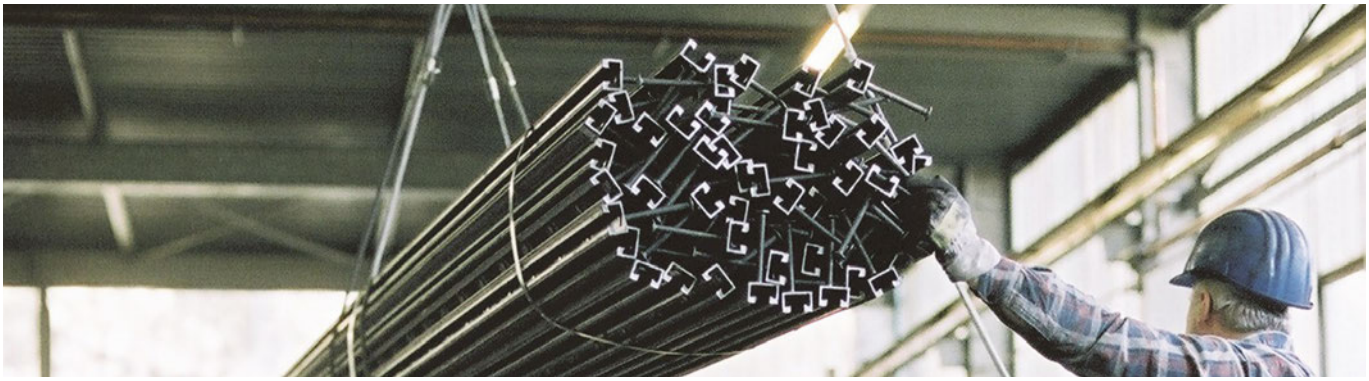
HALFEN

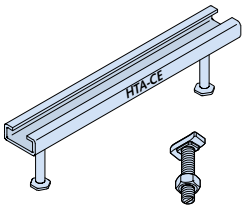
HALFEN CAST-IN CHANNELS
Technical Product Information

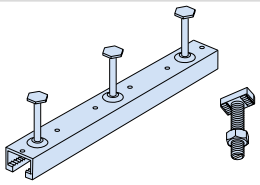
YOUR BEST CONNECTIONS

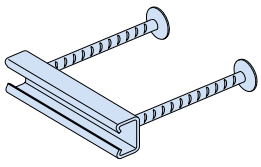
B 20-E

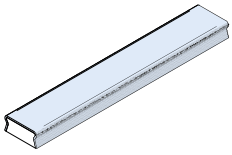


HALFEN CAST-IN CHANNELS
Content

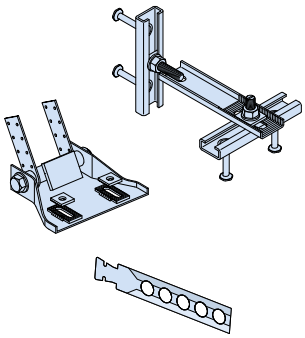


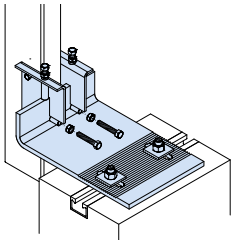


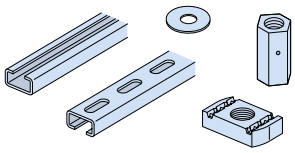




HALFEN CAST-IN CHANNELS
Content







BETTER SAFE THAN SORRY.
The right channel for every application.

Besides excellent adjustability HALFEN Cast-in channels save considerable installation time.
The result, faster construction and therefore cost saving.
HALFEN Cast-in channels are the ideal basis for easy to install, adjustable connections. A foam strip filler stops the ingress of concrete into the channel.

HALFEN Channels are suitable for various types of construction connections, for example; façades, precast concrete elements, stadium seating, in civil engineering (fixing of tunnel signals) lift guide-rails, crane runway, pipe fixings under bridges.
HALFEN Fixing systems – The intelligent alternative to drilling and welding.

HTA-CE Cast-in channels

Features
- adjustable
- hot-rolled profile; suitable for dynamic loads
- can be installed in concrete pressure and tensile-stress zones
- with European Technical Assessment

Application
- fixing of all types of building components

HZA Cast-in channels, serrated

Features
- adjustable
- load transmission in longitudinal channel direction
- can be installed in concrete pressure and tensile-stress zones
- suitable for dynamic loads (applies for all hot-rolled and serrated DYNAGRIP® channels)

Application
- fixing of all types of building components

HZA-PS Cast-in channels, Power Solution, serrated

Features
- as HZA Channels
- suitable for exceptional load cases caused by earthquake, plane crashes or explosions – for concrete crack widths up to 1.5 mm

Application
- fixing of all types of building components in safety critical areas of nuclear power stations and similar nuclear facilities

HGB Handrail connections

Features
- the special ribbed head anchor provides good load transfer in thin concrete elements

Application
- fastening railings on the thin front face of balcony slabs

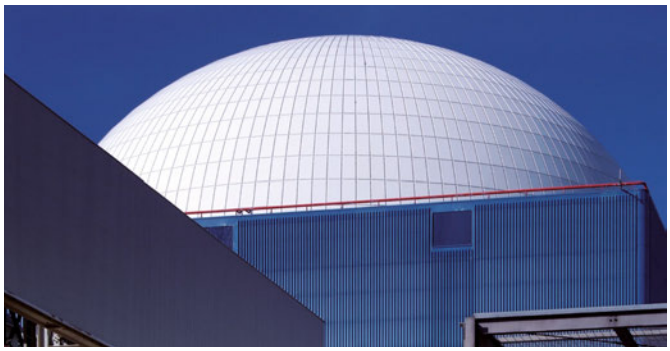
APPLICATION EXAMPLES HALFEN CAST-IN CHANNELS

Areas of Application

CURTAIN WALL

Edificio Gas Natural, Barcelona/Spain

POWER STATIONS

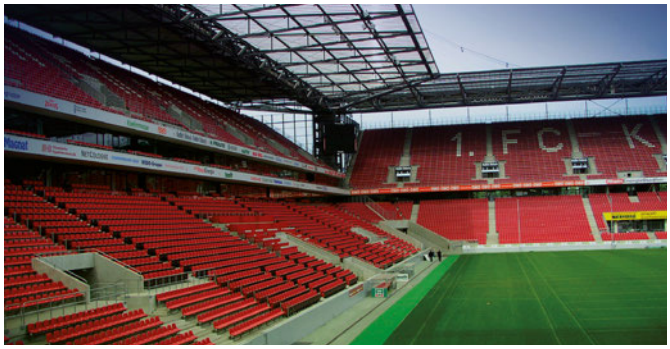


Power station

BRIDGES

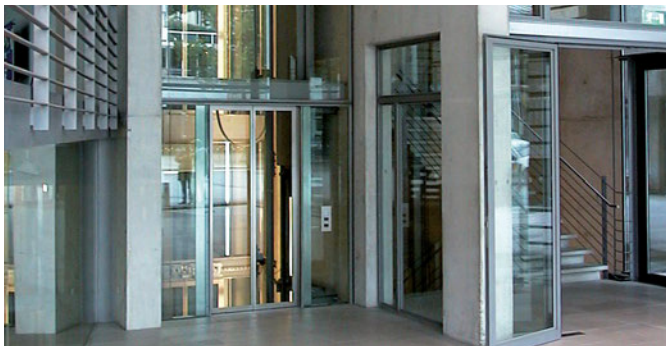
Passerelle Simone de Beauvoir, Paris/France

SPORTS



Rheinenergiestadion, Cologne/Germany

LIFTS AND ELEVATORS



Lift fixings, guide-rails

HTU TRAPEZOIDAL SHEET PANELS

UPS Air Hub, Cologne Bonn Airport, Germany

TUNNELS

Lötschberg-Base tunnel, Switzerland

ROOFS AND WALLS

Timber pitched-roof construction

HTA-CE CAST-IN CHANNELS
The advantages at a glance

Apart from excellent adjustability, HALFEN Cast-in channels save considerable installation time. The result; faster construction and therefore reduced overall cost.

HALFEN HTA-CE Cast-in channels, cold-rolled

HALFEN HTA-CE Cast-in channels, hot-rolled

Safe and reliable
- no damage to the reinforcement
- approved for fire-resistant structural elements
- suitable for use in concrete pressure and tensile stress zones
- high corrosion resistance steels available
- hot-rolled profiles suitable for dynamic loads
- European Technical Assessment (ETA)
- precise calculation with HALFEN Software

Quick and economical
- adjustable anchoring
- bolts instead of welding
- maximum efficiency when installing matrices and rows
- cost effective installation using standard tools
- optimised pre-planning reduces construction time
- large range of types available for various requirements
- no noise, no vibration during installation

HALFEN CAST-IN CHANNELS HTA-C
General

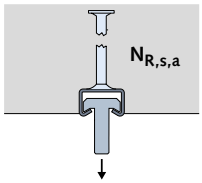
Verification method according to CEN/TS 1992-4 / EOTA TR 047 / EN 1992-4

Tension — **VERIFICATION** — **Shear**

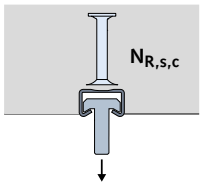
Tension

Steel

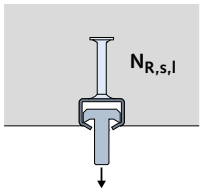
- Steel failure of the anchor



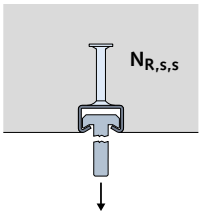
- Failure of channel-anchor connection



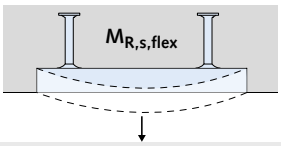
- Local flexure of the channel lip



- Steel failure special bolt

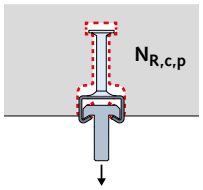


- Failure due to flexure of the channel

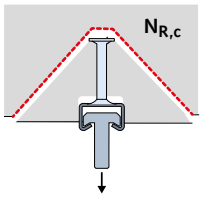


Concrete

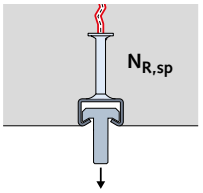
- Pull-out



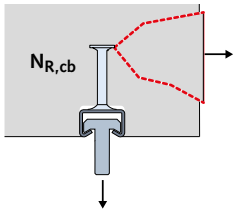
- Concrete cone failure



- Splitting



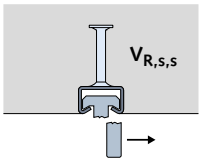
- Blow-out



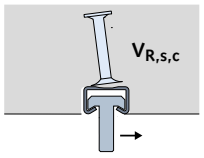
Shear

Steel

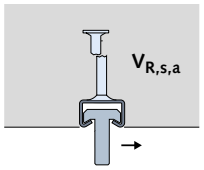
- Steel failure of the bolt



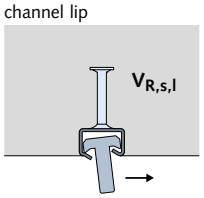
- Failure of channel-anchor connection



- Steel failure of the anchor

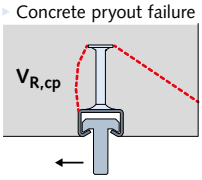


- Local flexure of the channel lip

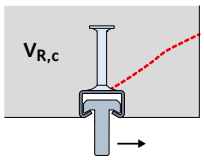


Concrete

- Concrete pryout failure



- Concrete edge failure



Additional verifications / tension
- Steel failure in the supplementary reinforcement
- Failure of the supplementary reinforcement in the breakout cone

Additional verifications / shear
- Special bolt for shear loads with cantilever
- Steel failure in the supplementary reinforcement
- Bond failure of reinforcement

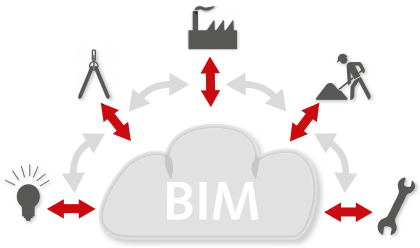
Decisive verifications for tension and shear

Superposition of tension and shear loadings

HALFEN HTA-CE CAST-IN CHANNELS
General

BIM

HALFEN already has considerable experience as a BIM partner and has successfully completed various projects using the BIM methodology. All HALFEN engineers are trained to properly supervise this process. With a combination of wide experience and highly-trained engineers the increasing demand for BIM projects can be efficiently met. Examples of previous projects developed using BIM can be found at **www.halfen.com ▻ Service ▻ BIM ▻ BIM references**.

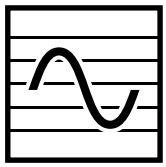


Sustainability

An EPD® (Environmental Product Declaration) provides transparent and comparable ecological data which helps to evaluate the sustainability of a building. Already during the planning phase the data provided here is of great significance for architects and planners. The data provided also helps to ensure the high demands on the environmental performance of the building are met.
Health Product Declarations (abbrev. =HPD) complement our information on sustainability. The HPDs include a list of all components and information on the health effects of these components.
The new HPD for hot-dip galvanized HALFEN Cast-in channels helps to achieve additional points in the Leed-v4-system.
www.halfen.com ▻ Brochures ▻ Product declarations.

Fire-resistance / Material fatigue

ETA-09/0339 contains characteristic values under fire stress according to TR 020 "Evaluation of anchorages in concrete with regard to fire resistance" as well as characteristic values for fatigue stress.



Approvals on the internet
Currently valid approvals can be found at:
www.halfen.com ▻ Brochures ▻ Approvals ▻ Fixing systems.
Or simply scan the code and select the required document.

Quality

Quality is the outstanding feature of our products. HALFEN materials and products are subjected to the most stringent quality control procedures.
A quality inspection by the DNV GL* has verified that our quality management system meets the requirements of the ISO 9001:2015 standard.

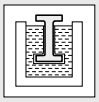
**merger of DNV (Det Norske Veritas) and GL (Germanischer Lloyd) in 2013*

QUALITY SYSTEM CERTIFICATION
DNV·GL
ISO 9001
www.dnvgl.com

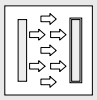
Certificate no. 202384-2016-AQ-GER-DAkkS

HALFEN HTA-CE CAST-IN CHANNELS
Materials/Corroision Protection

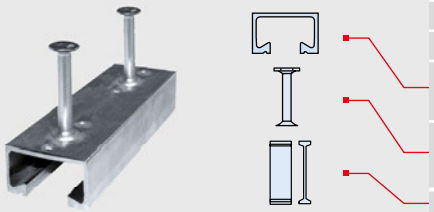
Hot-dip galvanized FV:
Dipped in a galvanizing bath, with a temperature of approx. 460 °C; this is a method used primarily for open-profile channels.



Zinc galvanized GVs:
HALFEN T-bolts are electrogalvanized and coated with a Cr(VI)-free thick layer passivation.



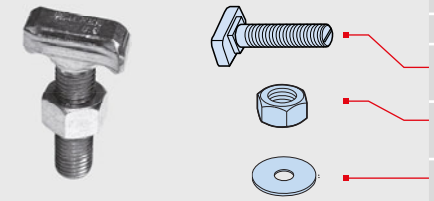
HALFEN Cast-in channels, steel, hot-dip galvanized



	Steel		
	Material	Standard	Zinc coat
Channel profile	1.0038 ☐	EN 10 025-2 ①	FV: ≥ 55 µm
	1.0044 ☐	EN 10 025-2 ①	FV: ≥ 55 µm
Bolt anchor B6	Steel ☐	EN 10263 or EN 10269	FV: ≥ 55 µm
Weld-on anchor	Steel ☐	EN 10 025-2	FV: ≥ 55 µm

① Steel according to EN 10 025-2 and HALFEN specification

HALFEN Bolts, galvanized steel



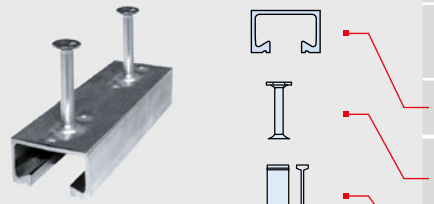
	Steel		
	Material	Standard	Zinc coat
Bolt	Steel (Sc) 4.6 or (Sc) 8.8 ☐ ☒	EN ISO 898-1	FV: ≥ 50 µm GVs: ≥ 12 µm
Hexagonal nut	Steel (Sc) 5 or (Sc) 8 ☐ ☒	EN 898-2	FV: ≥ 50 µm GVs: ≥ 12 µm
Washer	Steel ☐ ☒	EN ISO 7089, EN ISO 7093	FV: ≥ 50 µm GVs: ≥ 12 µm

(Sc) = Strength class

Stainless steel (NR):
Chromium is the most important alloy element in stainless steel. A specific chromium concentration ensures the generation of a passive layer on the surface of the steel that protects the base material against corrosion. This explains the high corrosion resistance of stainless steel.

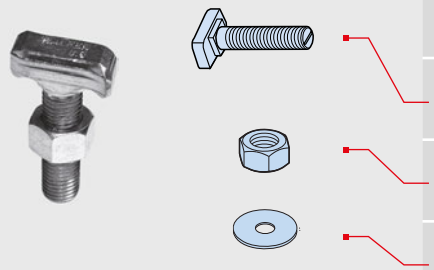
Materials:
- ☐ **WB** = Steel, mill finished
- ☐ **FV** = Steel, hot-dip galvanized
- ☒ **GVs** = Steel, zinc galvanized (with special coating)
- ☐ **A4** = Steel, stainless 1.4571 / 1.4404 / 1.4578
- ☒ **HCR** = Steel, stainless 1.4547 / 1.4529

HALFEN Cast-in channels, stainless steel



	Stainless steel		
	Material	Standard	Corrosion resistance class ②
Channel profile	1.4404 or 1.4571 ☐	EN 10 088	III
	1.4529 or 1.4547 ☒		V
Bolt anchor B6	1.4404, 1.4571 or 1.4578 ☐	EN 10 088	III
	1.4529 or 1.4547 ☒		V
Weld-on anchor	1.4404 or 1.4571 ☐	EN 10 088	III
	Steel ③ ☐	EN 10 025-2	

HALFEN Bolts, stainless steel



	Stainless steel		
	Material	Standard	Corrosion resistance class ②
Bolt	1.4404, 1.4571, 1.4578 (A4-50 or A4-70) ☐	EN 3506-1 and EN 10 088	III
	1.4529, HCR-50 ☒	EN 3506-1	V
Hexagonal nut	1.4404, 1.4571, 1.4578 (A4-50, A4-70) ☐	EN 3506-2 and EN 10 088	III
	1.4529, HCR-50 ☒		V
Washer	1.4404, 1.4571 ☐	EN 10 088	III
	1.4529 or 1.4547 ☒		V

② See EN 1993-1-4, table A.3 ③ Corrosion protection of mill finished anchor, see page 10

HALFEN HTA-CE CAST-IN CHANNELS
Materials/Corroision Protection

Corrosion protection requirements

Material and applications

Description	1 **Dry interior rooms**	2 **Damp interior rooms**	3 **Medium corrosion level**	4 **High level of corrosion**
Definition of application areas	Anchor channels may only be used in components in indoor environments. **For example:** living and office spaces, schools, hospitals, commercial shops with the exception of wet rooms as in column **2**.	Anchor channels may also be used in components in areas with normal humidity **For example:** kitchens, bathrooms and laundry-rooms in residential buildings. Exceptions; where permanent steam is present, and under water.	Anchor channels may also be used in outdoor environments (including industrial environments and coastal regions) or in wet rooms, if conditions are not especially aggressive (for example: continual immersion in sea water etc. as in column **4**).	Anchor channels may also be used in exceptionally aggressive environments (for example: continual immersion in sea water) or in seawater spray zones, chloride environments in swimming pools or in environments with an extremely aggressive chemical atmosphere (for example: flue gas desulphurization plants or road tunnels where de-icer systems are in use).
Channel profile	Steel 1.0038, 1.0044; EN 10025 Hot-dip galvanized ≥ 55. m ⑥	Steel 1.0038, 1.0044; EN 10025 Hot-dip galvanized ≥ 55µm ⑥ Stainless steel 1.4307, 1.4567, 1.4541; EN 10088	Stainless steel 1.4404, 1.4571, 1.4062, 1.4162, 1.4362 EN 10088	Stainless steel 1.4462 ②, 1.4529, 1.4547 EN 10088
Anchor	Steel 1.0038, 1.0214, 1.0401, 1.1132, 1.5525; EN 10263, EN 10269 Hot-dip galvanized 55µm ⑥	Steel 1.0038, 1.0214, 1.0401, 1.1132, 1.5525; EN 10263, EN 10269 Hot-dip galvanized ≥ 55µm ⑥ Stainless steel 1.4307, 1.4567, 1.4541; EN 10088	Stainless steel 1.4404, 1.4571, 1.4362, 1.4578 EN 10088 Mill finish, 1.0038 ③	
Special HALFEN Bolts with shaft and bolts in accordance with EN ISO 4018	Steel strength class 4.6/8.8 EN ISO 898-1 Zinc galvanized ≥ 5µm ④	Steel strength class 4.6 / 8.8; EN ISO 898-1, Hot-dip galvanized ≥ 50µm ① ⑤ Stainless steel, strength class 50, 70 1.4307, 1.4567, 1.4541 EN ISO 3506-1	Stainless steel Strength class 50, 70 1.4404, 1.4571, 1.4362, 1.4578 EN ISO 3506-1	Stainless steel Strength class 50, 70 1.4462 ②, 1.4529, 1.4547 EN ISO 3506-1
Washers EN ISO 7089 and EN ISO 7093-1 Product classification A, 200 HV	Steel EN 10025 Zinc galvanized ≥ 5µm ④	Steel EN 10025 Hot-dip galvanized ≥ 50µm 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
Hexagonal nut EN ISO 4032	Steel strength class 5/8 EN ISO 898-2 Zinc galvanized ≥ 5µm ④	Steel strength class 5/8 EN ISO 898-2 Hot-dip galvanized ≥ 50µm ① ⑤ Stainless steel, strength class 70, 80 Steel grade A2, A3 EN ISO 3506-2	Stainless steel Strength class 70, 80 Steel grade A4, A5 EN ISO 3506-2	Stainless steel Strength class 70, 80 1.4462 ②, 1.4529, 1.4547 EN ISO 3506-2

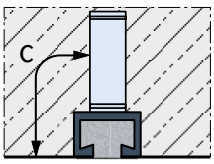
① or zinc galvanized with special coating ≥ 12 µm
② 1.4462 not suitable for swimming baths
③ Steel in accordance with EN 10025, 1.0038 not for anchor channels 28/15 and 38/17
④ Zinc galvanized in accordance with EN ISO 4042
⑤ Hot-dip galvanized in accordance with EN ISO 10684
⑥ Hot-dip galvanized in accordance with EN ISO 1461

HALFEN Channels (NR) ■
mill finish welded-on anchors □

Corrosion protection of the mill finished weld-on anchor is based on the following concrete cover c:

Profile HTA-CE	40/22P 40/25	52/34 54/33 50/30P 49/30	55/42	72/48 72/49
Concrete cover c [mm]	35	40	50	60

The minimum concrete cover depends on local environmental conditions and bid specifications.



Concrete cover c

HALFEN Channels (NR) ■
made completely in stainless steel

The HALFEN Cast-in channels "entirely of stainless steel" are not restricted to any minimum concrete cover as no relevant corrosion occurs.

Areas of application

- bridge and tunnel construction (fastening of pipes, etc.)
- construction of sewage treatment plants (fixing of spillovers)
- chemical industry (installations exposed to aggressive substances)
- ventilated façades, e. g. masonry renders
- also for all structural reinforced concrete elements with higher demands on the concrete cover

HALFEN Channels ☒
made in stainless steel – HCR

The high corrosion resistance (HCR) HALFEN Cast-in channels are mandatory when high concentrations of chlorides, sulphur and nitrogen oxides are present.

Areas of application

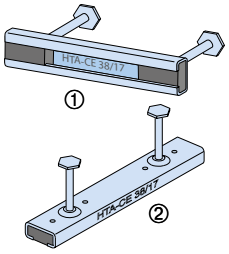
- road tunnels
- structures in salt water
- indoor swimming pools
- areas not routinely cleaned
- poorly ventilated parking garages
- in narrow, major city streets

1.1 Delivery and identification

HALFEN can supply ready to install short channels and standard lengths.

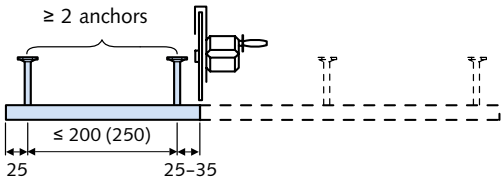
Product identification

① inside the channel
② also on the channel side



1.2 Installing to formwork

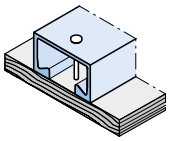
If required, HALFEN Cast-in channels can also be cut to size on site.

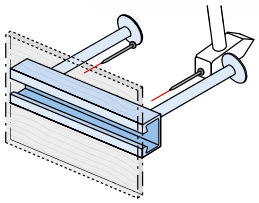


2.1 Fixing to the formwork

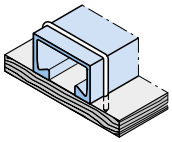
Timber formwork

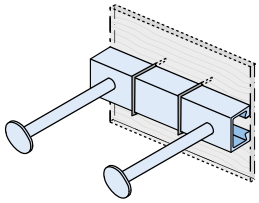
2.1.1 with nails





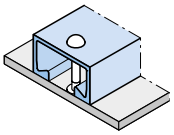
2.1.2 with staples

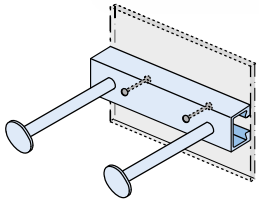




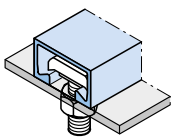
Steel formwork

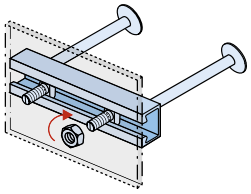
2.1.3 aluminium rivets





2.1.4 HALFEN Bolt and nut

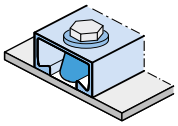




2.1 Fixing to the formwork, continued

Steel formwork

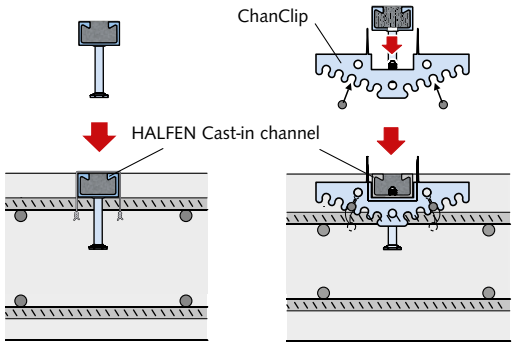
2.1.5 HALFEN HFK Fixing cone

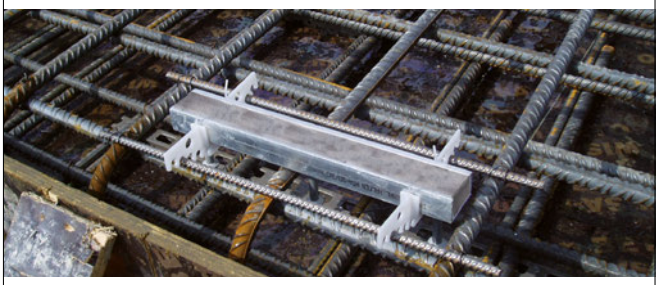


2.2 Top face installation

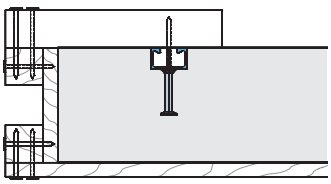
2.2.1 **directly to reinforcement:** with tying wire

2.2.2 with HALFEN HCP ChanClip





2.2.3 **Installation using an auxiliary aid**



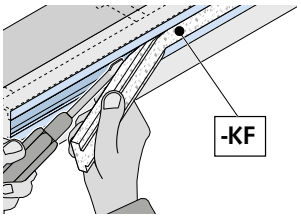
HALFEN HTA-CE CAST-IN CHANNELS
Installation/Assembly

3.1 Removing the filler

Strip filler, available in two versions:

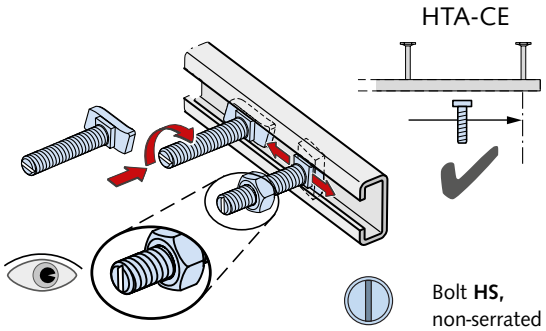
KF – PE strip filler
with reinforcement layer

KF – PE strip filler



Removing the strip filler
Grip the strip filler at one end and pull out in one piece by hand; use a tool, e. g. a screwdriver.

4.1 Installing HALFEN Bolts

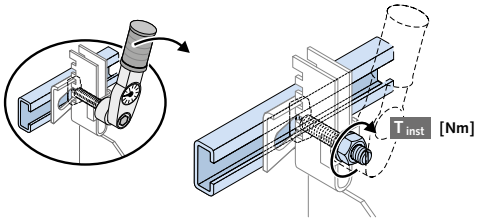


Bolt **HS,**
non-serrated
or

Bolt **HSR**
serrated or with nib

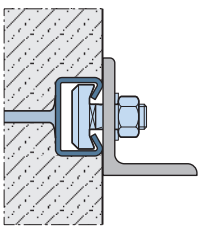
Safe assembly with HALFEN Cast-in channels
HALFEN Bolts can be inserted anywhere in the channel slot, turned 90° and then locked in place by tightening the nut. Do not position bolts at channel ends past the last anchor. On channels with bolt anchors, the anchor locations are visible through the channel slot.

Check
Bolts: After installation check that the bolts are properly aligned; the notch or notches in the tip of the shank must be at right angles to the longitudinal axis of the channel.

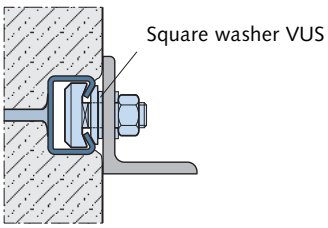


Fixings
The bolt heads must sit flush on both lips of the anchor channel and be secured by tightening the nut with a torque wrench with the required value. Observe the torque values in the tables on page 20.

Direct attachment ①



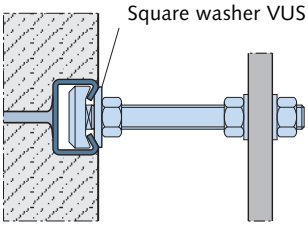
Surface-flush installation



Non-flush installation

① If the front surface of the channel is set back from the concrete surface, the attached structure must be shimmed with a washer (VUS).
In case of shear stress, add bolt flexure to the tensile force.

Stand-off installation ②



② Always install a square washer for stand-off installations.

Example:
HALFEN Channel: **HTA-CE 49/30**
HALFEN Bolt: **HS 50/30 - M16**
Washer: **VUS 49/30 - M16**

Assembly instructions on the internet
Multi-language assembly instructions can be found at **www.halfen.com ▻ Brochures ▻ Installation Instructions**.
Or scan the code and select the required document.

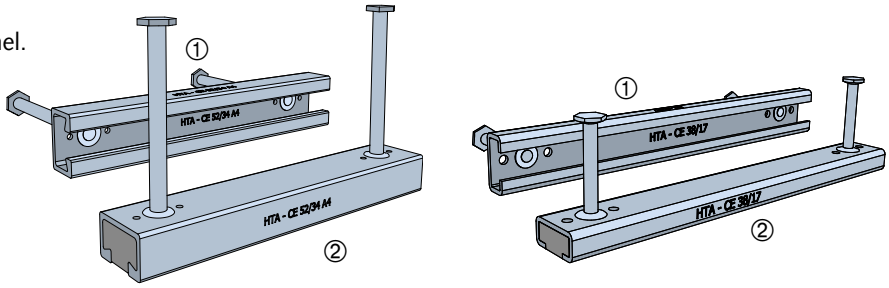
HALFEN HTA-CE CAST-IN CHANNELS
Identification/Geometry

Identification

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

Type identification

① Inside on the bottom of the channel.
② Additionally on the channel side



Minimum edge distances and minimum bolt spacing

Anchors must be installed at a minimum distance from the component edges.
The distance depends on the selected channel profile.
According to the ETA, the spacing between bolts s_{cbo} must not be less than 5 × d_s.
Reduction of the load bearing capacity is required if $s_{cbo} < s_{sl,N}$* (see table on page 16).
The concrete load-bearing capacity must be verified for each individual case using the HALFEN Software!

*$s_{sl,N}$ = centre distance of the bolts $N_{Rd,s,l}$

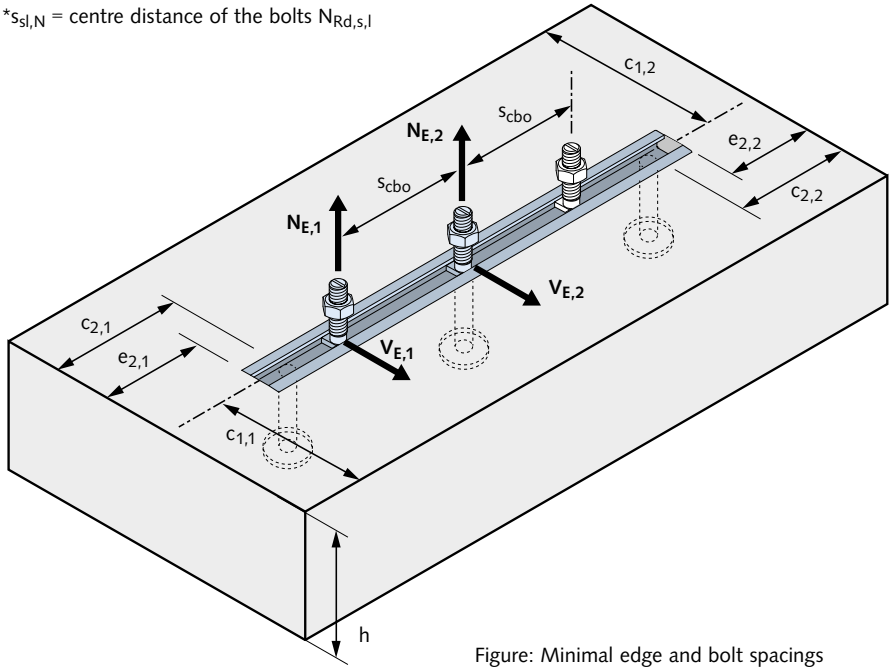


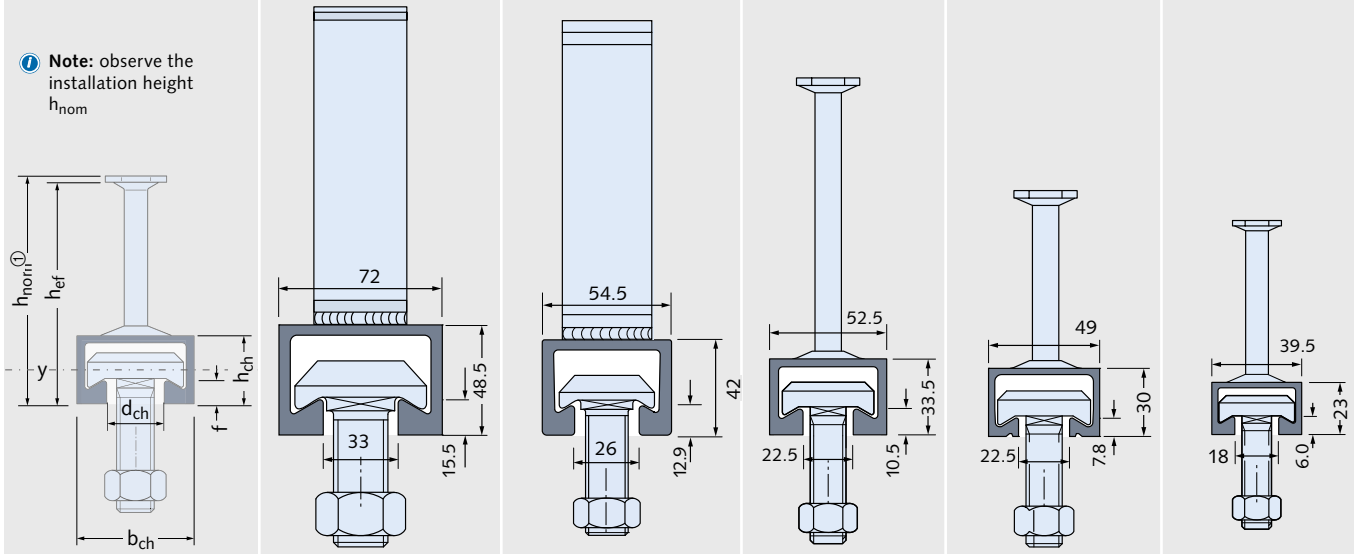
Figure: Minimal edge and bolt spacings

Edge and bolt spacing [mm]

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

HALFEN HTA-CE CAST-IN CHANNELS

Product range – Overview: channel and bolts

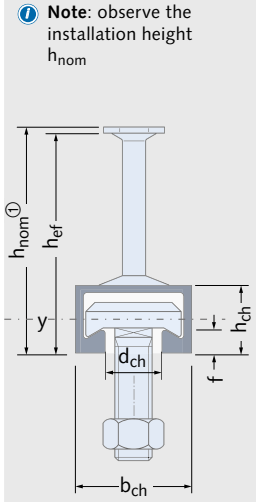
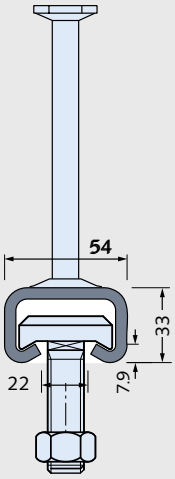
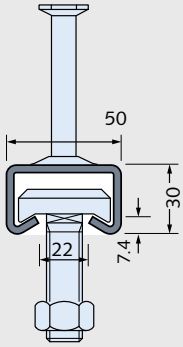
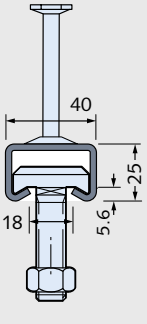
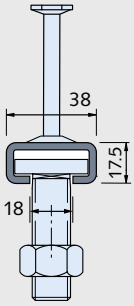
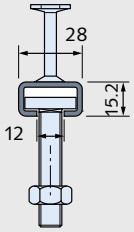
Identification values HTA-CE						
Profile		HTA-CE 72/48	HTA-CE 55/42	HTA-CE 52/34	HTA-CE 50/30P	HTA-CE 40/22P
Type		hot-rolled	hot-rolled	hot-rolled	hot-rolled	hot-rolled
Geometry HALFEN HTA-CE Channels **Note:** observe the installation height h_{nom}						
Material	Steel	■	■	■	■	■
material description: see page 10	A4	■		■	■	■
	HCR					
Bolts		HS 72/48	HS 50/30	HS 50/30	HS 50/30	HS 40/22
Threads		M 20-M 30	M 10-M 20	M 10-M 20	M 10-M 20	M 10-M 16
$s_{l,N}$ [mm]		144	109	105	98	79
Profile load capacity*						
$N^0_{Rd,s,l}$ [kN]		66.7	61.1	40.0	23.9	21.1
$V^0_{Rd,s,l}$ [kN]		81.1	61.1	43.5	32.8	19.4
$M_{Rd,s,flex}$ [Nm]	Steel	7472	5606	2933	2437	1208
	NR					
Geometry						
h_{nom} [mm] ① ②		(191)	182 (185)	162 (164)	112 (161)	97 (154)
b_{ch} [mm]		72	54.5	52.5	49	39.5
h_{ch} [mm]		48.5	42	33.5	30	23
I_y [mm⁴]	Steel	349721	187464	93262	52896	20029
	NR					
h_{ef} [mm]		179	175	155	106	91
c_{min} [mm]		150	100	100	75	50

* Concrete load capacity has to be verified for each individual case (taking the geometric boundary conditions into account).

c_{min} = minimal spacing channel/concrete edge
NR = Stainless steel
s_{slb} = axial spacing for bolts for $N^0_{Rd,s,l}$
$N^0_{Rd,s,l}$ = channel lip load capacity (tension)
$V^0_{Rd,s,l}$ = channel lip load capacity (shear)
① Nominal size and tolerance
② ( ) value in brackets is for weld-on I- or T- anchors

HALFEN HTA-CE CAST-IN CHANNELS

Product range – Overview: channel and bolts

Identification values HTA-CE						
Profile		HTA-CE 54/33	HTA-CE 49/30	HTA-CE 40/25	HTA-CE 38/17	HTA-CE 28/15
Type		cold-rolled	cold-rolled	cold-rolled	cold-rolled	cold-rolled
Geometry HALFEN Channels HTA-CE **Note**: observe the installation height h_{nom}							
Material	Steel	■	■	■	■	■
material description:	A4	■	■	■	■	■
see page 10	HCR		☒		☒	☒
Bolts		HS 50/30	HS 50/30	HS 40/22	HS 38/17	HS 28/15
Threads		M10-M20	M10-M20	M10-M16	M10-M16	M6-M12
$s_{l,N}$ [mm]		107	100	80	76	56
Profile load capacity*						
$N^0_{Rd,s,l}$ [kN]		30.6	17.2	11.1	10.0	5.0
$V^0_{Rd,s,l}$ [kN]						
$M_{Rd,s,flex}$ [Nm]	Steel	2595	1455	931	504	276
	NR					
Geometry						
h_{nom} [mm] ① ②		162 (164)	103 (101)	89 (89)	81 (82)	50 (79)
b_{ch} [mm]		54	50	40	38	28.0
h_{ch} [mm]		33	30	25	17.5	15.25
I_y [mm⁴]	Steel	72079	41827	20570	8547	4060
	NR			19097		
h_{ef} [mm]		155	94	79	76	45
c_{min} [mm]		100	75	50	50	40

* Concrete load capacity has to be verified for each individual case (taking the geometric boundary conditions into account).

c_{min} = minimal spacing channel/concrete edge
NR = Stainless steel
s_{slb} = axial spacing for bolts for $N^0_{Rd,s,l}$
$N^0_{Rd,s,l}$ = channel lip load capacity (tension)
$V^0_{Rd,s,l}$ = channel lip load capacity (shear)
① Nominal size and tolerance
② ( ) value in brackets is for weld-on I- or T-anchors

HALFEN HTA-CE CAST-IN CHANNELS
Product range

Standard product range

The standard HALFEN Cast-in channel product range with European Technical Approval is listed in the following table. See also current HALFEN Price list.

