HALFEN CAST-IN CHANNELS
TECHNICAL PRODUCT INFORMATION

HALFEN CAST-IN CHANNELS

CONCRETE

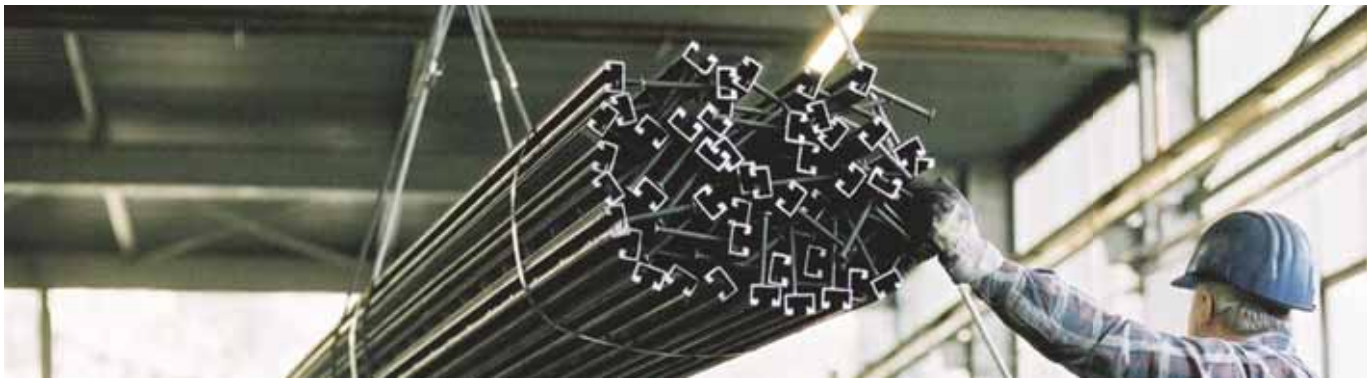
B 18-E

HALFEN

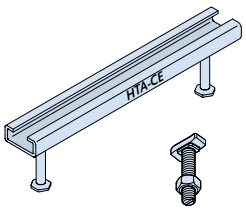
YOUR BEST CONNECTIONS

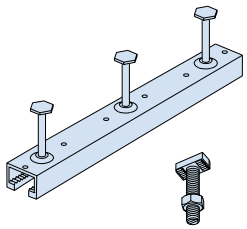
HALFEN CAST-IN CHANNELS

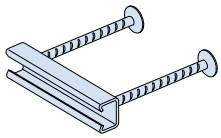
Contents

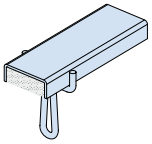


NEW: HTA-CE 50/30P and HTA-CE 40/22P.









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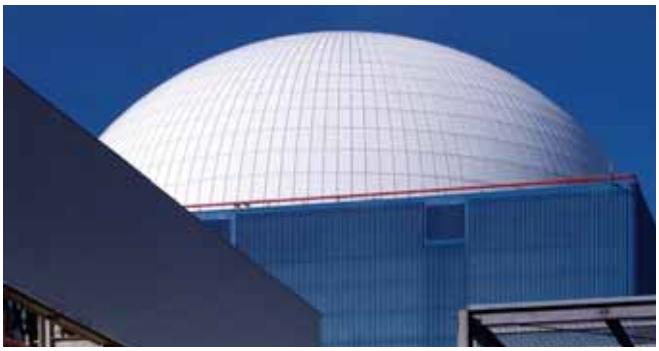
APPLICATION EXAMPLES HALFEN CAST-IN CHANNELS

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

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.

HALFEN HTA-CE Cast-in channels NEW!

Application
- fixing of all types of building components
- **NEW:** HTA-CE 50/30P and HTA-CE 40/22P with more load capacity.

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

HALFEN HZA Cast-in channels, serrated

Application
- fixing of all types of building components

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

HALFEN HZA-PS Cast-in channels, serrated

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

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

HALFEN HGB Handrail connections

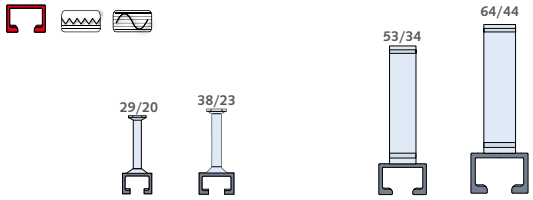
Application
- fastening banisters on the thin front face of balcony slabs

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

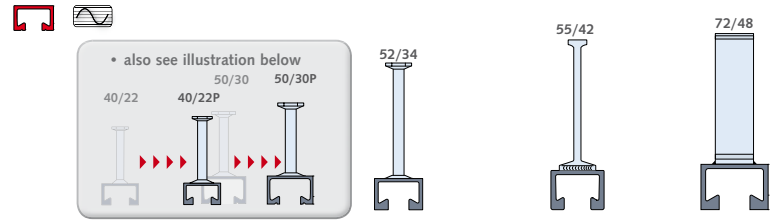
Channel range and steel load capacity/tension

HALFEN has enhanced its anchor channel range; two new channel profiles are now available: HTA-CE 40/22P and HTA-CE 50/30P.
The different profiles can now cover a significantly higher load range, providing up to 45 % more load capacity. Therefore allowing more economical solutions.

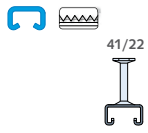
Load capacities for HALFEN Channels **hot-rolled, serrated**



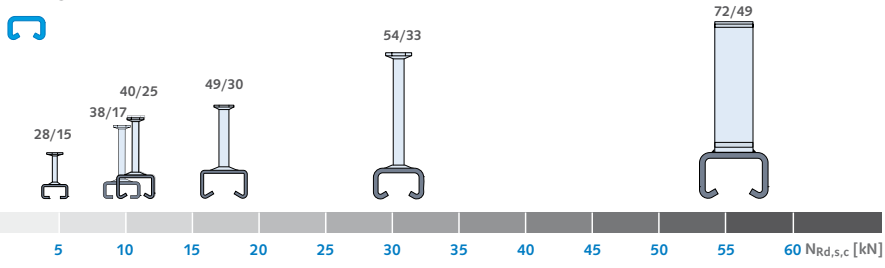
Load capacities for HALFEN Channels **hot-rolled**



Load capacities for HALFEN Channels **cold-rolled, serrated**



Load capacities for HALFEN Channels **cold-rolled**



NEW!

HALFEN Anchor channels – with increased load capacity!

New: HTA-CE 40/22P – Previously, for a load of N_{Ed} > 11.1 kN the next larger channel had to be selected; a HTA-CE 50/30 (with $N_{Rd,s,c}$ = 17.2 kN) instead of a HTA-CE 40/22.
Now in most cases the HTA-CE 40/22P (with $N_{Rd,s,c}$ = 16.1 kN) is sufficient.
This also allows a more economical screw to be used; a HS 40/22 instead of a HS 50/30.

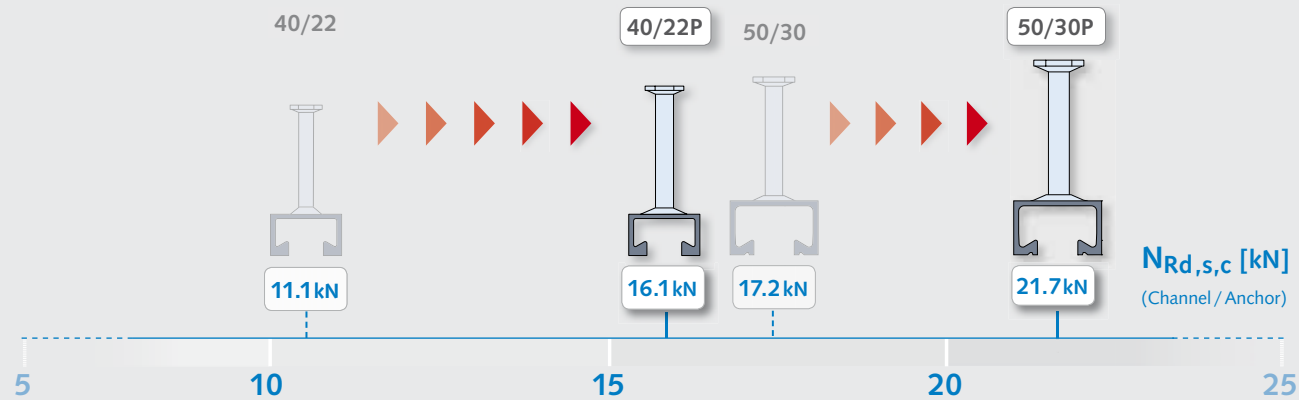
HTA-CE 50/30P – Previously, for a load of N_{Ed} > 17.2 kN the next larger channel had to be selected; a HTA-CE 52/34 (with $N_{Rd,s,c}$ = 30.6 kN) instead of a HTA-CE 50/30.
Now in most cases the HTA-CE 50/30P (with $N_{Rd,s,c}$ = 21.7 kN) is sufficient.

On-site safety: In many projects, different applications are therefore possible using a single channel profile. This reduces the risk of confusion when using different channels in one project. Furthermore, fewer bolt\screw types are required.

Minimal channel size for economical reinforcement layouts:
In respect to its load bearing capacity the new HTA-CE 40/22P can almost always be used instead of a HTA-CE 50/30.
With a height of only 23 mm, the new channel is almost always installed completely in the required concrete cover. This allows more efficient reinforcement planning (mesh and supplementary reinforcement).

European certification:
The new HTA-HTA-CE 40/22P and HTA-CE 50/30P types are included in ETA-16/0453 and are therefore certified for use, without restrictions, in 30 European countries.

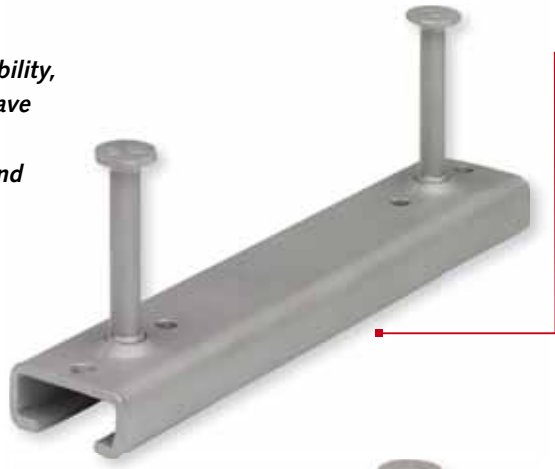
HTA-CE with improved load capacity (Illustrated: Steel load capacity/tension)



HALFEN Cast-in channels HTA-CE

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 Channels
cold-rolled

HALFEN HTA-CE Channels
hot-rolled

suitable for dynamic loads

NEW: HTA-CE 50/30P and HTA-CE 40/22P with more load capacity.

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
- suitable for dynamic loads
- European Technical Approval/ 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 forvarious requirements
- no noise, no vibration during installation, therefore no health hazards

CE European Technical Approval ETA-09/0339 432-CPD-8394-01

CE European Technical Assessment ETA-16/0453

What does HTA-CE involve?
HTA-CE signifies that the channel is CE marked. HALFEN as the manufacturer declares, that it is responsible for the conformity of the product with the (DoP - Declaration of performance), and that the specified performance and compliance with all relevant European legislation has been applied.

