 (7 from M20) mm

$$l_{req} = t_{fix} + f + h + v_{min}$$

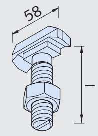
Dimensions V_{min}

Bolt diameter	v_{min} [mm]
M6	11.0
M8	12.5
M10	14.5
M12	17.0
M16	20.5
M20	26.0
M24	29.0
M27	31.5
M30	33.5

Dimensions of channel lip f

Channel profile	f [mm]
28/15	2.25
38/17	3.0
40/22	6.0
40/25	5.6 5.4
49/30	7.39
50/30	7.85
52/34	10.5
54/33	7.9
55/42	12.9
72/48	15.5
72/49	9.9

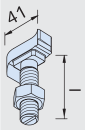
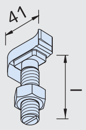
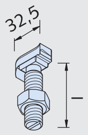
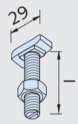
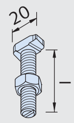
HALFEN T-head bolts

Suitable for profile	HTA-CE 72/48, 72/49			
Bolt	HS 72/48			
Bolt dimensions				
l [mm]	M 20	M 24	M 27	M 30
15				
20				
25				
30				
35				
40				
45				
50	FV4.6	A4-50 FV4.6		
55				
60				
65				
70				
72				
75	FV4.6 GVs8.8	FV4.6 FV8.8	FV4.6	FV4.6
80				
87				
100	FV4.6 GVs8.8	A4-50 FV4.6 GVs8.8	FV4.6 FV8.8	FV4.6
125				
150	FV4.6	FV4.6 GVs8.8		FV4.6
200	FV4.6	FV4.6		FV4.6
250		FV4.6		
300				

L = Left-hand thread, T = Partial thread

HALFEN HTA-CE CAST-IN CHANNELS

HALFEN HS T-head bolts

	HTA-CE 55/42	HTA-CE 55/42, 52/34, 54/33, 50/30, 49/30				HTA-CE 40/22, 40/25			HTA-CE 38/17			HTA-CE 28/15			
	HS 50/30	**HS 50/30**				**HS 40/22**			**HS 38/17**			**HS 28/15**			
															
	M 24	**M10**	**M 12**	**M 16**	**M 20**	**M 10**	**M 12**	**M 16**	**M 10**	**M 12**	**M 16**	**M 6**	**M 8**	**M 10**	**M12**
												GVs4.6	GVs4.6	GVs4.6	
						GVs4.6	GVs4.6		GVs4.6	GVs4.6	GVs4.6	GVs4.6	GVs4.6	A4-70 GVs4.6	
										A4-70	A4-50	GVs4.6	GVs4.6	A4-70 GVs4.6	
		FV4.6 GVs4.6	A4-50 GVs4.6	A4-50 GVs4.6		A4-70 GVs4.6	A4-50 FV4.6 GVs4.6	A4-50 GVs4.6	A4-70 FV4.6 GVs4.6	A4-70 FV4.6 GVs4.6	A4-50 FV4.6 GVs4.6	GVs4.6	A4-70 GVs4.6	HCR-50 A4-70 FV4.6 GVs4.6	GVs4.6
					GVs4.6										
		GVs4.6	A4-50 FV4.6 GVs4.6	A4-50 FV4.6 GVs4.6 GVs8.8		A4-70 GVs4.6	A4-50 GVs4.6 GVs8.8	A4-50 GVs4.6	A4-70 GVs4.6	HCR-50 A4-70 GVs4.6	A4-50 FV4.6 GVs4.6	GVs4.6	GVs4.6	A4-70 FV8.8 GVs4.6	
			GVs8.8		A4-50 GVs4.6 GVs8.8		GVs8.8								
		GVs4.6	A4-50 GVs4.6	HCR-50 A4-50 FV4.6 GVs4.6		A4-70 GVs4.6	A4-50 FV4.6 GVs4.6	A4-50 A4-50L FV4.6 GVs4.6	A4-70 GVs4.6	A4-70 A4-50L FV4.6 GVs4.6	A4-50 A4-50L FV4.6 GVs4.6	GVs4.6	GVs4.6	HCR-50 A4-70 A4-50L FV4.6 GVs4.6	GVs4.6
					A4-50 FV4.6 GVs4.6										
			GVs4.6 GVs8.8	A4-50 FV8.8 GVs4.6 GVs8.8	GVs8.8	GVs4.6	GVs4.6 GVs8.8	A4-50 GVs4.6 GVs8.8	A4-70 GVs4.6	HCR-50 A4-70 GVs4.6 GVs8.8	A4-50 FV8.8 GVs4.6 GVs8.8	GVs4.6	GVs4.6	A4-70 GVs4.6 GVs8.8	
					GVs4.6										
										FV8.8					
										A4-70T					
	FV4.6				A4-50 GVs4.6										
			GVs4.6 GVs8.8	HCR-50 A4-50 A4-50L GVs4.6 GVs8.8	GVs8.8	GVs4.6	A4-50 A4-50L GVs4.6 GVs8.8	A4-50 A4-50L GVs4.6 GVs8.8	GVs4.6	A4-70 A4-50L GVs4.6	A4-70 A4-50 A4-50L GVs4.6		GVs4.6	A4-70 GVs4.6	GVs4.6
			A4-70T	A4-70T											
			A4-50 GVs4.6	A4-50T FV4.6 GVs4.6 GVs8.8	A4-50 FV4.6 GVs4.6 GVs8.8	GVs4.6	A4-50 GVs4.6 GVs8.8	A4-50 FV4.6 GVs4.6	GVs4.6	A4-50 GVs4.6	A4-50 FV4.6 GVs4.6		GVs4.6	A4-50 GVs4.6	
			GVs4.6	GVs4.6	A4-50 GVs4.6		GVs4.6	GVs4.6		GVs4.6	GVs4.6			A4-50 GVs4.6	
			GVs4.6	A4-50 FV4.6 GVs4.6	A4-50 GVs4.6 GVs8.8		A4-50 GVs4.6	A4-50 GVs4.6	GVs4.6	A4-50 GVs4.6	A4-50 GVs4.6		GVs4.6	A4-50 GVs4.6	
			GVs4.6	GVs4.6	GVs4.6		GVs4.6	A4-50 GVs4.6		A4-50 GVs4.6	A4-50 GVs4.6			A4-50 GVs4.6	
								GVs4.6							
				GVs4.6	GVs4.6			GVs4.6							

HCR = High corroison resistance, A4 = stainless steel, FV = Hot dip galvanized, GVs = Zinc electro plated (with special coating)

General

The following information is necessary for verification of an anchor channel:

- Type of the HALFEN Cast-in channel and material
- Length of the HALFEN Cast-in channel with number and spacing of the anchors
- Location of the HALFEN Cast-in channel in the concrete member characterised by the edge distances downwards and upwards as well as to the left and right
- Thickness of the concrete component
- Strength class of the concrete
- Condition of the concrete, cracked or not cracked as a special case to be verified
- Presence of a dense reinforcement in the surroundings of the anchor channel
- Thread size of the HALFEN T-head bolt
- Arrangement of the bolts
- Tensile load and shear force of each bolt

Procedure of the verification method

1. Selection of the channel.
2. Verification of the local application (channel lips) for tension, shear and combined loading.
3. Determination of the anchor loads from tensile loads and shear forces according to the load influence model (unfavourable anchor and unfavourable load position).
4. Verification of the connection between anchor and channel (tension loading).
5. Verification against pull-out failure of the anchor (tension loading).
6. Verification against concrete cone failure (tension loading).
7. Verification against pry-out failure (loading in shear).
8. Verification against concrete edge failure (loading in shear) with consideration of a potential constructional edge reinforcement.
   → If verification cannot be provided, determination of the required supplementary reinforcement.
9. Verification for concrete failure at combined loading, combination of 6. and 7. as well as combination of 6. and 8.
   → If the last verification cannot be provided, determination of the required supplementary reinforcement.