Other lengths are available on request.

Supplied lengths and number of anchors

Length [mm] / Number of anchors				
HTA-CE 72/48	**HTA-CE 55/42**	**HTA-CE 40/25, 50/30P, 49/30, 52/34, 54/33**	**HTA-CE 40/22P**	**HTA-CE 28/15, 38/17**
150/2	**150**/2	**150**/2	**150**/2	**100**/2
200/2	**200**/2	**200**/2	**200**/2	**150**/2
250/2	**250**/2	**250**/2	**250**/2	**200**/2
300/2	**300**/2	**300**/2	**300**/2	**250**/2
350/3	**350**/3	**350**/3	**350**/3	**300**/3
400/3	**400**/3	**400**/3	**400**/3	**350**/3
550/3	**550**/3	**550**/3	**550**/3	**450**/3
1050/5	**1050**/5	**800**/4	**800**/4 ②	**550**/4
6070/25	**6070**/25	**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 spacing ≤ 250 mm				Anchor spacing ≤ 200 mm

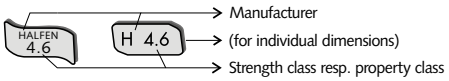
① Does not apply to HTA-CE 52/34, HTA-CE 54/33
② Does not apply to HTA-CE 40/22P - A4

HALFEN HTA CAST-IN CHANNELS
HALFEN HS Bolts

HALFEN Bolts — Type HS

Standard HALFEN Bolts (no nib or serration) for all profile types HTA-CE

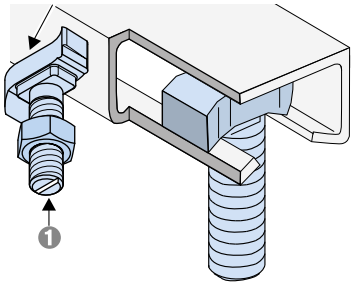
- two direction load capacity
- identified on bolt tip with **1 notch**



HALFEN 4.6 — Strength class 4.6 / 8.8 galvanized (GVs) or hot-dip galvanized (FV)

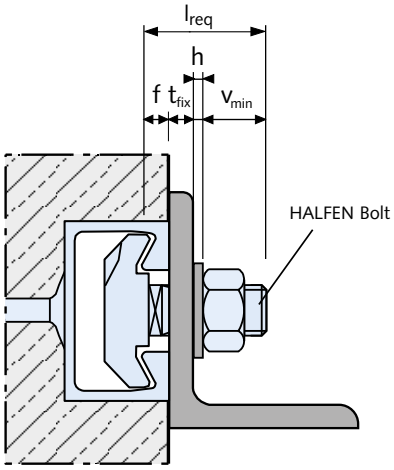
HALFEN A4-70 — Material grade A4-50 / A4-70 Stainless steel

HALFEN HCR50 — Strength class 50 Stainless steel (1.4529/1.4547)



Calculating the bolt length l_{req} for HALFEN Bolts

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



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

Lip dimensions f	
Channel profile	**f [mm]**
28/15	2.3
38/17	3.0
40/22P	6.0
40/25	5.6
49/30	7.4
50/30P	7.9
52/34	10.5
54/33	7.9
55/42	12.9
72/48	15.5

l_{req} = required bolt length
t_{fix} = thickness of clamped component
f = profile lip height
h = washer thickness
v_{min} = nut height EN ISO 4032 + overhang approximately 5 mm (for M20: 7 mm)

Bolt design values

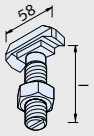
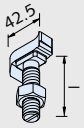
The table on the right lists the design resistance of HALFEN Bolts with different thread diameters, materials and strength classes.

$N_{Rd,s,s}$ is the resistance against tension loads, **$V_{Rd,s,s}$** is the the resistance against shear loads and **$M^0_{Rd,s,s}$** is the flexural resistance when subjected to transverse load induced with a cantilever.

Design resistance										
Material / Strength class		M6	M8	M10	M12	M16	M20	M24	M27	M30
4.6	$N_{Rd,s,s}$ [kN]	4.0	7.3	11.6	16.9	31.4	49.0	70.6	91.8	112.2
	$V_{Rd,s,s}$ [kN]	2.9	5.3	8.3	12.1	22.6	35.2	50.7	66.0	80.6
	$M^0_{Rd,s,s}$ [Nm]	3.8	9.0	17.9	31.4	79.8	155.4	268.9	398.7	538.7
8.8	$N_{Rd,s,s}$ [kN]	10.7	19.5	30.9	44.9	83.7	130.7	188.3	244.8	299.2
	$V_{Rd,s,s}$ [kN]	6.4	11.7	18.6	27.0	50.2	78.4	113.0	146.9	179.5
	$M^0_{Rd,s,s}$ [Nm]	9.8	24.0	47.8	83.8	213.1	415.4	718.4	1065.2	1439.4
A4-50	$N_{Rd,s,s}$ [kN]	3.5	6.4	10.1	14.8	27.4	42.8	61.7	80.2	98.1
	$V_{Rd,s,s}$ [kN]	2.5	4.6	7.3	10.6	19.8	30.9	44.5	57.9	70.7
	$M^0_{Rd,s,s}$ [Nm]	3.2	7.9	15.7	27.5	70.0	136.3	235.8	349.7	472.5
A4-70	$N_{Rd,s,s}$ [kN]	7.5	13.7	21.7	31.6	58.8	91.7	132.1	171.8	210.0
	$V_{Rd,s,s}$ [kN]	5.4	9.9	15.6	22.7	42.2	66.0	95.1	123.6	151.0
	$M^0_{Rd,s,s}$ [Nm]	6.9	16.8	33.5	58.8	149.4	291.3	503.7	746.9	1009.2

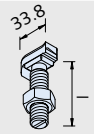
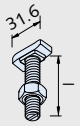
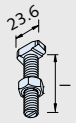
HALFEN HTA-CE CAST-IN CHANNELS
HALFEN HS Bolts

HALFEN HS Bolts

Suitable for profile	HTA-CE 72/48				HTA-CE 55/42, 52/34, 54/33, 50/30P, 49/30			
Bolt	**HS 72/48**				**HS 50/30**			
Bolt dimensions								
l [mm]	**M20**	**M24**	**M27**	**M30**	**M10**	**M12**	**M16**	**M20**
30	-	-	-	-	FV4.6 GVs4.6	-	-	-
	-	-	-	-	-	GVs4.6	GVs4.6	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	A4-50	-
	-	-	-	-	-	A4-70	-	-
40	-	-	-	-	-	-	-	-
	-	-	-	-	-	FV4.6	FV4.6	-
	-	-	-	-	GVs4.6	-	-	-
	-	-	-	-	-	GVs4.6	GVs4.6	-
	-	-	-	-	-	-	GVs8.8	-
	-	-	-	-	-	-	A4-50	-
	-	-	-	-	-	A4-70	-	-
45	-	-	-	-	-	-	-	GVs4.6
	-	-	-	-	-	GVs8.8	-	GVs8.8
	-	-	-	-	-	-	-	A4-50
50	FV4.6	FV4.6	-	-	-	-	FV4.6	-
	-	-	-	-	GVs4.6	GVs4.6	GVs4.6	-
	-	-	-	-	-	-	GVs8.8	-
	-	A4-50	-	-	-	-	A4-50	-
	-	-	-	-	-	A4-70	-	-
	-	-	-	-	-	-	HCR-50*	-
55	-	-	-	-	-	-	-	FV4.6
	-	-	-	-	-	-	-	GVs4.6
	-	-	-	-	-	-	-	A4-50
	-	-	-	-	-	-	-	A4-70*
60	-	-	-	-	-	FV4.6	-	-
	FV8.8	-	-	-	-	FV8.8*	FV8.8	-
	-	-	-	-	-	GVs4.6	GVs4.6	-
	-	-	-	-	-	GVs8.8	GVs8.8	GVs8.8
	-	-	-	-	-	-	A4-50	-
70	-	-	-	-	-	-	-	-
75	FV4.6	FV4.6	FV4.6	FV4.6	-	-	-	-
	-	FV8.8	-	-	-	-	-	-
	-	-	-	-	-	-	-	GVs4.6
	GVs8.8	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	A4-50
	-	-	-	-	-	-	-	A4-70*
80	-	-	-	-	-	-	-	FV4.6*
	-	-	-	-	-	FV8.8*	FV8.8*	-
	-	-	-	-	-	GVs4.6	GVs4.6	-
	-	-	-	-	-	GVs8.8	GVs8.8	GVs8.8
	-	-	-	-	-	-	A4-50	-
100	FV4.6	FV4.6	-	FV4.6	-	-	FV4.6	FV4.6
	-	-	FV8.8	-	-	-	-	-
	-	-	-	-	-	GVs4.6	GVs4.6	GVs4.6
	GVs8.8	GVs8.8	-	-	-	-	GVs8.8	GVs8.8
	-	A4-50	-	-	-	A4-50	-	A4-50
	-	-	-	-	-	-	-	A4-70*
	-	-	-	-	-	-	HCR-50*	-
125	-	-	-	-	-	GVs4.6	GVs4.6	GVs4.6
	-	-	-	-	-	-	-	A4-50*
150	FV4.6	FV4.6	-	FV4.6	-	-	FV4.6	-
	-	-	-	-	-	GVs4.6	GVs4.6	GVs4.6
	-	GVs8.8	-	-	-	-	-	GVs8.8
	-	-	-	-	-	-	A4-50	A4-50*
	-	-	-	-	-	-	HCR-50*	-
200	FV4.6	FV4.6	-	FV4.6	-	-	-	-
	-	-	-	-	-	GVs4.6	GVs4.6	GVs4.6
300	-	-	-	-	-	-	GVs4.6	GVs4.6*

Material types: see page 10 *on request ⓘ Other bolt lengths and materials on request!

HALFEN HS Bolts

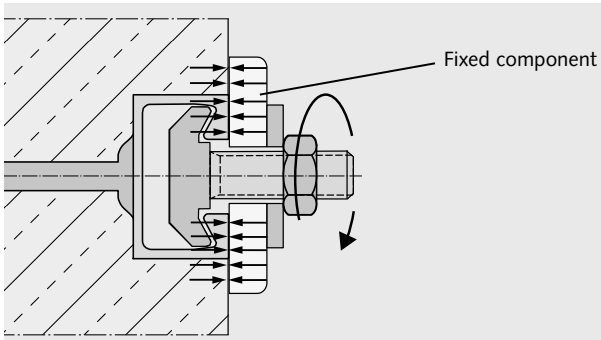
Suitable for profile	HTA-CE 40/22P, 40/25			HTA-CE 38/17			HTA-CE 28/15			
Bolt	**HS 40/22**			**HS 38/17**			**HS 28/15**			
Bolt dimensions										
l [mm]	**M10**	**M12**	**M16**	**M10**	**M12**	**M16**	**M6**	**M8**	**M10**	**M12**
30	GVs4.6 A4-70	FV4.6 GVs4.6 GVs8.8 A4-50	GVs4.6 A4-50	FV4.6 GVs4.6 A4-70	FV4.6 GVs4.6 A4-70	GVs4.6 A4-50	GVs4.6	GVs4.6 A4-70	FV4.6 GVs4.6 A4-70	GVs4.6
40	GVs4.6 A4-70	GVs4.6 GVs8.8 A4-50 A4-70	GVs4.6	GVs4.6	GVs4.6 A4-70	FV4.6 GVs4.6 A4-50	GVs4.6	GVs4.6	FV8.8 GVs4.6 A4-70	
45										
50	GVs4.6 A4-70	FV4.6 GVs4.6 A4-50	FV4.6 GVs4.6 A4-50 A4-70	FV4.6 GVs4.6 HCR-50*	FV4.6 GVs4.6 A4-70	FV4.6 GVs4.6 A4-50 HCR-50*		GVs4.6	FV4.6 GVs4.6 A4-50 HCR-50*	GVs4.6
55										
60	GVs4.6	FV4.6 FV8.8* GVs4.6 GVs8.8	FV4.6 FV8.8 GVs4.6 GVs8.8	GVs4.6	GVs4.6 GVs8.8 A4-70	FV8.8 GVs4.6 A4-50		GVs4.6	GVs4.6 A4-70*	
70					FV8.8					
75										
80	GVs4.6	FV4.6 GVs4.6 GVs8.8 A4-50	GVs4.6 GVs8.8 A4-50	GVs4.6	GVs4.6 A4-70	FV4.6 GVs4.6 A4-50		GVs4.6	GVs4.6 A4-70	GVs4.6
100	GVs4.6	GVs4.6 GVs8.8	FV4.6 GVs4.6 A4-50	GVs4.6 HCR-50*	GVs4.6 A4-50	FV4.6 GVs4.6 HCR-50*		GVs4.6	GVs4.6 A4-50* HCR-50*	
125		GVs4.6	GVs4.6		GVs4.6	GVs4.6			GVs4.6 A4-50*	
150		GVs4.6	GVs4.6	GVs4.6	GVs4.6	GVs4.6 HCR-50*		GVs4.6	GVs4.6 A4-50*	
200		GVs4.6	GVs4.6		GVs4.6	GVs4.6			GVs4.6 A4-50*	
300			GVs4.6							

Material types: see page 10 *on request ⓘ Other bolt lengths and materials on request!

HALFEN HTA-CE CAST-IN CHANNELS
HALFEN HS Bolts

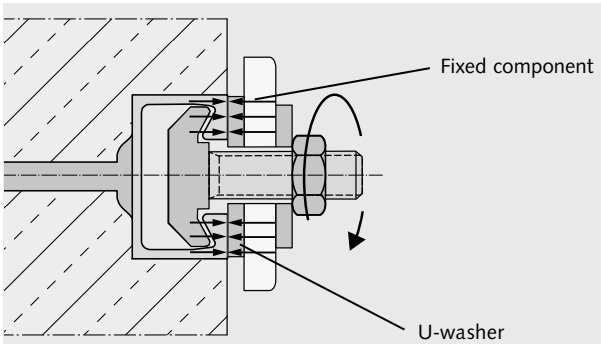
Torque values HS

Standard
Components are braced against the concrete and anchor channel.
Torque is applied as in the following table and must not be exceeded.



Standard torque values

Steel-Steel
Components are braced against the anchor channels using suitable washers.
Torque is applied as in the following table and must not be exceeded.



Torque values steel-steel

Standard: Recommended torque values T_{inst}

HTA-CE Profile	HALFEN Bolt HS...**M** [mm]	Torque value T_{inst} [Nm] Steel 4.6; 8.8 Stainless steel Strength class 50 Strength class 70
28/15	6	–
	8	8
	10	13
	12	15
38/17	10	15
	12	25
	16	40
40/22P 40/25	10	15
	12	25
	16	45
49/30 50/30P	10	15
	12	25
	16	60
	20	75
52/34 54/33	10	15
	12	25
	16	60
	20	120
55/42	10	15
	12	25
	16	60
	20	120
72/48	20	120
	24	200
	27	300
	30	380

Steel-Steel: Recommended torque values T_{inst}

HTA-CE Profile	HALFEN Bolt HS...**M** [mm]	Torque value T_{inst} [Nm] Steel 4.6	Steel 8.8	Stainless steel Strength class 50	Stainless steel Strength class 70
28/15	6	3	–	3	–
	8	8	20	8	15
	10	15	40	15	30
	12	25	70	25	50
38/17	10	15	40	15	30
	12	25	70	25	50
	16	65	180	60	130
40/22P 40/25	10	15	40	15	30
	12	25	70	25	50
	16	65	180	60	130
49/30 50/30P	10	15	40	15	30
	12	25	70	25	50
	16	65	180	60	130
	20	130	360	120	250
52/34 54/33	10	15	40	15	30
	12	25	70	25	50
	16	65	180	60	130
	20	130	360	120	250
55/42	10	15	40	15	30
	12	25	70	25	50
	16	65	180	60	130
	20	130	360	120	250
72/48	20	130	360	120	250
	24	230	620	200	440
	27	340	900	300	650
	30	460	1200	400	850

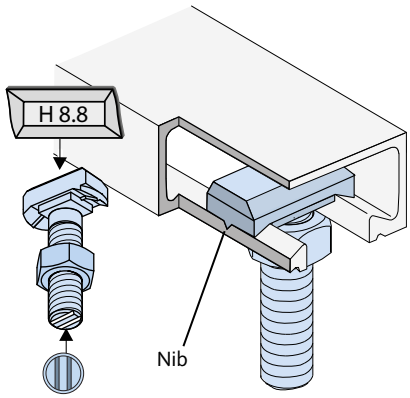
Torque values apply only to bolts in delivery condition (unlubricated).

HALFEN HSR Bolts with nib

HALFEN Bolts – Type HSR (not ETA approved)

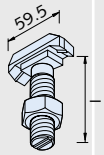
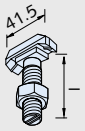
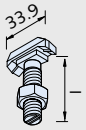
HALFEN Bolts with nib

- only for hot-rolled profiles: 40/22P, 50/30P, 52/34, 72/48
- only for normal steel: WB and FV
- load capacity in all directions
- load capacity in channel longitudinal direction according to expert report
- identification on bolt tip with **2 notches**



Bolt design values HSR

Available HSR

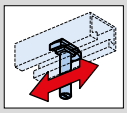
Suitable for profile	72/48	52/34, 50/30P		40/22P
Bolt	**HSR 72/48**	**HSR 50/30**		**HSR 40/22**
Bolt dimensions				
l [mm]	**M20**	**M16**	**M20**	**M16**
40	-	FV8.8	-	GVs8.8
45	-	-	GVs8.8	-
60	-	GVs8.8	GVs8.8	GVs8.8, FV8.8*
75	FV8.8	-	GVs8.8	-

GVs = Zinc galvanized with special coating
FV = Hot-dip galvanized
* on request

Torque values HSR

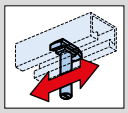
HSR 8.8	Torque values [Nm]
M16	200
M20	400

Load capacity HSR

 Bolt HSR	Grade 8.8 in channel longitudinal direction according to expert report F_{Rd} [kN]
40/22 - M16	7.0
50/30 - M16	7.0
50/30 - M20	10.5
72/48 - M20	10.5

HALFEN Bolts HS: Design value; load bearing capacity F_{Rd} [kN]

Design value F_{Rd} [kN] in channel longitudinal direction (for each HALFEN HS Bolt)

	for steel profiles		for profiles in stainless steel	
	Bolt type HS with strength class			
Thread Ø	**4.6**	**8.8**①	**A4-50**	**A4-70**
M6	0.14	0.56	-	
M8	0.28	0.98	0.28	
M10	0.42	1.54	0.42	
M12	0.70	2.24	0.70	
M16	1.26	4.20	1.26	
M20	1.96	6.58	1.96	
M24	2.80	9.52	2.80	
M27	3.64	12.46	-	
M30	4.48	15.26	-	

① Values only applicable with torque moments T_{inst} steel-steel (see table on the left, on page 20)

Not included in the ETA!

Following combination can be used in supporting structures subjected to loads in channel longitudinal direction:

- hot-rolled, smooth, hot-dip galvanized HALFEN Cast-in channels with HALFEN HSR Bolts with nib

If loads in the channel's longitudinal direction have been verified, we recommend using serrated HALFEN HZA Channels with serrated HALFEN HZS Bolts.
See pages 30-31.

HALFEN HTA-CE CAST-IN CHANNELS
Application Examples

CURTAIN WALL

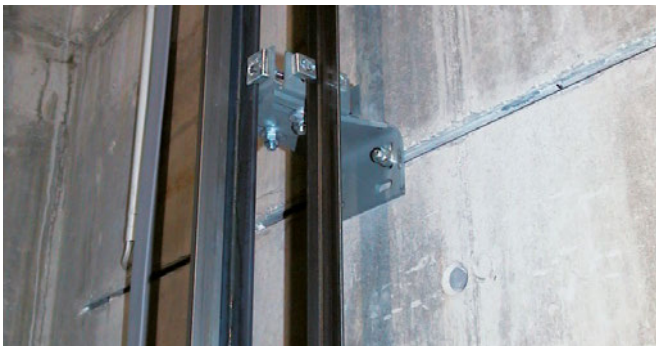
Fixings for curtain wall façades

CURTAIN WALL

Fixings for curtain wall façades

SPORTS


Seat fixing in stadiums

LIFTS/ELEVATOR FIXINGS

Fixing guide-rails with HALFEN Channels

NOISE BARRIERS

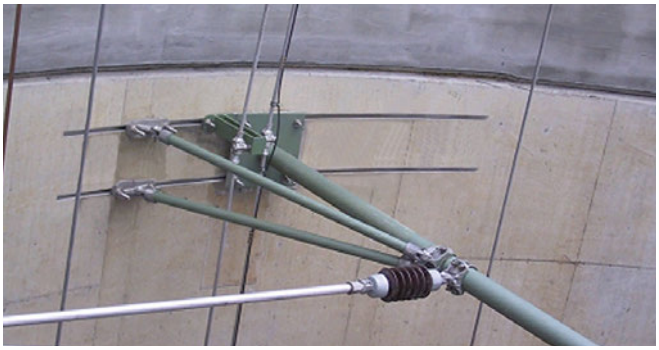
Fixings of noise barriers to concrete posts

BRIDGES

Fixings for drainage systems

UTILITY TUNNELS

Utility fixings in TBM tunnels with curved anchor channels

TUNNELS

Fixing of overhead cables in railway tunnels

HALFEN HTA-CE CAST-IN CHANNELS
Custom Anchors – Anchor Variations (Not ETA Approved)

ANK-E end anchor; for on-site custom cut-length of HALFEN Cast-in channels

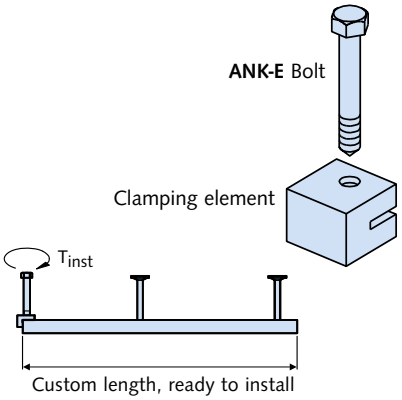
Notes for assembling end anchor, type ANK-E

- Cut the HALFEN Cast-in channel at the selected point. The cut face must be at a right angle to the longitudinal axis of the channel. The end projection "**e**" should not be less than 35 mm and not more than 175 (225) mm*.
- Select the correct **ANK-E** End anchor for the HALFEN Cast-in channel profile; see table on the right. Slide the clamping element on to the back of the channel. If necessary, push in the foam filler at the end of the channel.
- Tighten the bolt by applying the required torque. See table (right) for correct torque value.

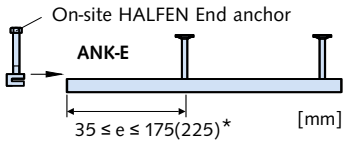
End anchor selection

for profile	End anchor	Thread	Torque T_{inst} [Nm]
28/15 - FV	ANK-E1 - FV	M8	10
28/15 - A4	ANK-E1 - A4	M8	10
38/17 - FV	ANK-E2 - FV	M10	20
40/25 - FV			
41/22 - FV ①			
38/17 - A4	**ANK-E2 - A4**	M10	20
40/25 - A4			
41/22 - A4 ①			

① Short HZA 41/22 sections may be used with one end anchor only. Not included in the approval.



Custom lengths



* 175: for 28/15, 38/17
225: for 40/25, 41/22

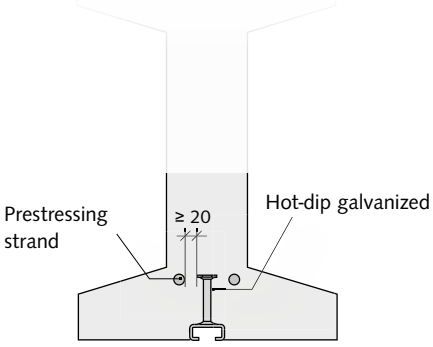
HALFEN Anchor channels, hot-dip galvanized with stainless steel anchors

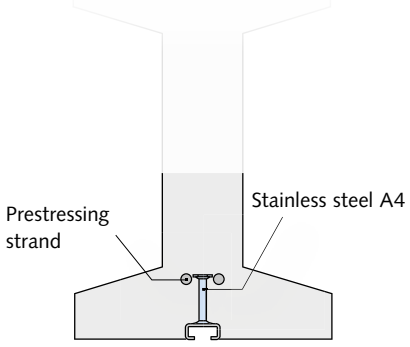
Requirements
according to EN 1992-1-1/NA (EC 2 with German National Annex, 2nd edition, 2016, chapter 8.10.1.1) *"Ensure at least 20 mm concrete between pre-stressed tension strands and galvanized components."* Otherwise there is a risk of hydrogen induced cracking.

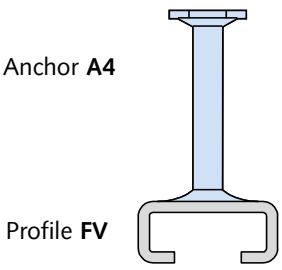
Solution
If hot-dip galvanized channels are used together with stainless steel bolt-anchors then the pre-stressed tension-strands are allowed to have contact with the stainless steel bolt anchor.

Types:
Lengths available: up to 6.07 m

Available profiles:
- 50/30P
- 49/30
- 40/25
- 38/17

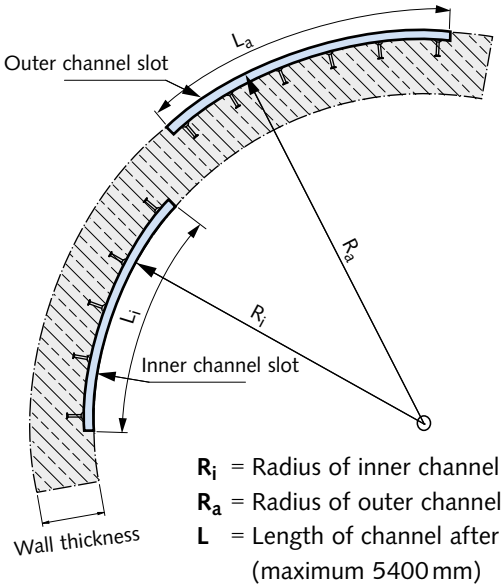






HALFEN HTA-CE CAST-IN CHANNELS
Available Types – HTA-CS/Channel Pairs/Corner Elements

HALFEN HTA-CS Channels — Curved Solution



R_i = Radius of inner channel slot
R_a = Radius of outer channel slot
L = Length of channel after bending (maximum 5400 mm)

Areas of application:
- tunnel construction
- reinforced concrete tunnels for service utilities
- curved walls
- sewage plants

Ordering example:
HALFEN Cast-in channel, curved
HTA-CS 52/34-Q - A4, R_i = 4000 mm, L = 1050 mm


Curved HALFEN Cast-in channels in tunnel segments

Smallest radius[m]*

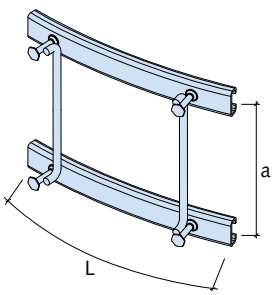
Profile / Material	HTA-CS 72/48	HTA-CS 54/33	HTA-CS 52/34	HTA-CS 50/30P	HTA-CS 49/30	HTA-CS 40/22P	HTA-CS 40/25	HTA-CS 38/17	HTA-CS 28/15
Inner channel slot: min. R_i ☐	on request	0.80 m	0.75 m	on request	0.80 m	on request	1.10 m	0.70 m	0.75 m
Inner channel slot: min. R_i ☐	on request	0.80 m	0.80 m	on request	0.80 m	on request	0.90 m	0.70 m	0.75 m
Outer channel slot: min. R_a ☐	on request	4.00 m	3.60 m	on request	3.00 m	on request	2.20 m	3.20 m	2.00 m
Outer channel slot: min. R_a ☐	on request	4.00 m	3.60 m	on request	5.70 m	on request	1.70 m	5.40 m	7.80 m

☐ hot-dip galvanized ☐ stainless A4 * please contact our technical support team for more detailed information

HALFEN Channel pairs

Material/type:
Channel (Type straight or curved):
FV = Hot-dip galvanized
A4 = Stainless steel

Spacer:
Reinforced concrete B500B or B500B/A NR, Ø 10-16 mm
Recommended for stainless steel type spacers in: B500B/A NR.



Ordering example:

Type:	HALFEN Channel pair HTA-CE 38/17
Dimensions:	L = 350 mm, a = 200 mm
Material:	hot-dip galvanized, with filler
Radius:	R_i =... (for curved type)

HALFEN Corner channel

Material/type:
Channel and anchor:
FV = Hot-dip galvanized
A4 = Stainless steel

Standard type:
a/b = 125/250 mm
Other lengths for a and b and other profiles are available on request

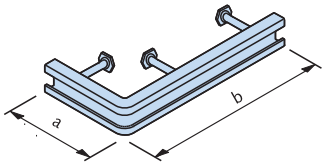


Figure: HTA-CE 38/17 – Corner piece

Area of application:
- fixing for HALFEN Console anchors for supporting brickwork cladding
- other near edge fixings

HALFEN HTA-CE CAST-IN CHANNELS
Calculation Basics

General

The following information is necessary to verify an anchor channel:

- type of HALFEN Cast-in channel and material
- length of the HALFEN Cast-in channel with number of anchors and spacing
- position of the HALFEN Cast-in channel in the concrete, defined by its distance from the lower, upper, left and right edges of the component
- thickness of the concrete elements
- concrete strength class
- condition of the concrete; cracked or verified as non-cracked
- dense reinforcement in the vicinity of the anchor channel
- HALFEN T-head bolt thread size
- bolt positions
- tensile load and shear load of each bolt

Technical support

Engineering services and technical support for your individual projects.
Our contact information can be found on page 88 of this catalogue.

Design resistances for dynamic loads, with dimensioning example, are given at page 37.

Verification method

1. Select channel.

2. Verify local load application (channel lips) for tension, shear and combined loading.

3. Calculate the anchor loads resulting from tensile loads and shear loads according to the load influence model (unfavourable anchor and load position).

4. Verify the connection between anchor and channel (tension loading).

5. Verify anchor pull-out failure (tension loading).

6. Verify concrete cone failure (tension loading).

7. Verify pry-out failure (loading in shear).

8. Verify concrete edge failure (loading in shear) considering a possible structural edge reinforcement.

If verification is negative, determine required additional reinforcement.

9. Verify concrete failure for combined loading, (combination of 6. and 7. as well as combination of 6. and 8.).

If last verification is negative, determine required additional reinforcement.

Tip:
A free, simple to use calculation software to simplify planning can be downloaded at **www.halfen.com**.

HALFEN HTA-CE CAST-IN CHANNELS
Software

HALFEN HTA-CE Software

The HALFEN Calculation program for HALFEN Cast-in channels according to the ETA provides the user with a convenient and very powerful calculation tool.

Verifications
CEN/TS 1992-4 and EOTA TR047 require a wide range of verifications for cast-in channels and the concrete used. These verifications are processed by the user-friendly HALFEN Software. In just a few seconds the user is provided with a list of suitable HALFEN Cast-in channels for the relevant load situation.

Boundary conditions
The calculation takes into account all necessary boundary conditions, typical examples being:

- cracked or non-cracked concrete
- the geometry of the concrete components, in particular the distances from the channel to the component edge
- various reinforcement patterns
- consideration of several dimensioning or characteristic loads
- positioning of the loads with a definable adjustment range, and the option of shifting the defined bolt pattern along the complete channel length
- verification of the required HALFEN T-head bolts and if required also for stand-off installations

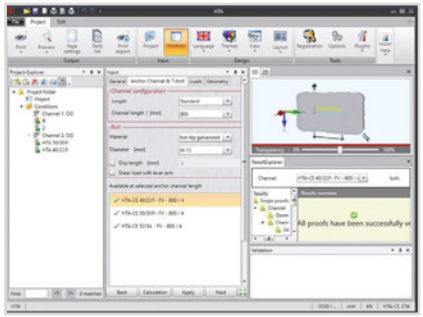
Input
The geometry and loads are entered interactively. Entries are displayed promptly in a 3D graphic. Entries can also be changed directly in the graphic. Click on the load, the measurement or the component line you want to change to make the required modification.

Input loads
In addition to direct input of bolt loads, it is also possible to calculate the resulting loads by entering the actions/loads caused by secondary components (for example, curtain wall applications).

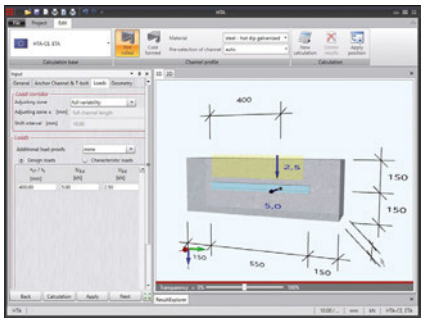
Results
After calculation, the software output provides either the results for a preselected profile, or in the case of automatic selection a list of all suitable profiles. Profiles and T-bolts with in-complete verifications are high-lighted in red.

All software can be found under: **www.halfen.com ▻ Downloads ▻ Software/CAD**

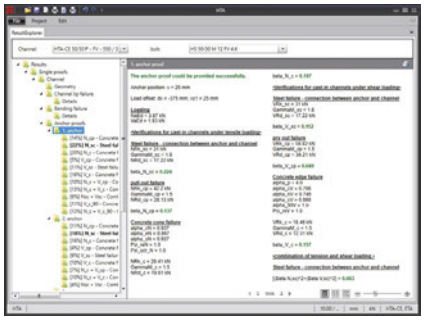
Screenshot 1: The HALFEN HTA-CE Software start screen



Screenshot 2: Input screen, HALFEN HTA-CE Software



Screenshot 3: Interactive 3D display



Screenshot 4: Results list

HALFEN HTA-CE CAST-IN CHANNELS
Software

HALFEN HTA-CE Software

Visual control
All verifications for the current channel profile are listed in a tree structure. Green check-marks indicate successful verifications. Red check-marks indicate unsatisfactory verifications.