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

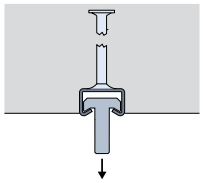
Verification method according to CEN/TS 1992-4 / EOTA TR 047 / EN 1992-4

VERIFICATION

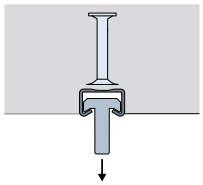
Tension

Steel

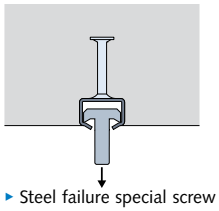
- Steel failure of the anchor



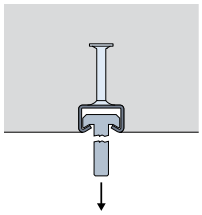
- Failure of channel-anchor connection



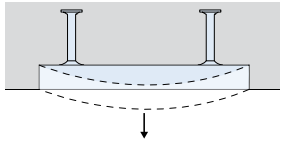
- Local flexure of the channel lip



- Steel failure special screw

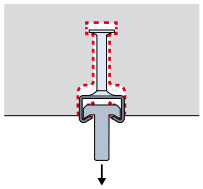


- Failure due to flexure of the channel

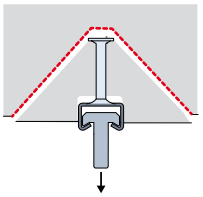


Concrete

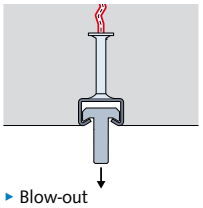
- Pull-out



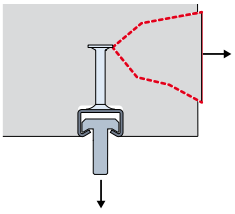
- Concrete cone failure



- Splitting



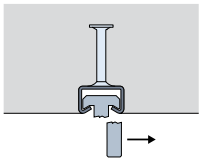
- Blow-out



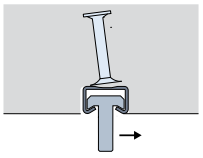
Shear

Steel

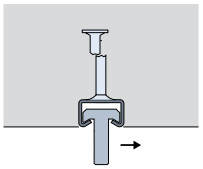
- Steel failure of the screw



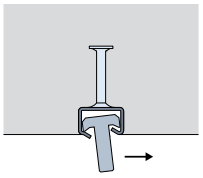
- Failure of channel-anchor connection



- Steel failure of the anchor

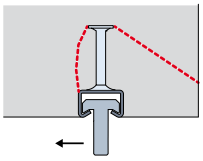


- Local flexure of the channel lip

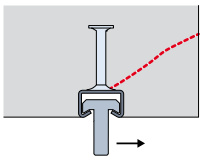


Concrete

- Concrete pryout failure



- Concrete edge failure



Additional verifications / tension

- Steel failure in the supplementary reinforcement
- Failure of the supplementary reinforcement in the failure cone

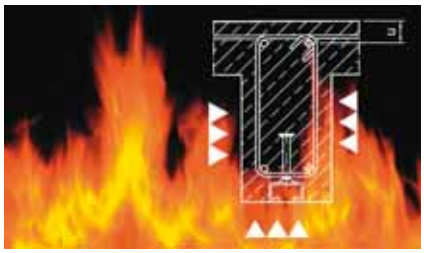
Additional verifications / Shear

- Special screw 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

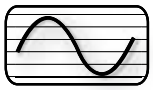
Fire-resistance



Verification of anchorages for fire load must take the specifications of the Technical Reports TR 020 into account. "Evaluation of anchorage in concrete with regards to fire resistance". The corresponding characteristic values can be found in the annexes of ETA-09/0339 and ETA-16/0453.

Material fatigue

Design values according to ETA can be found in ETA-09/0339 for the HTA-CE 52/34, and in ETA-16/0453 for the HTA-CE 40/22P and the HTA-CE 50/30P.



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*

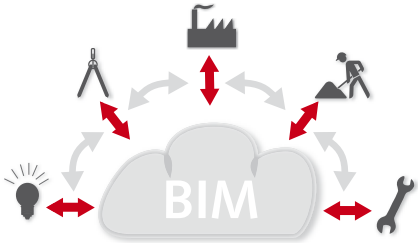
QUALITY SYSTEM CERTIFICATION
DNV·GL
ISO 9001
www.dnvgl.com

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

EPD

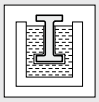
An EPD® (Environmental Product Declaration) provides transparent and comparable ecological data which helps to evaluate the sustainability of a building. Already during the planning phase the data provided here is of great significance for architects and planners. The data provided also helps to ensure the high demands on the environmental performance of the building are met.

BIM

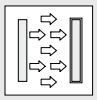


HALFEN already has considerable experience as a BIM partner and has successfully completed various projects using the BIM methodology. All HALFEN engineers are trained to properly supervise this process. With a combination of wide experience and highly-trained engineers the increasing demand for BIM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

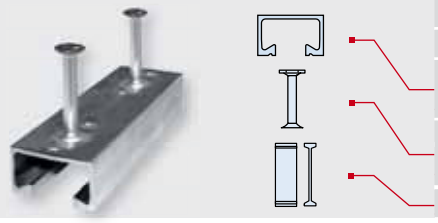
Hot-dip galvanized FV:
Dipped in a galvanizing bath, with a temperature of approx. 460 °C, this is a method used primarily for open-profile channels.



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



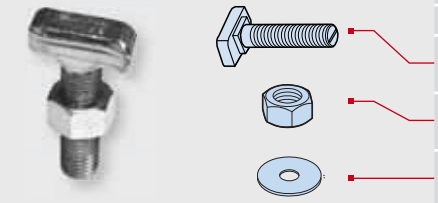
HALFEN Cast-in channels, steel, hot-dip galvanized



		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



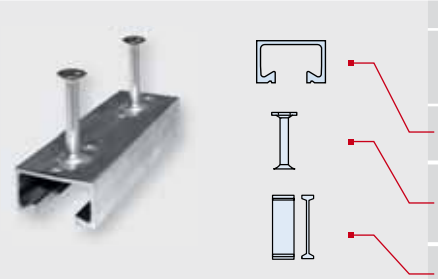
		Steel		
		Material	Standard	Zinc coat
Bolt	☐	Steel (Sc) 4.6 or (Sc) 8.8	EN ISO 898-1	FV: ≥ 50 µm
	☒			GVs: ≥ 12 µm
Hexagonal nut	☐	Steel (Sc) 5 or (Sc) 8	EN 898-2	FV: ≥ 50 µm
	☒			GVs: ≥ 12 µm
Washer	☐	Steel	EN ISO 7089, EN ISO 7093	FV: ≥ 50 µm
	☒			GVs: ≥ 12 µm

(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.

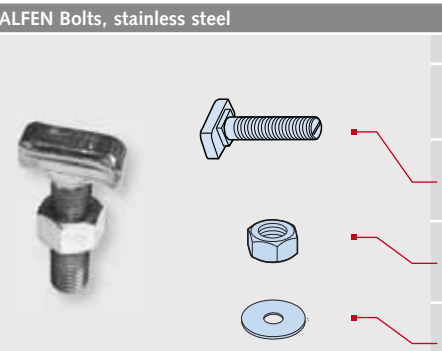
Materials:
- ☐ **WB** = Steel mill finished
- ☐ **FV** = Steel hot-dip galvanized
- ☒ **GVs** = Steel zinc galvanized (with special coating)
- ☐ **A4** = Steel, stainless 1.4571 / 1.4404 / 1.4578
- ☒ **HCR** = Steel, stainless 1.4547 / 1.4529

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 12

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 µm ⑥	Steel 1.0038, 1.0044; EN 10025 Hot-dip galvanized ≥ 55 µm 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 55 µm ⑥	Steel 1.0038, 1.0214, 1.0401, 1.1132, 1.5525; EN 10263, EN 10269 Hot-dip galvanized ≥ 55 µm 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 screws in accordance with EN ISO 4018	Steel strength class 4.6/8.8 EN ISO 898-1 Zinc galvanized ≥ 5 µm ④	Steel strength class 4.6 / 8.8; EN ISO 898-1, Hot-dip galvanized ≥ 50 µm 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 5 µm ④	Steel EN 10025 Hot-dip galvanized ≥ 50 µm ① ⑤ Stainless steel Steel grade A2, A3; EN ISO 3506-1	Stainless steel Steel grade A4, A5 EN ISO 3506-1	Stainless steel 1.4462 ②,1.4529, 1.4547 EN ISO 3506-1
Hexagonal nut EN ISO 4032	Steel strength class 5/8 EN ISO 898-2 Zinc galvanized 5 µm ④	Steel strength class 5/8 EN ISO 898-2 Hot-dip galvanized ≥ 50 µm 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

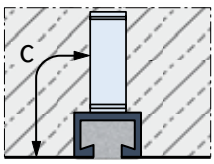
① or zinc galvanized with special coating ≥ 12 µm
② 1.4462 not suitable for swimming baths
③ Steel in accordance with EN 10025, 1.0038 not for Anchor channels 28/15 and 38/17
④ Zinc galvanized in accordance with EN ISO 4042
⑤ Hot-dip galvanized in accordance with EN ISO 10684
⑥ Hot-dip galvanized in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

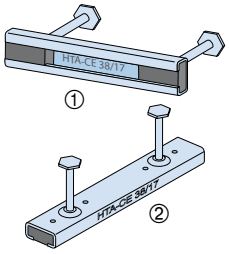
Areas of application

- 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

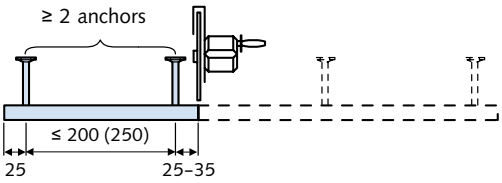
HALFEN can supply ready to install short channels and standard lengths.

Product identification:
① on channel inside
② also on channel side



1.2 Installing to formwork

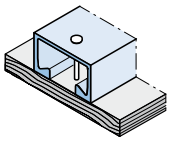
If required, HALFEN Cast-in channels can also be cut to size on site.