TECHNICAL SUPPORT

HALFEN ICT

International CompetenceCenter Technology

Engineering services and technical advice for your individual assignment.
You can find the contact data for all HALFEN products on the rear of the catalogue.

Example

ETA - 09/0339

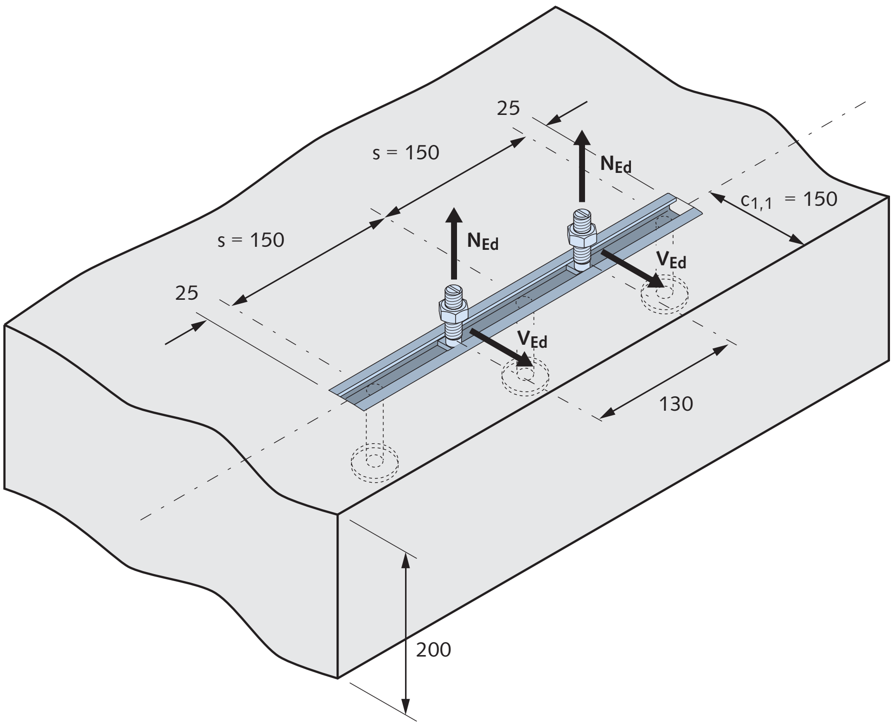
Given values from ETA - 09/0339						
Characteristic values			Safety coefficients			ETA Appendix
b_{ch}	=	50 mm				4
h_{ch}	=	30 mm				4
I_y	=	41827 mm^4				4
$N_{Rk,s,a}$	=	-	γ_{Ms}	=	-	11
$N_{Rk,s,c}$	=	31.0 kN	$\gamma_{Ms,ca}$	=	1.8	11
$N_{Rk,s,l}$	=	31.0 kN	$\gamma_{Ms,l}$	=	1.8	11
s_{slb}	=	81 mm				11
$M_{Rk,s,flex}$	=	1673 Nm	$\gamma_{Ms,flex}$	=	1.15	11
$N_{Rk,s,s}$	=	62.8 kN	γ_{Ms}	=	2.0	12
$N_{Rk,p}$	=	2,0 · 21,1 = 42,2 kN	γ_{Mc}	=	1.5	13
α_{ch}	=	0.91				13
h_{ef}	=	94 mm				13
$s_{cr,N}$	=	399 mm				13
$c_{cr,N}$	=	199 mm				13
$V_{Rk,s,l}$	=	31.0 kN	$\gamma_{Ms,l}$	=	1.8	14
k_5	=	2.0				14
α_p	=	3.0				14
$V_{Rk,s,s}$	=	37.7 kN	γ_{Ms}	=	1.67	15

Example Component

Profile HTA-CE 49/30, L = 350 mm,
3 anchors
End overhang: x = 25 mm
Anchor distance: s = 150 mm

2 bolts M16 4.6,
Bolt distance 130 mm
Influence per bolt
(dimensioning values)
N_{Ed} = 3.2 kN, V_{Ed} = 8.3 kN

Concrete C25/30, cracked
Component thickness h = 200 mm
Edge distance $c_{1,1}$ = 150 mm



Isometry example Component with HTA-CE 49/30

Verifications

The verifications of the bolts and the local load application are provided directly with the decisive tensile loads and shear forces of the bolts. If both loads are present simultaneously, the combined loading must also be verified.

Steel failure of the bolt

Tension loading:

$N_{Rk,s,s}$ = 62.8 kN, γ_{Ms} = 2.00, $N_{Rd,s,s}$ = 31.4 kN > 2.8 kN

$$\beta_N = \frac{2.8}{31.4} = 0.102$$

Loading in shear:

$V_{Rk,s,s}$ = 37.7 kN, γ_{Ms} = 1.67, $V_{Rd,s,s}$ = 22.6 kN > 11.1 kN

$$\beta_V = \frac{11.1}{22.6} = 0.491$$

Combined loading:

$$\beta_N^2 + \beta_V^2 = 0.089^2 + 0.491^2 = 0.249 < 1$$

Flexure of the channel lip

Tension loading:

Bolt distance: 150 mm > s_{slb} = 81 mm

The existing bolt distance does not require any reduction in the resistance.