For further visual control a progress bar on the right indicates the status of the verification process. Here too, red bars mean that a load has been exceeded, while green bars symbolize verifications that meet the criteria.

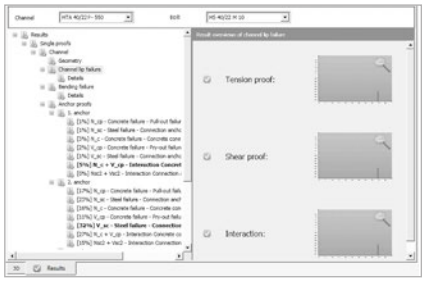
Detailed calculation information (with load positions, section sizes and utilization factors) can also be selected in a tree menu.

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

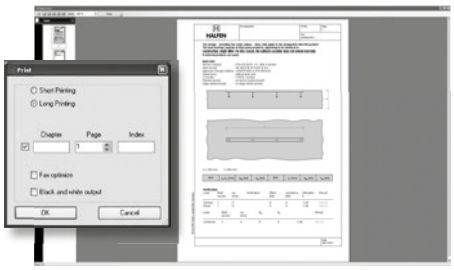
Print-outs
Print-outs are possible in a brief and in a verifiable long version. The long version includes all decisive verifications, a diagram of necessary reinforcement and a 2D graphic of the geometry and load.

The latest version of the dimensioning program is available for download on the Internet at *www.halfen.com*.

System requirements:
- Windows 10, Windows 8, Windows 7,
- Microsoft .NET Framework 4.6



Screenshot 5: Overview of results

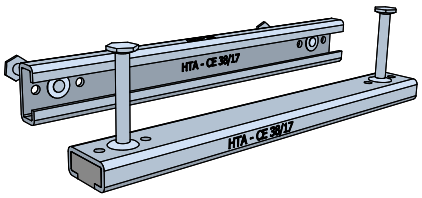


Screenshot 6: Print preview

Tender text

HALFEN HTA-CE type Channel 49/30 - A4 - 350 - KF - ANK.A4

HALFEN HTA-CE Channel 49/30 with smooth channel lips for adjustable fixing of components,



according to European Technical Assessment ETA-09/0339, suitable for anchoring in reinforced or non-reinforced standard concrete in a strength class of at least C12/15 and a maximum C90/105 in accordance with EN 206 under quasi-static loading as well as fire exposure.

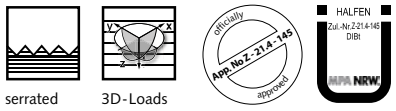
Type HTA-CE 49/30 - A4 - 350 - KF - ANK.A4
with
$N_{Rk,s,c}$ = 31 kN = char. resistance, steel failure (tension), connection channel anchor
A4 = Carbon steel or stainless steel 1.4404 / 1.4571,
350 = Channel length [mm] with 3 anchors,
KF = Foam strip filler,
ANK.A4 = Anchor in stainless steel 1.4404 / 1.4571 / 1.4578,

CE
ETA - 09 / 0339

or equivalent; deliver and install according to the manufacturer's instructions.

HZA CAST-IN CHANNELS, serrated
The advantages at a glance

Apart from providing excellent adjustability, HALFEN Cast-in channels save considerable time during installation. The result; faster construction and therefore reduced overall costs.



serrated | 3D-Loads

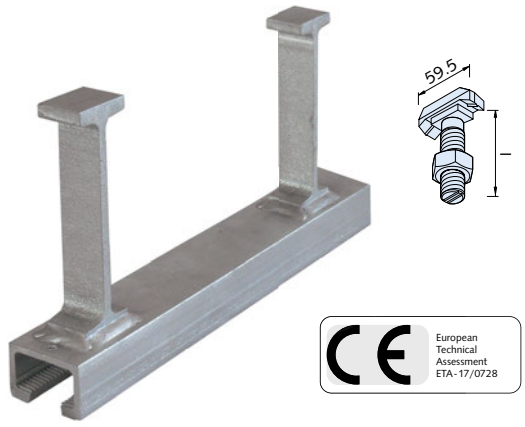
HZA HALFEN Channels, cold-rolled, serrated

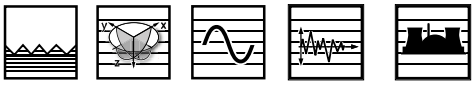
Safe and reliable

- no damage to the main reinforcement
- approved for fire-resistant structural elements
- suitable for installation in concrete pressure and concrete tensile zones
- hot-rolled channels, suitable for dynamic loads
- building authority approved

Quick and economical

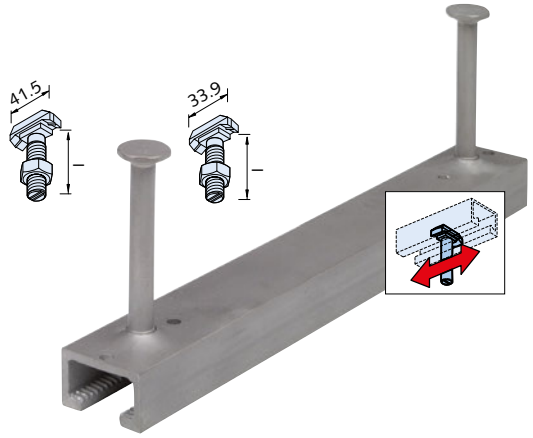
- adjustable anchorage
- bolts instead of welding
- maximum efficiency when installing in rows
- cost-effective installation using standard tools
- optimized pre-planning reduces construction time
- large range of channels types for various applications
- user-friendly installation; no noise, dust and vibration

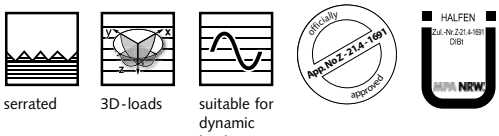




serrated | 3D-loads | suitable for dynamic loads | suitable for seismic loading | suitable for applications in safety relevant areas in nuclear facilities

HZA-PS HALFEN Channels, hot-rolled, serrated





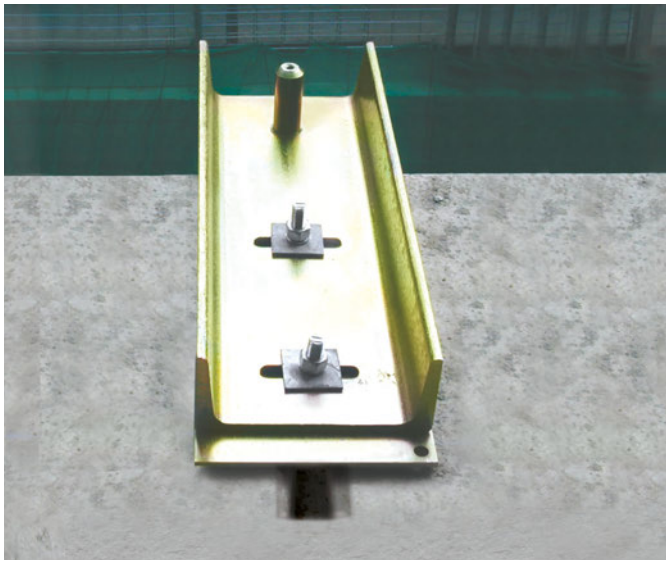
serrated | 3D-loads | suitable for dynamic loads

HZA DYNAGRIP Halfenschienen, gezahnt

HZA-PS CAST-IN CHANNELS
More Information on the HZA-PS is available at:
www.halfen.com ▻ Products ▻ Fixing systems ▻ HZA - DYNAGRIP Cast-In Channels
Or scan the QR-Code and select the current "HZA-PS" catalogue.

Application Examples: Installations with HALFEN HZA Cast-In Channels

CURTAIN WALL



Fixings of a Curtain wall façade, HZA near edge installation

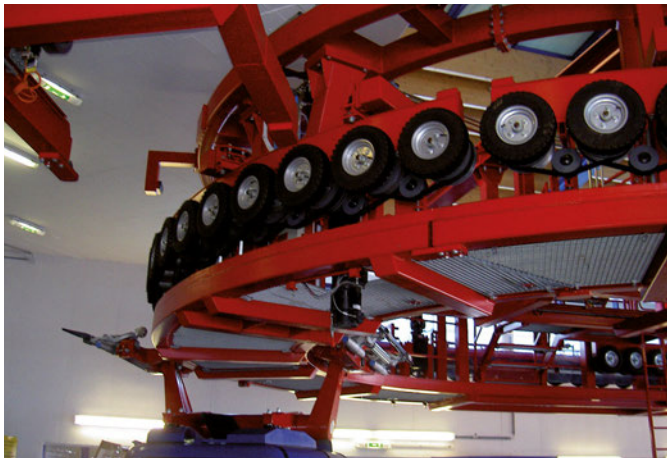
FAÇADES

Fixings for emergency access balconies
(Vertical installation of HALFEN Channels)

INDUSTRIAL PLANT INSTALLATIONS

Pipe supports on vertical HZA Channels

SKI LIFT



Fixing of the drive unit for a ski lift

LIFTS / ELEVATORS

Fixing for guide-rails

INDUSTRIAL BUILDING

Vertical channels in columns to attach further components

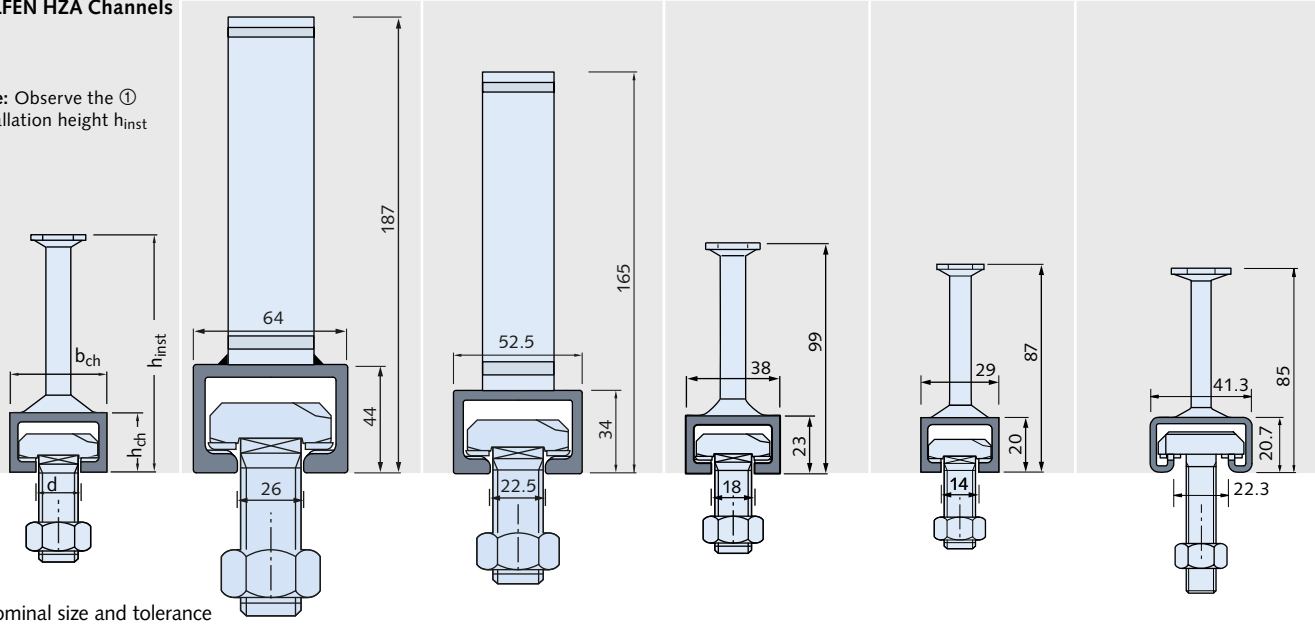
HALFEN HZA CAST-IN CHANNELS
Areas of Application

Material and area of application				
Area of application	Use only possible if all fixture components are protected by a minimum concrete cover, depending on environmental conditions, as specified in DIN EN 1992-1-1:2011-01.	For interior use only, for example; in residential, office and school buildings, hospital and retail facilities, not suitable for wet rooms.	For use in building components in rooms with normal humidity (including kitchens, bathrooms, laundry rooms in residential buildings).	Building components, corrosion class III, according to EN 1993-1-4, table A.3.
Channel profile	Mill finish	Hot-dip galvanized (thickness ≥ 50 µm)	Hot-dip galvanized (thickness ≥ 50 µm)	Stainless steel 1.4404/1.4571
Anchor	Mill finish	Hot-dip galvanized (thickness ≥ 50 µm)	Hot-dip galvanized (thickness ≥ 50 µm)	Welded anchor mill finish ②
			Bolt anchor in stainless steel 1.4404/1.4571	Stainless steel 1.4404/1.4462 1.4571/1.4578
Bolts, nuts, washers	No corrosion protection	Zinc galvanized (thickness ≥ 5 µm) Mechanically galvanized (thickness ≥ 10 µm)	Hot-dip galvanized ① (thickness ≥ 40 µm)	Stainless steel A4-50 FA-70 A4-70

① Or zinc galvanized with special coating, thickness > 12 µm.
② Only allowed for profiles 38/23, 53/34, 64/44 and 41/22.
For corrosion protection of the welded anchors a minimum concrete cover c is given:
for profile (38/23) 30 mm; (41/22) 30 mm; (53/34) 40 mm; (64/44) 50 mm.

Available HZA					
Profile	**HZA 64/44** DYNAGRIP	**HZA 53/34** DYNAGRIP	**HZA 38/23** DYNAGRIP	**HZA 29/20** DYNAGRIP	**HZA 41/22**
Geometry HALFEN HZA Channels	hot-rolled				cold-rolled

Note: Observe the ① installation height h_{inst}



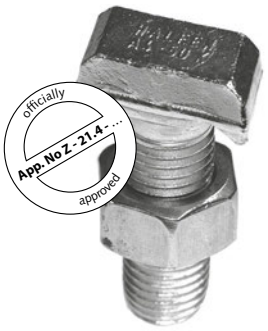
① Nominal size and tolerance

F_{Rd}	37.8 kN all load directions	26.6 kN / 30.8 kN all load directions		16.8 kN all load directions	11.2 kN all load directions	7.0 kN all load directions
Material	■ ■	■ ■		■ ■	■	■ ■
Bolt	HZS 64/44	HZS 53/34		HZS 38/23	HZS 29/20	HZS 41/22

■ **FV** = Steel hot-dip galvanized 1.0038/1.0044
■ **A4** =Stainless steel 1.4571/1.4404
Suitable for dynamic loads

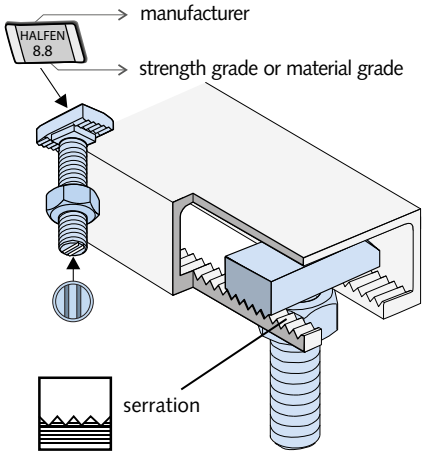
HALFEN HZA CAST-IN CHANNELS
HALFEN HZS Bolts

Available HALFEN HZS Bolts

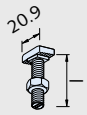
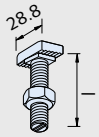
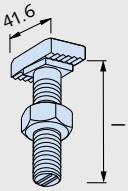
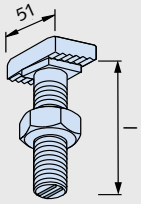
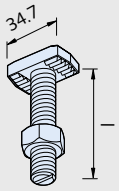


HALFEN Bolt, serrated

- The serration also ensures a positive load transmission in the longitudinal channel direction. The danger of bolt slippage is minimized.
- The bolt is marked on the shaft end with **2 notches.**



HALFEN HZS Bolts

Suitable for profile	HZA 29/20	HZA 38/23		HZA 53/34		HZA 64/44		HZA 41/22	
Bolt	**HZS 29/20**	**HZS 38/23**		**HZS 53/34**		**HZS 64/44**		**HZS 41/22**	
Bolts dimensions									
Ø / l [mm]	**M12**	**M12**	**M16**	**M16**	**M20**	**M20**	**M24**	**M12**	**M16**
30	GVs8.8	GVs8.8							
35								A4-50 FV8.8	
40	GVs8.8	GVs8.8	GVs8.8						
50	FV8.8* GVs8.8	FV8.8* GVs8.8	GVs8.8					A4-50 FV8.8	A4-50 FV8.8
60	GVs8.8	GVs8.8	A4-70 FV8.8 GVs8.8	A4-70 FV8.8* GVs8.8					
65					FV8.8* A4-70 GVs8.8				
80	GVs8.8	GVs8.8	A4-70 FV8.8* GVs8.8	FV8.8*	FV8.8*	A4-70* FV8.8* GVs8.8*	A4-70* GVs8.8*	A4-50	
100		GVs8.8	GVs8.8	A4-70 FV8.8* GVs8.8	A4-70 GVs8.8		FV8.8*		FV8.8
125						A4-70* GVs8.8*			
150			GVs8.8				A4-70* GVs8.8*		

*on request

HALFEN HZA CAST-IN CHANNELS

HALFEN HZA Channels: Standard Lengths/HALFEN HZA Channels Curved Solution

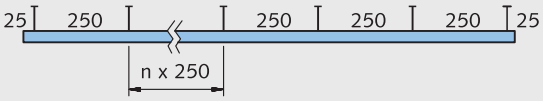
HALFEN HZA Channels — Standard lengths and Anchor positions

Standard lengths — Project related orders

HZA 38/23, 41/22, 53/34, 64/44

Length [mm] / Number of anchors

1050 / 5	**1300** / 6	**1550** / 7	**1800** / 8
2050 / 9	**2300** / 10	**2550** / 11	**2800** / 12
3030 / 13	**3300** / 14	**3550** / 15	**3800** / 16
4050 / 17	**4300** / 18	**4550** / 19	**4800** / 20
5050 / 21	**5300** / 22	**5550** / 23	**5800** / 24

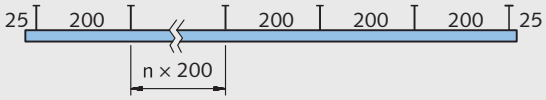


Standard lengths — Project related orders

HZA 29/20

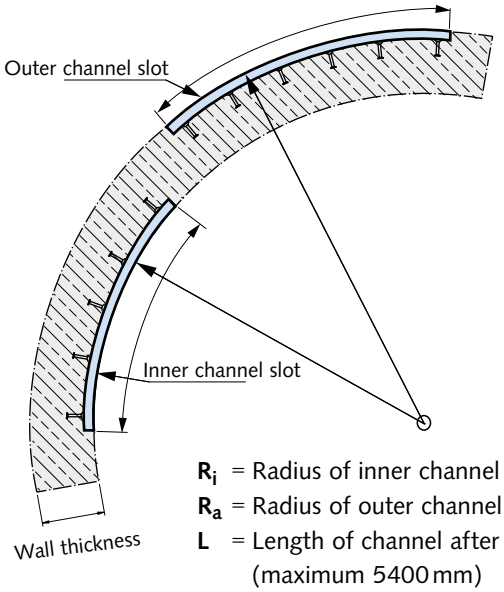
Length [mm] / Number of anchors

1250 / 7	**1450** / 8	**1650** / 9	**1850** / 10
2050 / 11	**2250** / 12	**2450** / 13	**2650** / 14
2850 / 15	**3030** / 16	**3250** / 17	**3450** / 18
3650 / 19	**3850** / 20	**4050** / 21	**4250** / 22
4450 / 23	**4650** / 24	**4850** / 25	**5050** / 26
5250 / 27	**5450** / 28	**5650** / 29	**5850** / 30



See HALFEN Price list for standard product range (short channels etc.)

HALFEN HZA Channels curved solution



R_i = Radius of inner channel slot
R_a = Radius of outer channel slot
L = Length of channel after bending (maximum 5400 mm)

Areas of application:

- tunnel construction
- reinforced concrete tunnels for utilities
- curved walls
- sewage plants

Ordering example:

HALFEN Cast-in channel, curved
HZA-CS 38/23-Q - A4, R_i = 4000 mm, L = 1050 mm

Curved HALFEN Cast-in channels in tunnel segments

Smallest radius [m]*

Profile / Material	HZA-CS 64/44	HZA-CS 53/34	HZA-CS 38/23	HZA-CS 29/20	HZA-CS 41/22
Inner channel slot: min. R_i ▫	on request	on request	2.60 m	0.85 m	0.70 m
Inner channel slot: min. R_i ▪	on request	on request	1.20 m	-	0.70 m
Outer channel slot: min. R_a ▫	on request	on request	1.40 m	1.10 m	2.20 m
Outer channel slot: min. R_a ▪	on request	on request	3.50 m	-	4.80 m

▫ hot-dip galvanized ▪ A4 stainless steel

* please contact our technical support for more detailed information

HALFEN HZA CAST-IN CHANNELS
Calculation

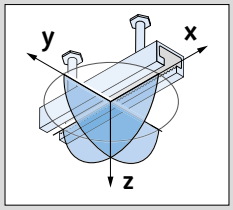
HZA DYNAGRIP Design resistance calculation value F_{Rd}

Design resistance F_{Rd}

F_{Rd} with simultaneous loading in **all directions**

Concrete ≥ C30/37 ①

$$F_{Ed} = \sqrt{N_{Ed}^2 + V_{xEd}^2 + V_{yEd}^2} \le F_{Rd}$$



		single loads ③	load pairs ④		
		F_{Rd} [kN]	F_{Rd} [kN] ②		
		$b_i \ge 250$	$p_i \ge 50$	$p_i \ge 100$	$p_i \ge 150$
Profile HZA DYNAGRIP	64/44	37.8	–	22.4	–
	53/34	30.8 26.6 (for profiles in A4)	–	19.3	–
	38/23	16.8	9.4	10.7	12.0
	29/20	11.2	6.3	7.6	9.0

s = Anchor spacing, see page 32

① The load spacings must be increased by a factor of 1.25 for concrete strength class C20/25, or 1.15 for concrete strength class C25/30. Alternatively the design resistances may be reduced by using the reciprocal values.
② Interim values may be linearly interpolated.
③ With loading at the end of the channel, the load distance to the next single load must be increased to x_s (≙ b_1). For HZA 53/34 and HZA 64/44 → b_1 ≥ 275 mm, for HZA 38/23 → b_1 ≥ 265 mm, for HZA 29/20 → b_1 ≥ 250 mm.
④ With loading at the end of the channel, the load distance to the next load pair must be increased to x_s (≙ b_1). For HZA 53/34 and HZA 64/44 → b_1 ≥ 100 mm.

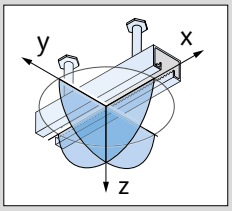
HZA Profile 41/22: Design resistance calculation value F_{Rd}

Design resistance F_{Rd}

F_{Rd} with simultaneous loading in **all directions**

Concrete ≥ C30/37

$$F_{Ed} = \sqrt{N_{Ed}^2 + V_{xEd}^2 + V_{yEd}^2} \le F_{Rd}$$



		single loads	load pairs ⑤
		F_{Rd} [kN]	F_{Rd} [kN]
		$b_i \ge 250$	$b_i \ge 250$, $p_i \ge 100$
Profile HZA	41/22	7.0	4.9

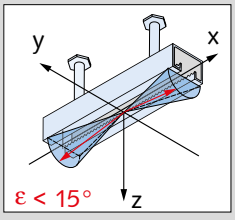
s = Anchor spacing, see page 32

Design resistance F_{Rd}

F_{Rd} with transverse load
Paired loads

Concrete ≥ C30/37

$$F_{Ed} = \sqrt{N_{Ed}^2 + V_{xEd}^2 + V_{yEd}^2} \le F_{Rd}$$



		load pairs	Calculation criteria ⑥
		F_{Rd} [kN]	
		$b_i \ge 450$, $p_i \ge 50$	$\beta = \arccos\left(\frac{V_{xEd}}{\sqrt{N_{Ed}^2 + V_{xEd}^2 + V_{yEd}^2}}\right) < 15°$
Profile HZA	41/22	7.0	

s = Anchor spacing, see page 32

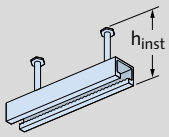
⑤ With simultaneous tension and shear stress perpendicular to the channel axis and shear load parallel to the channel axis, the load resultant F_{Rd} of the load pair must not exceed 4.9 kN.
⑥ If β > 15° the design load must be reduced to 4.9 kN.

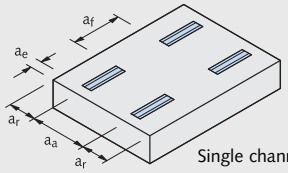
HALFEN HZA CAST-IN CHANNELS
Dimensioning

Minimum spacing a_r, a_e, a_a, a_f and h

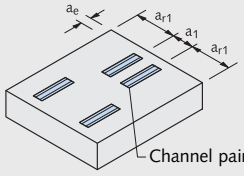
officially App. No Z-21.4 approved

Minimal spacing HALFEN Channel HZA [mm]

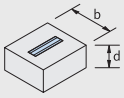




Single channel



Channel pair



Minimum component size

	a_r			a_a			a_e			a_f		a_{r1} ③	a_{a1} ③	a_{e1} ③	b①			h_{min} ②
	non-reinforced		rein-forced ④	non-reinforced		rein-forced ④	non-reinforced		rein-forced ④	non-rein-forced	rein-forced ④				non-reinforced		rein-forced	
	2 Anchors	> 2 Anchors		2 Anchors	> 2 Anchors		2 Anchors	> 2 Anchors							2 Anchors	> 2 Anchors		
HZA 64/44⑤	345	600	250	690	1200	500	720	1000	215	450	450	-	-	-	690	1200	500	225
HZA 53/34⑤	340	535	200	680	1070	400	700	950	165	350	350	-	-	-	680	1070	400	170
HZA 38/23⑤	200	335	150	400	670	300	410	550	130	250	250	90	180	170	400	670	300	120
HZA 29/20⑤	120	190	110	240	380	220	240	330	90	220	220	55	110	150	240	380	220	120
HZA 41/22⑤	90	150	110	180	300	220	200	230	90	220	220	50	100	150	180	300	220	120

① Minimum component width b = 2 x a_r applies to single channel configuration.
② Values are minimum values. $h_{min} \geq h_{inst} + c_{nom}$ must always be observed.
(h_{inst} is determined by channel height and anchor length. Required concrete cover "c_{nom}" according to EN 1992-1-1 (EC2), section 4.4.1.)
③ Only for centric tensile stress. To account for cracked concrete the spacings a_{r1} and a_{r2} must be doubled or alternatively the design resistances may be reduced by a factor of 1.4 (not required for HZA 41/22).
④ Reinforcement layout, see below.
⑤ All values (non-reinforced concrete) apply to non-cracked, concrete strength class C30/37 or higher. To account for cracked concrete the spacings must be increased by a factor of 1.5. Alternatively the design resistances may be reduced by factor 1.4. Reinforced concrete is assumed as cracked. For concrete strength class C20/25 the spacings must be increased by 1.25, and for concrete strength class C25/30 by 1.15. Alternatively the design resistances may be reduced by the reciprocal values. (except for h_{min}).

Minimum reinforcement

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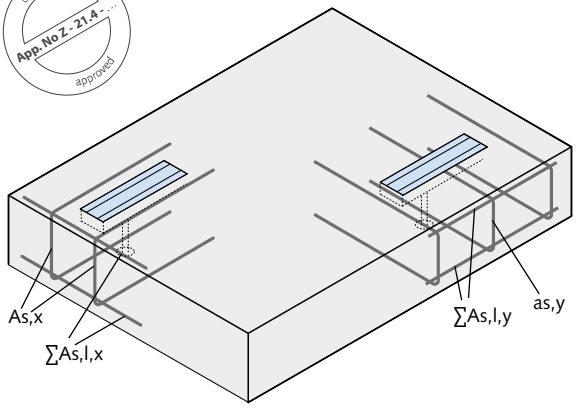
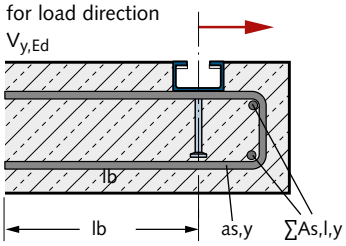
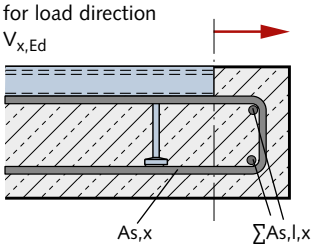


Min. reinforcement for load direction $V_{y,Ed}$



Min. reinforcement for load direction $V_{x,Ed}$



⑥ Symmetrically arranged, distributed over the whole anchor channel and beyond the channel length by a_r (c_{min} must be observed); anchoring length l_b according to EN 1992-1-1
⑦ At least one reinforcement bar installed at the edges.
⑧ Close to the anchors.

Minimum reinforcement

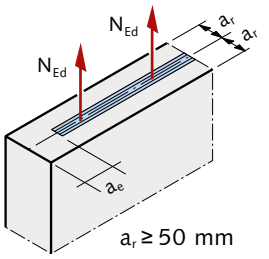
Profile	for load direction $V_{x,Ed}$	for load direction $V_{y,Ed}$	
	$A_{s,x}$ ⑧	$a_{s,y}$ ⑥	$\sum A_{s,lx}$ resp. $\sum A_{s,ly}$ ⑦
HZA 64/44	2Ø10	Ø10/200	2Ø10
HZA 53/34	2Ø8	Ø8/200	2Ø10
HZA 38/23	2Ø8	Ø8/200	2Ø10
HZA 29/20	2Ø6	Ø6/200	2Ø10
HZA 41/22	2Ø6	Ø6/200	2Ø10

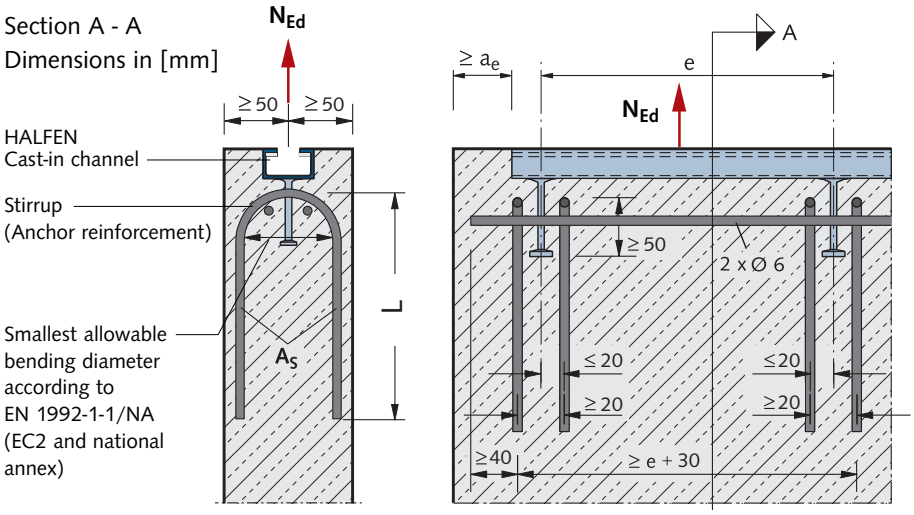
Dimensioning

Reduced edge distance a_r, with full centrical tensile stress

Preconditions for reducing the edge distance to 50 mm

Where minimum structural spacing cannot be maintained when installing HALFEN Channels, **HZA 41/22, 29/20 and 38/23,** for example, in thin façade panels, the distance to the edge a_r may be reduced to 50 mm, if additional anchor reinforcement as shown in figure 1 is used for the anchor loads and tensile splitting.





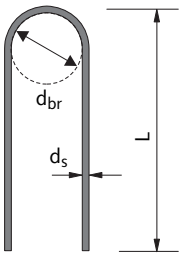


Figure 1: Additional reinforcement

Required reinforcement cross section

A_S [cm²] stirrup rebar:

$$\text{req. } A_s = \frac{F_{Ed}\,[kN]}{4 \times \sigma_{Rd}\,[kN/cm^2]} = \frac{F_{Ed}}{44}\ cm^2$$

Steel stress

σ_{Rd} = **11.0 kN/cm²**

Approval no. Z-21.4-145 (HZA), Z-21.4-1691 (HZA DYNAGRIP) for this example.

Required stirrup dimensions

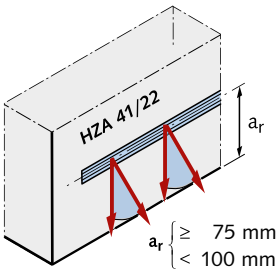
Profiles	stirrup dimensions [mm]		
	L	ds	d_{br}
HZA 29/20, 41/22	250	6	24
HZA 38/23	250	8	32

Additional reinforcement for HZA 41/22 with edge distance ≥ 75 mm and < 100 mm

Additional reinforcement for edge distance for HALFEN Channels **HZA 41/22** from 75 mm ≤ a_r < 100 mm and loads perpendicular to the edge (figure 2). According to approval, Z-21.4-145 annex 6.

$$\text{req. } A_s = \frac{F_{Ed}\,[kN]}{\sigma_{Rd}\,[kN/cm^2]} = \frac{F_{Rd}}{11.2}\ cm^2$$

σ_{Rd} → see above



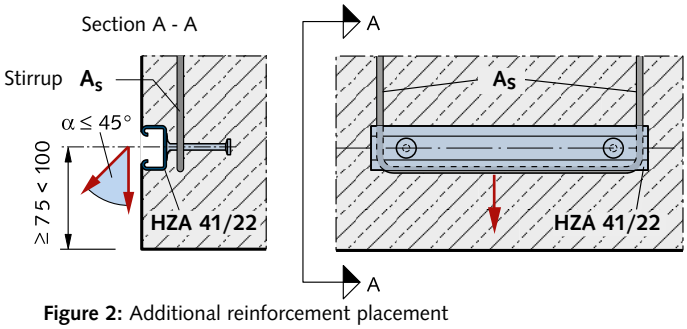


Figure 2: Additional reinforcement placement

HALFEN HZA CAST-IN CHANNELS
HALFEN Bolts: Dimensioning

HALFEN HZS Bolts — Load capacity and bending moment

Bolts type HZS — Design values F_{Rd} and M_{Rd} ①

 Bolt type	Grade 8.8		Stainless steel A4-50, HCR-50		Stainless steel A4-70	
	F_{Rd} [kN]	Bending moment for each bolt ② M_{Rd} [Nm]	F_{Rd} [kN]	Bending moment for each bolt ② M_{Rd} [Nm]	F_{Rd} [kN]	Bending moment for each bolt ② M_{Rd} [Nm]
29/20 - M12	27.0	83.8	–	–	–	–
38/23 - M12	27.0	83.8	–	–	–	–
38/23 - M16	50.2	213.1	–	–	42.2	149.4
41/22 - M12	27.0	83.8	10.6	27.5	–	–
41/22 - M16	50.2	213.1	19.8	70.0	–	–
53/34 - M16	50.2	213.1	–	–	42.2	149.4
53/34 - M20	78.4	415.4	–	–	66.0	291.3
64/44 - M20	78.4	415.4	–	–	66.0	291.3
64/44 - M24	113.0	718.4	–	–	95.1	503.7

① Observe profile load bearing capacity! If the load bearing capacity of the bolt and the HALFEN Cast-in channel differ, use the smaller of both values.
② Bending moment in the profile or concrete edge; see note below if bending with additional centric or diagonal tensile stress occurs.

Variable bending stress:
For façades renders subjected to variable stress conditions (e.g. due to temperature change), the alternating stress amplitude must not exceed a value of $\sigma_A = \pm 50$ N/mm² (γ=1.0) with a mean value of σ_M (relative to the stressed cross section of the bolt).

$$N_{Ed} \leq F_{Rd} \times (1 - M_{Ed} / M_{Rd})$$

F_{Rd} = Bolt design load capacity
M_{Rd} = Design value of possible bending moment
N_{Ed} = Design value of actual tensile load
M_{Ed} = Design value of actual bending moment

Note:
Combine stress values if bending occurs with additional centric or diagonal tensile stress.

Torque values for HALFEN Bolts

Torque values [Nm]

Bolt type / Material / Grade / Thread	**HZS 64/44 8.8**	HZS 64/44 A4-70	**HZS 53/34 8.8**	HZS 53/34 A4-70	**HZS 41/22 8.8**	HZS 41/22 A4-50	**HZS 38/23 8.8**	HZS 38/23 A4-70	**HZS 29/20 8.8**
M12	–	–	–	–	50	50	80	–	80
M16	–	–	200	200	120	80	120	120	–
M20	350	350	350	350	–	–	–	–	–
M24	450	450	–	–	–	–	–	–	–

Torque values apply only for bolts in delivery condition (unlubricated).

HALFEN CAST-IN CHANNELS HZA AND HTA
Dynamic Loading

Dynamic loads for hot-rolled HALFEN Cast-in channels

The stress amplitudes shown here only apply to anchor channels made of the specified material and with the specified anchor types.

Only the corresponding bolts according to the tables on this page are allowed.