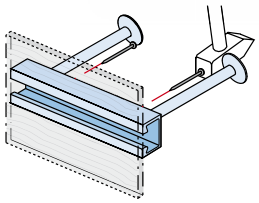


2.1 Fixing to the formwork

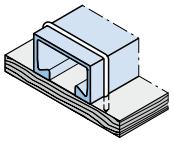
Timber formwork

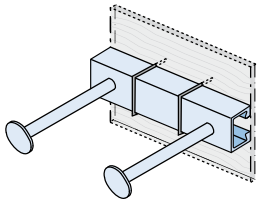
2.1.1 with nails





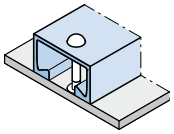
2.1.2 with staples

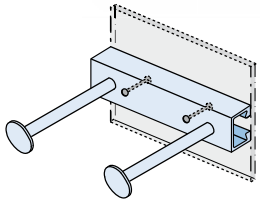




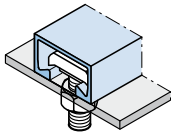
Steel formwork

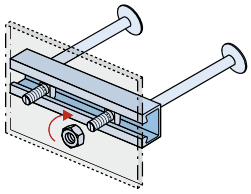
2.1.3 aluminium rivets





2.1.4 HALFEN Bolt and nut

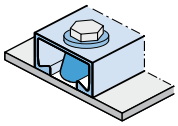




2.1 Fixing to the formwork, continued

Steel formwork

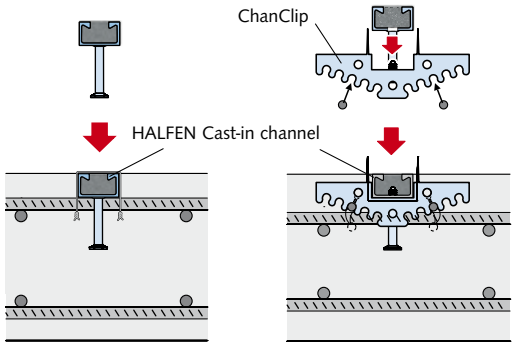
2.1.5 HALFEN HFK Fixing cone

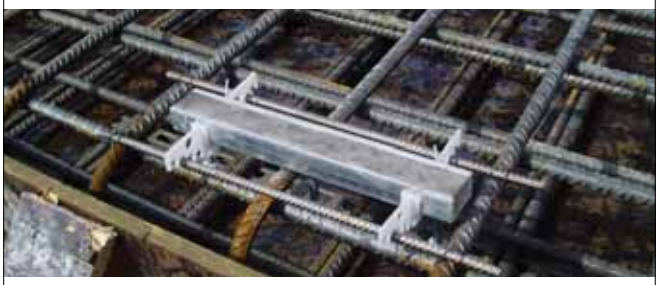


2.2 Top face installation

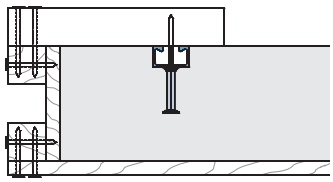
2.2.1 **directly to reinforcement:**
with tying wire

2.2.2
with HALFEN HCP ChanClip



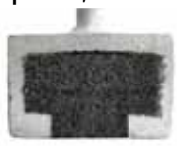


2.2.3 **Installation using an auxiliary aid**



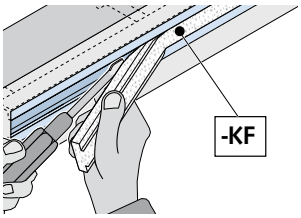
3.1 Removing the filler

Strip filler, available in two versions:



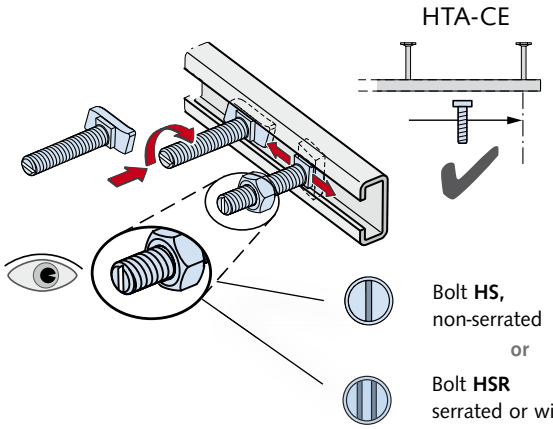
KF - PE strip filler
with reinforcement layer

KF - PE strip filler



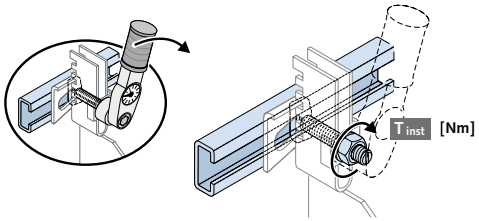
Removing the strip filler
Grip the strip filler at one end and pull out in one piece by hand, use a tool, e.g. a screwdriver.

4.1 Installing HALFEN bolts



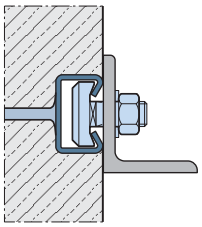
Safe assembly with HALFEN Cast-in channels
HALFEN Bolts can be inserted anywhere in the channel slot, turned 90° and then locked in place by tightening the nut. Do not position bolts at channel ends past the last anchor. On channels with bolt anchors, the anchor locations are visible through the channel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

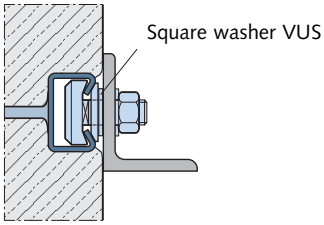


Fixings
The bolt heads must sit flush on both lips of the anchor channel and be secured by tightening the nut with a torque wrench with the required value. Observe the torque values in the tables on page 22.

Direct attachment ①



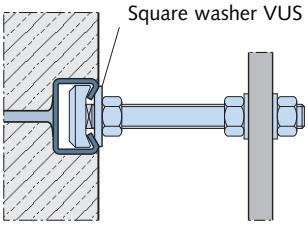
Surface-flush installation



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.

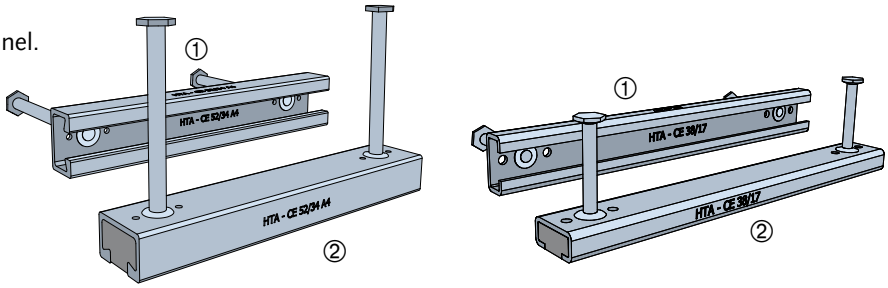
Example:
HALFEN Channel: **HTA-CE 49/30**
HALFEN Bolt: **HS 50/30 - M16**
Washer: **VUS 49/30 - M16**

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.

Identification

Channel material	Type identification
1.0038 / 1.0044	HTA-CE 38/17
A2: 1.4307	HTA-CE 38/17 - A2
A4: 1.4404 / 1.4571	HTA-CE 38/17 - A4
HCR: 1.4529 / 1.4547	HTA-CE 38/17 - HCR

Type identification:
① Inside surface, bottom of the channel.
② Additionally on 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 and the corresponding HALFEN T-head bolt.
According to the ETA, the spacing between bolts s_s must not be less than 5 × d_s.
Reduction of the load bearing capacity is required if $s_s < s_{slb}$* (see table on page 16).

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

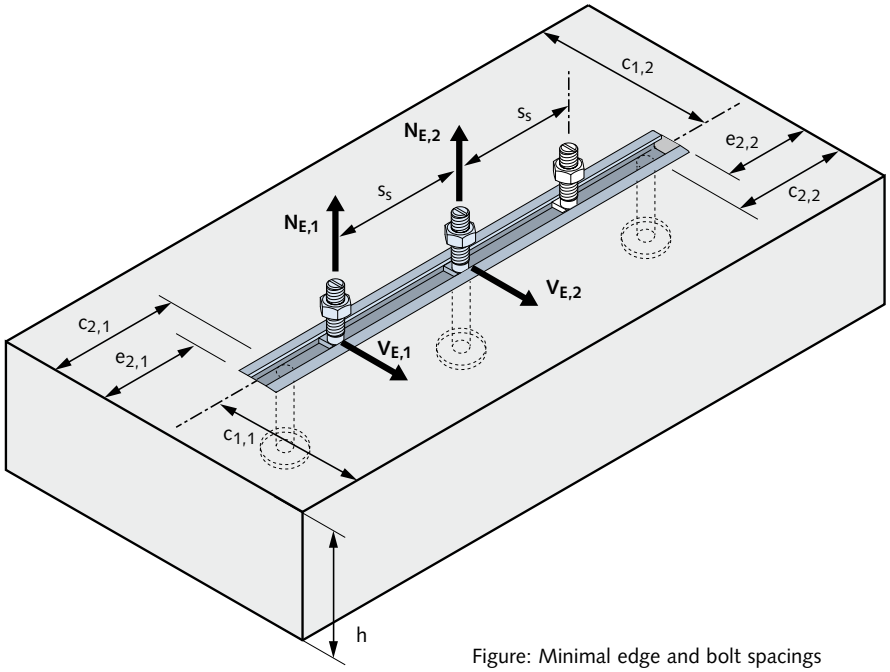


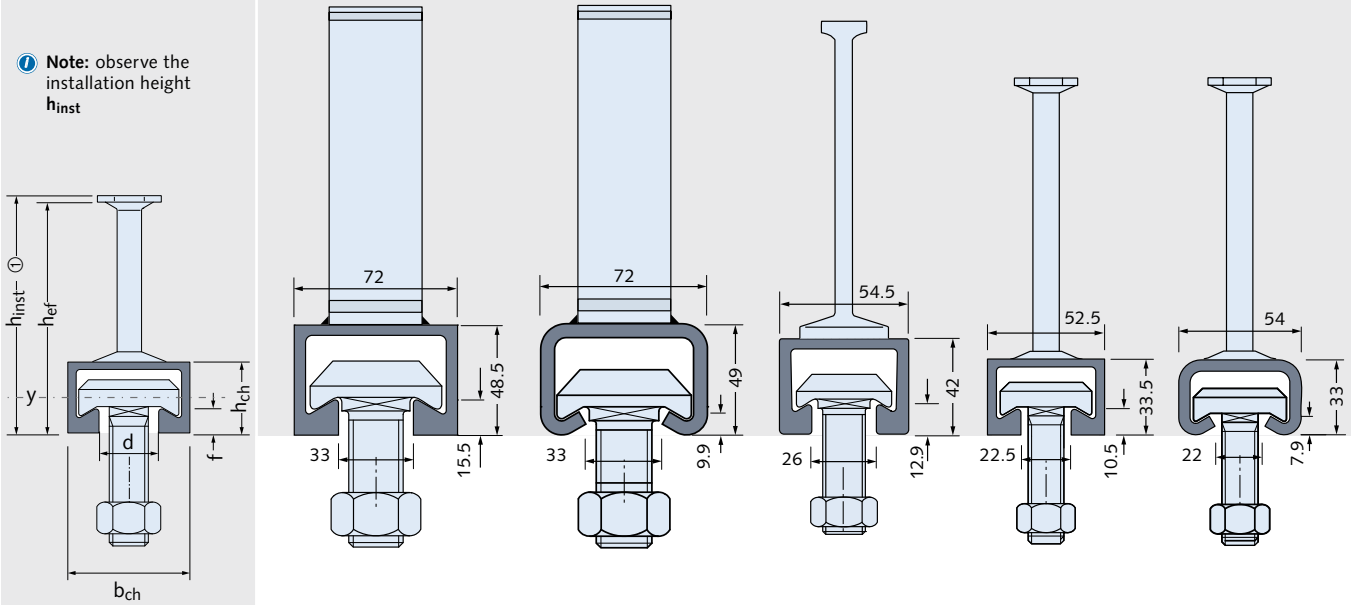
Figure: Minimal edge and bolt spacings

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
72/49 72/48	20	100	150	115
	24	120	150	115
	27	135	150	115
	30	150	150	115