$N_{Rk,s,l}$ = 31.0 kN, $\gamma_{Ms,l}$ = 1.8, $N_{Rd,s,l}$ = 17.2 kN > 2.8 kN

$$\beta_N = \frac{2.8}{17.2} = 0.163$$

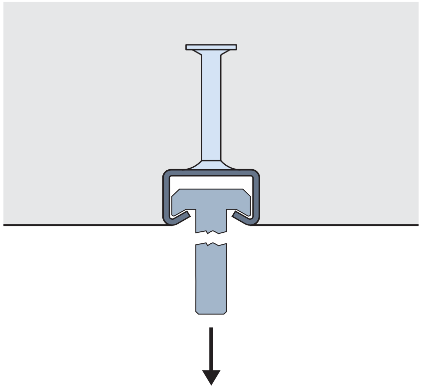
Loading in shear:

$V_{Rk,s,l}$ = 31.0 kN, $\gamma_{Ms,l}$ = 1.8 , $V_{Rd,s,l}$ = 17.2 kN > 11.1 kN

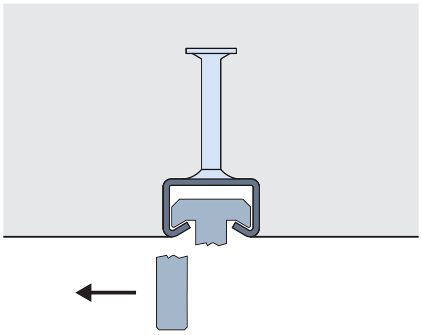
$$\beta_V = \frac{11.1}{17.2} = 0.645$$

Combined loading:

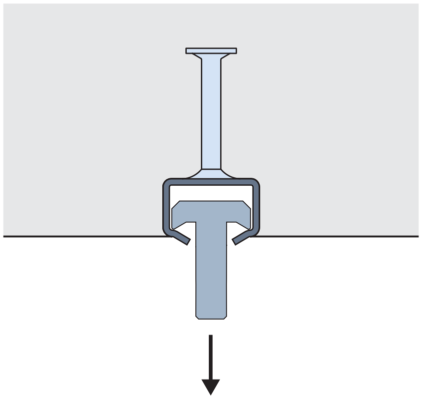
$$\beta_N^2 + \beta_V^2 = 0.163^2 + 0.645^2 = 0.443 < 1$$



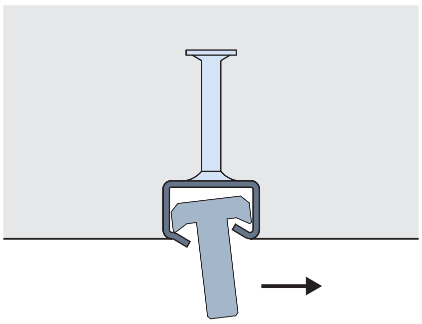
Steel failure of the bolt – tension loading



Steel failure of the bolt – loading in shear



Flexure of the channel lip – tension loading



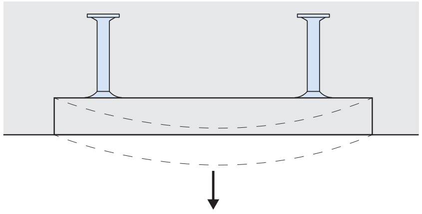
Flexure of the channel lip – tension in shear

Flexural loading of the anchor channel

The least favourable load position for the flexural loading occurs if a bolt is mounted centrally between two anchors. The bending moment is determined on a simply supported beam.

$$M_{Ed} = \frac{N_{Ed} \cdot s}{4} = \frac{2.8 \cdot 150}{4} = 105 \text{ Nm}$$

$M_{Rk,s,flex} = 1673$ Nm, $\gamma_{Ms,flex} = 1.15$, $M_{Rd,s,flex} = 1455 \text{ Nm} > 105 \text{ Nm}$



Flexural loading of the anchor channel

Load distribution

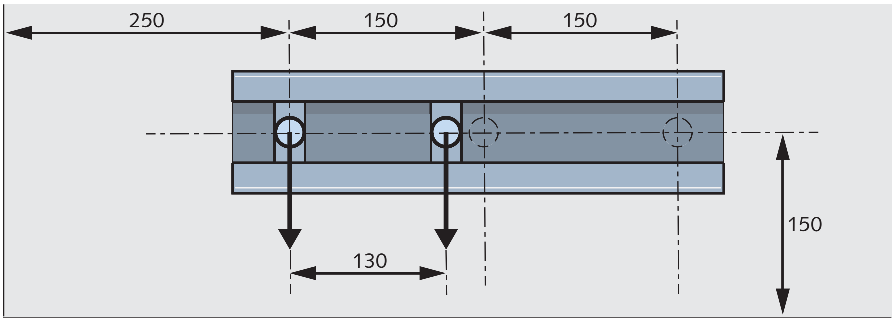
For verifications at the location of an anchor, the loads applied over the bolts to the channel profile must first be transmitted to the anchors.
The method is described in Part 3 of CEN/TS 1992-4 and is applicable for both tension loading and loading in shear. The load distribution depends on the rigidity of the channel profile and the distance of the anchors.

$$l_i = 13 \cdot I_y^{0.05} \cdot s^{0.5} = 13 \cdot 41827^{0.05} \cdot 150^{0.5} = 271 \text{ mm}$$

Two load positions are observed in order to consider the decisive load position in respect to the anchor and type of failure.

Load position 1

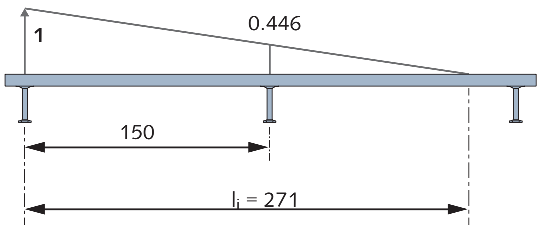
The first bolt is located directly over the first anchor, the second bolt is situated at a distance of 130 mm.
In relation to the start of the anchor channel, the positions of the bolts are at 25 mm and 155 mm.



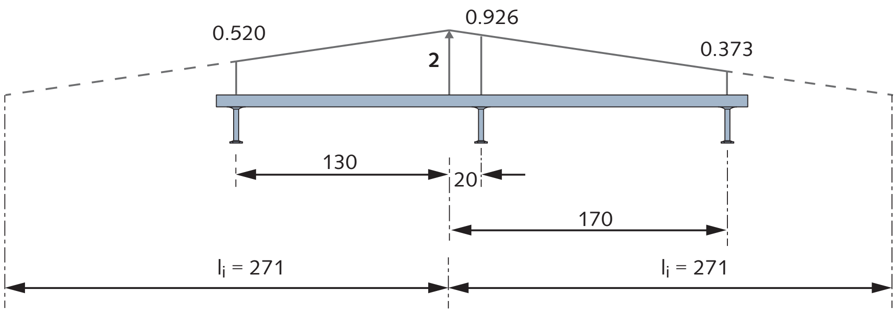
Load position 1

Load position 1				
		Anchor 1	Anchor 2	Anchor 3
1.1	Distance of the load at 25 mm to the anchor [mm]	0	150	300
1.2	$A'_i = 1 - s/l_i$	1	1 − 150/271 = 0.446	0
1.3	$k = 1/\Sigma A'_i$		$\frac{1}{1.00 + 0.446 + 0} = 0.691$	
1.4	$N^a_{Ed} = k \cdot A'_i \cdot N_{Ed}$	0.691 · 1 · 2.8 = 1,94	0.691 · 0.446 · 2.8 = 0.86	0
2.1	Distance of the load at 155 mm to the anchor [mm]	130	20	170
2.2	$A'_i = 1 - s/l_i$	1 − 130/271 = 0.520	1 − 20/271 = 0.926	1 − 170/271 = 0.373
2.3	$k = 1/\Sigma A'_i$		$\frac{1}{0.520 + 0.926 + 0.373} = 0.691$	
2.4	$N^a_{Ed} = k \times A'_i \cdot N_{Ed}$ [kN]	0.550 · 0.520 · 2.8 = 0.80	0.550 · 0.926 · 2.8 = 1.43	0.550 · 0.373 · 2.8 = 0.57
3	Resultant anchor load N^a_{Ed} (Line 1.4 + 2.4) [kN]	1.94 + 0.80 = **2.74**	0.86 + 1.43 = **2.29**	0 + 0.57 = **0.57**
	Analogous: Resultant anchor load V^a_{Ed} [kN]	**10.85**	**9.08**	**2.27**