Allowable amplitude / HALFEN HZA Channels, serrated

Allowable stress amplitude for load cycle n = 2 × 10⁶

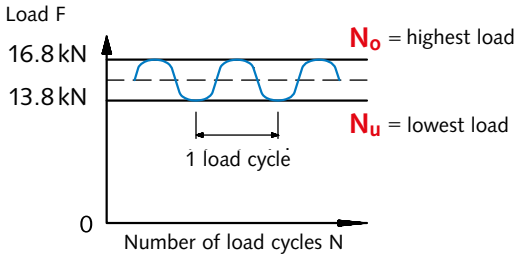
Profile, anchor configuration ①	Material	Allow. stress amplitude $\Delta F = F_o - F_u$ [kN] for tensile stress	Approved bolts
29/20-B6, 29/20-Q	1.0044	2.0	M 12
38/23-B6, 38/23-Q	1.0044	3.0	M 16
	1.4404/1.4571	2.4	
53/34-B6, 53/34-Q	1.0044	6.0/(12②)	M 16, 20
	1.4404/1.4571	4.0/(10②)	
64/44-Q/L②	1.0044	15.0②	M 20, 24
	1.4404/1.4571	11.0②	

① **Anchor configuration:**
B6: with bolt anchor
Q: with I-anchor welded transverse to the channel
Also see approval Z-21.4-1691
② values apply for anchor channels with weld-on anchors type I 140/7.1 with anchor orientation Q (crosswise), weld joint position L (lengthwise)

Example:
HZA 38/23 profile - FV (standard, hot-dip galvanized), channel length = 250 mm

max. load: $F_{Rd} = N_0 = 16.8$ kN

of which dynamic load:
3 kN (stress amplitude Δ F)



Design resistance / HALFEN HTA Channels

Design resistance for n = 2 × 10⁶ load cycles

Profile HTA	Type	$\Delta N_{Rd,s,0,n}$	Allowable bolts	Material
40/22P	FV	2.94	M12 M16	8.8 4.6 / 8.8
50/30P	FV	3.6	M16 M20	4.6 / 8.8 4.6 / 8.8
52/34	FV	4.9	M16 M20	8.8 8.8

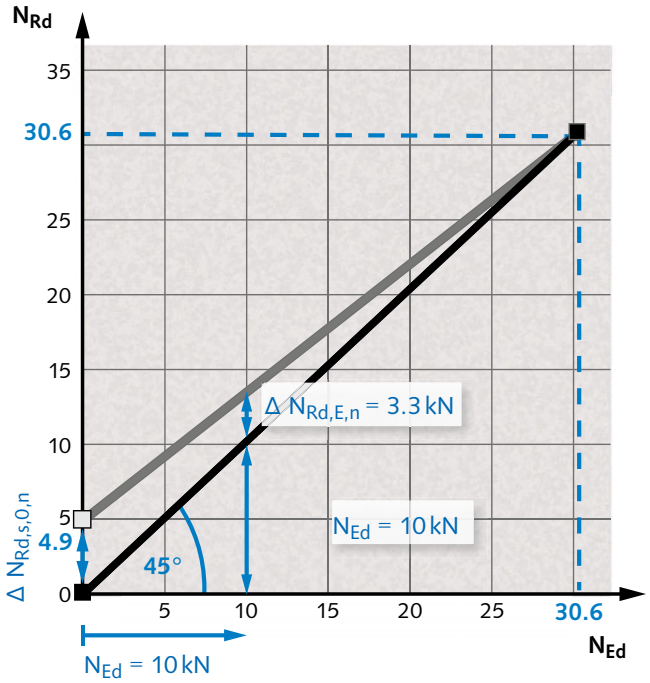
Example (also see diagram to the right):
Profile HTA-CE 52/34 - FV (standard, hot-dip galvanized), for n = 2 × 10⁶ load cycles:

N_{Rd} = 55 ÷ 1.8 = 30.6 (taken from the ETA)

N_{Ed} from permanent load = 10 kN (assumption)

$\Delta N_{Rd,E,n}$ = (30.6 − 10) × 4.9/30.6 = 3.3 kN

Diagram: HTA-CE 52/34 - FV for n = 2 × 10⁶ load cycles



HGB HANDRAIL CONNECTIONS
The advantages at a glance

Construction specialists consider the HALFEN HGB Handrail connections to be particularly suited for fastening railings and banisters to the thin front faces of balcony slabs

HALFEN HGB Handrail connections profile
HGB E-54/33-A4

Safe and reliable
- statically verified installation
- no damage to visible surfaces of concrete slabs
- also suitable to secure mandatory safety rails during construction (Refer to: EN 795 "Guard rails")
- use with HALFEN high-strength bolts to ensure a relible and statically sound connection of railing/banister components

Fast and cost-effective
- adjustable anchorage
- can also be used in slabs as thin as h ≥ 100 mm
- installed with bolts instead of welding or drilling
- pre-planning reduces on-site construction time
- all attached components remain fully adjustable or are easily replaced as required

HALFEN HGB Handrail connections profile
HGB E-49/30-A4

HALFEN HGB Handrail connections profile
HGB E-40/25-A4

HALFEN HGB Handrail connections profile
HGB E-38/17-A4

HALFEN HGB HANDRAIL CONNECTION
Application Examples

SAFETY BARRIERS IN STADIUMS

①-④: Safety barrier installation, multi purpose arena in Berlin

Fixing of safety rails, Rheinenergiestadion Cologne

Fixing of safety rails, Rheinenergiestadion Cologne

RAILINGS

Used to secure safety rails during the construction phase

Cast-in HGB Channel, residential building

HALFEN HGB HANDRAIL CONNECTION
General

Regulatory requirements

Balconies are part of the structural system. *"They must be designed, constructed, maintained and modified in such a fashion that public order and safety, especially to health or life, is not endangered"*. Model building code and construction guidelines (*Musterbauordnung MBO 07 und Ausführungsvorschriften*).

Technical guidelines issued by public notice as technical building regulations must be observed.* Technical rules provide information on load parameters, calculation, dimensioning of structural products, construction types, structural layouts etc. A requirement of regional building codes refers to structural stability: *"All structures must, as a whole and in their individual components, be structurally self-supporting"*. This stability must be statically verifiable based on current technical standards.

A further building regulation addresses traffic loads, for example: Balconies and loggias must be fitted with safety rails to prevent falls when they border on to an area with a drop of more than one metre. For a drop height up to 12 m the minimum railing height is 0.90 m measured from the upper surface of the finished floor surface or accessible ledge. For drop heights greater than 12 m the banister height must be at least 1.10 m. For exceptions see the German federal building regulations / Deutsche LandesBauOrdnung.

Other regulations, not covered here, address the design, dimensioning, required spacings in the guard rail design, fire protection, thermal/sound insulation and rainwater drainage.

*issued by the highest construction supervision authorities of the German Federal States

Regulations, standards and directives (to be observed when designing safety rails)

Regional Building Codes

Individual regional states have their own building codes and regulations. All current technical regulations require proof of structural safety and integrity. A static calculation or a building authority certificate is required when designing and dimensioning the fixings for guard rails.

VOB — Part B, § 4, execution of construction:

§ 4.2 (1) It is the contractor's responsibility to provide the static documentation in accordance with the contract. He has to observe the recognized standards of practice as well as with the provisions of the law and regulatory directives. Tender and Contract Regulations for the German building industry (*VOB Vergabe- und Vertragsordnung für Bauleistungen*) Part B, § 4.3, requires the contractor to report to the customer, in writing, any obvious design flaws, which he as the expert must be able to recognize. He alone is responsible for any resulting defect and consequential expenses. If he has satisfied his reporting obligation, the responsibility for the defect passes to the customer (defect example: banister attachment mounted in a concrete slab which is too thin).

BVM Directive

Directive on metal railings/banisters/balustrades, published by Federal Association of German Metalworkers (*BVM Berufsverband Metall*).

Other applicable regulations and standards (Extract):

- Accident Prevention Regulation "General Provisions" (DGUV Regulation 1)
- Industrial Safety Regulations
- ETB – Directive "Fall Prevention Installations", Publ. 1985
- Stainless Steels, EC3 part 1-4

EN 1992-1-1 (EC2):	Design and construction of concrete support structures; with National Annex (NA)
EN 1991 (EC1):	General effects on load structures; with National Annex (NA)
EN 1993 (EC3):	design and construction of steel structures; with National Annex (NA)

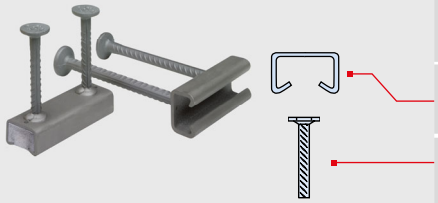
HALFEN HGB HANDRAIL CONNECTION
Materials/Corrosion Protection

Stainless Steel A4:
Chromium is the most important alloy element in stainless steel. A specific chromium concentration ensures the generation of a passive layer on the surface of the steel that protects the base material against corrosion. This explains the high corrosion resistance of stainless steel.

Stainless Steel

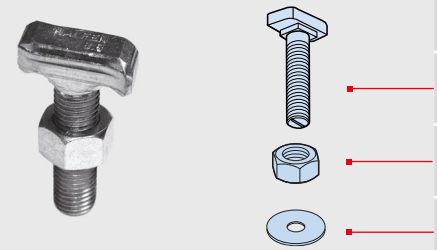
"Anchor channels in stainless steel may be used outdoors – also in an industrial and coastal environment, but may not be directly exposed to salt water".
See guidelines for "Metal railings, banisters and balustrades" issued by the German Association of Metalworkers (*BVM Bundesverband der Metallverarbeiter*).

HALFEN Cast-in channels, stainless steel



Description	Stainless steel		
	Materials	Standard	Corrosion resistance class according to EN 1993-1-4, table A.3
Channel profile	1.4404 or 1.4571 ■	EN 10 088	III
Ribbed-head anchor	Reinforcing steel B500B □ Reinforcing steel BSt 500 NR ■	DIN 488	

HALFEN Bolts, stainless steel



Description	Stainless steel		
	Materials	Standard	Corrosion resistance class according to EN 1993-1-4, table A.3
Bolt	A4-70: 1.4404 or 1.4571 ■	EN 3506-1 and EN 10 088	III
Hexagonal nut	A4-70: 1.4404 or 1.4571 ■	EN 3506-2 and EN 10 088	III
Washer	1.4404 or 1.4571 ■	EN 10 088	III

□ **WB** = Steel mill finish

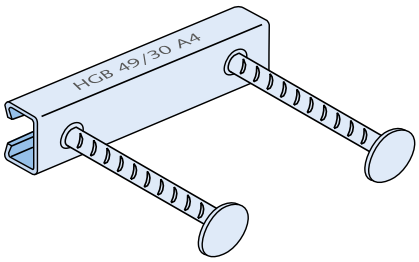
■ **A4** = Stainless steel

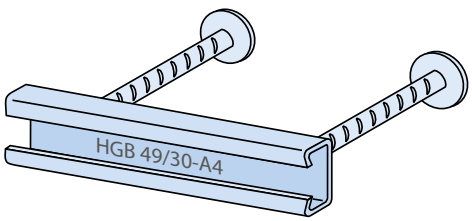
Galvanized:
Dipped in a galvanizing bath at a temperature of approximately 460°C, a method used primarily for open-profile channels.

Galvanized material for interior, dry rooms, for instance when installing staircase railings and banisters in residential buildings, schools or commercial retail stores.

Available on request

Identification of HALFEN HGB Cast-in channels

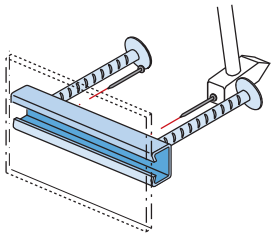




Product identification
- on channel side
- additionally inside the profile

HALFEN HGB HANDRAIL CONNECTION
Installation/Assembly

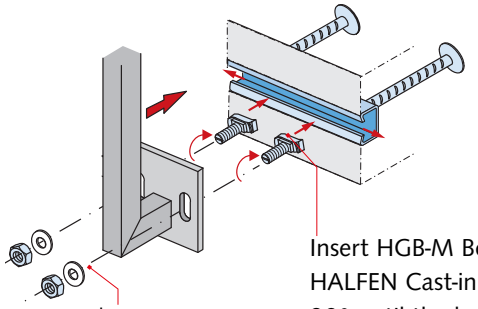
1 Nail the HALFEN Cast-in channel to the formwork



Where possible, use stainless steel nails to avoid corrosion.
After striking the formwork remove the foam filler from the HALFEN Cast-in channels.

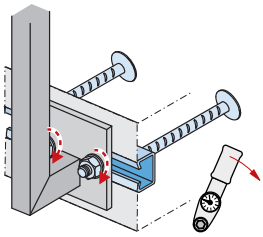
Nail the HALFEN Cast-in channel to the formwork

2 Installation and adjustment of balustrades



Insert HGB-M Bolts into the HALFEN Cast-in channel (turn 90° until the bolt locks into place).

3 Tighten the bolts

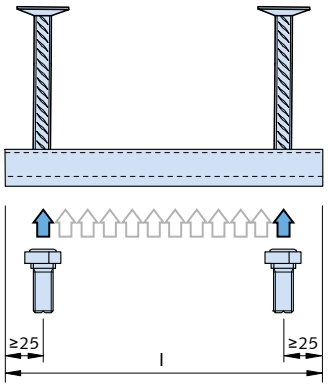


Tighten the nuts using a torque wrench. See table on the right for torque values

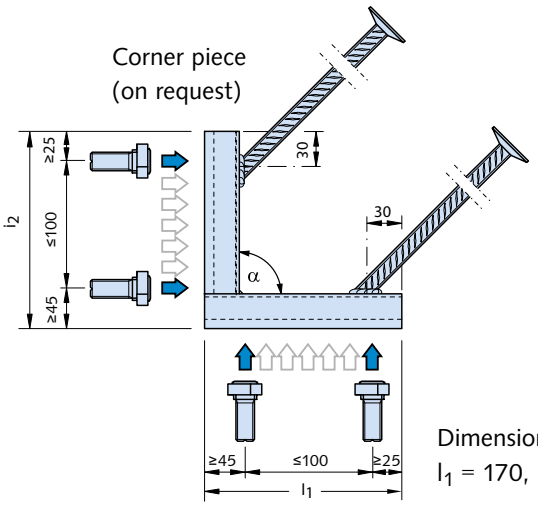
Railing bolts			
Stainless steel Material grade A4-70		**Torque [Nm]**	
HS 50/30		M16	60
for profile 49/30 and 54/33		M12	25
HS 40/22		M16	45
for profile 40/25		M12	25
HS 38/17		M16	40
for profile 38/17		M12	25

Fixing position of the bolts

Short piece



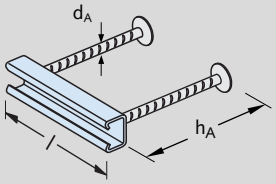
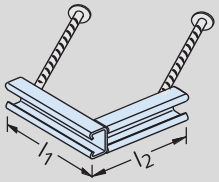
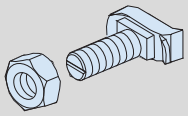
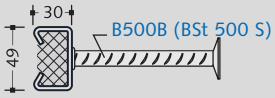
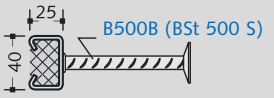
Corner piece
(on request)



Dimensions [mm]:
l_1 = 170, l_2 = 170, α = 90°

HALFEN HGB HANDRAIL CONNECTION
Product Range

HALFEN HGB Cast-in channels and bolts

Item description		Dimensions HGB-E [mm]			Dimensions HGB-EE [mm]				HALFEN HGB Bolts	
										
	l	d_A	h_A	Weight kg/each G	l_1 / l_2	d_A	h_A	Weight kg/each G	Type / FK	Dimensions
HGB E - 54/33-A4 	100	14	200	1.071	170/170	14	250	2.262	HS-50/30 A4-70	M12×40 M16×50
	150			1.307						
	200			1.543						
HGB E - 49/30-A4 	100	12	110	0.704	170/170	14	150	1.501	HS-50/30 A4-70	M12×40 M16×50
	150			0.855						
	200			1.007						
HGB E - 40/25-A4 	100	10	90	0.611	170/170	14	90	1.042	HS-40/22 A4-70	M12×40 M16×40
	150			0.717						
	200			0.822						
HGB E - 38/17-A4 	100	10	201	0.824	170/170	12	201	1.214	HS-38/17 A4-70	M12×40 M16×40
	150			0.911						
	200			0.999						

A4 = Stainless steel 1.4571/1.4404 **Alternative for interior use** (on request) **FV** = Steel hot-dip galvanized 1.0038/1.0044

Ordering and materials

Ordering example HGB channel:

HGB-E-49/30 - 200 - A4
- A4 → material
- 200 → length [mm]
- HGB-E-49/30 → description

Ordering example HALFEN Bolt:

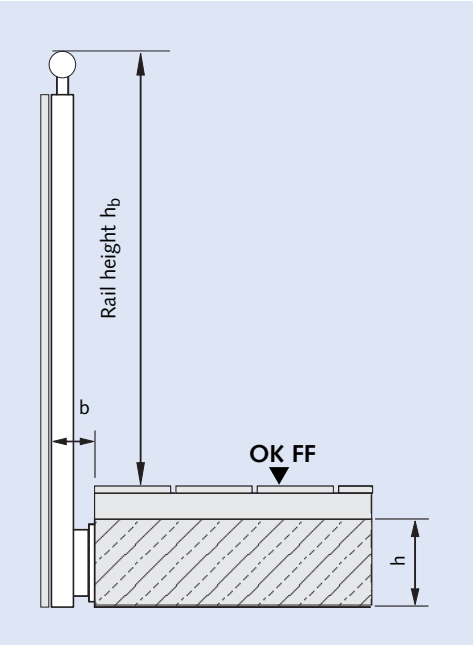
HS-50/30 - M12x40 - A4-70
- A4-70 → material
- M12x40 → thread-Ø × length
- HS-50/30 → description

HALFEN HGB HANDRAIL CONNECTION
Dimensioning Fundamentals

Railing height

The minimum height h_b of a railing is 0.90 m from the top surface of the finished floor or accessible ledge to the upper edge of the rail. For drop heights of more than 12.0 m the railing must be at least 1.10 m in height. (Exceptions; as specified in regional building codes)

It would be advisable to have one uniform minimum height of 1.00 m as has already been mandated in the commercial sector and in a number of European countries.



b = clear distance between the back of the balcony cladding and the front face of the balcony slab or gutter / kick plate

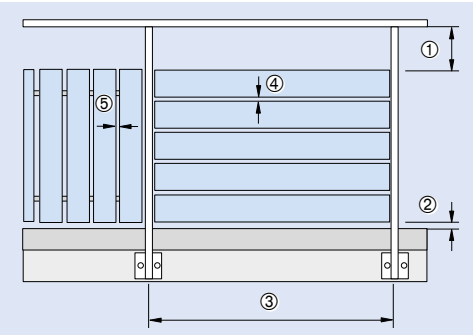
Balcony slab

Anchor channels or dowel installations require concrete of at least C 20/25 grade. A case-by-case decision must be made if the concrete grade is less than C 20/25 grade or is unknown.

The thickness of the balcony slab must be at least h = 100 - 150 mm when the HGB is cast in the slab edge (depends on channel profile and according to the German HGB approval). Other types of installation and systems require a thicker slab. All weather-exposed concrete-embedded installations (e.g. for balconies) must be made of stainless steel.

Spacings

Any structural design must take all basic requirements for railings and banisters into account. As a general rule, all railings and banisters must be designed so that personal injury is ruled out, for instance with correct spacing of rails, lattice bars or panels. They should also be designed so as not to entice but instead to discourage anyone from climbing over. The specific requirements for guard rail design are determined by the intended use (residential, public, commercial) and the drop height involved. Also observe the building codes of each country or region, the ETB guidelines "Fall Protection Components" and DIN 18065 (Stairs in Buildings — definition, rules, key measurements) and guard rail regulation applicable at the construction site. In Germany these are the Guardrail regulations 2012 set by the German Association of Metalworkers, (*"Geländer-Richtlinie 2012, BVM Berufsverband Metall"*) .



① clear distance between bottom edge of hand rail and top edge of facing / lower structure
② clear distance between the top edge of the finished floor and the bottom edge of the facing lower structure
③ axis spacing between posts
④ clear distance between horizontal facings
⑤ clear distance between vertical facings

HALFEN HGB HANDRAIL CONNECTION
Dimensioning

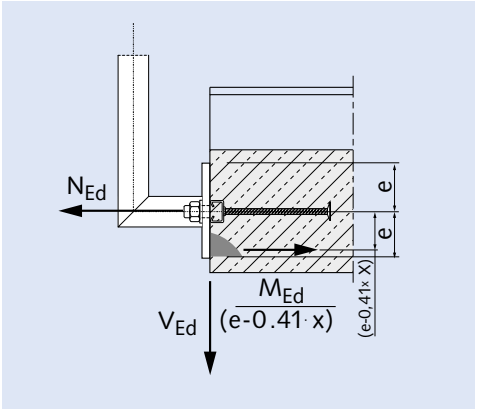
Dimensions

The forces acting on the railing must be transferred into the main building structure. It is necessary to verify that the forces

a) are wholly supported by the railing and

b) can be transferred via the connecting elements into the balcony slab.

$$N_{Ed} = \frac{M_{Ed}}{(e - 0.41 \cdot x)} + H_{Ed}$$



N_{Ed} = tensile force on the anchor
e = distance between channel axis and outer edge of the railing base plate
x = maximum concrete pressure zone level according to annex 8, table 8a and 8b

Railing heights

Drop height	Minimum height of rails (recommended)	Note
Less than 12 m	90 cm (100 cm)	Relevant regional building regulations and if necessary other regulations e.g. for civil constructions must be observed.
Greater than 12 m	110 cm	

Calculation

1. Railing/banister load h according to EN 1991-1-1/NA Table 6.12 DE

"Calculation must assume 100% traffic load in drop direction and 50 % of traffic load (but not less than 0.5 kN/m) in the opposite direction."

for example: residential buildings and communal areas with low foot traffic	**q_k = 0.5 kN/m**
for example: rooms for mass assembly, commercial sales spaces, corridors	**q_k = 1.0 kN/m**
for example: areas for large gatherings of people, factories, workshops	**q_k = 2.0 kN/m**

2. Vertical loads v according to BVM guidelines

Load assumptions to calculate vertical loads are according to the BVM guidelines for guard rails/banisters.

from dead weight of structure including any renders	**v_1 = 0.40 kN/m**
from window box	**v_2 = 0.35 kN/m**
support capacity	**v_3 = 0.15 kN/m**

3. Wind loads

F_w according to EN 1991-1-4 and EN 1991-1-4/NA

Velocity force q in kN/m² and and total wind pressure F_w are calculated according to EN 1991-1-4 with EN 1991-1-4/NA.

HALFEN HGB HANDRAIL CONNECTION
Dimensioning

Extract from HGB approval Z-21.4-1912, page 6

3.2.2 Actions and required verifications

The actions H_{Ed}, V_{Ed}, M_{Ed} and N_{Ed} have to be determined according to the calculation basics as in annex 7.
The ratio in the design calculation between horizontal action and bending moment is limited to:

$$\frac{H_{Ed}}{M_{Ed}} \leq 1.5\ [1/m] \qquad H_{Ed}\ [kN];\ M_{Ed}\ in\ [kNm]$$

It has to be verified that the design action value E_d does not exceed the design resistance value R_d:

$E_d \leq R_d$ see table 3.1 and 3.2 below
E_d = Design action value (N_{Ed}, V_{Ed}, M_{Ed})
R_d = Design resistance value (N_{Rd}, V_{Rd}, M_{Rd})

For a standard case the following equation for the design action value applies
(permanent load and variable load acting in the same direction):

$E_d = \gamma_G \cdot G_k + \gamma_Q \cdot Q_k$
$G_k; Q_k$ = characteristic value of permanent load or variable load according to recoqnized standards for load assumptions
$\gamma_G; \gamma_Q$ = partial safety factors for permanent and variable action

Extract from HGB approval no. Z-21.4-1912, page 7

Table 3.1 Required verifications for tensile loads	
Steel failure	$N_{Ed} \leq N_{Rd,s}$ $\leq N_{Rd,s,s}$ (for single-bolt fixing) $\leq 2\ N_{Rd,s,s}$ (for two-bolt fixing)
Pull out failure	
Concrete failure with anchor reinforcement	
Spalling	

Table 3.2 Required verifications for shear loads	
Steel failure	$V_{Ed} \leq V_{Rd,s}$ $\leq V_{Rd,s,s}$ (for single-bolt fixing) $\leq 2\ V_{Rd,s,s}$ (for two-bolt fixing)
Concrete failure with anchor reinforcement	
Concrete edge failure with anchor reinforcement	$V_{Ed} \leq V_{Rd,c}$
	$M_{Ed} \leq M_{Rd,c}$

With combined loads the following interactions must be verified:

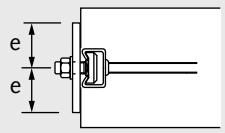
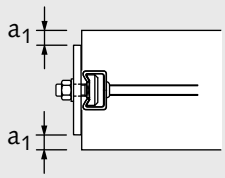
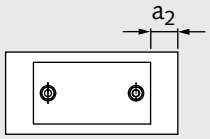
1. $\max.\ (\ N_{Ed} / N_{Rd,s}\ )^2 + \max.\ (\ V_{Ed} / V_{Rd,s}\ )^2 \leq 1.0$
   or
   $\max.\ (\ N_{Ed} / N_{Rd,s}\ ) + \max.\ (\ V_{Ed} / V_{Rd,s}\ ) \leq 1.2$

2. $M_{Ed} / M_{Rd,c} + 1.5\ V_{Ed} / V_{Rd,c} \leq 1.5$ for $0.333 \leq V_{Ed} / V_{Rd,c} \leq 1.0$

HALFEN HGB HANDRAIL CONNECTION
Dimensioning

Extract from HGB-approval no. Z-21.4-1912, annex 6

Table 6: Installation and anchor parameters

Description	Illustration	Anchor channels profiles			
		38/17	40/22 40/25	50/30 49/30	52/34 54/33
A) Profile shape and bolt positioning					
Minimum channel length required for a two-bolt fixing [mm]	annex 2	150	150	150	150
Minimum bolt distance p [mm]	see next page	80	80	80 (100) ①	80 (100) ①
B) Building element dimensions and anchor position in the element					
Minimum thickness of concrete element h [mm]	annex 8	100	120	140	150
Minimum edge distance c_1 [mm] (channel axis to the upper and the lower edge of the concrete element)	annex 8	50	60	70	75
Minimum distance a_e [mm] to edge of concrete element (from end of channel)	see next page	40	45	50	50
C) Size and position of anchor plate					
Minimum distance e [mm] from the channel axis to the upper and the lower edge of the anchor plate		30	30	35	37.5
Minimum distance a_1 [mm] from the upper and lower edge of the anchor plate to the upper and lower edge of the concrete element ②		10	10	10	10
Minimum distance a_2 [mm] from the outer edge of the anchor plate to the edge of the concrete element		40	45	45	45

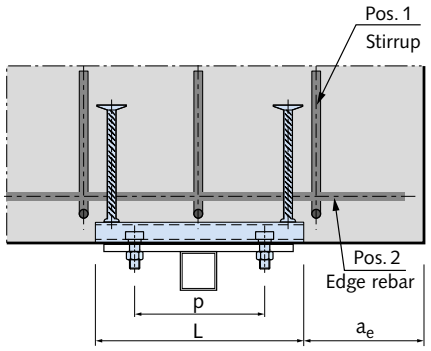
① The values in brackets apply when using M20 bolts
② In components with a weather groove, the bottom of the groove is regarded as the concrete element edge

HALFEN HGB HANDRAIL CONNECTION
Dimensioning

Extract; HGB approval no. Z-21.4-1912, annex 6

Table 7: Size and position of required minimum reinforcement				
Description	Anchor channels			
	38/17	40/25	49/30	54/33
Stirrup / Quantity	3 Ø 8 l_b = 200 mm	3 Ø 8 l_b = 250 mm	3 Ø 10 l_b = 300 mm	3 Ø 12 l_b = 400 mm
Edge rebar, top and bottom [mm]	Ø 8	Ø 8	Ø 10	Ø 12

Required minimum reinforcement:
One stirrup is placed centrally between the channel anchors and one stirrup directly next to each anchor at the channel ends (if positioned near to the edge, between the anchor and component edge).



Extract; HGB approval no. Z-21.4-1912, annex 8

Table 9: Design resistance for each bolt				
Tensile				
Bolts Ø		M12	M16	M20
$N_{Rd,s,s}$ [kN]	4.6	16.9	31.4	49.0
	8.8	44.9	83.7	130.7
	A4-, HC-50	14.8	27.4	42.8
	A4-70*	31.6	58.8	91.7
Shear				
$V_{Rd,s,s}$ [kN]	4.6	12.1	22.6	35.2
	8.8	27.0	50.2	78.4
	A4-, HC-50	10.6	19.8	30.9
	A4-70*	22.7	42.2	66.0

* Values also apply for all stainless steels of strength class 70 (see also HGB approval, annex 4)

Design resistance of concrete pressure zone

$$M_{Rd,c} = 0.81 \cdot x \cdot b \cdot \frac{f_{ck}}{\gamma_{Mc}} \cdot (e - 0.41 \cdot x)$$

where:

x = maximum height; concrete pressure zone (see table 8a and 8b)

b = width of pressure zone = width of anchor plate b_p

f_{ck} = characteristic compression strength of concrete in accordance with EN 206-1:2001-07, for concrete strength ≥ C30/37 only calculate using f_{ck} = 30 N/mm²

e = distance between anchor channel axis and outer edge of the anchor plate (see illustration on page 47, table 6)

γ_{Mc} = 1.5 (partial safety factor)

HALFEN HGB HANDRAIL CONNECTION
Dimensioning

Extract, HGB-approval no. Z-21.4-1912, annex 8

Table 8a: Design resistance of the channel using single-bolt fixing

Channel type		38/17	40/25	49/30	54/33
Minimum thickness of component h [mm]		100	120	140	150
Steel failure (single-bolt fixing)					
Tension	$N_{Rd,s}$ [kN]	10.0	11.1	17.2	30.6
Shear	$V_{Rd,s}$ [kN]	10.0	11.1	17.2	30.6
Concrete failure (single-bolt fixing)					
$V_{Rd,c}$ [kN]		6.7	9.0	11.7	12.7
Maximum height of concrete pressure zone x		0.25 · e ①	0.25 · e ①	0.30 · e ①	0.40 · e ①

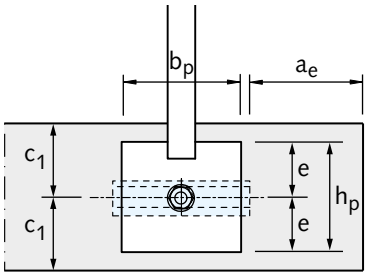
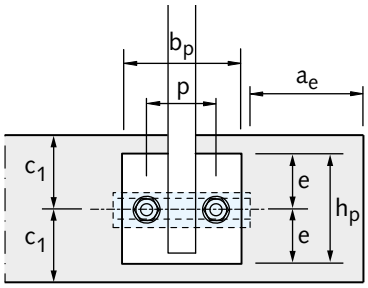


Table 8b: Design resistance of the channel using a two-bolt fixing

Profile		38/17	40/25	49/30	54/33
Minimum thickness of component h [mm]		100	120	140	150
Steel failure (two-bolt fixing)					
Tension	$N_{Rd,s}$ [kN]	15.0	16.7	25.8	45.8
Shear	$V_{Rd,s}$ [kN]	15.0	16.7	25.8	45.8
Concrete failure (two-bolt fixing)					
$V_{Rd,c}$ [kN]		6.7	9.0	11.7	12.7
Maximum height of concrete pressure zone x		0.25 · e ①	0.25 · e ①	0.30 · e ①	0.40 · e ①

① e = distance between the anchor channel axis and outer edges of the anchor plate. For asymmetrical anchor plates the smallest distance to the outer edge of the anchor plate is used for calculation.



Dimensioning example HALFEN HGB Guard rail fittings

M_{Ed} = used to calculate applicable moment relative to the channel axis

e_{V1}, e_{V2}, e_{V3} = distance of the vertical loads to the front edge of the channel

e_{h1}, e_{Fw} = distance of the horizontal loads to the front edge of the channel

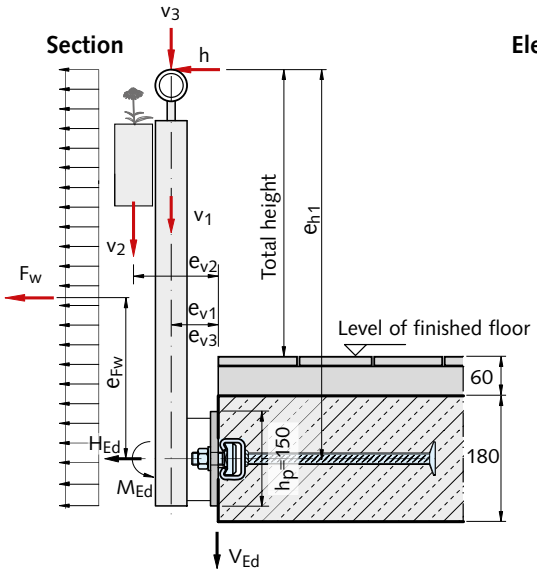
H_{Ed} = used to calculate the applicable horizontal effect

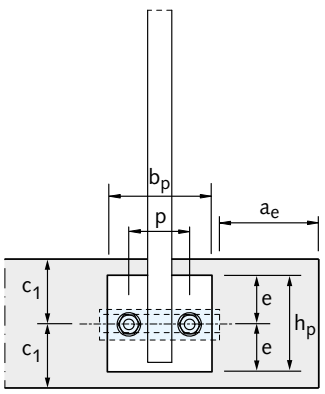
V_{Ed} = used to calculate the applicable vertical effect

h, F_w = horizontal load effects

v_1, v_2, v_3 = vertical load effects

b_p, h_p = anchor plate width and height





HALFEN HGB HANDRAIL CONNECTION
Dimensioning/Calculation Example

Calculation example

Post spacing	1.5 m
Post height from FFL	1.0 m
Structure height	9.0 m < 25.0 m
Railing/banister load	0.5 kN/m (residential buildings)
Concrete slab thickness	180 mm

Distance of channel axis to component edge	c_1 = 90 mm
Width of railing/banister anchor plate	b_p = 150 mm
Height of railing/banister anchor plate	h_p = 150 mm

Bolt spacing	p = 80 mm
Concrete strength	C30/37

Load

Vertical loads:

Dead load, railing/banister including siding	v_1 = 0.40 kN/m
Dead load, flower box	v_2 = 0.35 kN/m
Vertical traffic load on the railing/banister	v_3 = 0.15 kN/m

Horizontal loads:

Railing/banister load	h = 0.50 kN/m
Wind force	q = 0.50 kN/m²

(according to EN 1991-1-4 NA. B. 3)
(assumption: building height 9.0 m < 10:0 m, not prone to resonance frequency, inland wind zone 1)

Cantilevers:

$$e_{h1} = 1.0 + 0.06 + \frac{0.18}{2} = 1.15\,m$$

$$e_{Fw} = \frac{(1.15 + 0.075)}{2} - 0.075 = 0.53\,m$$

e_{v1} = 0.10 m
e_{v2} = 0.20 m
e_{v3} = 0.10 m

Wind load bearing zone:

$$A = (1.00 + 0.06 + \frac{0.18}{2} + \frac{0.15}{2}) \cdot 1.5 = 1.84\,m^2$$

External pressure coefficient (acc. to table 7.1 EN 1991-1-4):
h/d = 1, area B
$c_{pe,1}$ = −1.1 (wind-suction)
$c_{pe,10}$ = −0.8 (wind-suction)
according to EN 1991-1-4 chapter 7.2.1
the following is valid:
1 m² < A ≤ 10 m²
$c_{pe} = c_{pe,1} + (c_{pe,10} - c_{pe,1}) \cdot \lg A =$
$-1.1 + (-0.8 + 1.1) \cdot \lg 1.84 = -1.02$

Wind suction:
$F_w = c_{pe} \cdot q \cdot A = -1.02 \cdot 0.50 \cdot 1.84 = -0.94$ kN

Action per support:

Wind load	$F_{w,Ed} = -0.94 \cdot 1.5 = -1.41$ kN (suction) with γ_F = 1.5
Railing/banister	$H_{Ed} = 0.5 \cdot 1.5 \cdot 1.5 = 1.13$ kN with γ_F = 1.5
Dead load railing/banister	$V_{1Ed} = 0.40 \cdot 1.5 \cdot 1.35 = 0.81$ kN with γ_F = 1.35
Load from flower box	$V_{2Ed} = 0.35 \cdot 1.5 \cdot 1.35 = 0.71$ kN with γ_F = 1.35
Vertical load on railing/banister	$V_{3Ed} = 0.15 \cdot 1.5 \cdot 1.5 = 0.34$ kN with γ_F = 1.5

Determining bearing reactions H_{Ed}, V_{Ed} and M_{Ed}

Not classed as an utility (escape-route) balcony therefore combination with wind load is not required.

Load case 1: V + railing/banister load
$M_{Ed} = 0.81 \cdot 0.10 + 0.71 \cdot 0.20 + 0.34 \cdot 0.10 + 1.13 \cdot 1.15$
$= \mathbf{1.56\,kNm}$
$V_{Ed} = 0.81 + 0.71 + 0.34 = \mathbf{1.86\,kN}$
$H_{Ed} = \mathbf{1.13\,kN}$

Load case 2: V + wind
$M_{Ed} = 0.81 \cdot 0.10 + 0.71 \cdot 0.20 + 1.41 \cdot 0.53 = \mathbf{0.97\,kNm}$
$V_{Ed} = 0.81 + 0.71 = \mathbf{1.52\,kN}$
$H_{Ed} = \mathbf{1.41\,kN}$

Selected:
HGB-E 49/30, l = 200 mm, A4 stainless steel
Bolt spacing p = 80 mm
2 bolts HS 50/30 M12, A4-70,
Required minimum reinforcement:
Stirrups 3 Ø 10, l_b = 300 mm
(see page 48 approval extract→ annex 6, table 7),
Edge rebar 2 Ø 10

Splitting the moment into a load pair

$$N_{Ed} = \frac{M_{Ed}}{(e - 0.41 \cdot x)} + H_{Ed}$$

$$e = \frac{h_p}{2} = 75\,mm$$ (see approval no. Z-21.4.1912 annex 7)

$x = 0.30 \cdot e = 0.30 \cdot 75 = 22.5$ mm
see page 49 (approval extract → annex 8 / table 8b)
$e - 0.41 \cdot x = 75 - 0.41 \cdot 22.5 = 65.8$ mm

HALFEN HGB HANDRAIL CONNECTION
Calculation Example

Load case 1: V + railing/banister load

$N_{Ed} = \frac{1.56\,kNm}{0.0658\,m} + 1.13\,kN = \mathbf{24.84\,kN} \rightarrow \mathbf{decisive}$

$V_{Ed} = \mathbf{1.86\,kN} \rightarrow \mathbf{decisive}$

Load case 2: V + wind

$N_{Ed} = \frac{0.98\,kNm}{0.0658\,m} + 1.41\,kN = 16.30\,kN$

$V_{Ed} = 1.52\,kN$

Verifications

Geometrical boundry conditions according to approval Z-21.4-1912 annex 6, table 6 have been met.