HALFEN CAST-IN CHANNELS HTA-CE

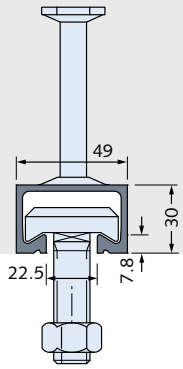
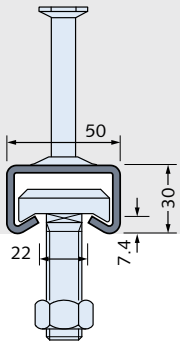
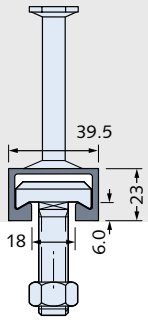
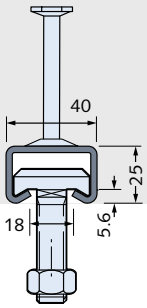
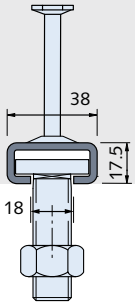
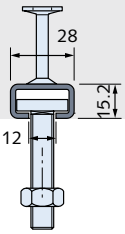
Product Range: Overview of Channels + Bolts

Identification values HTA-CE						
Profile		HTA-CE 72/48	HTA-CE 72/49	HTA-CE 55/42	HTA-CE 52/34	HTA-CE 54/33
Type		hot-rolled	cold-rolled	hot-rolled	hot-rolled	cold-rolled
Geometry HALFEN Channels HTA-CE **Note:** observe the installation height h_{inst}						
Material	Steel	■		■	■	■
	A4	■	■		■	■
	HCR					
Bolts		HS 72/48	HS 72/48	HS 50/30	HS 50/30	HS 50/30
Threads		M20 - M 30	M20 - M30	M10 - M20	M10 - M20	M10 - M20
s_{slb} [mm]		129	129	109	88	88
Profile load capacity						
$N_{Rd,s,l}$ [kN]		55.6	55.6	44.4	36.1	30.6
$V_{Rd,s,l}$ [kN]		72.2		57.8	39.7	
$M_{Rd,s,flex}$ [Nm]	Steel	7472	–	5606	2933	2595
	NR	7630	7493	–	2996	2595
Geometry						
h_{inst} [mm] ① ②		(191)	(193)	182 (185)	162 (164)	161 (164)
b_{ch} [mm]		72	72	54.5	52.5	54
h_{ch} [mm]		48.5	49	42	33.5	33
I_y [mm^4]	Steel	349721	293579	187464	93262	72079
	NR					
h_{ef} [mm]		179	179	175	155	155
c_{min} [mm]		150	150	100	100	100

* 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 $N_{Rd,s,l}$
$N_{Rd,s,l}$ = channel lip load capacity (tension)
$V_{Rd,s,l}$ = channel lip load capacity (shear)
① Nominal size and tolerance
② ( ) value in brackets is for weld-on I-anchors
Materials: See page 11

Product Range: Overview of Channels + Bolts

	HTA-CE 50/30P NEW!	HTA-CE 49/30	HTA-CE 40/22P NEW!	HTA-CE 40/25	HTA-CE 38/17	HTA-CE 28/15
	hot-rolled	cold-rolled	hot-rolled	cold-rolled	cold-rolled	cold-rolled
						
	☐	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐	☐
		☒			☒	☒
	HS 50/30	HS 50/30	HS 40/22	HS 40/22	HS 38/17	HS 28/15
	M10 - M20	M10 - M20	M10 - M16	M10 - M16	M10 - M16	M6 - M12
	98	81	79	65	52	42
	21.7 22.4	17.2	19.4	11.1	10.0	5.0
	2437	1455	1208	956	504	276
	2743	1485	1358	931	516	282
	112 (161)	103 (101)	97 (154)	89 (89)	81 (82)	50 (79)
	49	50	39.5	40	38	28.0
	30	30	23	25	17.5	15.25
	52575	41827	19859 19859	20570 19097	8547	4060
	106	94	91	79	76	45
	75	75	50	50	50	40

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. Also see table below: Project related orders "Standard fixed lengths".

Supplied lengths and number of anchors

Length [mm] / Number of anchors

HTA-CE 72/48	HTA-CE 72/49	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	**150**/2	**100**/2
200/2	**200**/2	**200**/2	**200**/2	**200**/2	**150**/2
250/2	**250**/2	**250**/2	**250**/2	**250**/2	**200**/2
300/2	**300**/2	**300**/2	**300**/2	**300**/2	**250**/2
350/3	**350**/3	**350**/3	**350**/3	**350**/3	**300**/3
400/3	**400**/3	**400**/3	**400**/3	**400**/3	**350**/3
550/3	**550**/3	**550**/3	**550**/3	**550**/3	**450**/3
1050/5	**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

Standard fixed lengths – Project related orders

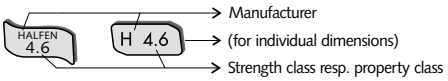
Supplied lengths and number of anchors – Project related orders

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

HALFEN Bolts – Type HS

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

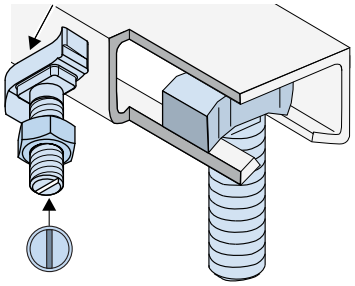
- two direction load capacity
- identified on bolt tip with **1 notch**



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

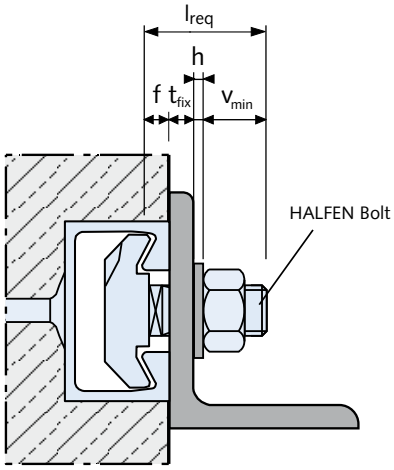
HALFEN A4-70 — Material grade A4-50 / A4-70 Stainless steel

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



Calculating the bolt length l_{req} for HALFEN Bolts

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



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	2.25
38/17	3.0
40/22P	6.0
40/25	5.6 / 5.4 ①
49/30	7.39
50/30P	7.85
52/34	10.5
54/33	7.9
55/42	12.9
72/48	15.5
72/49	9.9
① value **f** for stainless steel	

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

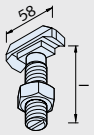
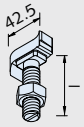
The table on the right lists the design resistance of HALFEN Bolts with different thread diameters, materials and strength classes.

$N_{Rd,s,s}$ 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**	**30**
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

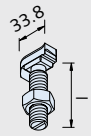
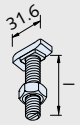
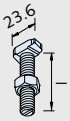
HALFEN Bolts HS

HALFEN Bolts HS

Suitable for profile	HTA-CE 72/48, 72/49				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
15								
20								
25								
30					FV4.6 GVs4.6	A4-70 GVs4.6	A4-50 GVs4.6	
35								GVs4.6
40					GVs4.6	A4-70 FV4.6 GVs4.6	A4-50 FV4.6 GVs4.6 GVs8.8	
45						GVs8.8		A4-50 GVs4.6 GVs8.8
50	FV4.6	A4-50 FV4.6			GVs4.6	A4-70 GVs4.6	HCR-50* A4-50 FV4.6 GVs4.6	
55								A4-50 FV4.6 GVs4.6
60	FV8.8					FV4.6 FV8.8* GVs4.6 GVs8.8	A4-50 FV8.8 GVs4.6 GVs8.8	GVs8.8
65								GVs4.6
70								
72								
75	FV4.6 GVs8.8	FV4.6 FV8.8	FV4.6	FV4.6				A4-50 GVs4.6
80						FV8.8* GVs4.6 GVs8.8	HCR-50* A4-50 A4-50L FV8.8* GVs4.6 GVs8.8	FV4.6* GVs8.8
87						A4-70T	A4-70T	
100	FV4.6 GVs8.8	A4-50 FV4.6 GVs8.8	FV8.8	FV4.6		A4-50 GVs4.6	A4-50T FV4.6 GVs4.6 GVs8.8	A4-50 FV4.6 GVs4.6 GVs8.8
125						GVs4.6	GVs4.6	A4-50 GVs4.6
150	FV4.6	FV4.6		FV4.6		GVs4.6	A4-50 FV4.6 GVs4.6	A4-50 GVs4.6 GVs8.8
200	FV4.6	FV4.6		FV4.6		GVs4.6	GVs4.6	GVs4.6
250								
300							GVs4.6	GVs4.6

L = Left-hand thread T = Partial thread Material types: see page 11 *on request ⓘ Other bolt lengths and materials on request!

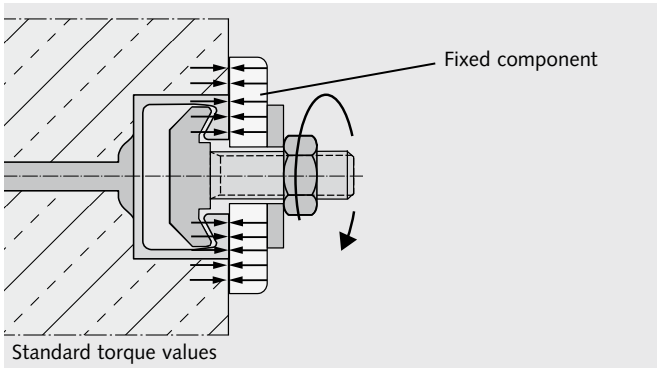
HALFEN Bolts HS

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**
15							GVs4.6	GVs4.6	GVs4.6	
20	GVs4.6	GVs4.6		GVs4.6	GVs4.6		GVs4.6	GVs8.8 GVs4.6	GVs4.6	
25						A4-50	GVs4.6	GVs4.6	A4-70 GVs4.6	
30	A4-70 GVs4.6	A4-50 FV4.6 GVs4.6 GVs8.8	A4-50 GVs4.6	A4-70 FV4.6 GVs4.6	A4-70 FV4.6 GVs4.6	A4-50 GVs4.6	GVs4.6	A4-70 GVs4.6	HCR-50* A4-70 FV4.6 GVs4.6	GVs4.6
35										GVs4.6
40	A4-70 GVs4.6	A4-50 A4-70 GVs4.6 GVs8.8	GVs4.6	GVs4.6	A4-70 GVs4.6	A4-50 FV4.6 GVs4.6	GVs4.6	GVs4.6	A4-70 FV8.8 GVs4.6	
45		GVs8.8								
50	A4-70 GVs4.6	A4-50 FV4.6 GVs4.6	A4-70 A4-50 A4-50L FV4.6 GVs4.6	FV4.6 GVs4.6	A4-70 A4-50L FV4.6 GVs4.6	A4-50 A4-50L FV4.6 GVs4.6		GVs4.6	HCR-50* A4-70 A4-50L FV4.6 GVs4.6	GVs4.6
55										
60	GVs4.6	FV4.6 FV8.8* GVs4.6 GVs8.8	FV4.6 FV8.8 GVs4.6 GVs8.8	GVs4.6	HCR-50* A4-70 GVs4.6 GVs8.8	A4-50 FV8.8 GVs4.6		GVs4.6	GVs4.6	
65										
70					FV8.8					
72					A4-70T					
75										
80	GVs4.6	A4-50 A4-50 FV4.6 GVs4.6 GVs8.8	A4-50 A4-50L GVs4.6 GVs8.8	GVs4.6	A4-70 A4-50L GVs4.6	A4-50 FV4.6 GVs4.6		GVs4.6	A4-70 GVs4.6	GVs4.6
87										
100	GVs4.6	GVs4.6 GVs8.8	A4-50 FV4.6 GVs4.6	GVs4.6	A4-50 GVs4.6	FV4.6 GVs4.6		GVs4.6	GVs4.6	
125		GVs4.6	GVs4.6		GVs4.6	GVs4.6			GVs4.6	
150		GVs4.6	GVs4.6	GVs4.6	GVs4.6	GVs4.6			GVs4.6	
200		GVs4.6	GVs4.6		GVs4.6	GVs4.6			GVs4.6	
250			GVs4.6							
300			GVs4.6							

L = Left-hand thread T = Partial thread Material types: see page 11 *on request Other bolt lengths and materials on request!