Dimensioning example



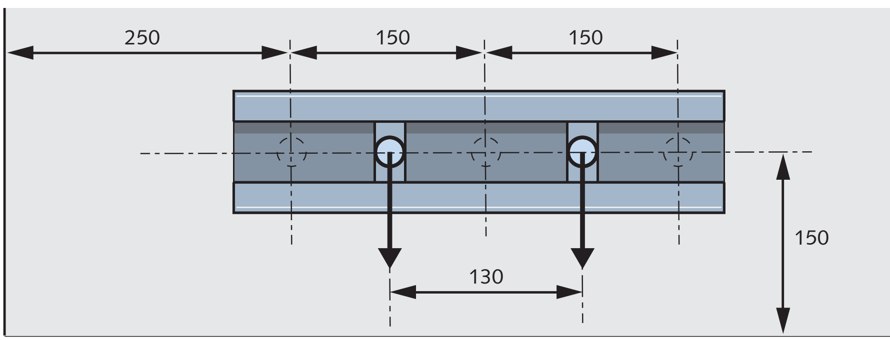
Determination of the anchor forces from bolt load 1



Determination of the anchor forces from bolt load 2

Load position 2

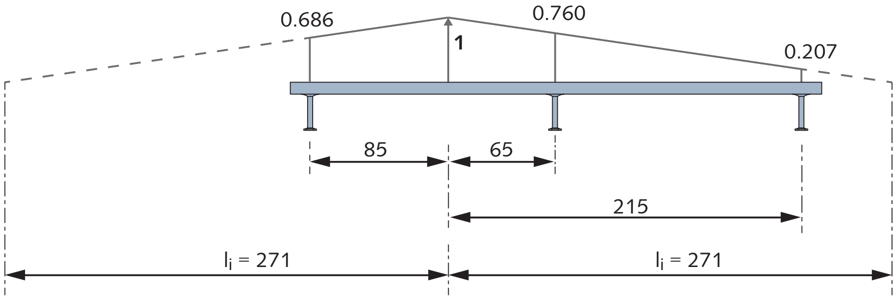
The bolts are arranged symmetrically to the central anchor. In relation to the start of the anchor channel, the positions of the bolts are at 110 mm and 240 mm.



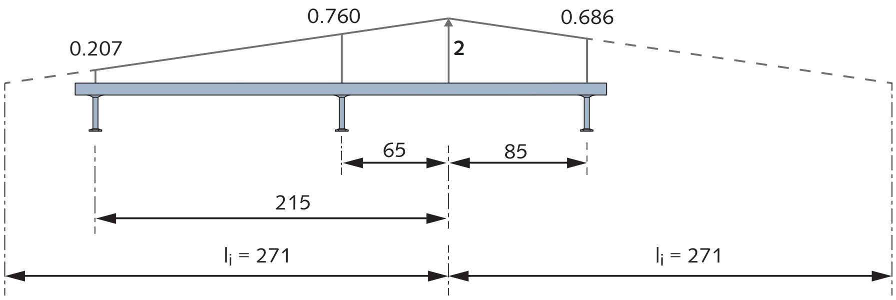
Load position 2

Load position 2				
		Anchor 1	Anchor 2	Anchor 3
1.1	Distance of the load at 110 mm to the anchor [mm]	85	65	215
1.2	$A'_i = (l_i - s)/l_i$	1 – 85/271 = 0.686	1 - 65/271 = 0.760	1 – 215/271 = 0.207
1.3	$k = 1/\Sigma A'_i$		$\frac{1}{0.686 + 0.760 + 0.207} = 0.691$	
1.4	$N^a_{Ed} = k \cdot A'_i \cdot N_{Ed}$	0.605 · 0.686 · 2.8 = 1.16	0.605 · 0.760 · 2.8 = 1.29	0.605 · 0.207 · 2.8 = 0.35
2.1	Distance of the load at 240 mm to the anchor [mm]	215	65	85
2.2	$A'_i = 1 - s/l_i$	1 – 215/271 =0.207	1 – 65/271 = 0.760	1 – 85/271 = 0.686
2.3	$k = 1/\Sigma A'_i$		$\frac{1}{0.207 + 0.760 + 0.686} = 0.605$	
2.4	$N^a_{Ed} = k \cdot A'_i \cdot N_{Ed}$ [kN]	0.605 · 0.207 · 2.8 = 0.35	0.605 · 0.760 · 2.8 = 1.29	0.605 · 0.686 · 2.8 = 1.16
3	Resultant anchor load N^a_{Ed} (Line 1.4 + 2.4) [kN]	1.16 + 0.35 = **1.51**	1.29 + 1.29 = **2.58**	0.35 + 1.16 = **1.51**
	Analogous: Resultant anchor load V^a_{Ed} [kN]	**6.00**	**10.20**	**6.00**

Dimensioning example



Determination of the anchor forces from bolt load 1



Determination of the anchor forces from bolt load 2

Verifications at the anchor – tension loading
Connection between anchor and channel

Anchor 1 at load position 1 is decisive here
$N_{Rk,s,c}$ = 31.0 kN, $\gamma_{Ms,c}$ = 1.8, $N_{Rd,s,c}$ = 17.2 kN > 2.74 kN

Tension loading steel failure of anchor not decisive
(ETA, Appendix 11)

Pull-out failure:
Anchor 1 at load position 1 is decisive here

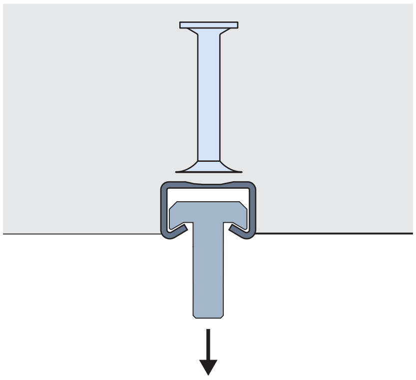
$N_{Rk,p}$ = 42.2 kN, γ_{Mc} = 1.5, $N_{Rd,p}$ = 28.1 kN > 2.74 kN

$$\beta_N = \frac{2.74}{28.1} = 0.098$$

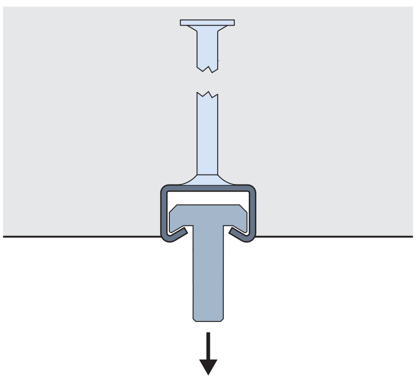
Concrete cone failure:
Anchor 2 at load position 2 is decisive here.
$N_{Rk,c} = N^0_{Rk,c} \cdot \alpha_{s,N} \cdot \alpha_{e,N} \cdot \alpha_{c,N} \cdot \psi_{re,N} \cdot \psi_{ucr,N}$