Verification of steel capacity

Design resistance (steel) channel HGB 49/30 using 2 bolt fixing

$N_{Rd,s} = 25.8\,kN$ see page 48 (approval extract → annex 8, table 8b)
$V_{Rd,s} = 25.8\,kN$

Channel, centric pull load

$\frac{N_{Ed}}{N_{Rd,s}} = \frac{24.84}{25.8} = 0.96 < 1$ ✓

Channel, shear load

$\frac{V_{Ed}}{V_{Rd,s}} = \frac{1.86}{25.8} = 0.07 < 1$ ✓

Channel, interaction

$\left(\frac{N_{Ed}}{N_{Rd,s}}\right)^2 + \left(\frac{V_{Ed}}{V_{Rd,s}}\right)^2 = \left(\frac{24.84}{25.8}\right)^2 + \left(\frac{1.86}{25.8}\right)^2$

$= 0.93 + 0.01 = 0.94 < 1$ ✓

Design resistance (steel) **bolt M12, A4-70**

$\mathbf{N_{Rd,s,s} = 31.6\,kN}$ see page 48 (approval extract → annex 8, tab. 9)
$\mathbf{V_{Rd,s,s} = 22.7\,kN}$

Bolt, centric pull load

$\frac{0.5 \cdot N_{Ed}}{N_{Rd,s,s}} = \frac{0.5 \cdot 24.84}{31.6} = 0.39 < 1$ ✓

Bolt, shear load

$\frac{0.5 \cdot V_{Ed}}{V_{Rd,s,s}} = \frac{0.5 \cdot 1.86}{22.7} = 0.04 < 1$ ✓

Bolt, interaction

$\left(\frac{0.5 \cdot N_{Ed}}{N_{Rd,s,s}}\right)^2 + \left(\frac{0.5 \cdot V_{Ed}}{V_{Rd,s,s}}\right)^2 = 0.39^2 + 0.04^2 = 0.15 < 1$ ✓

Verification of concrete capacity

Design resistance concrete

$\mathbf{V_{Rd,c}} = 11.7\,kN$
see page 49 (annex 8, table 8b)

$\mathbf{M_{Rd,c}} = 0.81 \cdot x \cdot b \cdot \frac{f_{ck}}{\gamma_{Mc}} \cdot (e - 0.41 \cdot x)$

$\mathbf{M_{Rd,c}} = 0.81 \cdot 22.5 \cdot 150 \cdot \frac{30}{1.5} \cdot 65.8 = 3\,597\,615\,Nmm$

$= \mathbf{3.60\,kNm}$

Concrete edge failure

$\frac{V_{Ed}}{V_{Rd,c}} = \frac{1.86}{11.7} = 0.16 < 1$ ✓

$\frac{M_{Ed}}{M_{Rd,c}} = \frac{1.56}{3.60} = 0.43 < 1$ ✓

$\frac{V_{Ed}}{V_{Rd,c}} = 0.16 < 0.333$ → According to the approval verification of interaction is not required, see page 46 (approval extract / page 7).

Verifying the ratio between horizontal action and bending moment

$\frac{H_{Ed}}{M_{Ed}} = \frac{1.13\,kN}{1.56\,kNm} = 0.72 < 1.5$

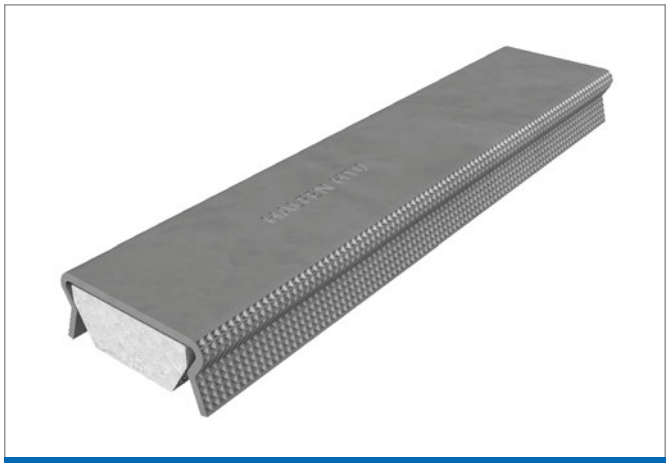
→ Design model is applicable
see page 46 (approval extract / page 6)

HALFEN HTU CAST-IN CHANNEL FOR FIXING PROFILED METAL SHEETING

The benefits at a glance

The HALFEN HTU Cast-in channel is ideal for fixing all types of profiled sheeting – easy and simple with self-tapping screws. Suitable for both shear loads and tension loads.

Thanks to the innovative channel design with its corrugated sides and filler, the new generation of HALFEN HTU Cast-in channel is installed entirely in the required concrete cover. This avoids any problem with the required reinforcement.



HALFEN HTU Cast-in channel
for fixing profiled metal sheeting

Safe and reliable

- innovative geometry and corrugated edging ensure reliable anchorage
- polystyrene filler prevents the drill-bit or self-tapping screw from hitting concrete
- building authority approved
- the type stamp on the channel back ensures identification after installation

Efficient and economical

- simple installation in the required concrete cover
- one channel type irrespective of the reinforcement layout
- simple installation in the precast plant

Fixing of trapezoidal metal sheeting roof element

Vertical HALFEN HTU Cast-in channels for fixing façade panels

Façade fixed using HALFEN HTU Cast-in channels (Cologne Bonn Airport)

HALFEN HTU Cast-in channels in a pre-stressed concrete beam

HALFEN HTU CAST-IN CHANNELS
General/product range

The HALFEN Cast-in channel for fixing trapezoidal metal sheeting has a U-shaped cross-section with the sides angled outwards. The corrugated sides of the channel provide a positive-lock with the concrete.

Both HTU Channel lengths (60 and 100mm) allow various bolt fixing and layout options. The HALFEN HTU Cast-in channels are building authority approved.
Approval: DIBt no. Z-21.4-2096

Fixing trapezoidal sheet metal using self-tapping screws

Area of application	Fixing of trapezoidal sheeting or wall-cladding elements using building authority or ETA approved self-tapping screws. Installed flush with the surface of precast concrete elements; concrete strength C25/30 up to C50/60, cracked or non-cracked.
Materials/corrosion protection	HTU Channel made of zinc-plated steel may be installed in environments of C1 to C3 corrosion category acc. to EN ISO 12944-2:2018-04.

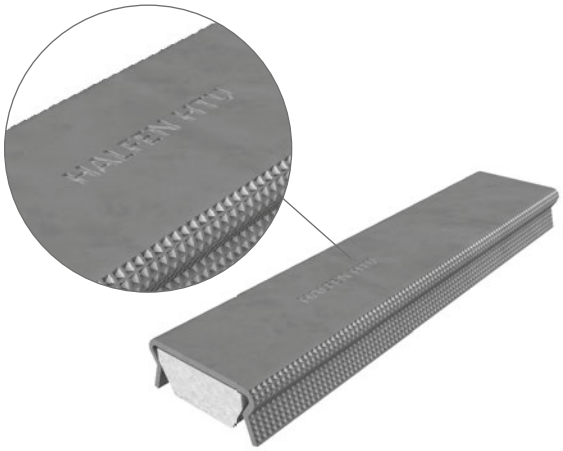
Available lengths:
HTU-Channels are available in 3000 or 6000 mm lengths.

Order example HTU Channel:

HTU 60/25/2,5-S **6000**

length [mm]
product name

Identification
Original HALFEN Cast-in channels for fixing trapezoidal metal sheeting can be identified by the stamp on the back of the channel displaying the company name and the product description `HALFEN HTU´.



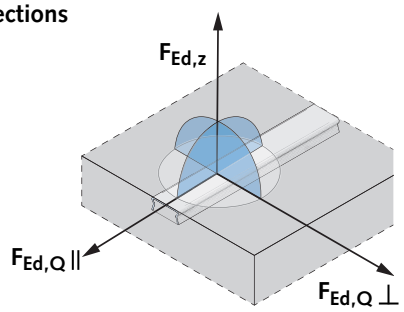
Detailed installation instructions for the self anchoring HALFEN HTU Channel can be found at:
www.halfen.com ▻ Brochures ▻ Installation Instructions ▻ Fixing systems

HALFEN HTU CAST-IN CHANNELS

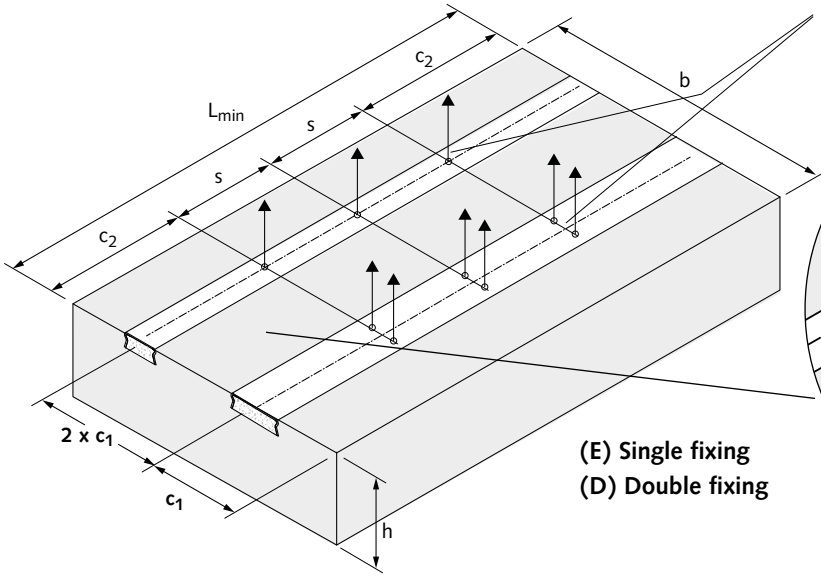
Dimensioning

Anchorages must to be planned in accordance with engineering standards. Verification of direct local force transmission from the channel into the concrete has been provided if the approved values are complied with. Connecting accessories must be verified separately. Technical design must comply with building authority approval no. Z-21.4-2096.

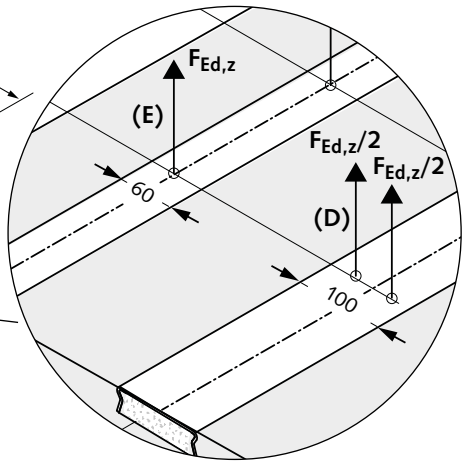
Load directions



Constructive boundary conditions

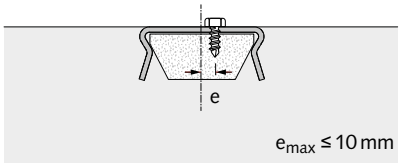


Load application point $F_{Ed,z}$ examples



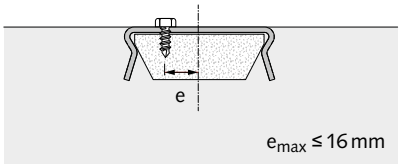
(E) Single fixing
(D) Double fixing

HTU 60 ($e_{max} \leq b_{HTU}/6$)



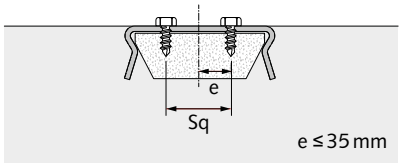
$e_{max} \leq 10$ mm

HTU 100 (E) ($e_{max} \leq b_{HTU}/6$)



$e_{max} \leq 16$ mm

HTU 100 (D) (50 mm ≤ Sq ≤ 70 mm)



e ≤ 35 mm

Minimum element dimensions, bolt spacings and load resistances for concrete strength class C30/37 to C50/60 ①③

Channel	L_{min}	(E) Single (D) Double fixing	b_{min}	h_{min}	$C_{1,min}$	$C_{2,min}$	s_{min}	F_{Rd} ①②③
	[mm]		[mm]	[mm]	[mm]	[mm]	[mm]	[kN]
HTU 60/25/2,5-S	150	E	2 x c1	200	90	75	150	3,6
	250	E				125	250	4,9
	310	E				155	310	5,7
HTU 100/25/3-S	150	E	2 x c1	200	120	75	150	2,4
		D						4,2
	250	E				125	250	3,5
		D						6,0
	310	E				155	310	4,2
		D						7,1

① Resistance F_{Rd} applies for all load directions. The constant-load factor must be ≤ 0.15 F_{Rd}.
② For concrete strength class C20/25 the resistances must be reduced with factor 0.82. For concrete strength C25/30 with factor 0.91.
③ For concrete strength class ≥ C30/37 the resistance F_{Rd} may be increased by Ψc acc. to (appendix 5, table 2)

ROOF AND WALLS

The right solution for each application

The efficient and established installation systems for timber roof structures, masonry restraints and connectors for concrete façades are proven practical solutions for the construction industry, greatly improving construction time with significant cost-saving.

HALFEN HSF Rafter shoe

Suitable for horizontal forces acting on rafter and collar beam roofs.

HALFEN HNA Timber fixing strap

Suitable for all acting loads e.g. wind loads in roof structures.

HALFEN HKZ or SPV Restraint ties

For connection of tension and compression loads from concrete walls elements.

HALFEN ML and BL Brick tie anchor system

For connection of brickwork to concrete walls and columns or steel elements.

HALFEN HVL-M Precast connection with HALFEN HVL-E Cast-in channel

Suitable for horizontal loads in concrete wall elements (loads perpendicular to the bracket).

HALFEN HKW Corner guard

Wall and column corner protector; application in industry and multi-storey car parks.

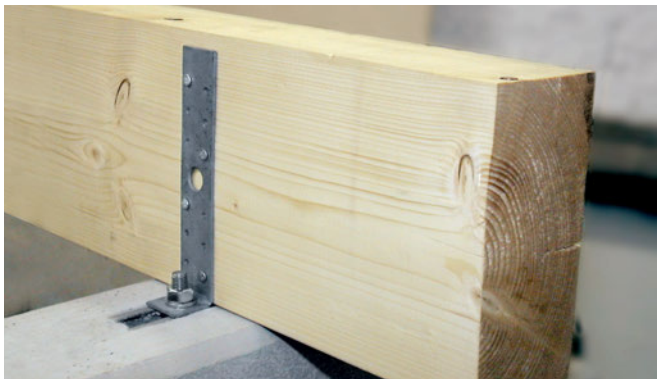
ROOF AND WALLS
Application Examples

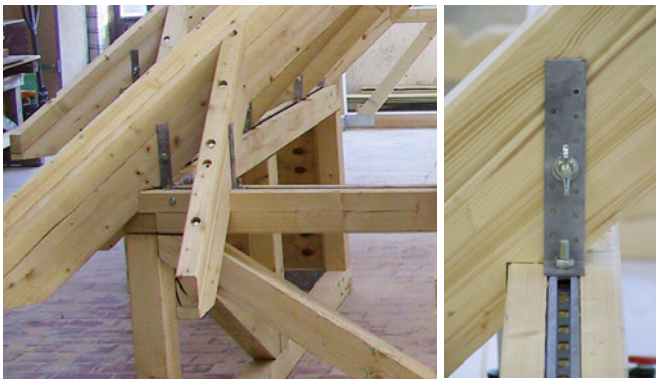

HALFEN HSF Rafter shoe 6/12


HALFEN HKZ Restraint tie with serrated washer


Airbus paintshop with HALFEN HVL Restraint tie


HVL-System in precast building components

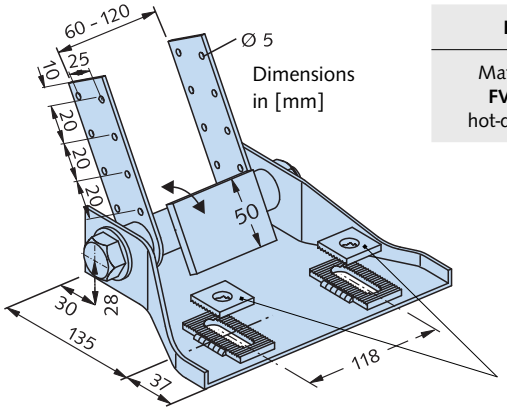

Connecting construction timbers to concrete using HALFEN HNA


Timber roof construction with HALFEN HNA Fixing straps


Corner guards in an industrial environment


HALFEN ML Brick-tie anchor system

HALFEN HSF Rafter Shoe



HSF 6/12

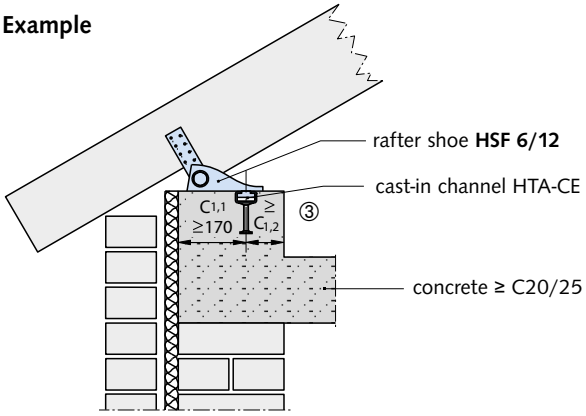
Material/Finish:
FV = 1.0038,
hot-dip galvanized

In modern wood constructions, HSF 6/12 rafter shoes are used to support the horizontal forces in rafter and collar tie roofs.

The advantages at a glance:

- minimal planning; simply specify the profile and position of the HALFEN Cast-in channels in the concrete element
- clearly defined statics with flexible rafter shoes
- complex and therefore costly support structures are not necessary
- simple and straightforward roof construction:
  a) adjustable support plate
  b) adjustable nailing brackets for vertical anchorage for various rafter widths from 60 to 120 m
  c) adjustable in longitudinal rafter axis ± 15 mm
- freely adjustable rafter spacings in the longitudinal axis of the HALFEN Channel without additional measures
- hot-dip galvanized for excellent corrosion protection

Example

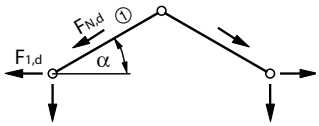


Definition $c_{1,1}$ and $c_{1,2}$ see page 13

The horizontal forces are transferred into the main concrete structure using (ETA) European Technical approved HALFEN HTA-CE Cast-in channels.
During assembly ensure that the serration in the counter plates engages in the base plate. The marking on the counter plates must be at right angles to the slot in the base plate.

Rafter roof static system:

$F_{1,d} < F_{Rd}$

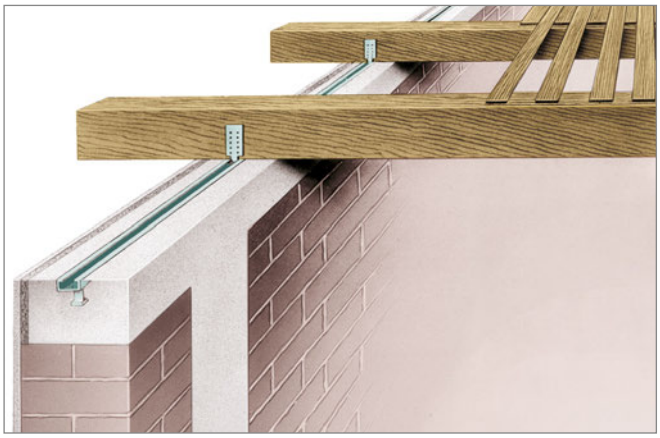


Design values F_{Rd}

Load F_{Rd} [kN/Rafter]	Required HALFEN Cast-in channel Type	Min. edge distance ② $C_{1,2}$ [mm]	Required HALFEN Bolt Type dimensions
12.6	HTA-CE 38/17	75	HS 38/17 - M16 × 40
16.8	HTA-CE 40/22 P HTA-CE 40/25	100	HS 40/22 - M16 × 50
19.6	HTA-CE 50/30 P HTA-CE 49/30	150	HS 50/30 - M16 × 50

① The maximum rafter strength is limited by the design load of each individual component in the rafter shoe. Load tests resulted in a mean breaking load of 50 kN. With normal loads larger than the recommended load capacity (= about ⅓ of the breaking load), the rafter spacing will need to be reduced.
② If lower loads are present, then the minimum edge distance $C_{1,2}$ for the HALFEN Cast-in channels can be reduced. The distance to the concrete edge must be at least 170 mm.
③ Make sure that the HALFEN Cast-in channels are installed flush with the concrete surface. Use spacers if necessary.

ROOF AND WALLS
HALFEN HNA Timber Fixing Strap



Typical installation of timber beams using HNA nailing straps with HALFEN Cast-in channels embedded in concrete.

To provide an optimal base for roof framework, continuous HALFEN HTA-CE Cast-in channels or HALFEN HTA-CE Cast-in channel short elements are cast in the concrete; suitable for concrete ring beams or slabs. The type of HALFEN HTA-CE Cast-in channels, nailing straps and nails depend on the assumed loads (ex. wind force).

For calculation and design criteria see:
- EN 1991-1-4 (EC1) and EN 1991-1-4/NA
- EN 1995-1-1 (EC5)

The timber fixing straps can be positioned on one or both sides of the timber beams or rafters. Refer to the following table for F_{Rd} load capacities. The beams / framework must be secured against twisting when straps are used only on one side of the beams, (example by nailing to the upper wood roof boarding).

Type selection

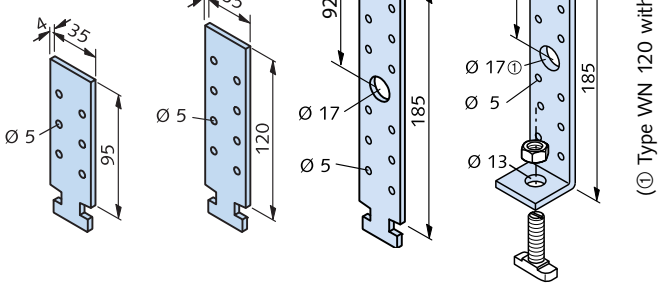
Dimensions in [mm]

N 95
BN 95

N 120
BN 120

BN 185

WN 120
WN 185



HALFEN Bolt M10 with nut, **please order separately!**

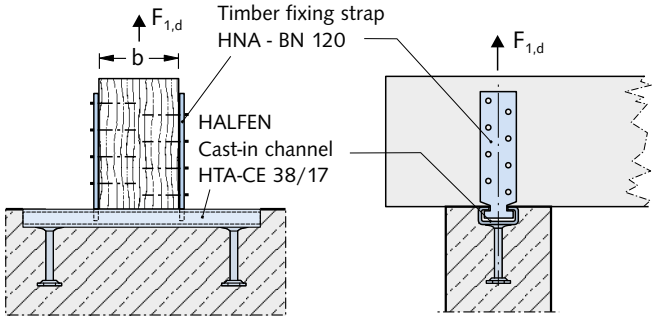
Ordering example:

HNA - BN 120 - FV

- finish
- length [mm]
- type

Assembly example:

$F_{1,d} < F_{Rd}$



Type selection, timber fixing straps

Suitable for HALFEN Cast-in channel:	Material/Finish FV = 1.0038, hot-dip galvanized	Design value for load capacity F_{Rd} [kN] for each beam attachment			Attaching timber fixing straps to wooden beams/rafters	
	Item name: Length [mm]	Position of timber fixing straps			Wire nails	Anchor nails
		Single-sided	Double-sided			
			for b ≥ 60 mm	b ≥ 100 mm		
HTA-CE 28/15 hot-dip galvanized (FV)	**HNA - N 95 - FV**	4.2	4.9	5.6	according to EN 10230-1	according to the manufacturer's technical approval
	HNA - N 120 - FV					
	HNA - WN 120 - FV	1.4	2.8	2.8		
	HNA - WN 185 - FV					
HTA-CE 38/17 hot-dip galvanized (FV)	**HNA - BN 95 - FV**	6.3	7.5	8.4		
	HNA - BN 120 - FV					
	HNA - BN 185 - FV					
	HNA - WN 120 - FV	1.4	2.8	2.8		
	HNA - WN 185 - FV					

Brick Tie Anchor Systems ML + BL

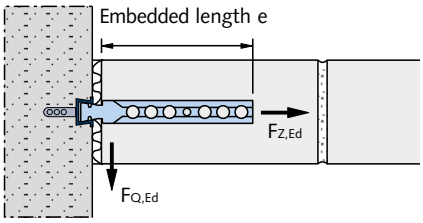
HALFEN ML and BL Brick tie anchors are tried and tested efficient installation systems for securing brick walls, masonry in-fills, partition walls, brick renders (with or without ventilation gap and heat insulation) to concrete walls, concrete supports, steel or wooden structures.

The brick tie anchors are able to move freely in the brick tie channels, considerably reducing cracks caused by masonry settlement.

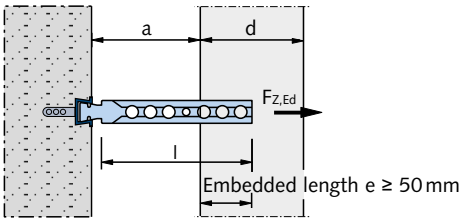
All HTA-CE and HMS profiles have a foam filling to prevent concrete ingress. The channels are attached to the formwork using standard nails.

The HALFEN Brick tie anchors are inserted at the recommended intervals (static requirements) in the brick wall during construction (see page 62). The anchors are inserted in the brick tie channels, laid flat between the rows of brick and pressed into the mortar. The perforations in the anchors optimise anchorage with the mortar.

Plan view; wall attachment



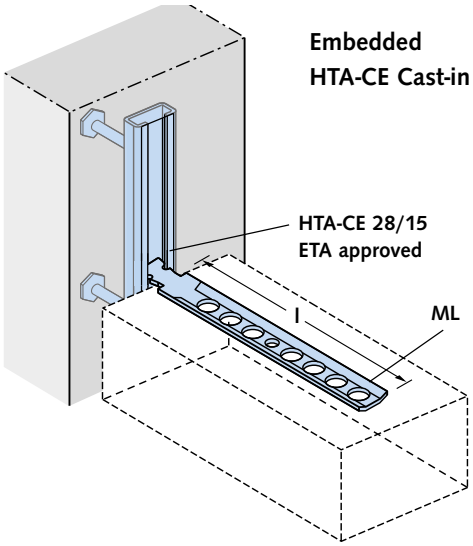
Plan view; attachment of facing brickwork



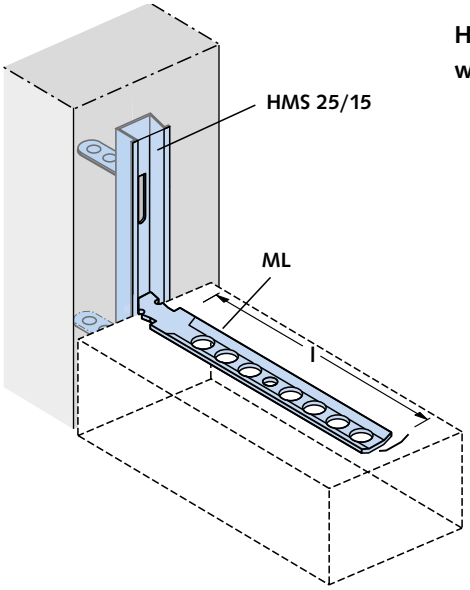
For spacing a — see HALFEN Technical Product Information façade, Brickwork Support

Brick tie anchor ML in combination with HALFEN Cast-in channels 25/15-D and 28/15

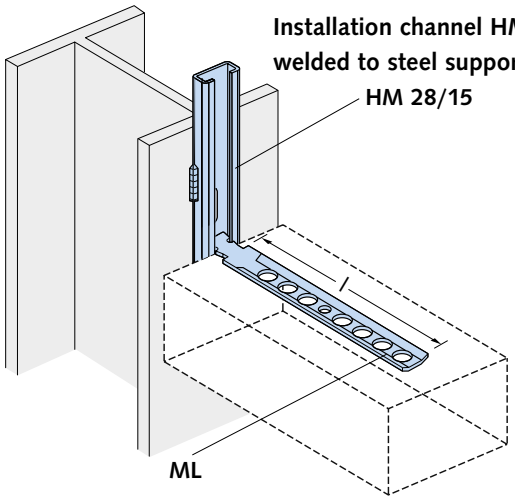
Embedded HTA-CE Cast-in channel



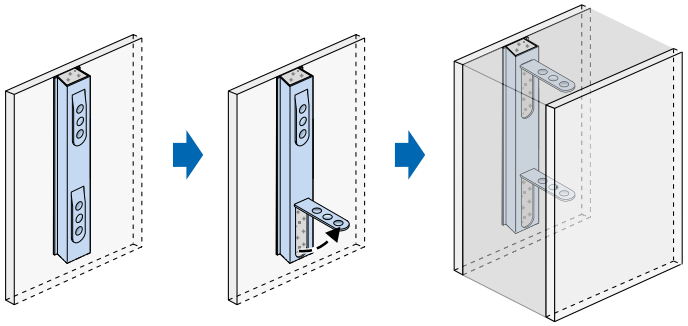
HMS Cast-in channel with Brick-tie anchor



Installation channel HM welded to steel supports



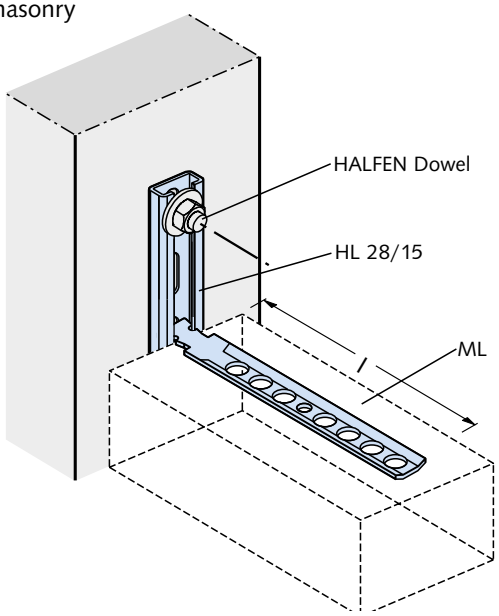
1. Attach to formwork
2. Bend out lug anchors
3. Pour the concrete



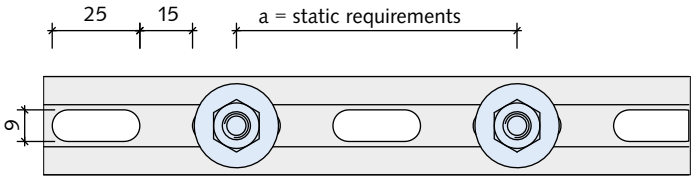
Lug anchors are bent out on-site by hand every 250 mm to ensure secure anchorage in the concrete.

ROOF AND WALLS
Brick Tie Anchor System, ML + BL; HALFEN Anchor Bolt Systems

HL slotted framing channels anchored to concrete or masonry



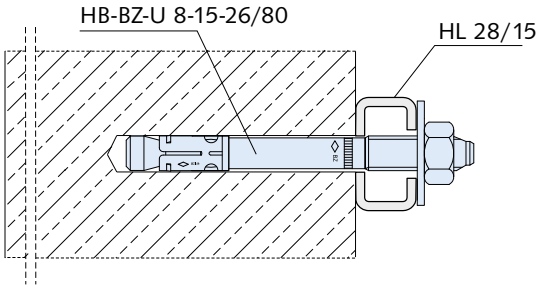
Top view



ETA-17/0196 ETA-16/0691

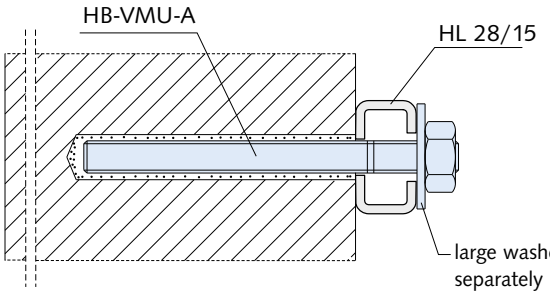
ETA 17/0196 (brickwork) and ETA 16/0691 (concrete)/ Injection system HB-VMU plus

For more information on application and assembly see the Technical Product Information catalogue, **HALFEN HB Anchor bolt systems**



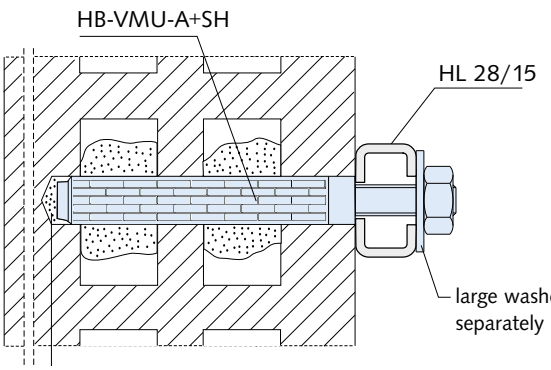
Bolt anchor HB-BZ-U 8-15-26/80

- galvanized or (A4) stainless steel
- approved for cracked and uncracked concrete
- with large washer DIN 9021/EN ISO 7093



Anchor rod HB -VMU-A 8-20/110

- galvanized or (A4) stainless steel
- approved for **monolithic masonry**
- with large washer DIN 9021/EN ISO 7093 (order separately)
- mortar cartridge HB-VMU plus 280 and static mixer (order separately)



Anchor rod HB-VMU-A 8-20/110 with Perforated sleeve HB-VMU-SH 16×85

- galvanized or (A4) stainless steel
- approved for **perforated brick masonry**
- with large washer DIN 9021/EN ISO 7093 (order separately)
- mortar cartridge HB-VMU plus 280 and static mixer (order separately)

Brick Tie Anchor System, ML + BL

Brick tie anchors

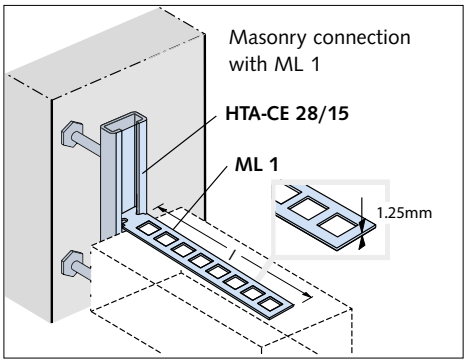
ML, BL

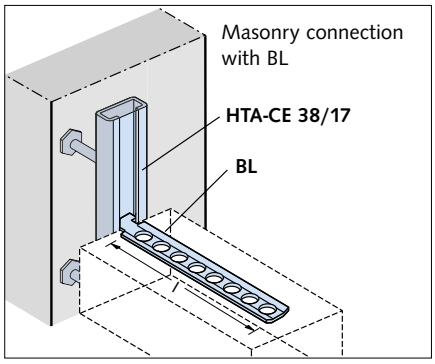
- max. load $F_{Z,Ed}$ = 0.32 kN per cm embedment length e
- max. $F_{Z,Ed} \leq 3.2$ kN= $F_{z,Rd}$
- max. $F_{Q,Ed} \leq 2.7$ kN= $F_{Q,Rd}$

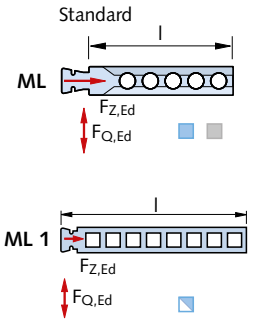
ML 1

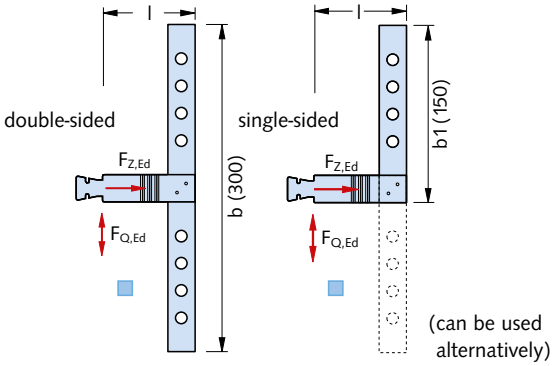
- max. $F_{Z,Ed} \leq 2.5$ kN = $F_{z,Rd}$
- max. $F_{Q,Ed} \leq 1.4$ kN = $F_{Q,Rd}$

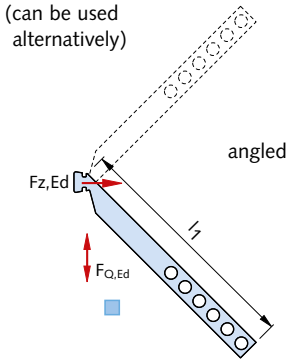
Observe profile load capacity!







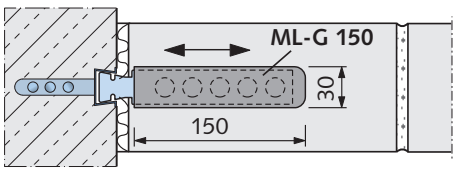




Brick tie anchor	Brick tie anchor				
HMS 25/15 D L = 2500 mm	ML Standard 26 × 2 [mm]	ML1 25 × 1.25 [mm]	MLQ - D ② Double-sided 25 × 3 [mm]	MLQ - E ② Single-sided 25 × 3 [mm]	MLS Angled 22 × 3 [mm]
HTA-CE 28/15 L = 1050 mm ① L = 6070 mm ①	Type / Length l [mm]	Type / Length l [mm]	Type / Length l [mm]	Type / Length l [mm]	Type / Length l_1 [mm]
	ML - 85	ML 1 - 125	MLQ-D - 85	MLQ-E - 85	MLS - 300
HL 28/15 L = 6070 mm ①	ML - 120	ML 1 - 185	MLQ-D - 120	MLQ-E - 120	MLS - 350
	ML - 180	ML 1 - 245	MLQ-D - 180	MLQ-E - 180	MLS - 400
HTA-CE 38/17 L = 1050 mm ① L = 6070 mm ①	BL Standard 30 × 2 [mm]	BLQ - D ② Double-sided 30 × 3 [mm]	BLQ - E ② Single-sided 30 × 3 [mm]	**Material:** FV = Steel 1.0038, hot-dip galvanized SV = Steel DX51D + Z275, sendzimir galvanized A4 = Stainless steel 1.4571/1.4404 A2 = Stainless steel 1.4307	
	Type / Length l [mm]	Type / Length l [mm]	Type / Length l [mm]		
	BL-85	BLQ-D-85	BLQ-E-85		
	BL-120	BLQ-D-120	BLQ-E-120		
	BL-180	BLQ-D-180	BLQ-E-180		

① Other lengths: **Available on request**
② Thickness in the overlap area: 6 mm (2×3 mm)

Debond sleeve ML-G 150 for wall attachments, suitable for ML-anchors



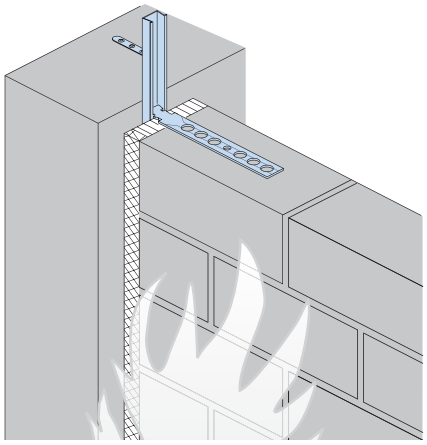
Permits movement in the longitudinal anchor direction, e.g. in long masonry bonds or partition walls adjoining concrete load bearing structures; prevents cracks forming.