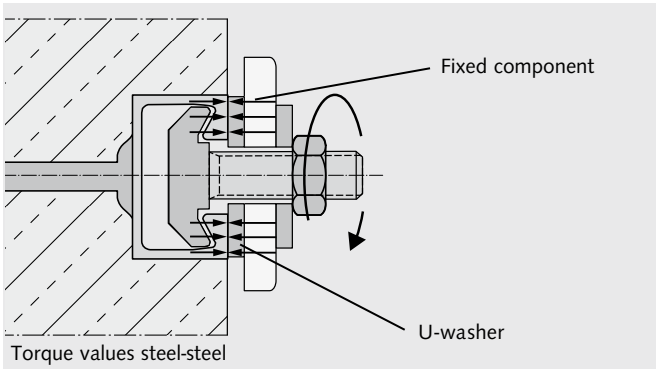
Torque values HS

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 72/49	20	120
	24	200
	27	300
	30	380

Steel-Steel: Recommended torque values T_{inst}

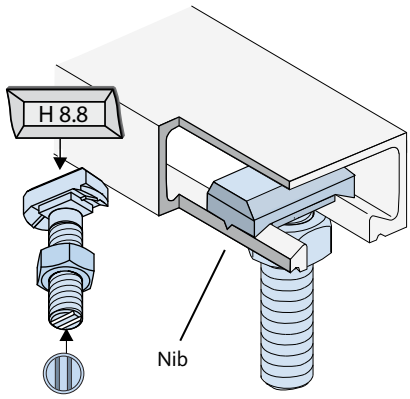
HTA-CE Profile	HALFEN Bolt HS...**M** [mm]	Torque value T_{inst} [Nm] Steel 4.6	Steel 8.8	Stainless steel Strength class 50	Stainless steel Strength class 70
28/15	6	3	–	3	–
	8	8	20	8	15
	10	15	40	15	30
	12	25	70	25	50
38/17	10	15	40	15	30
	12	25	70	25	50
	16	65	180	60	130
40/22P 40/25	10	15	40	15	30
	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 72/49	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 Bolts – Type HSR

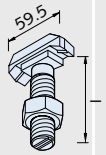
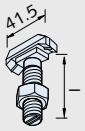
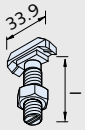
HALFEN Bolts with nib

- 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	

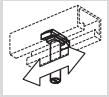
GVs = Zinc galvanized with special coating
FV = Hot-dip galvanized

* on request

Torque values HSR

HSR 8.8	Torque values [Nm]
M16	200
M20	400

Load capacity HSR



Bolt HSR

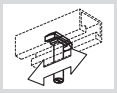
Grade 8.8
in channel longitudinal direction according to expert report

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 (per 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 appliable with torque moments T_{inst} steel-steel (see table on the right, on page 22)

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 Channels with HALFEN HSR Type Bolts with nib
- serrated HALFEN Channels HZA with serrated HALFEN Bolts HZS, see page 29

See table on the left for the maximum design values for friction load.
See page 22 for torque values.

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

Notes for assembling end anchor type ANK-E

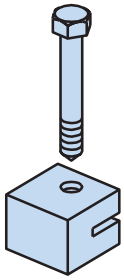
- Cut the HALFEN Cast-in channel at the selected point. The cut face must be at a right angle to the longitudinal axis of the channel. The end projection "**e**" should not be less than 35 mm and not more than 175 (225) mm*.
- Select the correct **ANK-E** End anchor for the HALFEN Cast-in channel profile; 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.

officially App. No Z - 21.4 - 34 approved

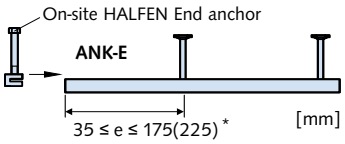
End anchor selection

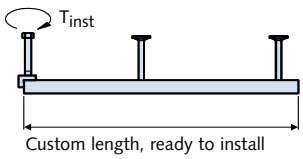
for profile	End anchor	Thread	Torque T_{inst} [Nm]
28/15 - FV	**ANK-E1 - FV**	M8	10
28/15 - A4	ANK-E1 - A4	M8	10
38/17 - FV	**ANK-E2 - FV**	M10	20
40/25 - FV			
41/22 - FV ①			
38/17 - A4	ANK-E2 - A4	M10	20
40/25 - A4			
41/22 - A4 ①			

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

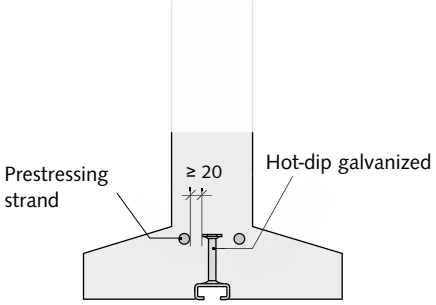
HALFEN Anchor channels, hot-dip galvanized with stainless steel anchors

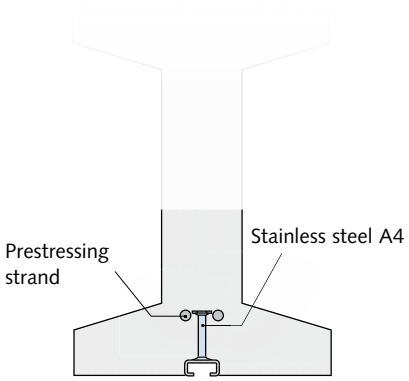
Requirements
according to EN 1992-1-1/NA (EC 2 with German National Annex, 2nd edition, 2016, chapter 8.10.1.1)
"Ensure at least 20 mm concrete between pre-stressed tension strands and galvanized components."
Otherwise there is a risk of hydrogen induced stress corrosion cracking.

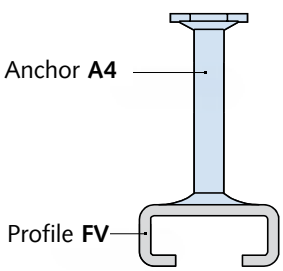
Solution
If hot-dip galvanized channels are used together with stainless steel bolt-anchors then the pre-stressed tension-strands are allowed to have contact with the stainless steel bolt anchor.

Types:
Lengths available:
up to 6.07 m

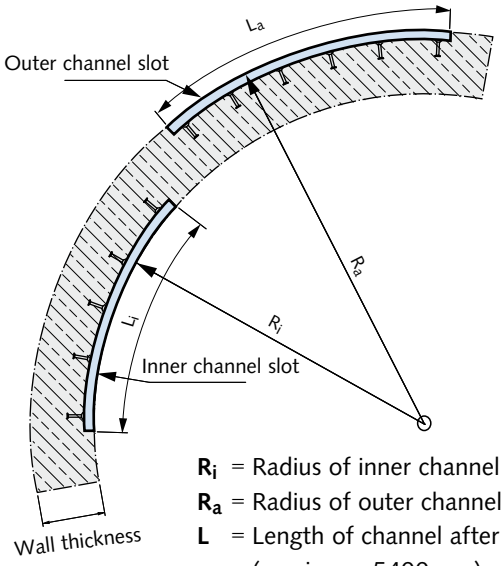
Available profiles:
- 50/30P
- 49/30
- 40/25
- 38/17







HALFEN Channels HTA-CS – 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
HTA-CS 52/34-Q - A4, R_i = 4000 mm, L = 1050 mm


Curved HALFEN Cast-in channels in tunnel segments

Smallest radius – all materials

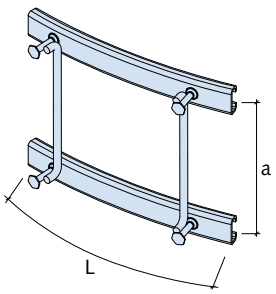
Profile / Material		HTA-CS 72/48	HTA-CS 72/49	HTA-CS 54/33	HZA-CS 53/34	HTA-CS 52/34	HTA-CS 50/30P	HTA-CS 49/30	HTA-CS 40/22P	HTA-CS 40/25	HZA-CS 41/22	HZA-CS 29/20	HZA-CS 38/23	HTA-CS 38/17	HTA-CS 28/15
Inner channel slot: min. R_i	☐	on request	on request	0.80 m	on request	0.75 m	0.80 m	0.80 m	1.80 m	1.60 m	on request	on request	on request	on request	on request
	☐	on request	on request	0.80 m	on request	0.80 m	0.80 m	0.80 m	2.40 m	2.50 m	on request	–	on request	on request	on request
Outer channel slot: min. R_a	☐	4.00 m	on request	4.00 m	on request	3.60 m	2.10 m	3.00 m	2.10 m	4.00 m	on request	on request	on request	on request	on request
	☐	on request	on request	4.00 m	on request	3.60 m	2.10 m	5.70 m	6.00 m	4.00 m	on request	–	on request	on request	on request

☐ hot-dip galvanized ☐ stainless steel A4

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

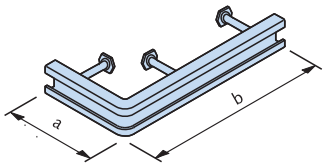


Figure: HTA-CE 38/17 – Corner piece

Area of application:
- fixing for HALFEN Console anchors for supporting masonry renders
- other near edge fixings

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, located by its distance from the lower, upper left and right edges of the component
- thickness of the concrete components
- concrete strength class
- condition of the concrete; cracked or verified as non-cracked
- is there 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 91 of this catalogue.

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 Software HTA-CE

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 presented 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
- engineering consideration of fatigue loads and fire influence

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.