Basic value
Anchoring depth h_{ef} = 94 mm
Factor α_{ch} = 0.91

$$N^0_{Rk,c} = 8{,}5 \cdot \alpha_{ch} \cdot \sqrt{f_{ck,cube}} \cdot h_{ef}^{1,5} = 8{,}5 \cdot 0{,}91 \cdot \sqrt{30} \cdot 94^{1,5} = 38{,}6 \text{ kN}$$



Steel failure connection anchor – channel

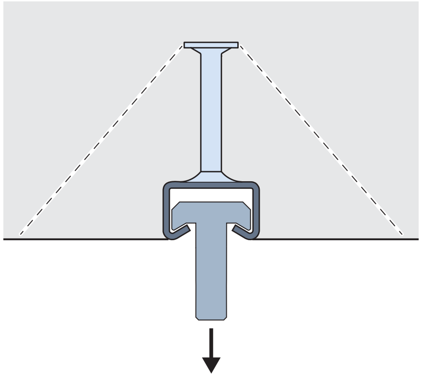


Steel failure of the anchor

Influence of adjoining anchors:
Characteristic axis distance
$s_{cr,N}$ = 399 mm

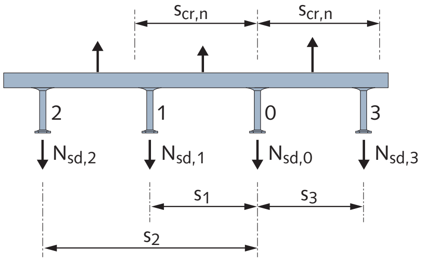
$$\alpha_{s,N} = \frac{1}{1 + \left(1 - \frac{s_1}{s_{cr,N}}\right)^{1,5} \cdot \frac{N^a_{Ed,1}}{N^a_{Ed,2}} + \left(1 - \frac{s_3}{s_{cr,N}}\right)^{1.5} \cdot \frac{N^a_{Ed,3}}{N^a_{Ed,2}}}$$

$$= \frac{1}{1 + \left(1 - \frac{150}{399}\right)^{1.5} \cdot \frac{1,51}{2,58} + \left(1 - \frac{150}{399}\right)^{1.5} \cdot \frac{1,51}{2,58}} = 0.633$$



Cone failure

Influence of the concrete member edge:
Characteristic edge distance
$c_{cr,N}$ = 199 mm
Existing edge distance $c_{1,1}$ = 150 mm < $c_{cr,N}$, $c_{1,2} > c_{cr,N}$
$\alpha_{e,N} = (c_1/c_{cr,N})^{0.5} = (150/200)^{0.5} = 0.867 < 1$



Influence of adjoining anchors

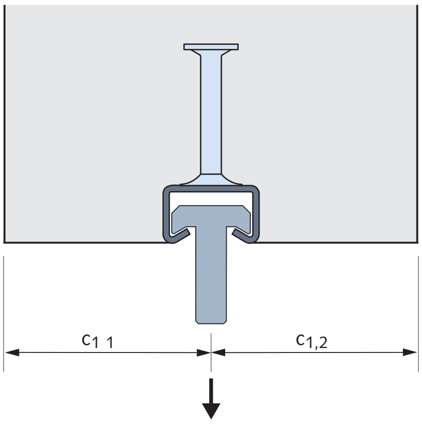
Influence of the concrete member corner:
Edge not present or edge distance $c_2 > c_{cr,N}$
$\alpha_{c,N}$ = 1.0

Influence of a dense reinforcement:
It is assumed that the axis distance of the reinforcement is greater than 150 mm.
There is therefore no dense reinforcement. $\psi_{re,N}$ = 1,0

Condition of the concrete:
The concrete is cracked. $\Psi_{ucr,N}$ = 1

$N_{Rk,c} = N^0_{Rk,c} \cdot \alpha_{s,N} \cdot \alpha_{e,N} \cdot \alpha_{c,N} \cdot \psi_{re,N} \cdot \psi_{ucr,N}$
$N_{Rk,c} = 38.6 \cdot 0.633 \cdot 0.867 \cdot 1.0 \cdot 1.0 \cdot 1.0$
$= 21.21$ kN, $\gamma_{Mc} = 1.5$, $\cdot N_{Rd,c} = 14.14$ kN > 2.58 kN

$$\beta_N = \frac{2.58}{14.14} = 0.182$$



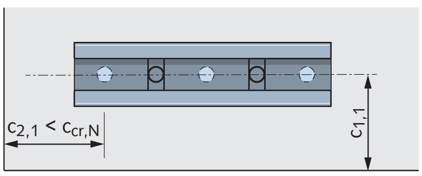
Influence of the concrete member edge

Splitting failure of the concrete:
The verification is not necessary according to ETA.

Blow-out failure:
The verification is not necessary according to ETA

Verifications at the anchor – tension loading
Pry-out failure:
Anchor 2 at load position 2 is decisive here.
$V_{Rk,cp} = k_5 \cdot N_{Rk,c}$
$k_5 = 2.0$
$V_{Rk,cp} = 2 \cdot 21.20 = 42.42$ kN, $\gamma_{Mc} = 1.5$, $V_{Rd,cp} = 28.28$ kN > 10.20 kN

$$\beta_V = \frac{10.20}{28.28} = 0.361$$



Influence of the concrete member corner

Dimensioning example

Loading in shear – concrete edge failure:
Anchor 2 at load position 2 is decisive here.

$V_{Rk,c} = V^0_{Rk,c} \cdot \psi_{re,V} \cdot \alpha_{s,V} \cdot \alpha_{c,V} \cdot \alpha_{h,V}$

Basic value
The concrete is cracked. The edge reinforcement involves a straight edge rod ≥ diam. 12 mm there being no special requirements for the brackets.
$\alpha_p \cdot \psi_{re,V} = 4.1$

$V^0_{Rk,c} \cdot \psi_{re,V} = \alpha_p \cdot \psi_{re,V} \cdot \sqrt{f_{ck,cube}} \cdot c_1^{1,5} = 4{,}1 \cdot \sqrt{30} \cdot 150^{1,5} = 41{,}62\ \text{kN}$

Influence of adjoining anchors:
Characteristic axis distance

$s_{cr,V} = 4 \cdot c_1 + 2 \cdot b_{ch} = 4 \cdot 150 + 2 \cdot 50 = 700\ \text{mm}$

$$\alpha_{s,V} = \frac{1}{1 + \left(1 - \frac{s_1}{s_{cr,V}}\right)^{1.5} \cdot \frac{V^a_{Ed,1}}{V^a_{Ed,2}} + \left(1 - \frac{s_3}{s_{cr,V}}\right)^{1.5} \cdot \frac{V^a_{Ed,3}}{V^a_{Ed,2}}}$$

$$= \frac{1}{1 + \left(1 - \frac{150}{700}\right)^{1.5} \cdot \frac{6.00}{10.20} + \left(1 - \frac{150}{700}\right)^{1.5} \cdot \frac{6.00}{10.20}} = 0.550$$