ML-G 150, material: soft PVC, material thickness 1.5 mm

ROOF AND WALLS
Firewall Connections with Wall Connecting System ML + BL

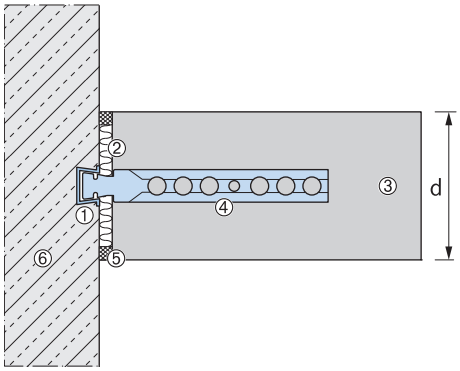
Firewall connection according to DIN 4102-4: 2016-05

Solid masonry fire walls
Statically required connections of load bearing, room enclosing, masonry walls can also be designed as fire walls in accordance with DIN 4102-4 section 9.8.4 using HALFEN Brick tie channels.
The anchorage to adjacent components (steel reinforced concrete supports or walls) meet the requirements for stability and fire resistance if the anchorage conforms to the standards set in DIN 4102-4 section 9.8.4 (figure 9.13, variant 2).

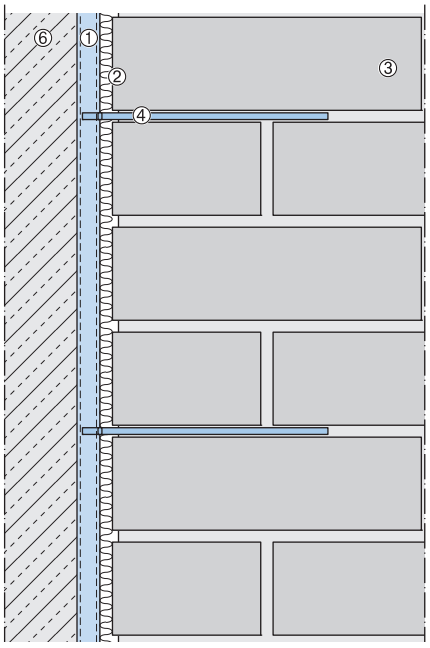


Connection of a load bearing masonry wall as a fire wall according to DIN 4102-4 section 9.8.4 (figure 9.13) or according to EN 1996-1-2: 2011-04 (figure E.4B)

Horizontal section



Vertical section



Definition, DIN regulations

① **HALFEN Cast-in channel**

② **Insulation layer:**
According to DIN 4102-4 section 9.2.14 insulation layers in connecting joint gaps must "[...] be made of non-flammable mineral fibre; have a melting point ≥ 1000 °C as stated in DIN 4102-17; and have a gross density of ≥ 30 kg/m³ and must not smoulder".

③ **Masonry:**
Bricks (gross density class) and minimum wall thickness according to EN 1996-1-2: 2011-04.

④ **Masonry connection** (vertically adjustable)

⑤ **Expansion joint**

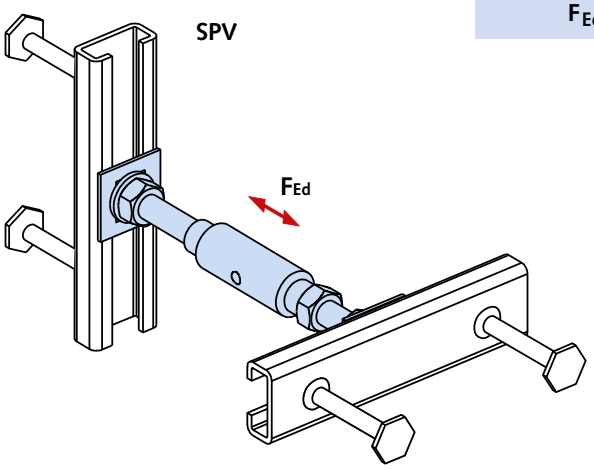
⑥ **Concrete**

Product information

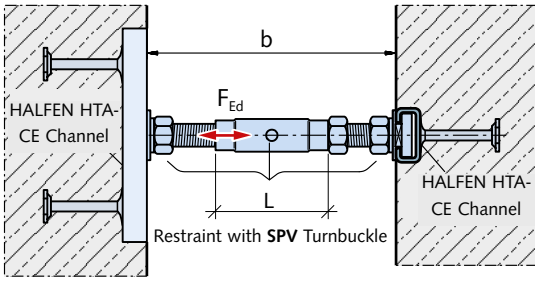
HALFEN Cast-in channel type ①	④ Brick tie anchor (see page 59 ff.)	
	for standard mortar	for thin bed mortar
HMS 25/15 D	ML	ML 1
HTA 28/15	ML	ML 1
HTA 38/17	BL	–

Anchor spacings
HALFEN Brick tie anchors can be used at any position along the whole length of the brick tie channel.
Generally the standard spacing between the anchors is 250 mm (4 anchors per metre).

Restraint with Turnbuckle SPV



F_{Ed} = load

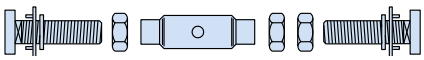


Ensure adequate screw depth:
M12 → ≥ 10 mm
M16 → ≥ 13 mm

Product description

The restraint with turnbuckle SPV is suitable for compressive and tensile loads up to F_{Ed} = 14.0 kN and for clearances up to 200 mm. By turning the clamping sleeve (sleeve has a right and left-hand thread), the clearance can be freely adjusted within the given range. Connected to the building structure using HALFEN Cast-in channels (order separately).

Included in delivery



- Turnbuckle SPH
- 2 HALFEN Bolts
  (1 right-hand thread, 1 left-hand thread)
- 3 standard nuts
- 2 washers and 2 SIC locking washers

Ordering example:

Item name: **SPV - 7,0 - 100 - A4**

type
load group
wall clearance b
material / finish

HALFEN Cast-in channels must be ordered separately

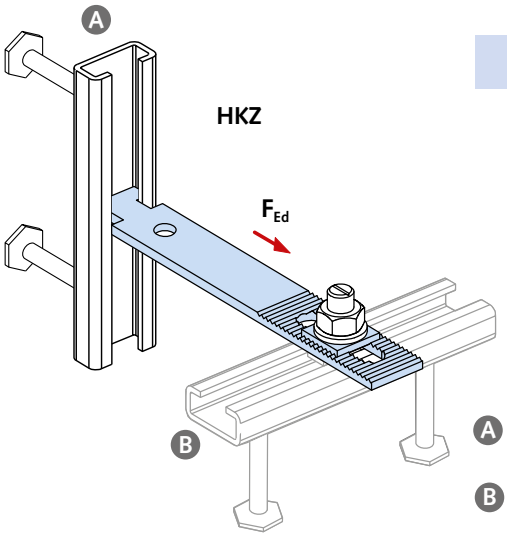
HALFEN SPV Restraint with turnbuckle

Load capacity F_{Rd} [kN]		±7.0			±9.8			±14.0		
Type	Stand-off distance	HALFEN Bolt left-hand thread	Sleeve	HALFEN Bolt right-hand thread	HALFEN Bolt left-hand thread	Sleeve	HALFEN Bolt right-hand thread	HALFEN Bolt left-hand thread	Sleeve	HALFEN Bolt right-hand thread
	b	M12	L	M12	M16	L	M16	M16	L	M16
	[mm] ②	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
SPV	100±10	50	60	40	50	60	40	–	–	–
	120±15	50	75	40	50	75	40	–	–	–
	140±15	50	75	60	50	75	60	80	60	50
	160±15	50	95	60	50	95	60	80	75	60
	180±15	50	115	60	50	115	60	80	95	60
	200±15	50	135	60	50	135	60	80	115	60
HALFEN Cast-in channel		HTA-CE 38/17 ①			HTA-CE 38/17 ①			HTA-CE 49/30 ①		

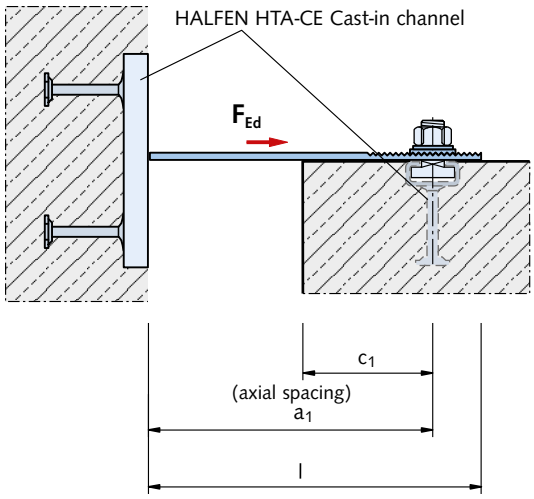
① Short elements 150, 200 and 250 ② With F_{Rd} -load group 9.8 kN restricted to negative tolerance

For further concrete façades accessories see the **FB Concrete Façade catalogue**

ROOF AND WALLS
Restraint Tie HKZ



F_{Ed} = load



A HALFEN Channel suitable for HKZ-Restraint ties

B HALFEN Channel or dowel according to approval

Product characteristics

The serrations in the bracket and in the washer ensure positive static load transmission.

Two HALFEN Cast-in channels embedded at right angle in the concrete ensure three-dimensional adjustability.

Please order HALFEN Cast-in channels and HALFEN Bolts and washers separately

Ordering example:

Item name: **HKZ-38/17 - 100 - A4**

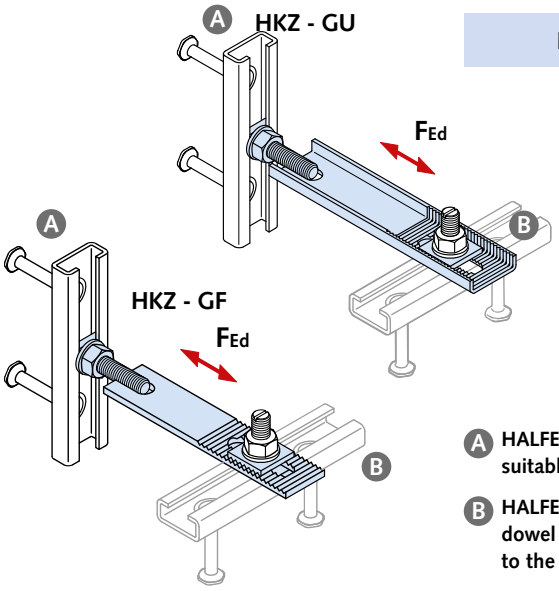
- type
- clearance a_1
- material / finish

HALFEN HKZ Restraint tie

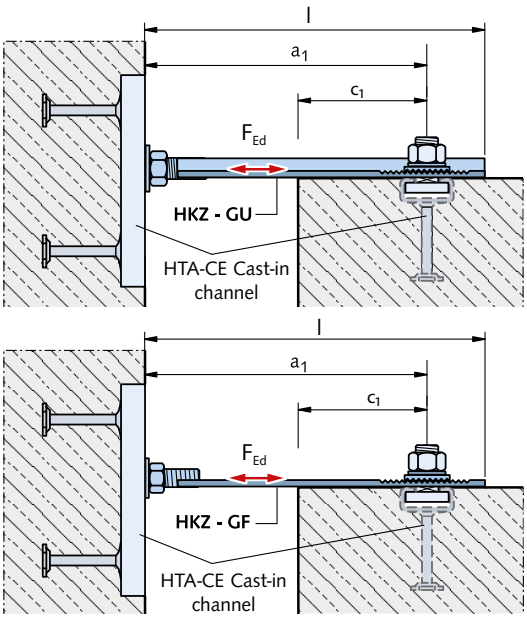
Characteristics: ① Load capacity F_{Rd} [kN]	Type selection: GV = galvanized. Not suitable for façades with ventilation gaps. Type	a_1 [mm]	Type selection: A4 = Stainless steel grade 1.4571/1.4404. Type	a_1 [mm]	Dimensions: Length l [mm]	Spacing a_1 [mm]	Tolerance [mm]	Holes [mm]
+4.9 (tension only)	HKZ 28/15 - 50 - GV		HKZ 28/15 - 50 - A4		90	50	a_1 ±20	LL 11 × 55
	HKZ 28/15 - 75 - GV		HKZ 28/15 - 75 - A4		115	75		
	HKZ 28/15 - 100 - GV		HKZ 28/15 - 100 - A4		140	100		LL 11 × 55 RL 11
	HKZ 28/15 - 125 - GV		HKZ 28/15 - 125 - A4		165	125		
	HKZ 28/15 - 150 - GV		HKZ 28/15 - 150 - A4		190	150		
	HKZ 28/15 - 175 - GV		HKZ 28/15 - 175 - A4		215	175		
	HKZ 28/15 - 200 - GV		HKZ 28/15 - 200 - A4		240	200		
	HKZ 28/15 - 225 - GV		HKZ 28/15 - 225 - A4		265	225		
	HKZ 28/15 - 250 - GV		HKZ 28/15 - 250 - A4		290	250		
+9.8 (tension only)	HKZ 38/17 - 75 - GV		HKZ 38/17 - 75 - A4		115	75	a_1 ±20	LL 13 × 55
	HKZ 38/17 - 100 - GV		HKZ 38/17 - 100 - A4		140	100		LL 13 × 55 RL 13
	HKZ 38/17 - 125 - GV		HKZ 38/17 - 125 - A4		165	125		
	HKZ 38/17 - 150 - GV		HKZ 38/17 - 150 - A4		190	150		
	HKZ 38/17 - 175 - GV		HKZ 38/17 - 175 - A4		215	175		
	HKZ 38/17 - 200 - GV		HKZ 38/17 - 200 - A4		240	200		
	HKZ 38/17 - 225 - GV		HKZ 38/17 - 225 - A4		265	225		
	HKZ 38/17 - 250 - GV		HKZ 38/17 - 250 - A4		290	250		
	HKZ 38/17 - 275 - GV		HKZ 38/17 - 275 - A4		315	275		
	HKZ 38/17 - 300 - GV		HKZ 38/17 - 300 - A4		340	300		

① The load capacities apply for the HKZ-restraint ties. The channel A and the fixing dowel/channel B must be verified, depending on the edge distance c_1, the concrete grade and the reinforcement, for each application.

Restraint Tie HKZ - GF/GU



F_{Ed} = load



Ⓐ HALFEN Channel suitable for HKZ-Restraint ties

Ⓑ HALFEN Channel or dowel according to the approval

Product description

The serrations in the bracket and in the washer ensure positive static load transmission.

Please order HALFEN Cast-in channels and HALFEN Bolts and washers separately.

The double-sided attachment using a HALFEN Bolt and a threaded plate ensures positive and slippage-free wind anchoring when used in combination with HALFEN HTA-CE Cast-in channels set in concrete; the connection is three-dimensionally adjustable.

Ordering example:

Item name: **HKZ - GF 38/17 - 125 - GV**

- HKZ - GF 38/17 - 125 - GV
- type
- axial spacing a_1
- material/ GV/A4

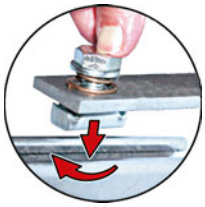
HALFEN Restraint ties, type HKZ-GF and type HKZ-GU

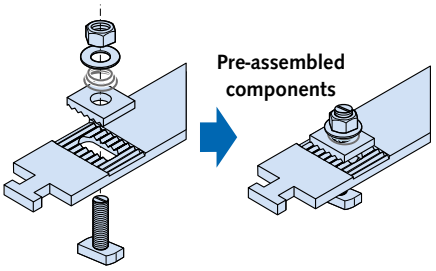
Characteristics: ① Load capacity F_{Rd} [kN]	Type selection: GV = galvanized not suitable for façades with ventilation gap Type	a_1 [mm]	Type selection: A4 = Stainless steel 1.4571/1.4404 Type	a_1 [mm]	Dimensions: Length l [mm]	Spacing a_1 [mm]	Tolerance [mm]	Slot [mm]
±4.9	HKZ - GF 28/15 - 75 - GV		HKZ - GF 28/15 - 75 - A4		115	75	a_1 ±20	11 × 55
	HKZ - GF 28/15 - 100 - GV		HKZ - GF 28/15 - 100 - A4		140	100		
	HKZ - GF 28/15 - 125 - GV		HKZ - GF 28/15 - 125 - A4		165	125		
	HKZ - GF 28/15 - 150 - GV		HKZ - GF 28/15 - 150 - A4		190	150		
	HKZ - GF 28/15 - 175 - GV		HKZ - GF 28/15 - 175 - A4		215	175		
±9.8	HKZ - GF 38/17 - 100 - GV		HKZ - GF 38/17 - 100 - A4		140	100	a_1 ±20	13 × 55
	HKZ - GF 38/17 - 125 - GV		HKZ - GF 38/17 - 125 - A4		165	125		
	HKZ - GF 38/17 - 150 - GV		HKZ - GF 38/17 - 150 - A4		190	150		
	HKZ - GF 38/17 - 175 - GV		HKZ - GF 38/17 - 175 - A4		215	175		
	HKZ - GU 38/17 - 200 - GV		HKZ - GU 38/17 - 200 - A4		240	200	a_1 ±20	13 × 55
	HKZ - GU 38/17 - 225 - GV		HKZ - GU 38/17 - 225 - A4		265	225		
	HKZ - GU 38/17 - 250 - GV		HKZ - GU 38/17 - 250 - A4		290	250		
±16.8	HKZ - GU 50/30 - 200 - GV		HKZ - GU 50/30 - 200 - A4		240	200	a_1 ±20	17 × 60
	HKZ - GU 50/30 - 225 - GV		HKZ - GU 50/30 - 225 - A4		265	225		
	HKZ - GU 50/30 - 250 - GV		HKZ - GU 50/30 - 250 - A4		290	250		
	HKZ - GU 50/30 - 275 - GV		HKZ - GU 50/30 - 275 - A4		315	275		
	HKZ - GU 50/30 - 300 - GV		HKZ - GU 50/30 - 300 - A4		340	300		

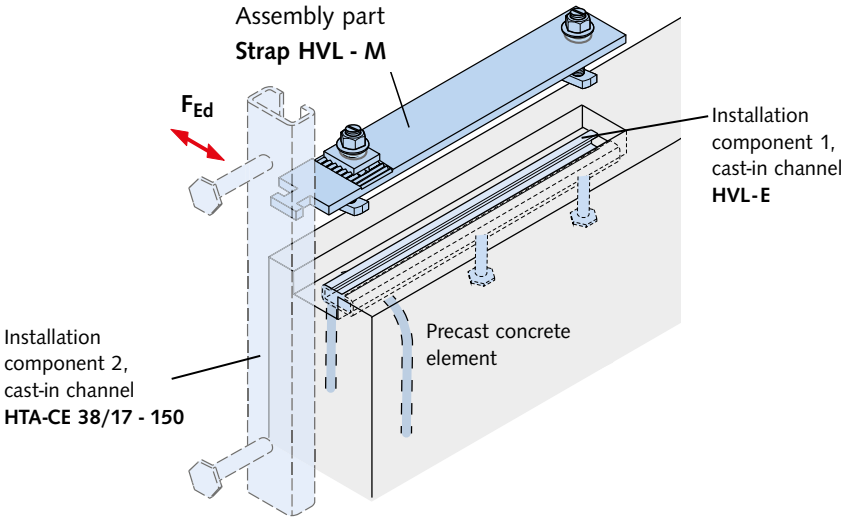
① The load capacities apply for the HKZ-restraint ties. The channel Ⓐ and the fixing dowel/channel Ⓑ must be verified, depending on the edge distance c_1, the concrete grade and the reinforcement, for each application.

ROOF AND WALLS
HVL Precast Connection

Assembly:
The connecting strap is delivered ready to be installed: The bolt fastening sets and the counter plate are pre-assembled for fast installation.







Assembly part HVL-M
Pre-assembled, consisting of:
- serrated hammer-head strap
- 1 serrated counter plate
- 2 bolt sets
  (Bolt HS 38/17 - M12 × 50
  + washer + tapered compressed spring)

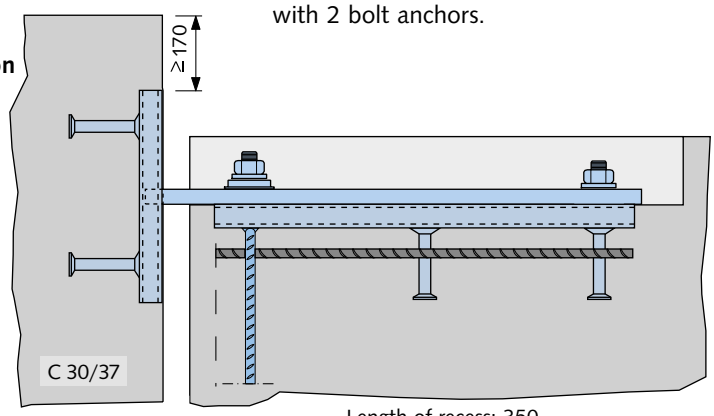
Installation component 1 HVL-E:
HALFEN Cast-in channel
HTA 38/17-300-SK with 2 bolt anchors and one loop end anchor.

Installation component 2:
HALFEN Cast-in channel
HTA-CE 38/17-150
with 2 bolt anchors.

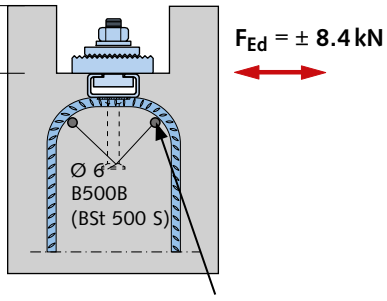
Corrosion protection
- hammer-head strap, cast-in channel: hot-dip galvanized
- HALFEN Bolts, nuts, washers and springs: galvanized

These parts are covered by mortar after installation.

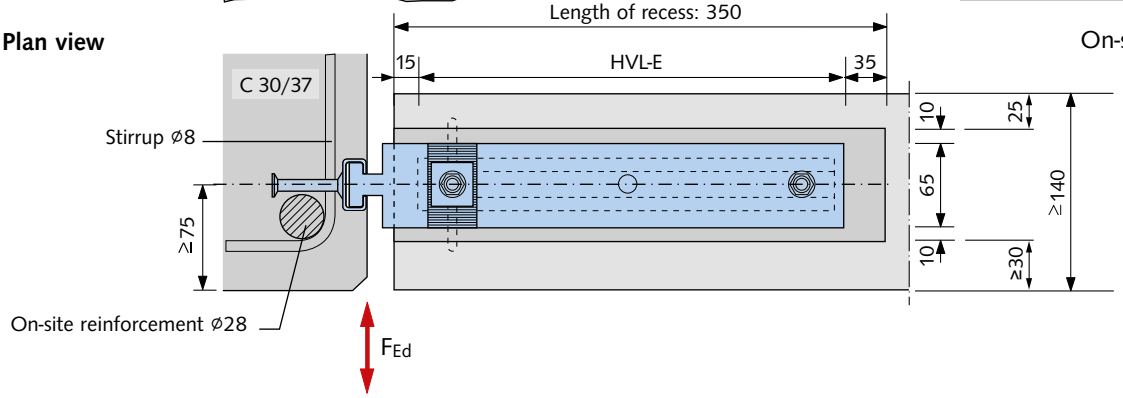
Longitudinal section



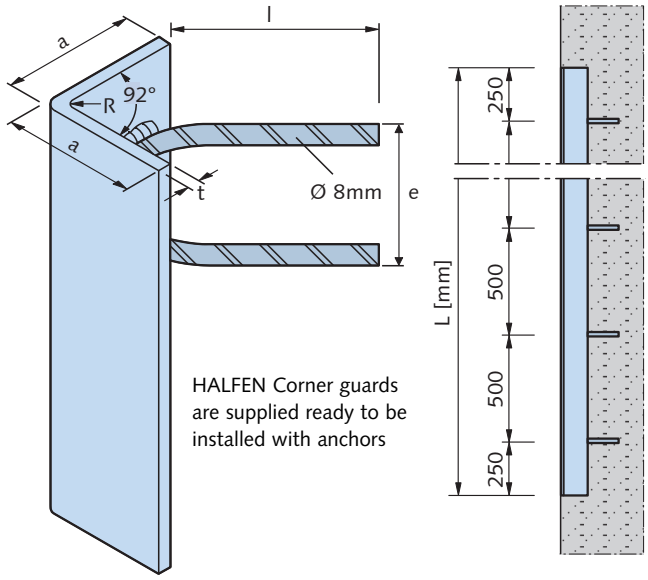
Cross section



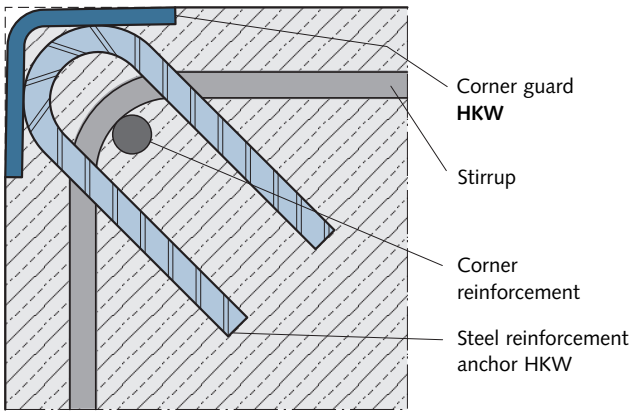
Plan view



HALFEN HKW Corner Guard



Column edge, typical cross-section



Corner guard HKW						
Type selection:				Material/Finish:		Anchor dimensions	Radius
Type	a/t [mm]	Length L [mm]	no. of anchors	FV = hot-dip galvanized	A2 = Stainless steel	l × e [mm]	R [mm]
HKW	50/5 -	500	2	FV	A2	75 × 55	6
		750	2	FV	A2		
		1000	2	FV	A2		
		1500	3	FV	A2		
		2000	4	FV	A2		
HKW	80/6 -	500	2	FV	A2	100 × 85	8
		750	2	FV	A2		
		1000	2	FV	A2		
		1500	3	FV	A2		
		2000	4	FV	A2		
HKW	100/8 -	500	2	FV	A2	110 × 85	16
		750	2	FV	A2		
		1000	2	FV	A2		
		1500	3	FV	A2		
		2000	4	FV	A2		

Material/Finish:

- **FV** = **Corner profile:** Steel hot-dip galvanized 1.0038
  Anchor: B500B (BSt 500 S)
- **A2** = **Corner profile:** Stainless steel 1.4307
  Anchor: B500B/A NR

Advantages:

- 92° angle ensures a tight fit to the formwork. This prevents concrete seeping between the formwork and the corner profile, resulting in a smoother finish
- U-shaped concrete reinforced anchors do not restrict the corner reinforcement and allow easy installation of the reinforcement
- anchors are of reinforcement steel quality to guarantee optimal anchorage
- competitive pricing through serial production

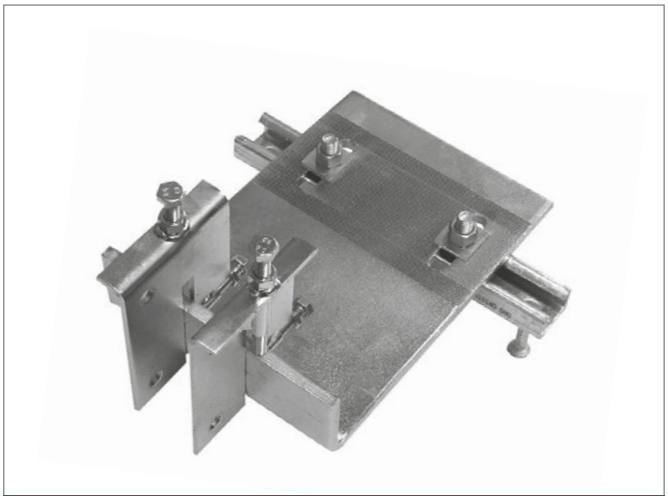
Ordering example:

HKW 50/5 - A2 - 2000/4

- 2000/4 = length / no. of anchors
- A2 = material / finish
- HKW 50/5 = type / profile

HALFEN CURTAIN WALL SYSTEM
The advantages at a glance

Modern buildings require façades of the highest quality that can be installed quickly and safely. This is the reason the HALFEN Curtain Wall System is chosen more and more frequently by architects and investors.



HCW-B2 Bracket

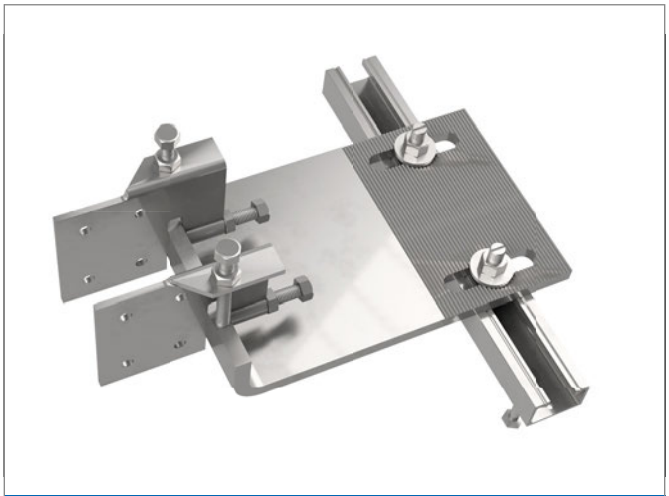
For modular façades. Anchored to the top surface of floor slabs.

Fast and cost-effective

- 3-dimensional adjustable connection when used with cast-in channels
- uses bolts instead of welding
- fast assembly reduces installation time

HCW-ED/-EW Brackets

For post and beam façades. Anchored to the edges of slabs.



HCW-B1 Bracket

For post and beam façades. Anchored to the top surface of floor slabs.

HALFEN CURTAIN WALL SUPPORT SYSTEMS
General

HALFEN Curtain wall system

This type of construction is characterized by an outer wall with a continual outer skin (see figure 1).

The façade is attached to the main structure of the building using only the required number of point-load connections.
Curtain wall façades protect the interior of buildings from external, unwanted environmental influences whilst still permitting visual contact with the outside environment with structural components that can be opened or are transparent. Specifically, this includes sufficient stability against wind loads, adequate insulation against frost in winter, heat in summer as well as against external noise.
In addition, various requirements must be met to protect against fire and other critical situations.

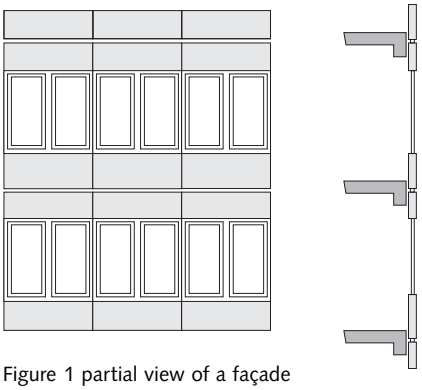


Figure 1 partial view of a façade

Post and beam façade and the modular façade

Basically, we distinguish between two methods of curtain wall façades:

- the **post and beam façade**
- and the **modular façade**.

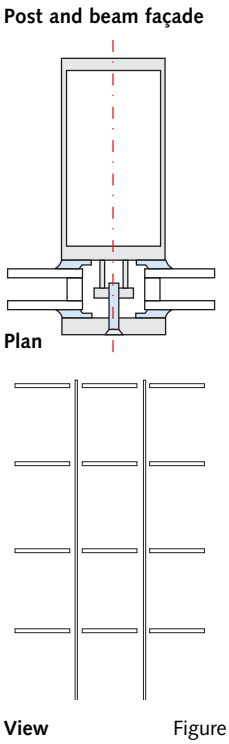


Figure 2

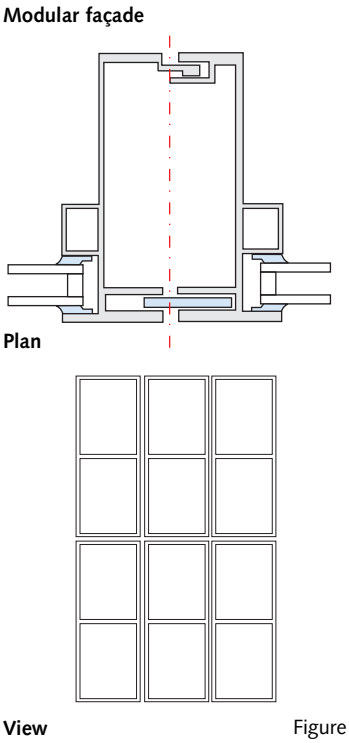


Figure 3

Post and beam façade
One basic distinctive difference is the way expansion in the façade is distributed (for example; thermal expansion). With the post and beam façade (see figure 2) the vertical and horizontal frame supports are installed in spacings corresponding to the façade elements. The supports are installed with an expansion gap between components allowing for sufficient expansion.

The respective longitudinal and transverse connections have an expandable joint. The filler elements (glass or panel) installed in a post and beam structure permit movement within the tolerance of the designed expansion joint. The glass and filler elements are delivered separately and are then installed on site, requiring on-site scaffolding.

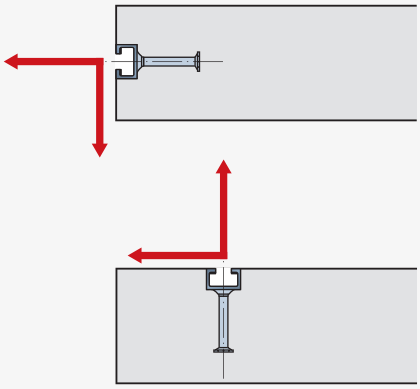
Modular façade
With the modular façade method (see figure 3), the façade is made of prefabricated elements, in which glass, natural stone or infills are pre-installed. The façade profiles are designed as a key and slot system to allow for expansion.

This method provides immediate weather protection and allows the building contractor to start interior work on the respective floor directly after the prefabricated modules have been installed.
Scaffolding is not required with this method of construction.