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 highlighted 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 Software HTA-CE

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 progressbar 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

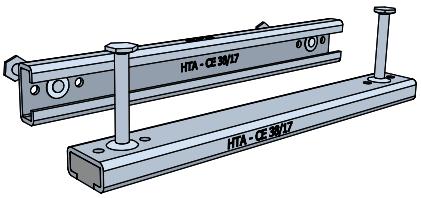
Screenshot 6: Print preview

Tender text

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

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

according to European Technical approval 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 of stainless steel 1.4404 / 1.4571 / 1.4578,

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

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

HALFEN Cast-in channels HZA

The advantages at a glance

***A**part from excellent adjustability, HALFEN Cast-in channels save considerable installation time. The result: faster construction and therefore reduced overall costs.*

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

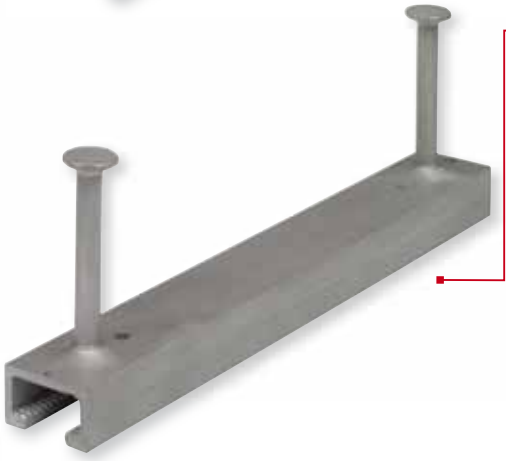
HZA HALFEN Channels
Cold-rolled, serrated

serrated

3D-Loads

officially App. No Z-21.4-145 approved

HALFEN Zul.-Nr. Z-21.4-145 DIBt MPA NRW



HZA HALFEN Channels DYNAGRIP
Hot-rolled, serrated

serrated

3D-Loads

suitable for dynamic loads

officially App. No Z-21.4-1691 approved

HALFEN Zul.-Nr. Z-21.4-1691 DIBt MPA NRW

HZA-PS HALFEN Channels
Hot-rolled, serrated

serrated

3D-Loads

suitable for dynamic loads

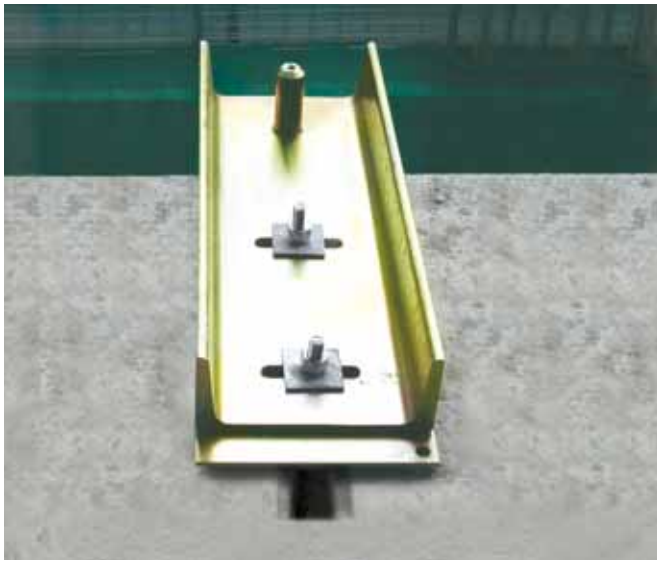
suitable for seismic loading

suitable for applications in safety relevant areas in nuclear facilities

HALFEN Cast-in channels HZA-PS
More Information on 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 Cast-in Channels HZA

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

Fixings of the drive unit for a ski lift

LIFTS / ELEVATORS

Fixing for guide rails

INDUSTRIAL BUILDING

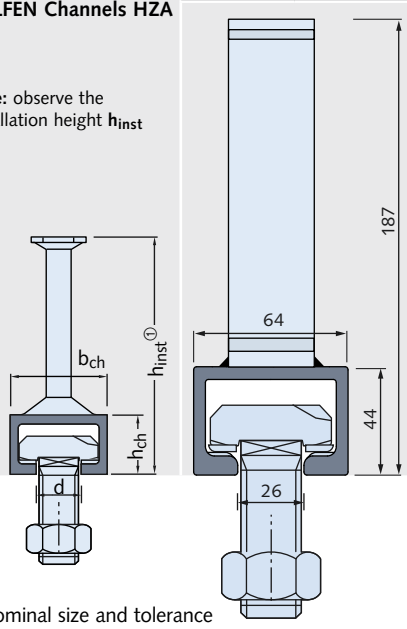
Vertical channels in columns to attach further components

Areas of Application / Product Range

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 Channels HZA	hot-rolled				cold-rolled
Note: observe the installation height h_{inst}					
F_{Rd}	37.8 kN all load directions	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

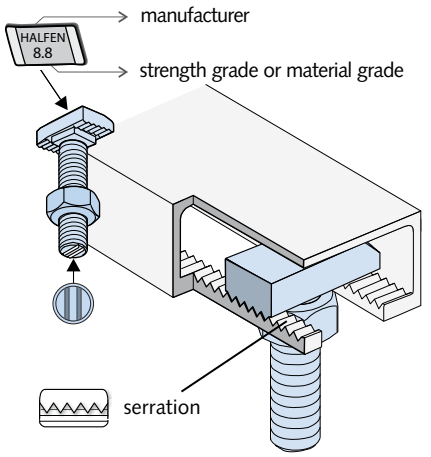
① Nominal size and tolerance

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

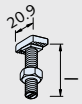
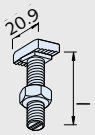
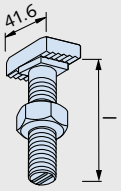
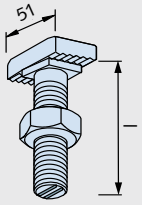
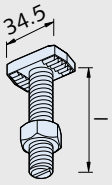
Available HALFEN HZS Bolts

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 Bolts HZS

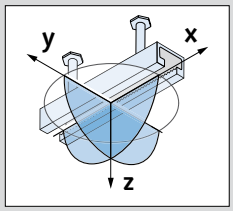
Suitable for profile	HZA 29/20	HZA 38/23		HZA 53/34		HZA 64/44		HZA 41/22	
Bolt	**HZS 29/20**	**HZS 38/23**		**HZS 53/34**		**HZS 64/44**		**HZS 41/22**	
Bolts dimensions									
Ø / l [mm]	**M12**	**M12**	**M16**	**M16**	**M20**	**M20**	**M24**	**M12**	**M16**
30	GVs8.8	GVs8.8							
35								A4-50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

HZA DYNAGRIP Design resistance calculation value F_{Rd}

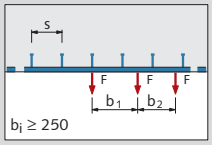
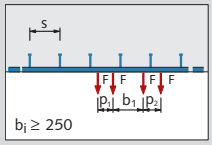
Design resistance F_{Rd}

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



Concrete ≥ C20/25 ①

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

		single loads	load pairs		
		 F_{Rd} [kN]	 F_{Rd} [kN] ②		
		$b_i \geq 250$	$p_i \geq 50$	$p_i \geq 100$	$p_i \geq 150$
Profile HZA DYNAGRIP	64/44	37.8	–	22.4	–
	53/34	30.8 26.6 (for profiles in A4)	–	19.25	–
	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 35

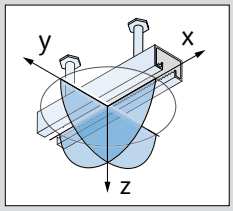
① The allowable loads for C20/25 may be reduced by the factor 0.7 when anchoring in concrete, strength class C12/15 and by a factor of 0.67 when anchored in light dense concrete ≥ LC 25/28, expanded clay or slate or pumice concrete.

② Interim values may be linearly interpolated.

HZA Design resistance calculation value F_{Rd}

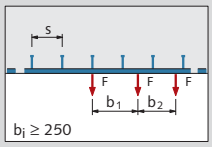
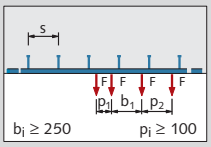
Design resistance F_{Rd}

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



Concrete ≥ C20/25

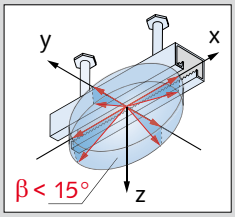
$$F_{Ed} = \sqrt{N_{Ed}^2 + V_{xEd}^2 + V_{yEd}^2} \leq F_{Rd}$$

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

s = Anchor spacing, see page 35

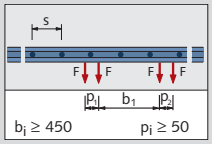
Design resistance F_{Rd}

F_{Rd} with transverse load
Paired loads



Concrete ≥ C20/25

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

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

s = Anchor spacing, see page 35

Minimum spacing a_r, a_e, a_a, a_f and h

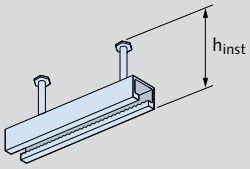
The minimum spacing specified in the table applies to reinforced standard weight concrete of all strength classes ≥ C20/25.

There are no additional requirements for reinforcement if spacing is increased by 30 %.

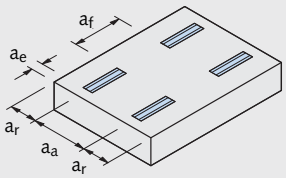
officially approved App. No Z-21.4-...

Minimal spacing HALFEN Channel HZA [mm]

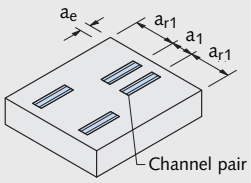
All dimensions in [mm]



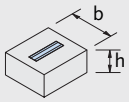
Single channel



Paired channels ③



Minimum component size



	Single channel				Paired channels ③			Minimum component size	
	a_r ④	a_a	a_e	a_f	a_{r1}	a_1	a_e	b①	h②
HZA 64/44 DYNAGRIP	250	500	225	450	–	–	225	500	187 + c_{nom}
HZA 53/34 DYNAGRIP	200	400	175	350	–	–	175	400	165 + c_{nom}
HZA 41/22	100⑤	150	80	200	100	100	80	200⑤	85 + c
HZA 38/23 DYNAGRIP	150	300	130	250	225	150	130	300	99 (154) + c_{nom}
HZA 29/20 DYNAGRIP	100	200	80	200	140	125	80	200	87 + c_{nom}

① Minimum component width b = 2 × a_r applies for single channel configuration.

② Determined by channel height, anchor length and required concrete cover "c_{nom}" as stated in EN 1992-1-1 (EC2), chapter 4.4.1. Channel height h_{inst} in brackets for HZA 38/23 apply only for channel types with weld-on anchor.

③ Only for centric tensile stress, and for HZA 41/22 also if exposed to stress in channel longitudinal direction.

④ For transverse and angled tensile load the distance from the edge of the unstressed component may be reduced to $a_{r\,red.}$ = 0.5 × a_r or 50 mm if, as in the illustration on page 36, additional reinforcement is used.

⑤ Additional anchor reinforcement must be used for angled tensile load ≤ 45° and transverse tensile stress perpendicular to the edge for spacings of 75 to 100 mm, see page 36.

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 Bolts HZS – 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 per bolt ② M_{Rd} [Nm]	F_{Rd} [kN]	Bending moment per bolt ② M_{Rd} [Nm]	F_{Rd} [kN]	Bending moment per bolt ② M_{Rd} [Nm]
29/20 - M12	27.2	61.2	–	–	–	–
38/23 - M12	27.2	61.2	–	–	–	–
38/23 - M16	50.5	155.4	–	–	33.0	116.6
41/22 - M12	27.2	61.2	13.0	21.4	–	–
41/22 - M16	50.5	155.4	24.2	54.3	–	–
53/34 - M16	50.5	155.4	–	–	33.0	116.6
53/34 - M20	79.0	303.0	–	–	51.5	227.2
64/44 - M20	79.0	303.0	–	–	51.5	227.2
64/44 - M24	113.7	524.0	–	–	54.3	183.4

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/mm^2 (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 present tensile load
M_{Ed} = Design value of present bending moment

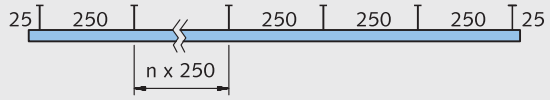
Note:
Combine stress values if bending occurs with additional centric or diagonal tensile stress.