Influence of the component corner:
Characteristic edge distance
$c_{cr,V} = 2 \cdot c_{2,1} + b_{ch} = 2 \cdot 150 + 50 = 350\ \text{mm}$

Edge not present or edge distance $c_2 > c_{cr,V}$
$\alpha_{c,V} = 1.0$

Influence of the component thickness
Characteristic component thickness

$h_{cr,V} = 2 \cdot c_2 + 2 \cdot h_{ch} = 2 \cdot 150 + 2 \cdot 30 = 360\ \text{mm}$

Existing component thickness $h = 200\ \text{mm} < h_{cr,V}$

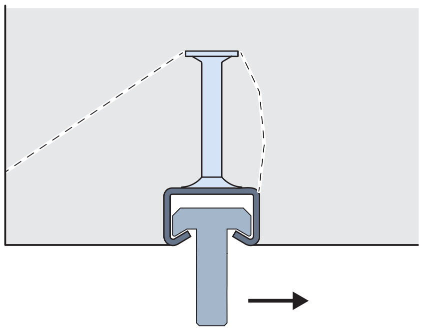
$\alpha_{h,V} = (h/h_{cr,V})^{2/3} = (200/360)^{2/3} = 0.676$

$V_{Rk,c} = V^0_{Rk,c} \cdot \psi_{re,V} \cdot \alpha_{s,V} \cdot \alpha_{c,V} \cdot \alpha_{h,V}$

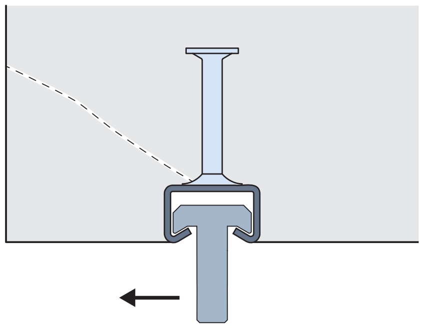
$V_{Rk,c} = 41.26 \cdot 0.550 \cdot 1.0 \cdot 0{,}676 = 15.33\ \text{kN},$

$\gamma_{Mc} = 1.5,\ V_{Rd,c} = 10.22\ \text{kN} > 10.21\ \text{kN}$

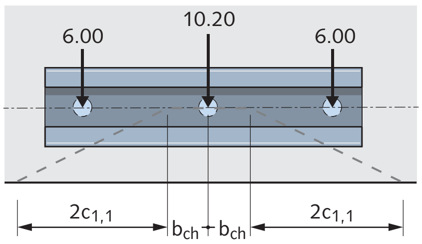
$$\beta_V = \frac{10.21}{10.22} = 0.999$$



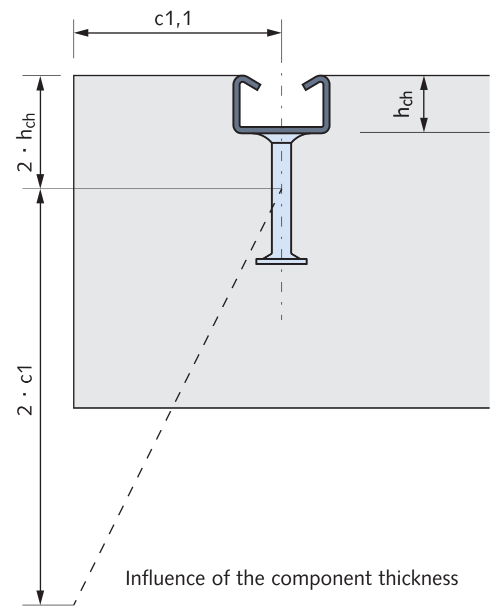
Loading in shear – pry-out failure



Loading in shear – concrete edge failure



Influence of adjoining anchors



Influence of the component thickness

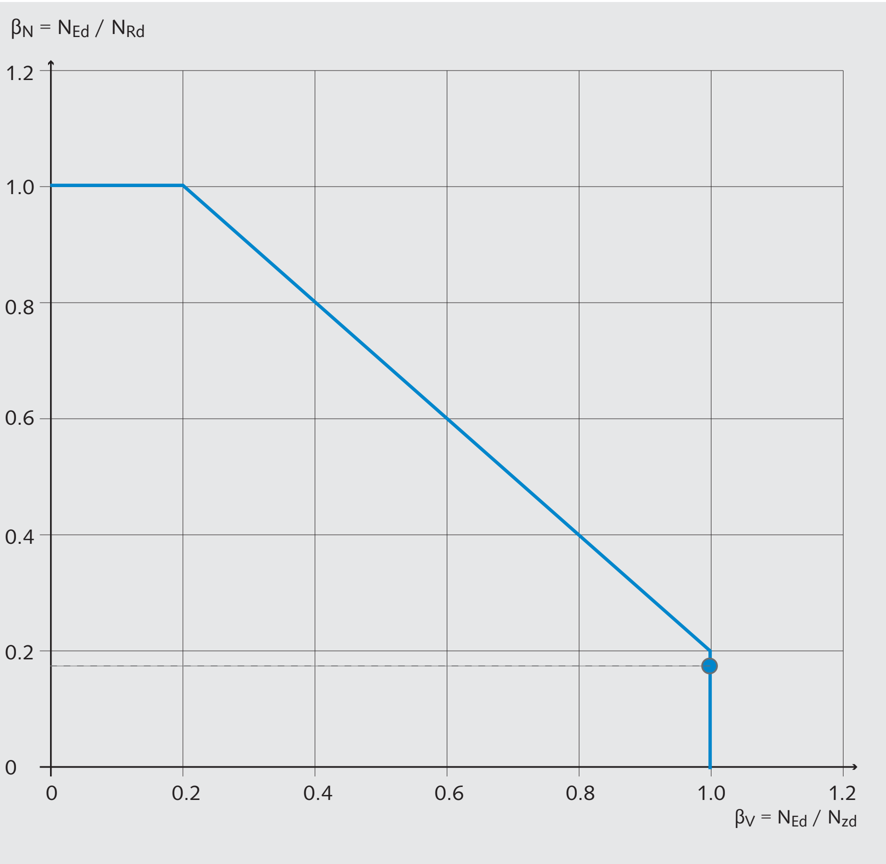
Dimensioning example

Combined loading:
Concrete failure (blow-out failure – concrete edge failure)

$\beta_N = 0.182$ $\beta_V = 0.999$

$$\frac{\beta_N + \beta_V}{1.2} = \frac{0.182 + 0.999}{1.2} = 0.984 < 1$$

Verifications provided.