HALFEN CURTAIN WALL SUPPORT SYSTEMS
Product range

Load conditions and required HALFEN Cast-in channels

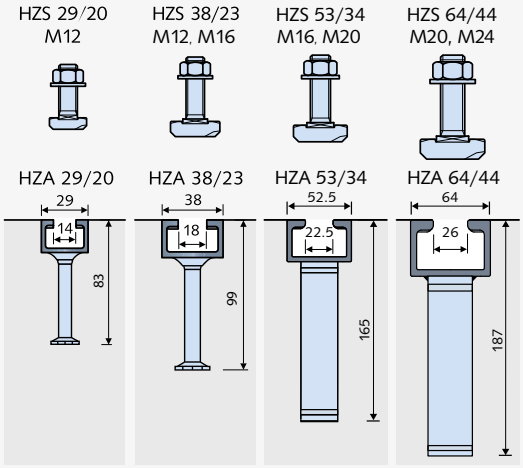
Standard slab thickness
with standard tensile and transverse tensile loads
HALFEN Channels with bolt anchors and weld-on I-anchors



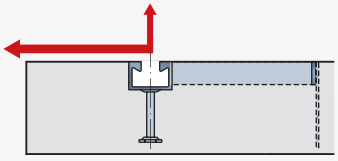
officially App. No Z-21.4-1691 approved

see pages 14-15, 30

Hot-rolled serrated channels and bolts

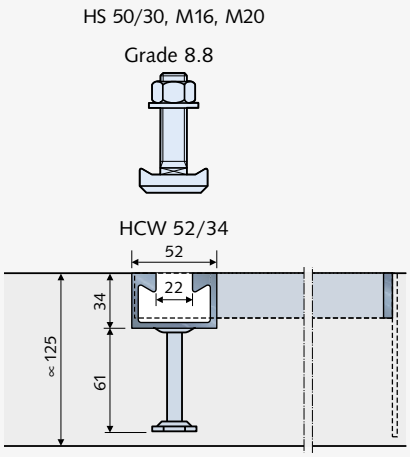


Thin slabs (thickness ≥ 12.5 cm)
with high transverse tensile loads
and small edge distance
HALFEN Curtain wall channel
HCW 52/34
(not included in the HTA-CE approval)

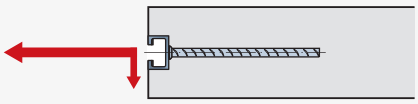


see pages 72-73

HCW 52/34 and bolt

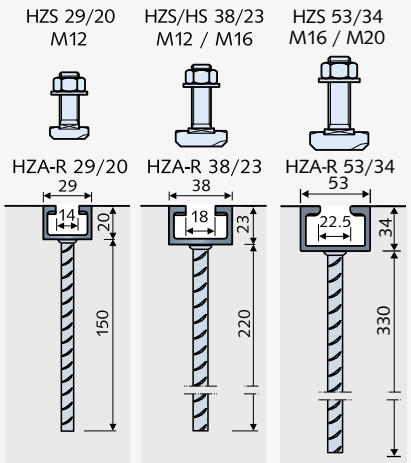


Thin slabs (thickness ≥ 10 cm)
with high tension loads
HALFEN Channels HTA-R or HZA-R
with rebar anchors
(not included in the HTA-CE and
HZA approvals)

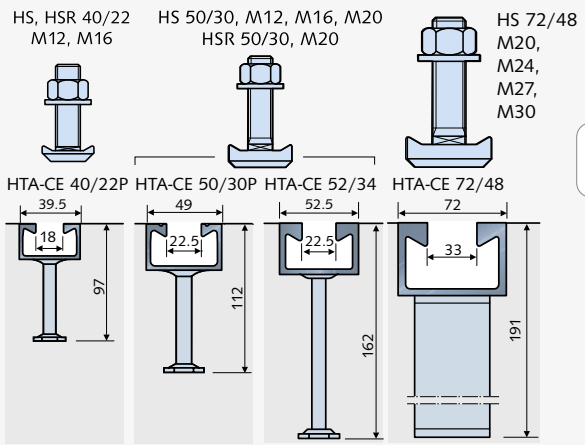


see page 75

Hot-rolled serrated channels with
rebar anchors and bolts



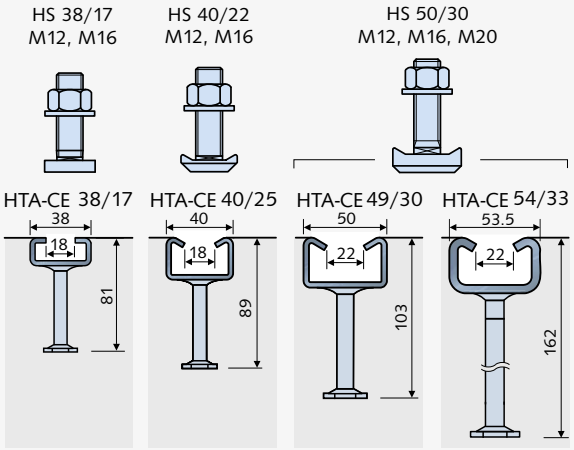
Hot-rolled (standard) channels and bolts

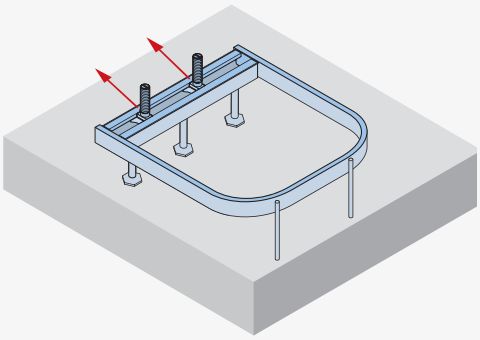


CE European Technical Approval ETA-09/0339

HSR Bolt according to expert reports

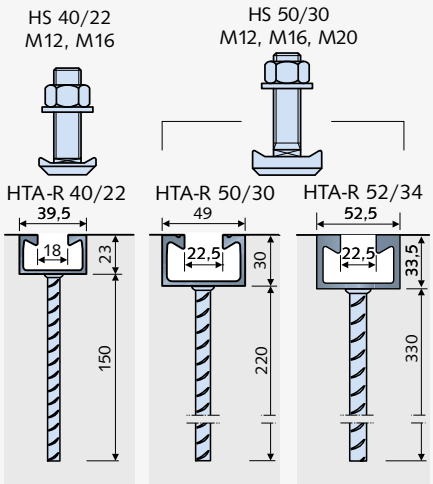
Cold-rolled (standard) channels and bolts



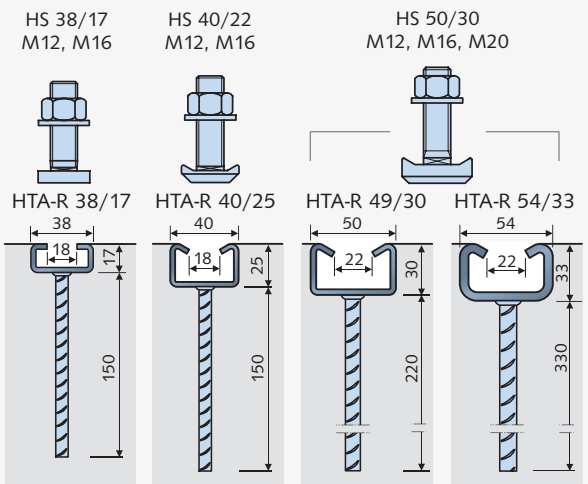


HCW 52/34 with bolts and bracket

Hot-rolled (smooth) channels with rebar anchors and bolts

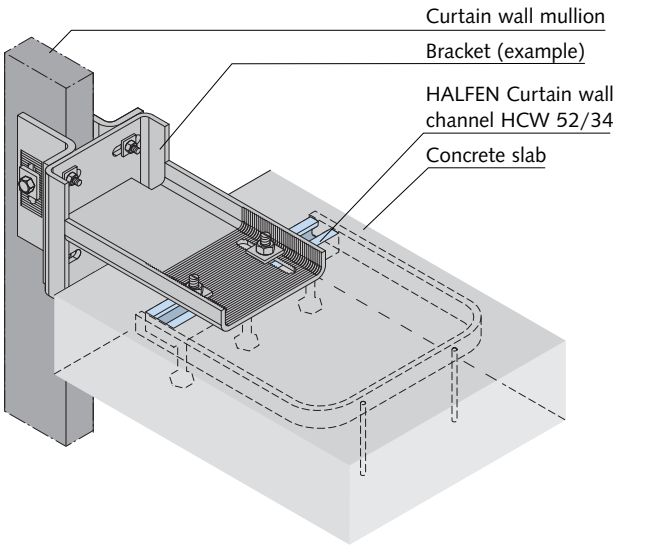


Cold-rolled (smooth) with rebar anchors and bolts



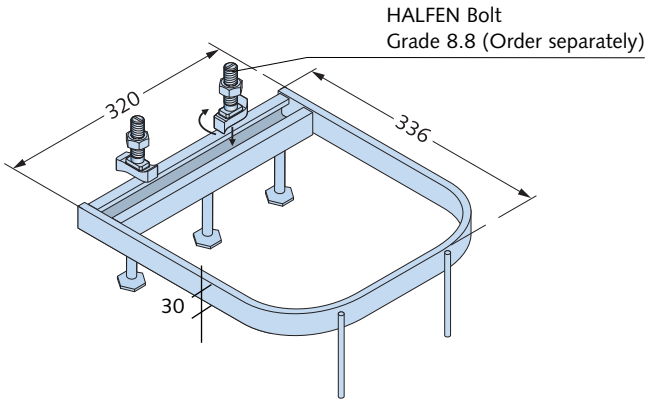
HALFEN CURTAIN WALL SUPPORT SYSTEMS
HALFEN Channel HCW 52/34

Typical installation



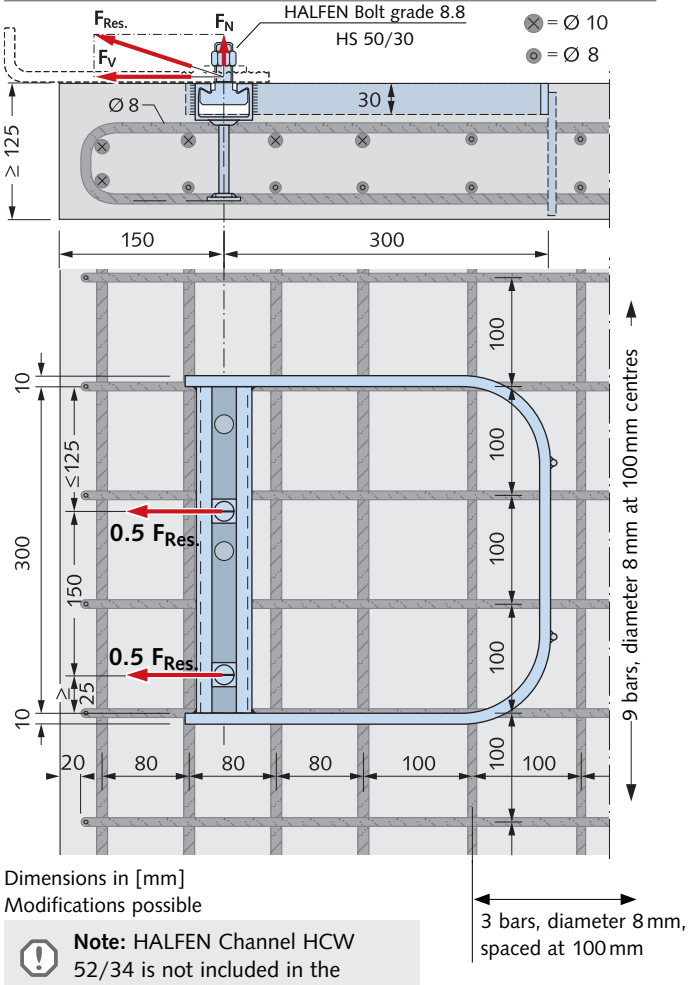
Product description

Identification: HCW 52/34
Material: hot-dip galvanized



Dimensions in [mm]

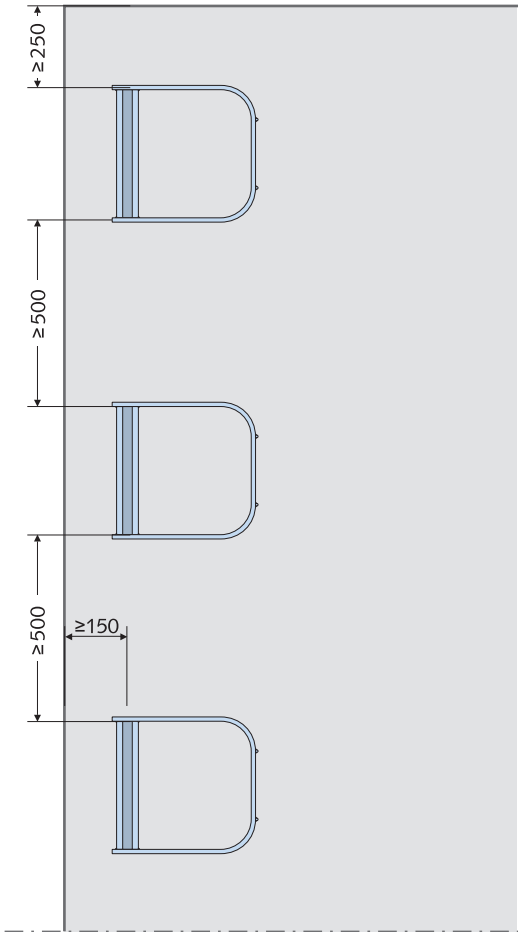
Reinforcement requirements



Dimensions in [mm]
Modifications possible

Note: HALFEN Channel HCW 52/34 is not included in the HTA-CE/HZA approval.

Channel dimensions and edge spacing



HALFEN Cast-in Channel HCW 52/34

Channel load data

The following load failure were averaged from three tests:

$F_{V\ failure}$		= 142.3 kN
$F_{N\ failure}$		= 47.4 kN
$F_{res,failure}$	= $\sqrt{F_N^2 + F_V^2}$	= 150.0 kN

The load deformation diagram (see right) may be used to determine allowable loads based on acceptable displacement and the required safety factor according to local building codes. The diagram is based on the following:

- tensile and transverse loads were increased at a ratio of 1:3 up to breaking point
- concrete slab thickness ≥ 125 mm and reinforcement as shown on page 72
- concrete strength class ≥ C 20/25 N/mm²
- load is transferred into the channel via two HALFEN Bolts HS 50/30 M20 Grade 8.8. The bolt spacing is 150 mm. A sample calculation is shown below.

The safety factor is freely selected. However, it must be determined which factors are actually to be implemented, whether these are based on project specific boundary condition or on valid building regulations.

Calculation example: Assumed safety factor v = 3
(failure test load / working load)

Average failure load from the tests:

Transverse tensile stress	$F_{V\ ultimate}$	=	142.3 kN
Tensile stress	$F_{N\ ultimate}$	=	47.4 kN
Res. diagonal tensile load	$F_{res,ultimate}$	=	150.0 kN

Actual working loads at bolts (specification by façade engineer):

Transverse tensile stress	F_V = 35 kN
Tensile stress	F_N = 10 kN

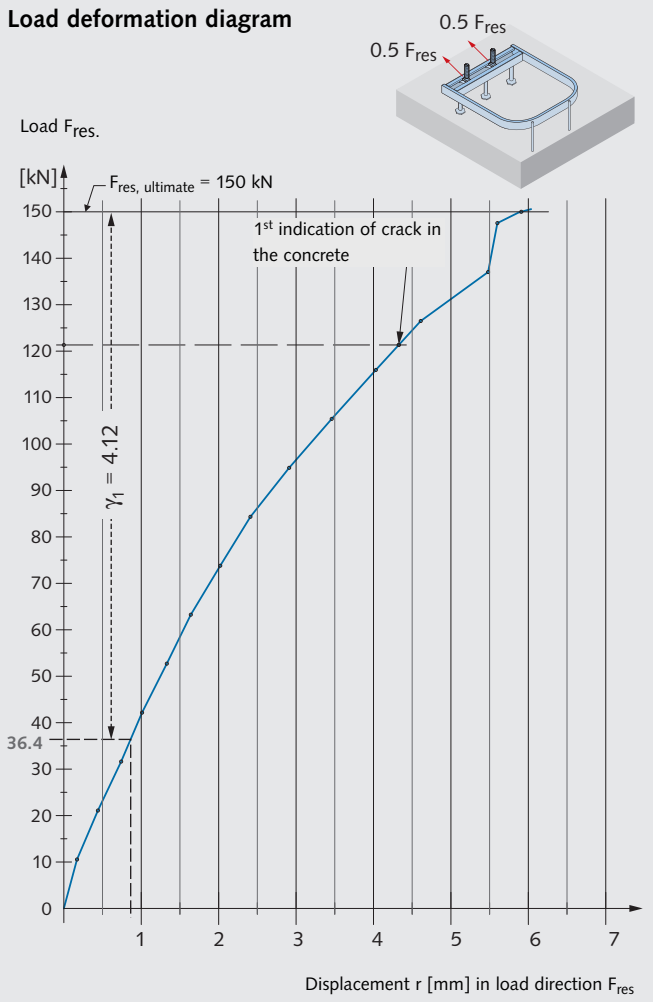
Allowable load with v = 3 against average ultimate load from tests:

perm. F_V	= 142.3 / 3	= 47.4 kN
perm. F_N	= 47.4 / 3	= 15.8 kN
perm. F_{res}	= 150 / 3	= 50.0 kN

Control: Working load F_V = 35 kN < 47.4 kN
Working load F_N = 10 kN < 15.8 kN
Working load F_{res} = $\sqrt{(10)^2 + (35)^2}$ = 36.4 kN < 50 kN

Displacement at working load < 1 mm (see diagram).
Actual safety factor for average ultimate load γ_1 = (150 / 36.4) = 4.12.

Load deformation diagram



Corresponding HALFEN Bolts HS 50/30

Depending on the load size, we also recommend using HALFEN Bolts HS 50/30 M16 or M20, grade 8.8 in combination with HALFEN Cast-in channel HCW 52/34. The bolts stated below are zinc galvanized with a special coating.

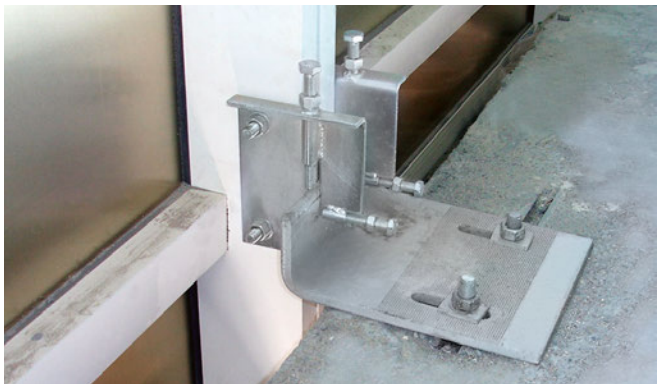
For interior use this design is considered equivalent to a hot-dip galvanized design. Other bolt sizes and materials can be supplied. Please contact us for detailed information. Addresses can be found at the back of this catalogue.

Type selection HALFEN Bolts HS 50/30 GV Grade 8.8

Thread	Material grade	Available length L [mm]	Allowable resulting bolt load (all directions) perm. F_s [kN]	Allowable bending moment [Nm]	Recommended torque [Nm]
M 16	8.8	40, 60, 80, 100	36.1	111	60
M 20	8.8	45, 60, 80, 100	56.4	216	120

If the bolt is stressed in the direction of a slot its load capacity must be verified taking bolt flexure into account.

HALFEN CURTAIN WALL SUPPORT SYSTEMS
Application Examples


Fixing of a curtain wall system using HCW-B2 Brackets connected to HTA-CE Cast-in channels


Liberty Life, Johannesburg


Torre Espacio, Madrid


Fixing of a post and beam façade using HCW-ED Brackets on HTA-CE Cast-in channels

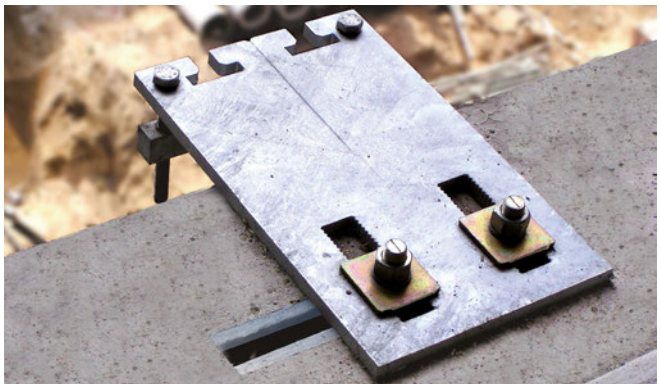

Post office Tower, Bonn


Sage Centre, Gateshead


Fixing of a modular façade using HCW-ED Brackets on HTA-CE Cast-in channels


Burj Chalifa, Dubai


Edificio Gas Natural, Barcelona


Typical curtain wall fixing with HTA-CE Cast-in channels


Westin Libertador Hotel, Lima

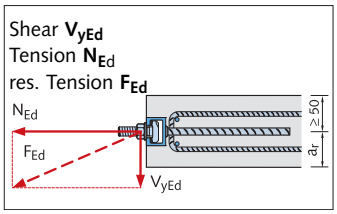

World Financial Center, Shanghai

HALFEN Cast-in Channels with Rebar Anchor HTA-R and HZA-R

Design basics

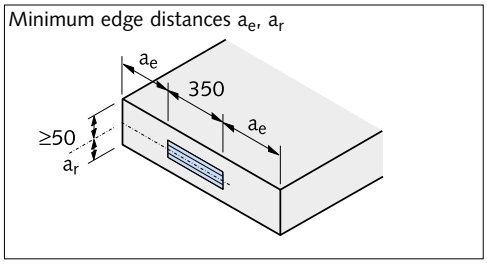
Structural analysis

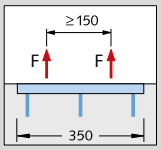
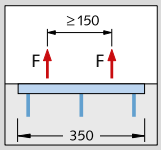
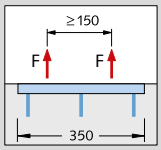
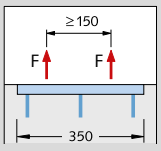
	Material resistance		Design load	
Material resistance shear	V_{yRd}	≥	V_{yEd}	
Material resistance tension	N_{Rd}	≥	N_{Ed}	
Material resistance resulting diagonal pull	F_{Rd}	≥	F_{Ed}	$= \sqrt{N_{Ed}^2 + V_{y,Ed}^2}$



HALFEN Channels HTA-R and HZA-R – Design values for material resistance

The minimum edge distance shown in the table applies to reinforced concrete



HALFEN Cast-in channel type		HTA-R 38/17 ②	HTA-R 40/25 ② HTA-R 40/22 ② HZA-R 29/20 ③	HTA-R 49/30 ② HTA-R 50/30 ② HZA-R 38/23 ③	HTA-R 54/33 ③ HTA-R 52/34 ② HZA-R 53/34 ③
		350 mm 3 anchors	350 mm 3 anchors	350 mm 3 anchors	350 mm 3 anchors
Concrete strength grade ≥ C20/25 $f_{ck,cyl.}$ = 20 N/mm² $f_{ck,cube}$ = 25 N/mm²					
$F_{Rd} = N_{Rd}$ [kN]		2 × 7.0	2 × 9.1	2 × 14.0	2 × 24.5
a_r [mm]	a_e [mm]	V_{yRd} [kN]			
≥ 50	≥ 40	2 × 2.4			
≥ 60	≥ 45	2 × 3.7			
≥ 70	≥ 50	2 × 4.9			
≥ 75	≥ 50	2 × 5.6			
Material: hot-dip galvanized	Channel	1.0038 / 1.0044			
	Anchor	B500B (BSt 500S)			
Material: stainless steel	Channel	1.4571 / 1.4404④			
	Anchor	B500B (BSt 500S)			

② Material 1.0038, ③ Material 1.0044 , ④ Not available for HALFEN Cast-in channels HZA-R 29/20

Notes: HALFEN Cast-in channels HTA-R / HZA-R are not included in the HTA-CE/HZA approval

Other channel lengths from 150 - 6070 mm are available

HALFEN CURTAIN WALL SUPPORT SYSTEMS
Edge of Slab Brackets HCW-ED Post and Beam Façades

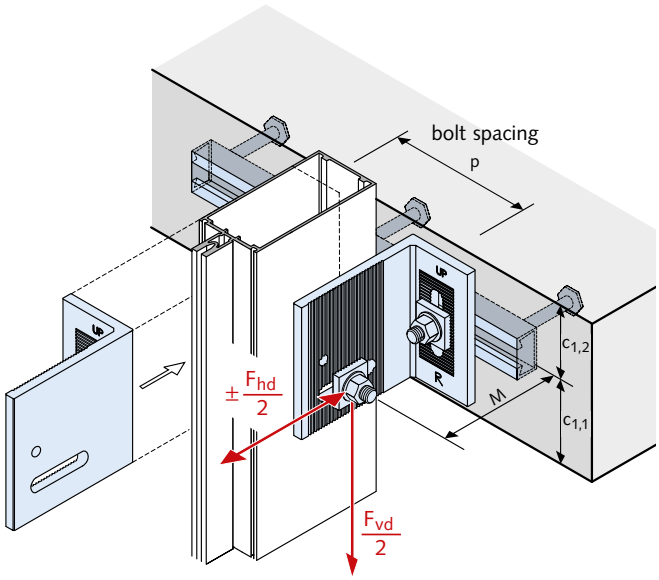
Application example

HALFEN Edge of slab brackets are connected in pairs, one each side of the mullion, and are available in two types:

- **Type HCW-ED** Brackets are designed to support both **vertical and horizontal** loads.
- **Type HCW-EW** Brackets are designed to support only **horizontal** wind loads.

The brackets guarantee a simple adjustable connection. The HALFEN Bolts (connection: bracket to HALFEN Channel) and the standard hexagonal bolts M12 (connection: bracket to façade mullion) must be grade strength 8.8.
A round auxiliary hole in the long arm of the brackets can be used for temporary attachments. For example; temporary fixing of brackets to support the post with self-tapping screws until the final connection is made.

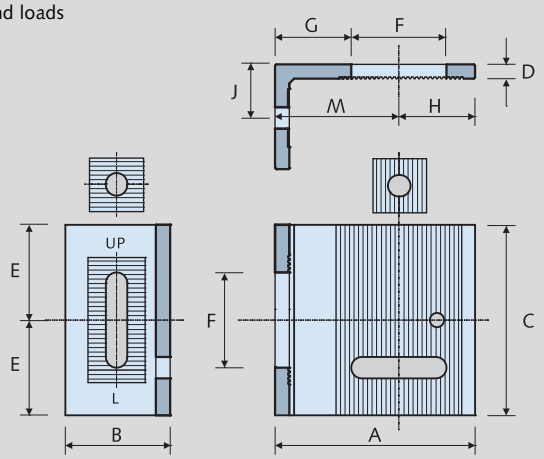
The brackets are made of high quality aluminium material. Special nylon discs are placed between the "Wind load" Bracket HCW-EW and support post.



To guarantee correct installation, the HCW-ED brackets are marked `R´ for right, `L´ for left and `UP´ for top.

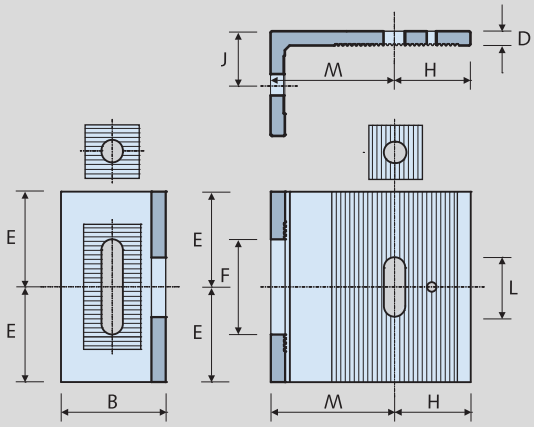
Bracket dimensions [mm]

HCW-ED Brackets
for dead loads
and wind loads



Serrated washers must be ordered separately

HCW-EW Brackets
wind loads only

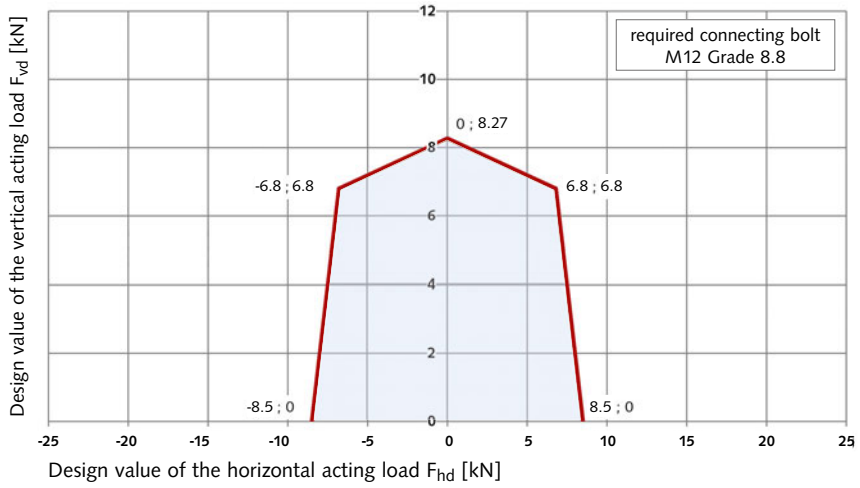


Serrated washers must be ordered separately

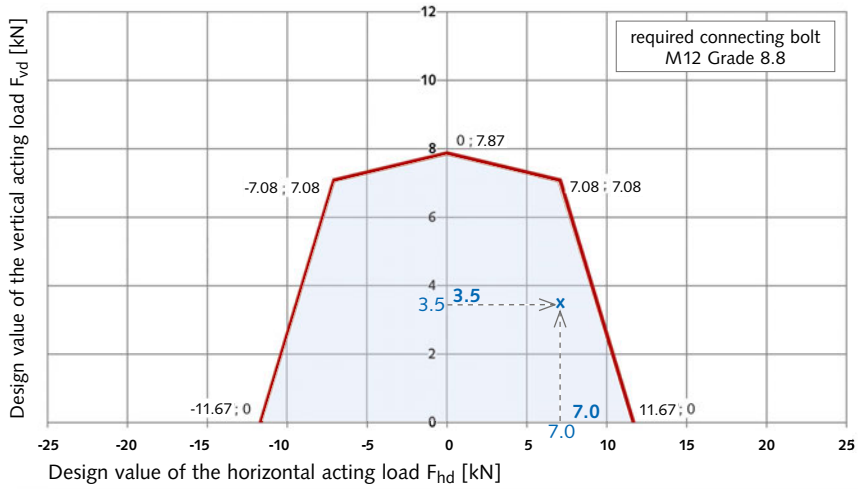
Size	Bracket code	A	B	C	D	E	F	G	H	J	L	M
Small	**HCW-ED 1 HCW-EW 1**	108	70	114	10	57	64	25	51	36	40	57
Medium	**HCW-ED 2**	133	70	127	10	64	64	51	51	36	40	82
Large	**HCW-ED 3 HCW-EW 3**	159	70	140	10	70	64	76	51	36	40	108

Dimensioning

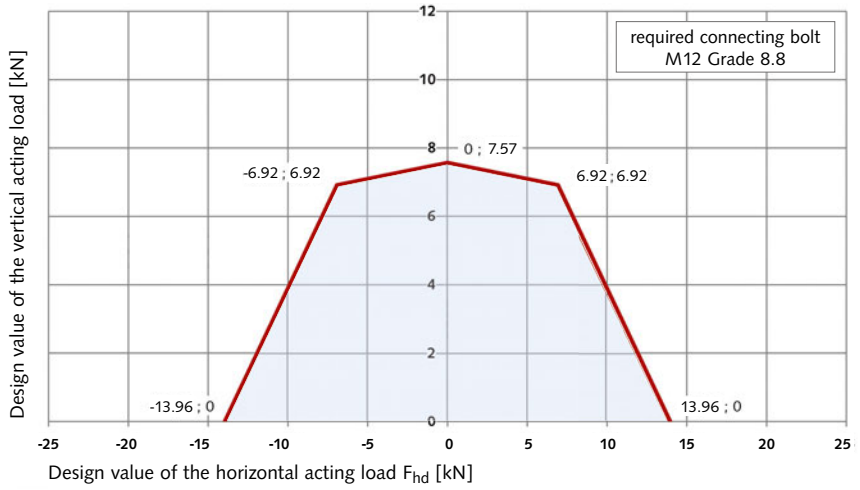
Interaction diagram for type HCW-ED1 (small)



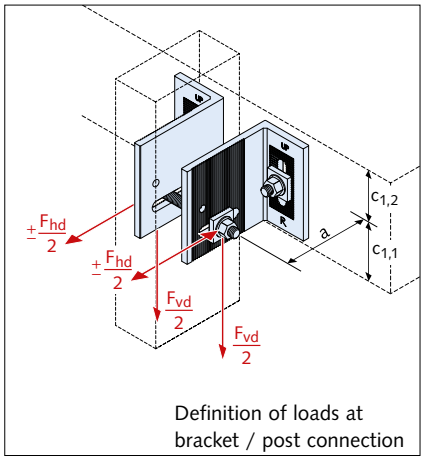
Interaction diagram for type HCW-ED2 (medium)



Interaction diagram for type HCW-ED3 (large)



Calculation basis



Definition of loads at bracket / post connection

Permitted load interaction area

HALFEN CURTAIN WALL SUPPORT SYSTEMS

Design Loads using two HCW-EW Brackets, Loads in the HALFEN Bolts (HCW-ED)

Design wind loads for type HCW-EW

Max. applied design load F_{hd} [kN]			
Size	Bracket code	max. F_{vd} [kN]	max. F_{hd} [kN]
Small	**HCW-EW 1**	0	8.5
Large	**HCW-EW 3**	0	13.96

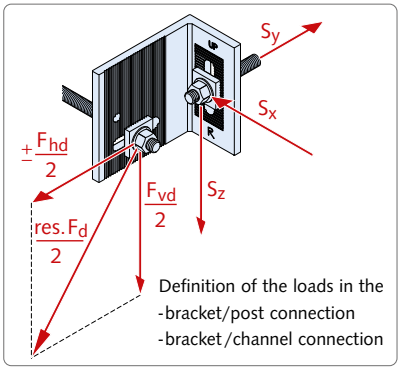
HCW-EW Brackets are only suitable for wind loads.

Forces acting on the T-head bolts at the channel (HCW-ED)

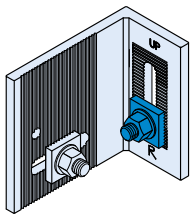
The components of the design-reaction forces in the HALFEN Bolts at the connection of the curtain wall bracket to HALFEN Cast-in channel, are calculated by multiplying the design loads F_{vd} and F_{hd} at connection curtain wall bracket and façade support post with the factors s_x, s_y and s_z.
The factors are dependent on the bracket geometry, the load direction and the bolt position (see figure on the right). See table below for multiplication factors for determining the design reaction forces in the HALFEN Bolts.

Lower installation position of HALFEN Bolt (Position 3)									
	Dead load $S_i = (F_{vd} / 2) \times s_i$			Wind load $S_i = (F_{hd} / 2) \times s_i$			Resulting load 45° $S_i = (\text{res. } F_d / 2) \times s_i$		
Bracket	s_x	s_y	s_z	s_x	s_y	s_z	s_x	s_y	s_z
HCW-ED 1	0.5	3.2	−1.0	−1.0	1.0	0.0	−0.3	3.0	−0.7
HCW-ED 2	0.5	3.6	−1.0	−0.5	1.0	0.0	0.0	3.3	−0.7
HCW-ED 3	0.5	4.0	−1.0	−0.4	1.0	0.0	0.1	3.5	−0.7
Upper installation position of HALFEN Bolt (Position 1)									
HCW-ED 1	0.6	1.3	−1.0	−1.0	3.6	0.0	−0.3	3.4	−0.7
HCW-ED 2	0.6	1.6	−1.0	−0.5	3.1	0.0	0.0	3.4	−0.7
HCW-ED 3	0.6	1.9	−1.0	−0.4	2.9	0.0	0.1	3.4	−0.7

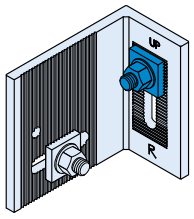
Calculation basis



① Lower installation position of HALFEN Bolts **(Position 3)**



② Upper installation position of HALFEN Bolts **(Position 1)**



Calculation example

Assumed: slab thickness = 200 mm, width of mullion = 80 mm,
projection a = 80 mm (install. position see page 79)
design dead load $F_{vd} = +3.5$ kN
design wind load (wind suction) $F_{hd} = +7.0$ kN

Selected: HALFEN Bracket type HCW-ED 2
⇒ possible projection M = 82 ± 25 mm
⇒ Interaction diagram type HCW-ED 2 (see page 77) proves that the assumed load is within the permitted load interaction zone

Determination of the design reaction forces in a HALFEN Bolt

① Lower installation position (Position 3)

$S_x = (3.5/2) \times 0.5 + (7/2) \times (-0.5) =$ −0.88 kN
$S_y = (3.5/2) \times 3.6 + (7/2) \times 1.0 =$ +9.80 kN
$S_z = (3.5/2) \times (-1.0) + 0 =$ −1.75 kN

⇒ Resulting bolt load

$\text{res. } S_d = \sqrt{(-0.88)^2 + (9.80)^2 + (-1.75)^2} = 9.99$ kN per bolt

② Upper installation position (Position 1)

$S_x = (3.5/2) \times 0.6 + (7/2) \times (-0.5) =$ −0.70 kN
$S_y = (3.5/2) \times 1.6 + (7/2) \times 3.1 =$ +13.65 kN
$S_z = (3.5/2) \times (-1.0) + 0 =$ −1.75 kN

⇒ Resulting bolt load

$\text{res. } S_d = \sqrt{(-0.70)^2 + (13.65)^2 + (-1.75)^2} = 13.78$ kN → each bolt
→ determining factor for bolt selection

Selected HALFEN Channel:

HTA-R 50/30 - 350 - 3 Anchor - FV see page 75

with $V_{yRd} = 2 \times 5.6$ kN $> 2 \times |S_z| = 2 \times 1.75$
($a_r \geq 75$ mm)
$F_{Rd} = 2 \times 14.0$ kN $> 2 \times \text{res. } S_d = 2 \times 13.78$ kN

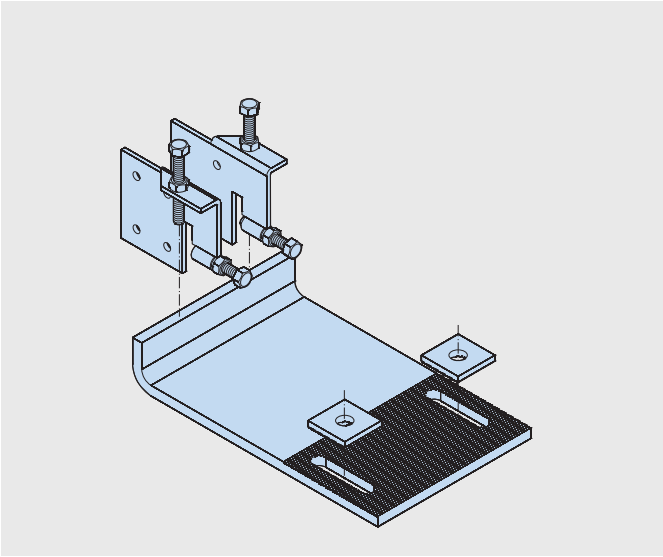
Check: bolt spacing: P = 80 + 2 × 36 = 152 mm
Selected HALFEN Channel: > 150 mm ✔

HS 50/30 - M12 × 60 GV 8.8

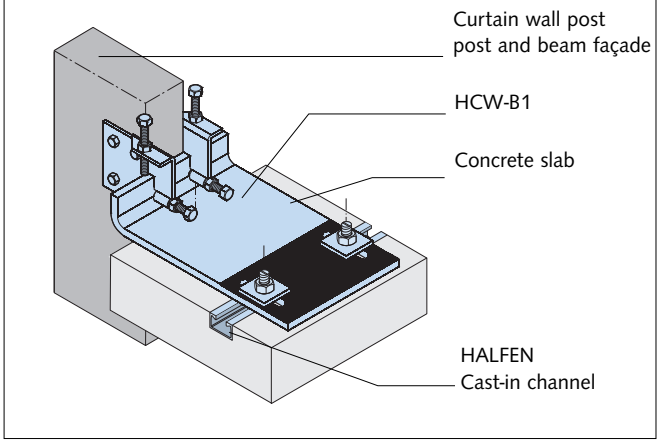
Requirement according to interaction diagram see page 77

Top of Slab Brackets HCW-B1

Support brackets for horizontal and vertical loads



Typical installation



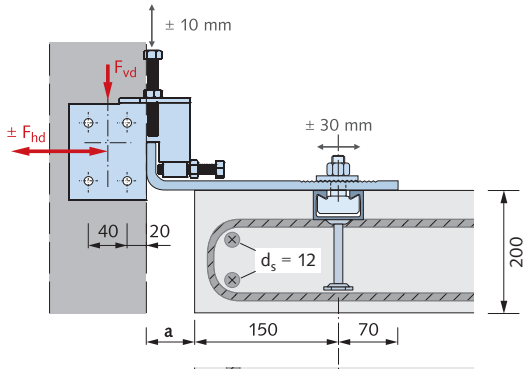
HALFEN Brackets HCW-B1

HALFEN Brackets HCW-B1 for installing to the top of concrete slabs, are available in two load ranges and three cantilever sizes.

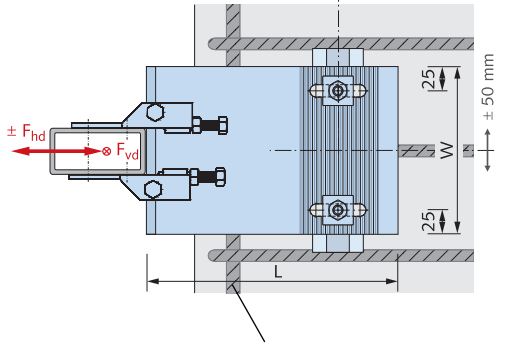
The brackets are made in grade S355 quality galvanized steel. Vertical adjustability is ±10 mm.

Three-dimensional adjustability is ensured when used in combination with HALFEN HTA-CE Cast-in channels.