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.)

Reduced edge distance a_r, with full centrical tensile stress

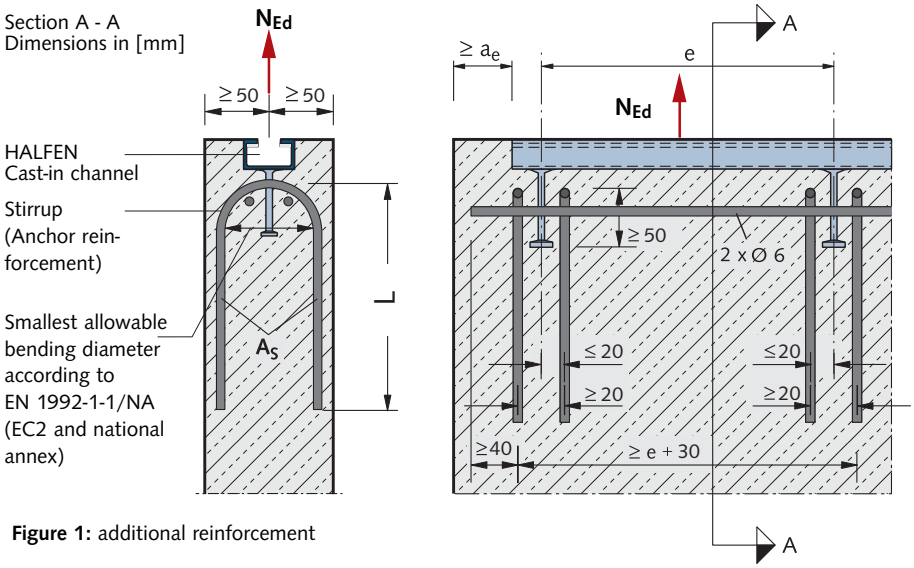
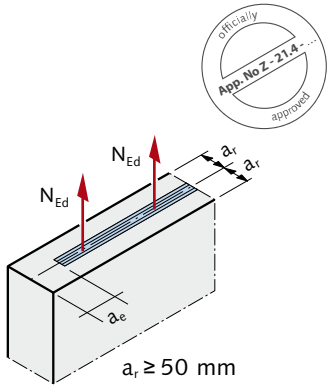
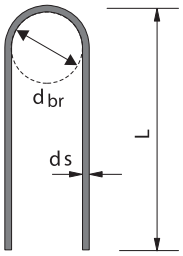


Figure 1: additional reinforcement





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.

Required reinforcement cross section
A_S [cm²] stirrup rebar:

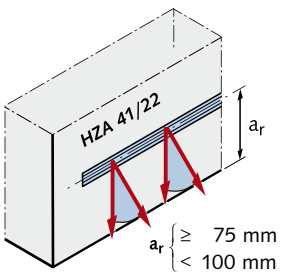
$$\text{req. } A_s = \frac{F_{Rd}\,[kN]}{4 \times \sigma_{Rd}\,[kN/cm^2]} = \frac{F_{Rd}}{44.8}\ cm^2$$

Steel stress
$\sigma_{Rd} = (1.4 \times \sigma_S) =$ **11.2 kN/cm²**
with $\sigma_S =$ 8 kN/cm² as in the approval.
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



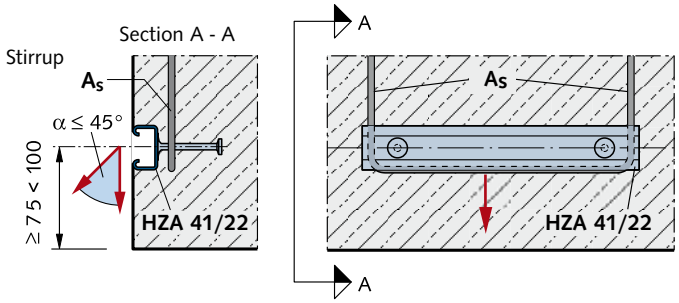


Figure 2: Additional reinforcement placement

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

σ_{Rd} → see above

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).

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 screws according to the tables on this page are allowed.

Allowable amplitude / HALFEN HZA Channels, serrated

Allowable stress amplitude for load cycle n = 2 × 10^6

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 refer to approvals 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)

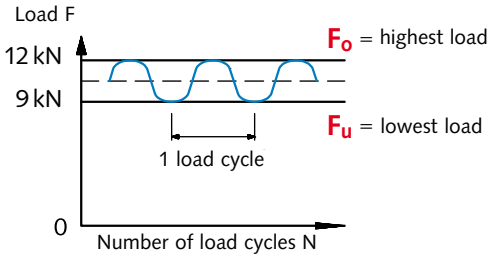
Example:
HZA 38/23 profile - FV (standard, hot-dip galvanized), channel length = 250 mm

max. load:

12 kN (allow. F = $\frac{16.8\,\text{kN} \rightarrow \text{page } 33}{1.4}$) = $\frac{F_{Rd}}{1.4}$

of which dynamic load:

3 kN (stress amplitude Δ F)



Design resistance / HALFEN HTA Channels

Design resistance for n = 2 × 10^6 load cycles

Profile HTA	Type	$\Delta N_{Rd,s,0,n}$	Allowable bolts	Material
40/22P	FV	3.0	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	6.1	M16 M20	8.8 8.8

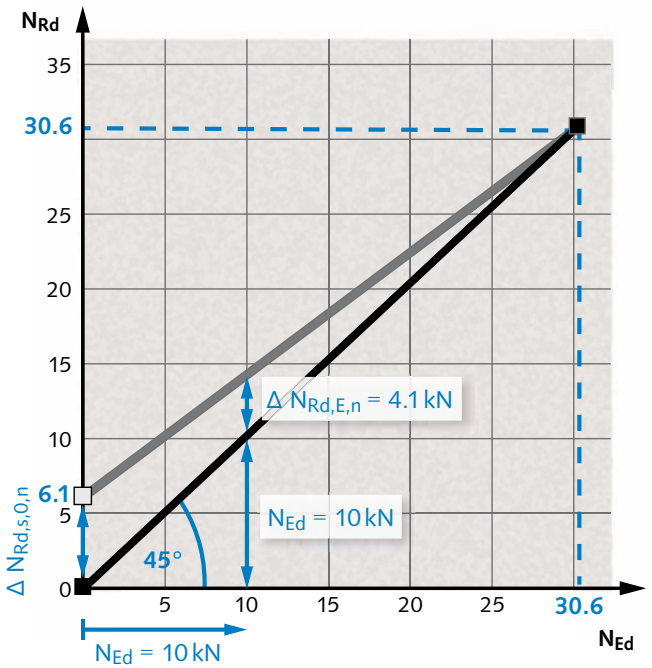
Example (also see diagram to the right):
Profile HTA-CE 52/34 - FV (standard, hot-dip galvanized), for n = 2 × 10^6 load cycles:

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) × 6.1/30.6 = 4.1 kN

Diagram: HTA-CE 52/34 - FV for n = 2 × 10^6 load cycles



HGB Handrail Connections

The advantages at a glance

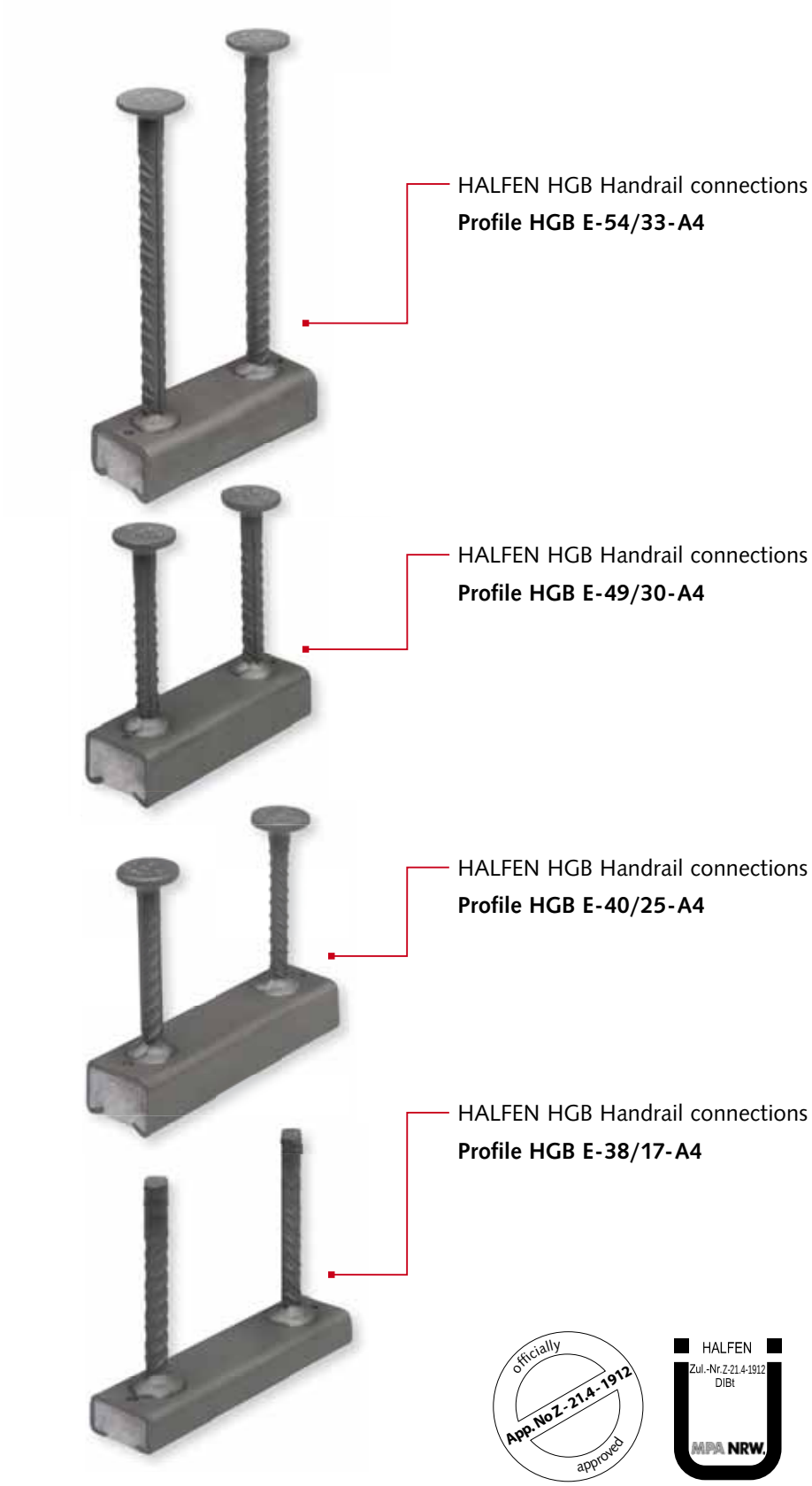
Construction specialists consider the HALFEN HGB Handrail connections to be particularly well suited for fastening banisters to the thin front faces of balcony slabs.

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

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 secure and statically sound connection of banister components



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

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

officially App. No Z-21.4-1912 approved

HALFEN Zul.-Nr. Z-21.4-1912 DIBt MPA NRW.