Combined loading, concrete failure (blow-out failure - concrete edge failure)

Specification text

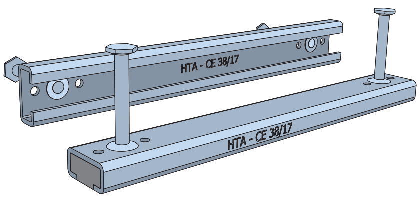
Halfen HTA-CE 49/30 Cast-In Channels

HALFEN HTA-CE 49/30 cast-in channel with smooth channel lips for the adjustable fixing of connecting constructions,

in accordance with the European Technical Approval ETA-09/0339, suitable for anchoring in reinforced or non-reinforced normal concrete of strength classes of minimum C12/15 and maximum C90/105 as per EN 206:2000-12, statically verified in accordance with CEN/TS 1992-4 Part 1 and 3,

Type HTA-CE 49/30 - FV - 350 – Vf
with
FV = corrosion protection hot-dip galvanised,
350 = length of the channel [mm],
Vf = foamfiller made from Haropor®,

or equivalent, supply and installation corresponding to the assembling instructions of the manufacturer.



ETA - 09 / 0339
432-CPD-8394-01

All tender specifications are available at the service area under *www.halfen.de*

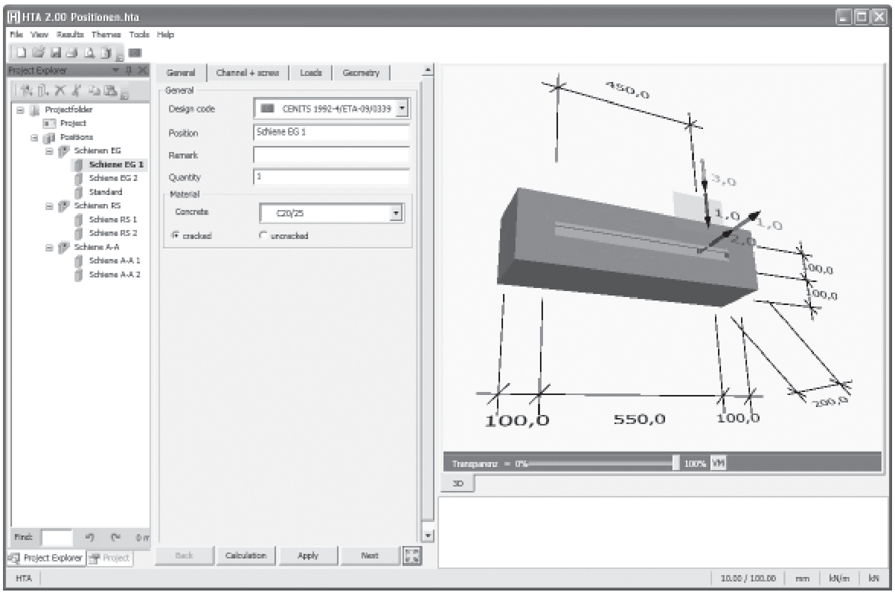
HALFEN Software HTA-CE

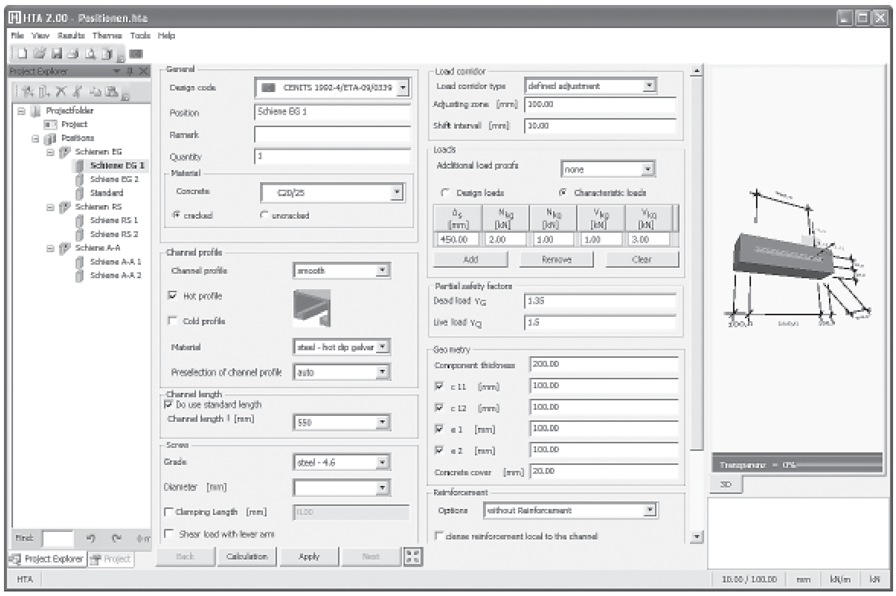
The new HALFEN dimensioning program for calculating HALFEN Cast-in channels with European Technical Approval (ETA) provides the user with a convenient and very powerful tool.
Although HALFEN Cast-in channels could previously be selected from tables according to their load bearing capacity, a wide variety of verifications for the channels and the concrete are now necessary in accordance with the ETA. These verifications are processed by the user-friendly HALFEN software, the potential HALFEN Cast-in channels for the relevant load situation being suggested to the user in just a few seconds.

The calculation takes into account all necessary boundary conditions, typical examples that can be cited being:

- Cracked or non-cracked concrete
- The concrete member geometry, in particular the distances of the channel to the component edge
- Diverse reinforcement guides
- Consideration of several dimensioning or characteristic loads
- The positioning of the loads with definable adjustment range, alternative to this shifting of the defined bolt pattern over the complete channel length
- Verification of the associated HALFEN T-head bolts, if necessary also for distance installation
- Engineering consideration of fatigue loads and fire influence.

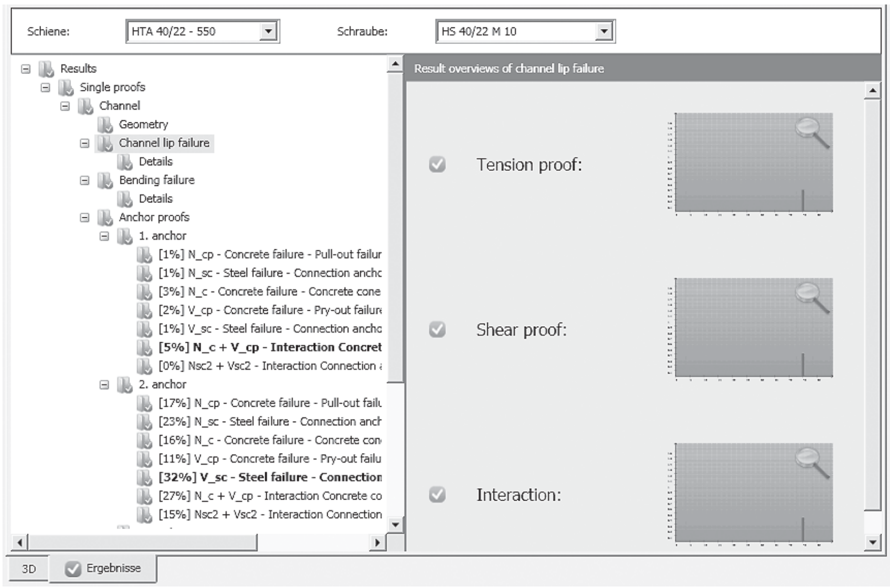
The geometry and loads are entered interactively. The entries made are visualised directly in a 3D graphic and can also be changed in the graphic itself. You only need to click on the load, the dimensioning or the component edge to make a corresponding modification.