The lateral connecting plates are connected to the façade posts using M8 screws (not included). The façade planner is responsible for providing the static verification for the support posts. Use M16 HALFEN Bolts, grade 8.8 (order separately), to connect the base bracket to the HALFEN Cast-in channel. Depending on the façade type, the connection between the connecting plate and the base bracket can be designed either laterally adjustable or as a fixed point.



Section



Plan

Required edge reinforcement ≥ ø12 (B500B)

Dimensioning / Type selection

Design load ranges

Load range [kN]	dead load F_{vd} [kN]	wind load F_{hd} [kN] (wind suction + compression)
4/12	4	±12
7/20	7	±20

F_{vd}, F_{hd}: allowable design loads with a partial safety factor γ_F = 1.35 for dead load and γ_F = 1.5 for wind load.

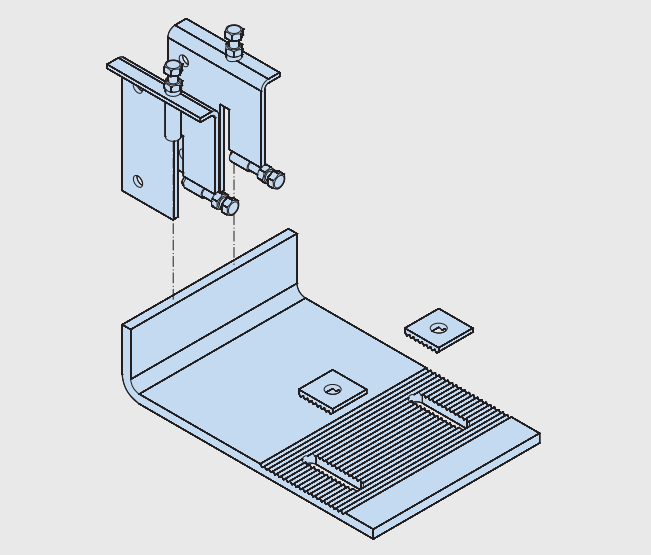
Type selection

Load range [kN]	a [mm]	Item name HCW-B1-...	L [mm]	W [mm]	HALFEN Channel ①	Recommended HALFEN Bolt
4/12	50	...-4/12-50	270	150	HTA-CE 40/22P-250 2 Anchors	HS 40/22 M16×60 8.8
	75	...-4/12-75	295	150		
	100	...-4/12-100	320	150		
7/20	50	...-7/20-50	270	175	HTA-CE 50/30P-300 3 Anchors	HS 50/30 M16×60 8.8
	75	...-7/20-75	295	175		
	100	...-7/20-100	320	200		

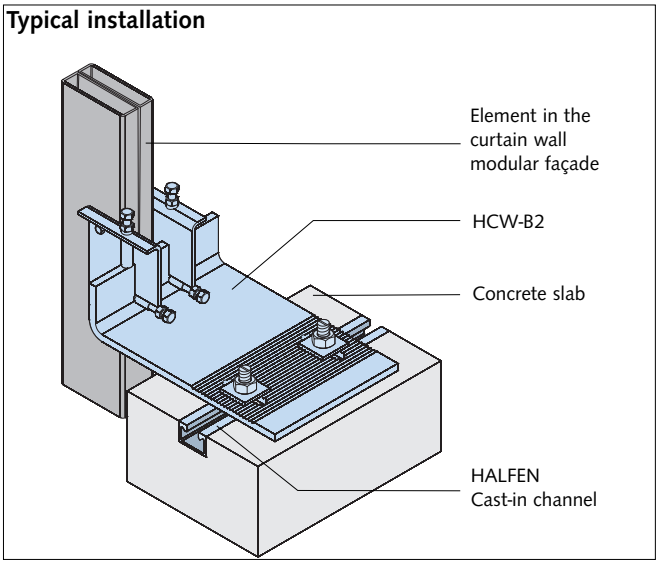
① Recommended HALFEN Channel exploiting full load capacity of bracket

HALFEN CURTAIN WALL SUPPORT SYSTEMS
Top of Slab Brackets HCW-B2

Brackets for horizontal and vertical loads



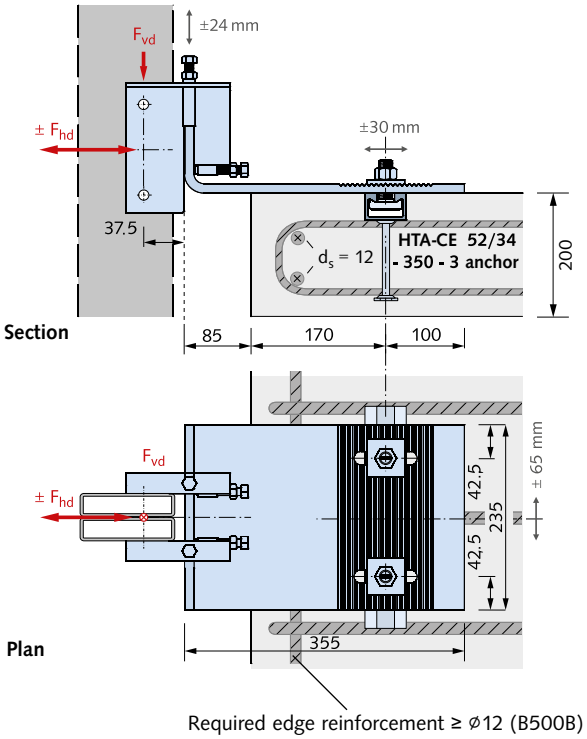
Typical installation



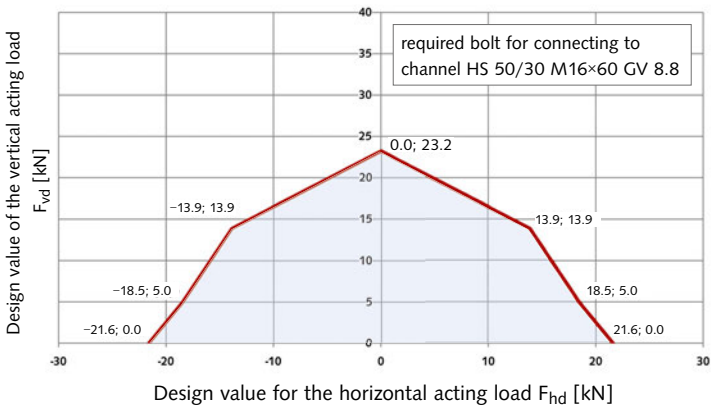
HALFEN Brackets HCW-B2

HALFEN Brackets HCW-B2 are made in grade S355 quality galvanized steel. The vertical adjustability is ±24 mm. Three-dimensional adjustability is ensured when used in combination with HALFEN Cast-in channels HTA-CE. The lateral connecting plates are connected to the façade posts using M12 screws (not included in delivery).

The façade planner is responsible for providing the static verification for the support posts. Use M16 HALFEN Bolts, grade 8.8 (order separately), to connect the base bracket to the HALFEN Cast-in channel. Depending on the façade type, the connection between the connecting plate and the base bracket can be designed either laterally adjustable or as a fixed point.



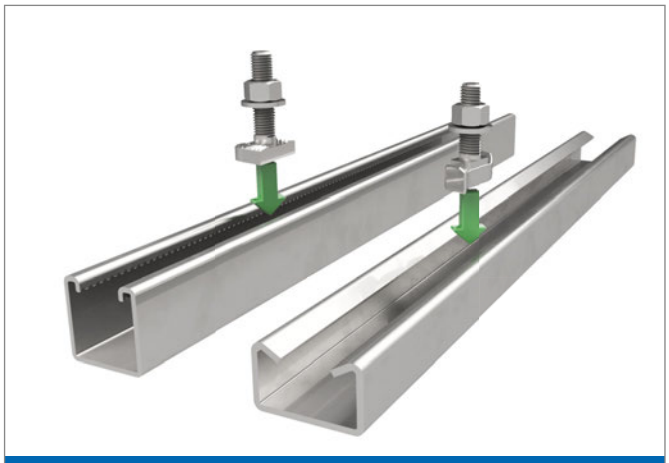
Dimensioning



Allowable load interaction area

ACCESSORIES/FRAMING CHANNELS
The advantages at a glance

To complement its product range HALFEN has a wide range of accessories. We can supply everything you need for your project; everything from one source.

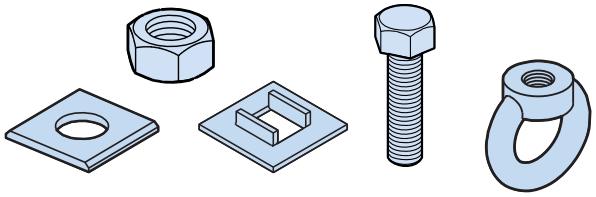


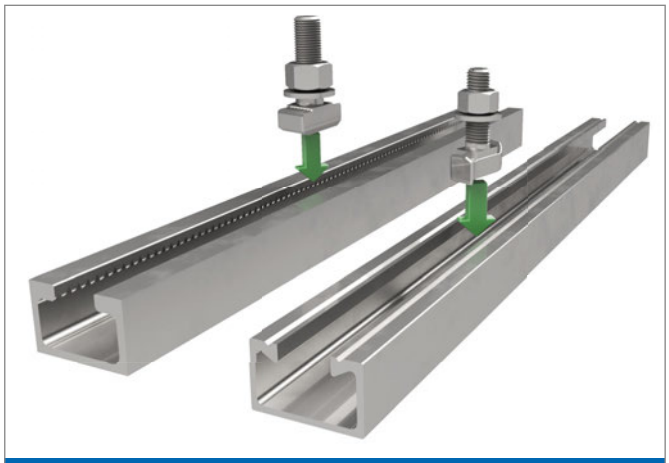
HALFEN HM/HZM Framing channel, cold-rolled

HALFEN Framing channels, used in combination with matching HALFEN Bolts (or threaded plates) have all the benefits needed for versatile bolt and frame constructions.

Quick and economical

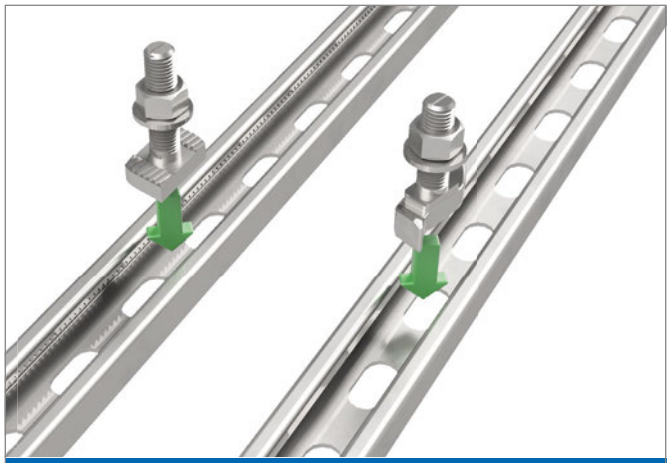
- full flexibility in positioning and dimensioning of the bolt connection
- quick installation and adjustability of plant equipment or building components
- dirt and noise free on-site modifications
- innovative modular assembly system; numerous complementary accessories available
- no more welding in hazardous environments
- bolted connections do not damage the corrosion protection of plant components





HALFEN HM/HZM Framing channel, hot-rolled

The HALFEN Framing channels range includes hot and cold-rolled channel profiles with standard or serrated channel lips.



HALFEN HL/HZL Slotted channels

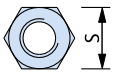
HALFEN Framing channels are available, mill-finished, hot-dip galvanized or in stainless steel materials; slotted or non-slotted.

The complete, available product range for industrial application can be found in the technical product information catalogues; MT-FBC (Flexible Bolt connections) or MT-FFC (Flexible framing connections).

ACCESSORIES
Nuts, Washers

Accessories: Nuts, Washers

MU
Hexagonal nuts
EN ISO 4032/
DIN 934

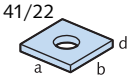


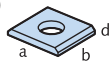
GV galvanized FK 8 thread	A4 stainless steel A4 thread	S/m DIN [mm]	S/m ISO [mm]
M6	M6	10/5	10/5,2
M8	M8	13/6,5	13/6,8
M10	M10	17/8	16/ 8,4
M12	M12	19/10	18/10,8
M16	M16	24/13	24/14,8
M20	M20	30/16	30/18
M24	-	36/19	36/21,5
FV hot-dip galvanized thread	**A2 stainless steel A2 thread**	**S/m DIN [mm]**	**S/m ISO [mm]**
M6	-	10/5	10/6
M8	M8	13/6.5	13/7.5
M10	M10	17/8	16/9.5
M12	M12	19/10	18/12
M16	M16	24/13	24/15.5

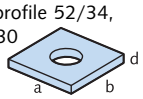
VUS
Square washers

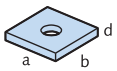
FV hot-dip galvanized for bolt	A4 stainless steel for bolt	a × b × d [mm]
VUS 40/25 for profile 40/25; HZA 41/22		
M10	M10	40 × 40 × 5
M12	M12	40 × 40 × 5
M16	M16	40 × 40 × 5
VUS 49/30 for profile 54/33, 49/30		
M10	M10	37 × 37 × 5
M12	M12	37 × 37 × 5
M16	M16	37 × 37 × 5
M20	M20	37 × 37 × 5
VUS 52/34 for profile 52/34, 50/30		
M16	M16	50 × 50 × 6
M20	M20	50 × 50 × 6
VUS 72/49 for profile 72/48, 72/49		
M20	M20	54 × 54 × 6
M24	M24	54 × 54 × 6
M27	M27	54 × 54 × 6
M30	M30	54 × 54 × 6
VUS 41/41 for all 41 profiles		
M6	M6	40 × 40 × 6
M10	M10	40 × 40 × 6
M12	M12	40 × 40 × 6

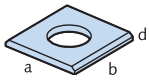
Ordering example: **VUS 52/34 - FV - M20**



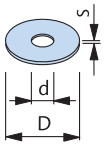








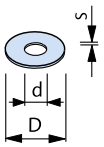
US
Washer
DIN 9021
EN ISO
7094/
DIN 440



DIN	GV galvanized for bolt	A4 stainless steel for bolt	D [mm]	d [mm]	s [mm]
440	M6	-	22	6.6	2
9021	M8	M8	24	8.4	2
9021	M10	M10	30	10.5	2.5
440	M12	-	45	13.5	4
9021	M12	M12	37	13	3
9021	M16	M16	50	17	3
440	M20	-	72	22	6

Ordering example: **US - M12 - GV -DIN 9021**

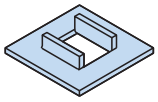
US
Washers
EN ISO 7089/
DIN 125



GV galvanized for bolt	A4 stainless steel for bolt	D [mm]	d [mm]	s [mm]
M6	M6	12	6.4	1.6
M8	M8	16	8.4	1.6
M10	M10	21	10.5	2
M12	M12	24	13	2.5
M16	M16	30	17	3
M20	M20	37	21	3
M24	-	44	25	4
FV hot-dip galvanized for bolt	**A2 stainless steel for bolt**	**D [mm]**	**d [mm]**	**s [mm]**
-	M8	17	8.4	1.6
M10	M10	21	10.5	2
M12	M12	24	13	2.5
M16	M16	30	17	3

Ordering example: **US - M12 - GV - DIN 125**

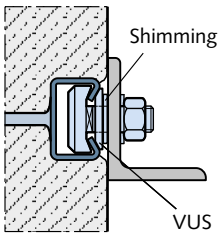
SIC
Locking washer



GV galvanized	A4 stainless steel	Suitable for HALFEN Bolts type	Suitable for HALFEN Bolts dimensions
SIC-50/30-GV	SIC-50/30-A4	50/30	M16, M20
SIC-40/22-GV	SIC-40/22-A4	38/17 40/22	M16
SIC-38/23-GV	-	38/23	M16
SIC-29/20-GV	-	29/20	M12
SIC-38/17-GV	SIC-38/17-A4	38/17 40/22	M12, M10
SIC-28/15-GV	SIC-28/15-A4	28/15	M8, M10
SIC-20/12-GV	SIC-20/12-A4	20/12	M8

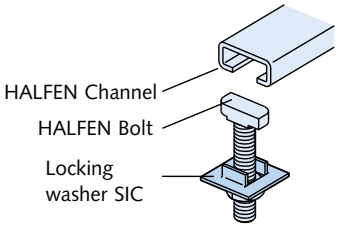
Ordering example: **SIC - 38/17 - GV**

Application VUS:
For shimming non-flush installations



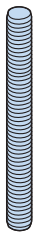
Application SIC:
For securing HALFEN Bolts; prevents bolts turning when tightening the nuts

Assembly scheme:



Accessories: Threaded Rods, Hex Bolts, Coupler Sleeves, Ring Nuts

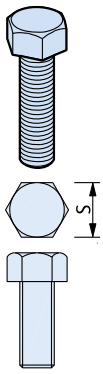
GWS
Threaded rods
DIN 976-1



GV galvanized FK 4.6 thread	A4 stainless steel thread	Length [mm]	F_{Rd} ① [kN]	perm. F [kN]
M6	M6	1000	3.1	2.2
M8	M8	1000	5.6	4.0
M10	M10	1000	9.0	6.4
M12	M12	1000	13.0	9.3
M16	M16	1000	24.2	17.3
M20	M20	1000	37.8	27.0
M24	-	1000	54.3	38.8

Ordering example: **GWS - M12 × 1000 - GV**

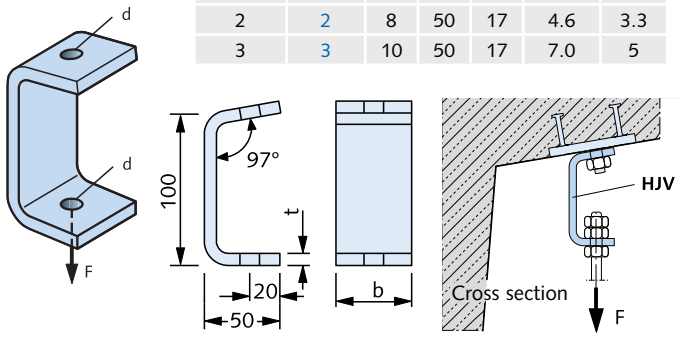
HSK
Hexagonal head bolts
EN ISO 4017/
DIN 933
(without nut)



Hex bolts are used in combination with HALFEN Threaded plates

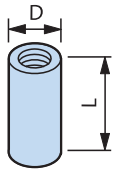
GV 8.8 galvanized FK 8.8 bolt size	A4 stainless steel A4 bolt size	S DIN [mm]	S EN ISO [mm]
M6 × 12	-	10	10
M6 × 25	-		
M8 × 25	M8 × 25	13	13
M8 × 40	-		
M10 × 20	-	17	16
M10 × 30	M10 × 30		
M10 × 45	M10 × 45		
M10 × 60	-		
M10 × 70	-		
M12 × 22	-	19	18
M12 × 25	M12 × 25		
M12 × 30	M12 × 30		
M12 × 40	M12 × 40		
M12 × 50	-		
M12 × 60	M12 × 60		
M12 × 80	M12 × 80		
M12 × 90	-		
M16 × 40	M16 × 40	24	24
M16 × 60	M16 × 60		
M16 × 90	M16 × 90		

HJV
Adjustment coupler



FV hot-dip galvanized type	A4 stainless steel type	t [mm]	b [mm]	d [mm]	max. F_{Ed} ② [kN]	perm. F [kN]
1	1	6	40	13	2.1	1.5
2	2	8	50	17	4.6	3.3
3	3	10	50	17	7.0	5

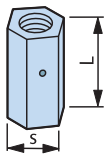
VBM
Coupler sleeves, round



GV hot-dip galvanized thread	A4 stainless steel thread	D [mm]	L [mm]	F_{Rd} ① [kN]	perm. F [kN]
M6	M6	10/10	15	3.1	2.2
M8	M8	12/14	20	5.6	4.0
M10	M10	13/16	25	9.0	6.4
M12	M12	16/20	30	13.0	9.3
M16	M16	21/25	40	24.2	17.3
M20	M20	26/32	50	37.8	27.0

Ordering example: **VBM - A4 - M16**

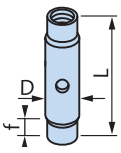
SKM
Hexagonal coupler sleeves with view holes



FV hot-dip galvanized thread	A4 stainless steel thread	S [mm]	L [mm]	F_{Rd} ① [kN]	perm. F [kN]
M10	M10	13	40	9.0	6.4
M12	M12	17	40	13.0	9.3
M16	M16	22	50	24.2	17.3

Ordering example: **SKM - FV - M12**

SPH
Turnbuckle with right- and left-hand thread

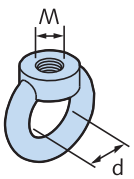


f = minimum screw depth:
M12 ≈ 10 mm
M16 ≈ 13 mm

A4 stainless steel thread M12 × length L [mm]	A4 stainless steel thread M16 × length L [mm]	D for M12 [mm]	D for M16 [mm]
M12 × 60	M16 × 60	16	22
M12 × 75	M16 × 75	16	22
M12 × 95	M16 × 95	16	22
M12 × 115	M16 × 115	16	22
M12 × 135	M16 × 135	16	22
perm. F = 5 kN F_{Rd} = 7 kN	perm. F = 10 kN F_{Rd} = 14 kN		

Ordering example: **SPH - A4 - M 12 × 75**

RM
Ring nut
DIN 582
edition 2010-09



GV C15E, galvanized thread	d [mm]	F_{Rd} ① [kN]	perm. F [kN]
M8	20	2.0	1.4
M10	25	3.2	2.3
M12	30	4.8	3.4
M16	35	9.8	7.0
M20	40	16.8	12.0

Ordering example: **RM - GV - M12**

① Recommended design value of the load capacity with a centric tensile stress
② Recommended design value of the load

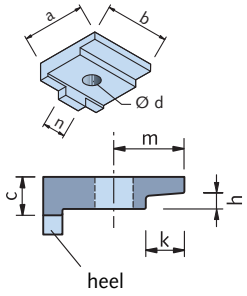
ACCESSORIES
Rail Clips

KLP-S Rail clips, steel 1.0038 forged

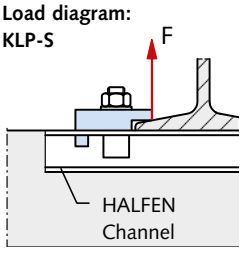
FV hot-dip galvanized Type	Heel width n [mm]	for HALFEN Bolts Ø × l [mm]	Dimensions [mm] a	b	c	Ø d	h	k	m	Allowable load at σ allowable = 125 N/mm² F [kN]	Preferred for use with Standard profile I	other beam, flange thickness channels t [mm]	channels
No. 10	16	M16 × 60	44.0	45	12	18	5	12.0	22.0	3.5	80 – 140	4 – 6	S24
No. 26	without heel	M16 × 60	62.5	64	21	18	9	16.5	34.5	3.5	160 – 240	7 – 9	S24, A45, A55
No. 20	20	M20 × 65	52.0	55	19	□ 21	8	15.0	24.0	10.0	160 – 240	7 – 9	S24 – S49

Ordering example: **KLP - S - Nr. 26 - FV**

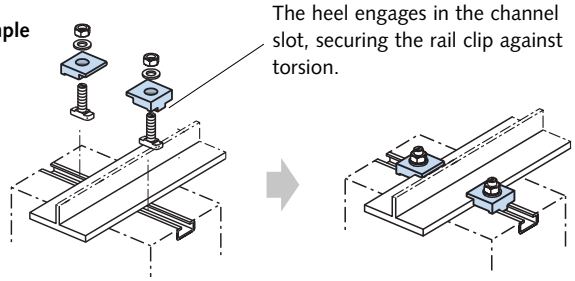
□ = square opening



Load diagram: KLP-S



Assembly example KLP-S



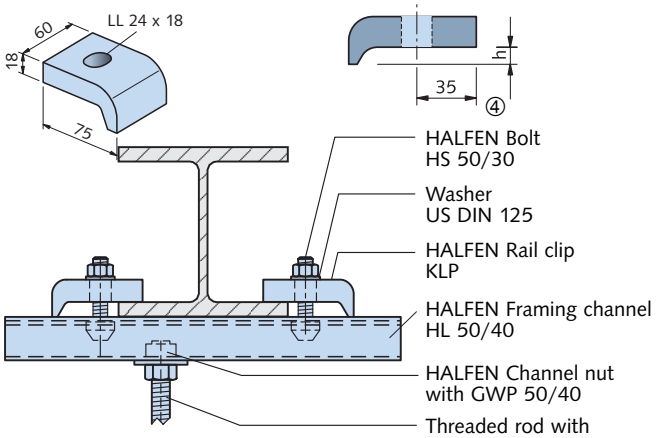
The heel engages in the channel slot, securing the rail clip against torsion.

KLP - 60 Rail clips

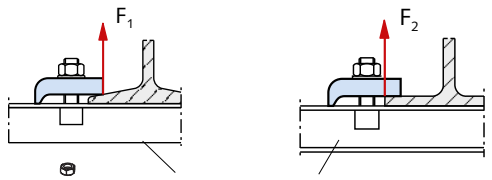
FV Hot-dip galvanized	Clamping height h [mm]	Allowable load② [kN]	Preferred for use with Standard profile I	Standard profile IPB	Crane and running tracks④
60/10	10	F_1 = 7.0 HALFEN Bolt M16 × 60, Grade 4.6	120 – 160	100	A65, S33, S41
60/12	12		220 – 240	140	A100, S49, A75
60/14	14		240 – 280	160 – 180	A120, S54
60/16	16	F_2 = 11.25 HALFEN Bolt M16 × 60, Grade 8.8	300 – 340	200 – 220	S64
60/18	18③		360 – 380	240 – 260	-
60/20	20③		400 – 450	280 – 300	-

② Take the load capacity of HALFEN Channels into account (Cantilever must be considered when selecting the HALFEN Channels and bolts)
③ Bolt M16 × 80 necessary ④ Check flange thickness of profile!

Order example: **KLP - 60/10 - FV**

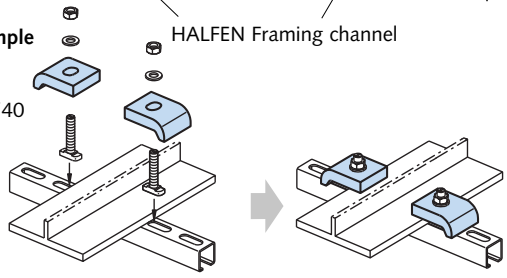


Load diagram KLP - 60



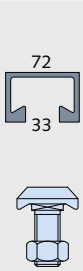
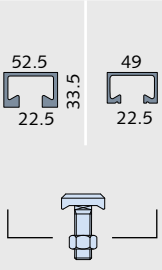
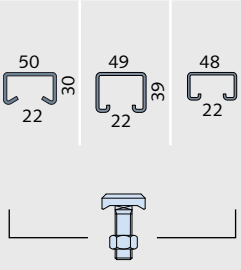
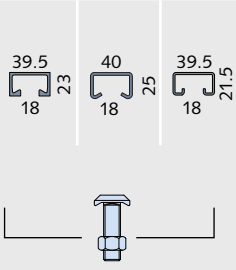
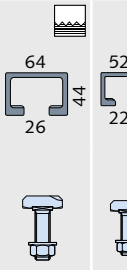
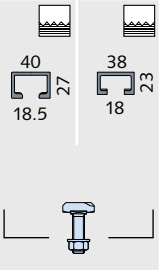
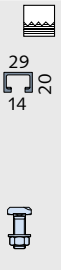
Assembly example KLP - 60

e.g. HL 50/40

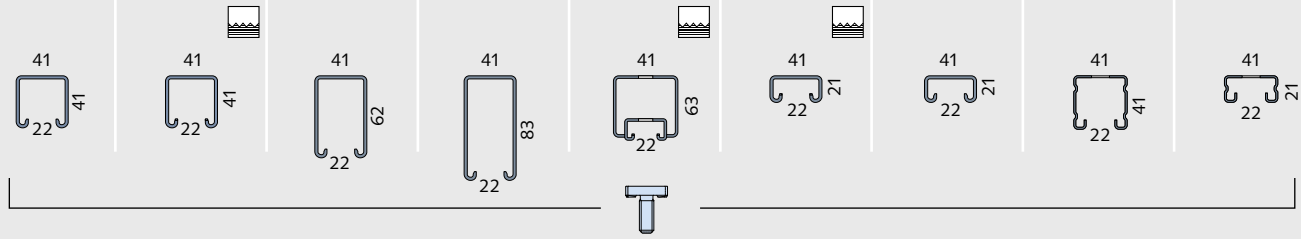


ACCESSORIES
Framing Channels HM/HZM/HL/HZL — Type Overview

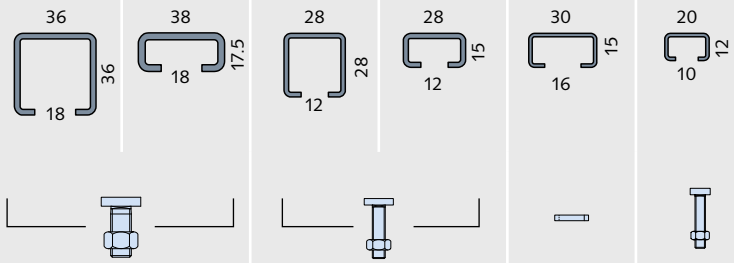
Heavy Duty Framing System

Hot-rolled				Cold-rolled			Hot-rolled	Cold-rolled		Hot-rolled, serrated				
HM 72/48	HM 55/42	HM 52/34	HM 50/30	HM 49/30	HM / HL 50/40	HM 486	HM 40/22	HM 40/25	HM 422	HZM 64/44	HZM 53/34	HZM 41/27	HZM 38/23	HZM 29/20
														
HS / HSR 72/48, GWP 72/48	HS 50/30	HS / HSR 50/30, GWP 50/30		HS 50/30, GWP 50/30 or GWP 50/40			HS / HSR 40/22, GWP 40/22			HZS 64/44	HZS 53/34	HZS 38/23	HZS 38/23, HS 38/17	HZS 29/20, HS 28/15

Medium Duty Framing System

Cold-rolled	Cold-rolled, serrated	Cold-rolled		Cold-rolled, serrated		Cold-rolled	Cold-rolled	
HM / HL 41/41	HZM / HZL 41/41	HM / HL 41/62	HM / HL 41/83	HZL 63/63	HZM / HZL 41/22	HM / HL 41/22	HLL 41/41	HLL 41/22
								
HZS/HS 41/41, HZS 41/22 GWP 41/41, GWP 41/22								

Light Duty Framing System

Cold-rolled					Cold-rolled
HM 36/36, HL 36/36	HM 38/17	HM 28/28, HL 28/28	HM 28/15, HL 28/15	HM 315	HM 20/12, HL 20/12
					
HS 38/17, GWP 38/17		HS 28/15, GWP 28/15		GWP 28/15	HS 20/12, GWP 20/12

Materials/Finish:

- FV Steel hot-dip galvanized or WB steel mill finished
- SV Steel, sendzimir galvanized
- A4 Stainless steel 1.4571/1.4404
- A2 Stainless steel 1.4307 (on request)
- HCR Stainless steel 1.4547/1.4529 (on request)

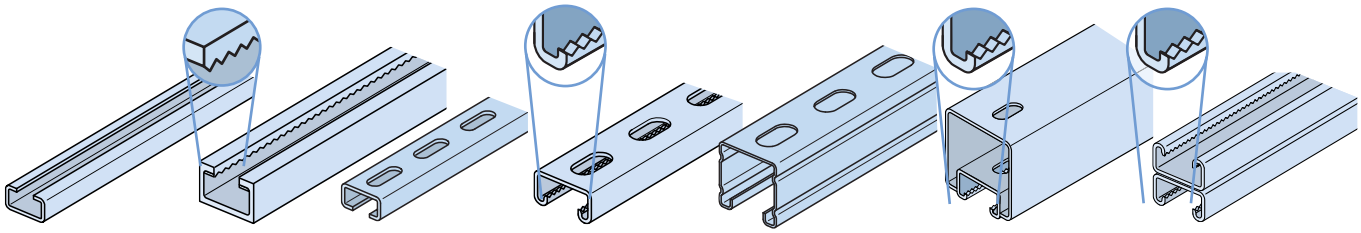
For information on materials → see page 9-10

HZM/HZL serrated profiles

ACCESSORIES
Framing Channels HM/HZM/HL/HZL – Application Examples

Type Overview

Framing channel	Framing channel *serrated*	Slotted framing channel	Slotted framing channel *serrated*	Slotted framing channel	Slotted framing channel *serrated*	Double channel *serrated*



HM 28/15 | HZM 38/23 | HL 28/15 | HZL 41/22 | HLL 41/41 | HZL 63/63 | HZM 41/22D

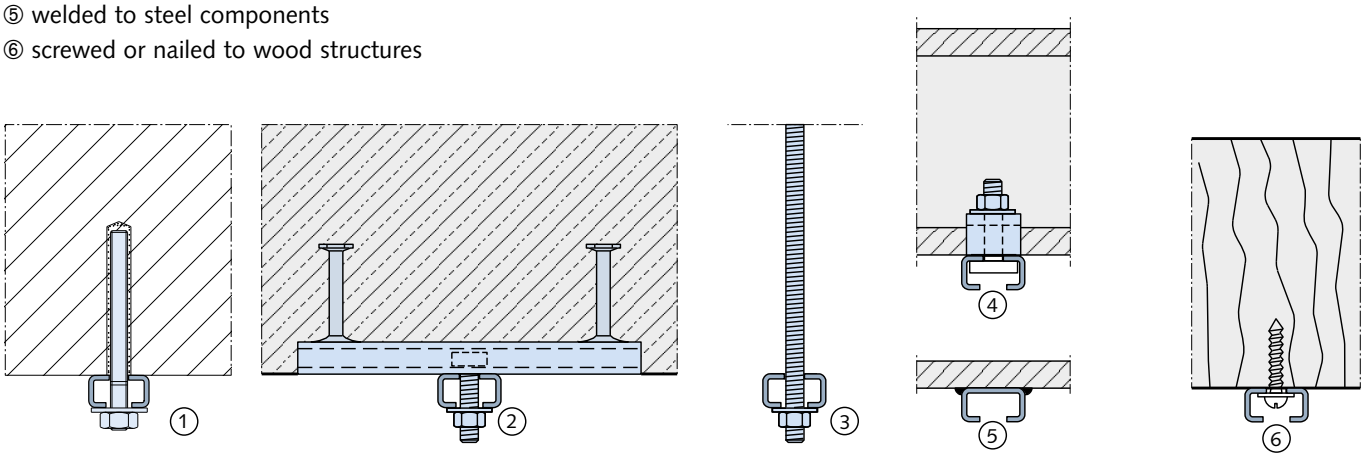
Application Examples

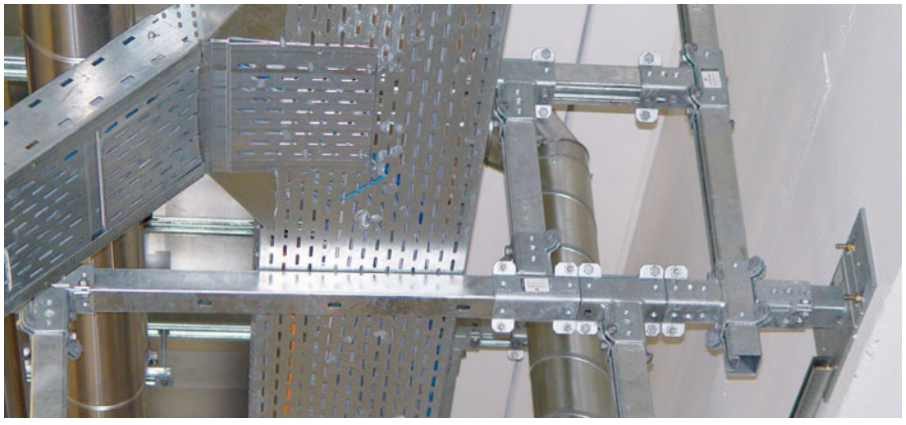
HALFEN Framing channels HM/HZM and slotted HALFEN Framing channels HL/HZL can be attached to a supporting structure using various methods:

① fastened to concrete or masonry with HB-VMU plus wedge anchors
② bolted to HALFEN HTA-CE and HZA Cast-in channels
③ connected to threaded rods
④ clamped to steel profile supports
⑤ welded to steel components
⑥ screwed or nailed to wood structures

HALFEN Framing channels are a part of the HALFEN Framing system:

- installations for plant engineering
- technical equipment in buildings
- heavy and light installations





Typical application of the HALFEN Powerclick system

The HALFEN Framing system product range can be found in the following catalogues:
HALFEN Flexible bolt connections,
HALFEN Flexible framing connections
HALFEN Powerclick System.

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HALFEN is represented by subsidiaries in the following 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	
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
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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: +33-1-44523152
Germany	HALFEN Vertriebsgesellschaft mbH Liebigstr. 14 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: tecnico@halfen.it Internet: www.halfen.it	Fax: +39-035-0760799
Netherlands	HALFEN b.v. Oostermaat 3 7623 CS Borne	Phone: +31-74-267 14 49 E-Mail: info@halfen.nl Internet: www.halfen.nl	Fax: +31-74-267 26 59
Norway	HALFEN AS Postboks 2080 4095 Stavanger	Phone: +47-51 82 34 00 E-Mail: post@halfen.no Internet: www.halfen.no	
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 IBERICA, S.L. Polígono Industrial Santa Ana c/ Ignacio Zuloaga 20 28522 Rivas-Vaciamadrid	Phone: +34 91 632 18 40 E-Mail: info@halfen.es Internet: www.halfen.es	Fax: +34 91 633 42 57
Sweden	Halfen AB Vädursgatan 5 412 50 Göteborg	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: info@halfen.ch Internet: www.halfen.ch	Fax: +41-44-849 78 79
United Kingdom / Ireland	HALFEN Ltd. A1/A2 Portland Close Houghton Regis LU5 5AW	Phone: +44 - 1582 - 47 03 00 E-Mail: info@halfen.co.uk Internet: www.halfen.co.uk	Fax: +44-1582-47 03 04
United States of America	HALFEN USA Inc. PO Box 18687 San Antonio TX 78218	Phone: +1 800.423.91 40 E-Mail: info@halfenusa.com Internet: www.halfenusa.com	Fax: +1 877.683.4910
For countries not listed HALFEN International	HALFEN International GmbH Liebigstr. 14 40764 Langenfeld / Germany	Phone: +49 -2173 -970-0 E-Mail: info@halfen.com Internet: www.halfen.com	Fax: +49 -2173 -970-849

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