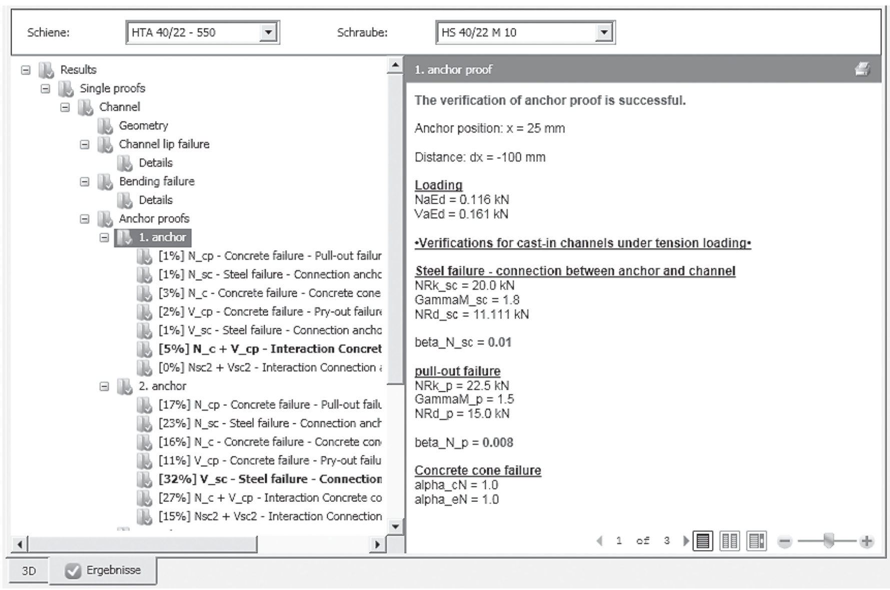
HALFEN Software HTA-CE

After the dimensioning, either only the results for a preselected profile are output, or – in the case of automatic selection – all potential profiles are listed in a list box. The profiles and bolts for which a complete verification could not be provided are marked red.



All verifications for the channel profile in question are listed in structured form as a tree layout. Green checkmarks represent successful verifications. Verifications that have not been successful are marked by red crosses.

Bar diagrams with utilisation factors for the loads or anchors are available on the right of the results overview for further visual control. Here too, red bars mean that a load has been exceeded while green bars symbolise fulfilled verifications.



Detailed information on the verifications (with load positions, section sizes and utilisation factors) can also be called up via the tree structure.

After choosing a HALFEN Cast-in channel and associated bolts, the dimensioning results can be imported into the data list and saved.

Printouts are possible in a brief and verifiable long version. The latter includes a 2D graphic of the geometry and load, all decisive verifications and a diagram of the reinforcement that may be necessary.

The latest version of the dimensioning program is available for downloading in the Internet at *www.halfen.de.*

System requirements:
- Windows XP, Vista, Windows 7
- Installed .NET Framework 3.5

CONTACT HALFEN WORLDWIDE

HALFEN is represented by subsidiaries in the following 14 countries, please contact us:

Austria	HALFEN Gesellschaft m.b.H. Leonard-Bernstein-Str. 10 1220 Wien	Phone: +43 - 1 - 259 6770 E-Mail: office@halfen.at Internet: www.halfen.at	Fax: +43 - 1 - 259 - 6770 99
Belgium/Luxembourg	HALFEN N.V. Borkelstraat 131 2900 Schoten	Phone: +32 - 3 - 658 07 20 E-Mail: info@halfen.be Internet: www.halfen.be	Fax: +32 - 3 - 658 15 33
China	HALFEN Construction Accessories Distribution Co.Ltd. Room 601 Tower D, Vantone Centre No.A6 Chao Yang Men Wai Street Chaoyang District Beijing · P.R. China 100020	Phone: +86 - 10 5907 3200 E-Mail: info@halfen.com Internet: www.halfen.cn	Fax: +86 - 10 5907 3218
Czech Republic	HALFEN-DEHA s.r.o. K Vypichu 986 · Komerčni zóna Rudná, hala 6 25219 Rudná	Phone: +420 - 311 - 690 060 E-Mail: info@halfen-deha.cz Internet: www.halfen-deha.cz	Fax: +420 - 311 - 671 416
France	HALFEN S.A.S. 18, rue Goubet 75019 Paris	Phone: +33 - 1 - 445231 00 E-Mail: halfen@halfen.fr Internet: www.halfen.fr	Fax: +33 - 1 - 445231 52
Germany	HALFEN Vertriebsgesellschaft mbH Katzbergstrasse 3 40764 Langenfeld	Phone: +49 - 2173 - 970 0 E-Mail: info@halfen.de Internet: www.halfen.de	Fax: +49 - 2173 - 970 225
Italy	HALFEN S.r.l. Soc. Unipersonale Via F.lli Bronzetti N° 28 24124 Bergamo	Phone: +39 - 035 - 0760711 E-Mail: info@halfen.it Internet: www.halfen.it	Fax: +39 - 035 - 0760799
Netherlands	HALFEN b.v. Oostermaat 3 7623 CS Borne	Phone: +31 - 742 - 6714 49 E-Mail: info@halfen.nl Internet: www.halfen.nl	Fax: +31 - 742 6726 59
Norway	HALFEN AS Postboks 2080 4095 Stavanger	Phone: +47 - 51 82 34 00 E-Mail: post@halfen.no Internet: www.halfen.no	Fax: +47 - 51 82 34 01
Poland	HALFEN Sp. z o.o. Ul. Obornicka 287 60-691 Poznan	Phone: +48 - 61 - 622 14 14 E-Mail: info@halfen.pl Internet: www.halfen.pl	Fax: +48 - 61 - 622 14 15
Spain	HALFEN S.L. c/ Fuente de la Mora 2, 2° D 28050 Madrid	Phone: +34 - 91 - 632 18 40 E-Mail: info@halfen.es Internet: www.halfen.es	Fax: +34 - 91 - 633 42 57
Sweden	Halfen AB Box 150 435 23 Mölnlycke	Phone: +46 - 31 - 98 58 00 E-Mail: info@halfen.se Internet: www.halfen.se	Fax: +46 - 31 - 98 58 01
Switzerland	HALFEN Swiss AG Hertistrasse 25 8304 Wallisellen	Phone: +41 - 44 - 849 78 78 E-Mail: mail@halfen.ch Internet: www.halfen.ch	Fax: +41 - 44 - 849 78 79
United Kingdom / Ireland	HALFEN Ltd. Humphrys Road · Woodside Estate Dunstable LU5 4TP	Phone: +44 - 1582 - 47 03 00 E-Mail: info@halfen.co.uk Internet: www.halfen.co.uk	Fax: +44 - 1582 - 47 03 04

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