HALFEN HGB HANDRAIL CONNECTIONS

Application Examples

SAFETY BARRIERS IN STADIUMS

①–④: Safety rail 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

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"*. (MBO = *Musterbauordnung* / model building code 07 and construction guidelines).

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 its 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 banister 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.

*through 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. VOB (Vergabe- und Vertragsordnung für Bauleistungen / Tender and Contract Regulations for the German building industry) 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 too thin a concrete slab).

BVM Directive

Directive on metal banisters / balustrades, published by the: BVM Berufsverband Metall / Federal Association of German Metalworkers.

Other applicable regulations and standards (Extract):

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

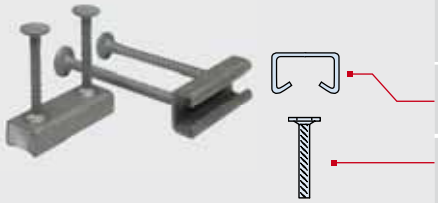
EN 1992-1-1 (EC2):	Design and construction of concrete support structures; with National Annex (NA)
EN 1991 (EC1):	General effects on load structures; with National Annex (NA)
EN 1993 (EC3):	design and construction of steel structures; with National Annex (NA)

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

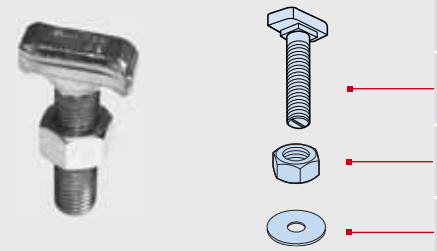
"Anchor channels in stainless steel may be used outdoors – also in an industrial and coastal environment, but may not be directly exposed to salt water".
See guidelines for "Metal banisters and balustrades" issued by the BVM (Bundesverband der Metallverarbeiter) (German Association of Metalworkers).

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

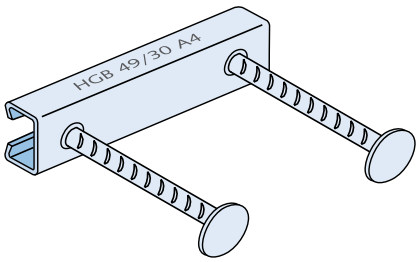
□ **WB** = Steel mill finish
■ **A4** = Stainless steel

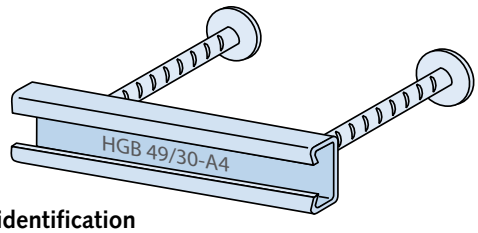
Galvanized:
Dipped in a galvanizing bath at a temperature of approximately 460°C, a method used primarily for open-profile channels.

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

Available on request

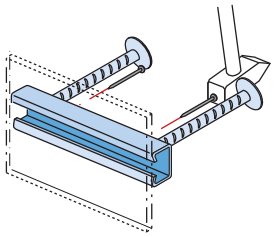
Identification of HALFEN HGB Cast-in channels





Product identification
- on channel side
- additionally inside the profile

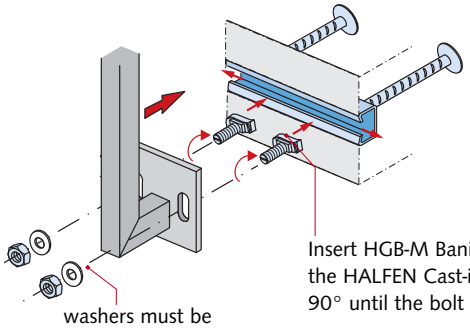
1 Nail the HALFEN Cast-in channel to the formwork



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

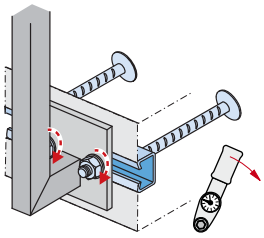
2 Installation and adjustment of balustrades



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

washers must be ordered separately

3 Tighten the bolts

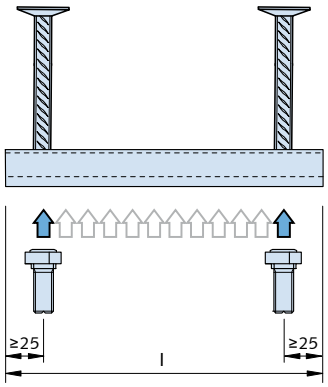


Tighten the nuts using a torque wrench. See table on the right for torque values

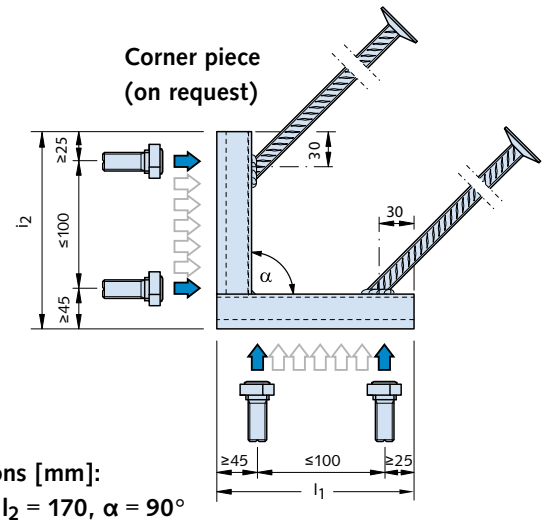
Railing bolts			
Stainless steel Material grade A4-70		**Torque [Nm]**	
HGB - M 50/30		M16	60
for profile 49/30 and 54/33		M12	25
HGB - M 40/22		M16	45
for profile 40/25		M12	25
HGB - M38/17		M16	40
for profile 38/17		M12	25

Fixing position of the bolts

Short piece

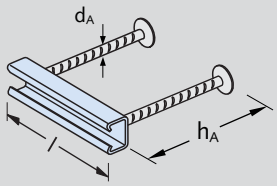
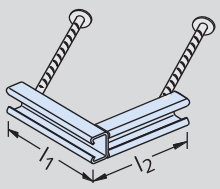
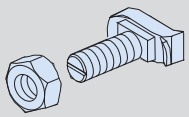
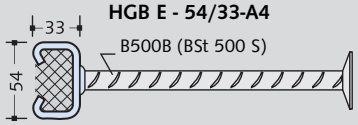
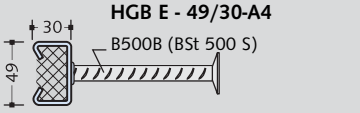
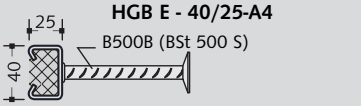
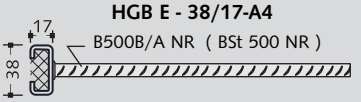


Corner piece (on request)



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

HALFEN HGB 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	HGB M-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	HGB M-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	HGB M-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	HGB M-38/17 A4-70	M12×40 M16×40
	150			0.911						
	200			0.999						

■ **A4** = Stainless steel
1.4571/1.4404

Alternative for interiors
(on request):
■ **FV** = Steel hot-dip galvanized
1.0038/1.0044

In addition to the cold-rolled profiles listed in the table above the following hot-rolled profiles are also generally available:
- 40/22
- 50/30
- 52/34

Ordering and materials

Ordering example HGB channel:

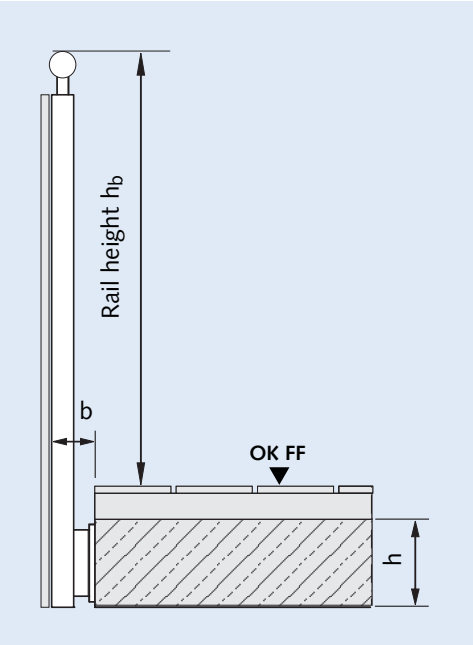
HGB-E-49/30 - 200 - A4
- material:
- length [mm]
- description

Ordering example banister bolt:

HGB-M-50/30 - M12x40 - A4-70
- material:
- thread-Ø × length
- description

Banister height
The minimum height h_b of a banister 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 banister 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.

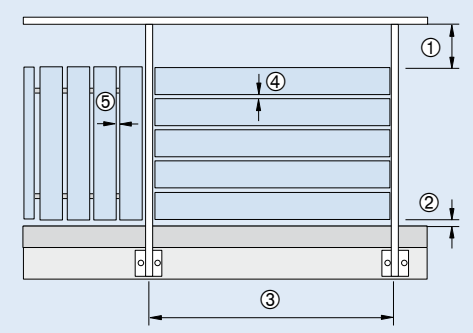


b = clear distance between the back of the veneer and the front face of the balcony slab or gutter / kick plate

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

The thickness of the balcony slab must be at least h = 100 – 150 mm when the HGB is mounted in the slab edge (depends on channel profile and according to 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 "Geländer-Richtlinie 2012 (BVM Berufsverband Metall)", Federal Association of German Metalworkers.



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

Dimensions

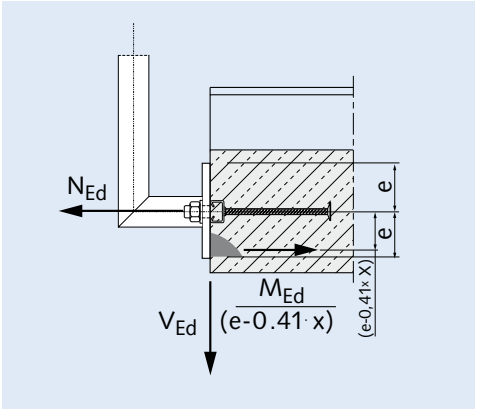
The forces acting on the banister must be transferred into the main building structure. It is necessary to verify that the forces

a) are wholly supported by the banister 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 banister base plate
x = maximum concrete pressure zone level according to appendix 8, table 8a and 8b



Banister 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. 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 with 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.

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 appendix 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
γ_G; γ_Q = partial safety factors for permanent and variable action

Extract from HGB approval 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-bolts 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. $\max.\ (\ N_{Ed} / N_{Rd,s}\ )^2 + \max.\ (\ V_{Ed} / V_{Rd,s}\ )^2 \leq 1.0$

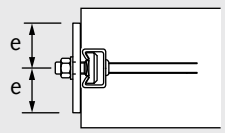
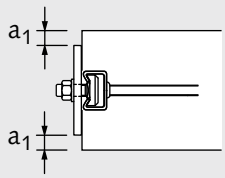
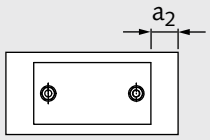
   or

   $\max.\ (\ N_{Ed} / N_{Rd,s}\ ) + \max.\ (\ V_{Ed} / V_{Rd,s}\ ) \leq 1.2$

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

Extract from HGB-approval Z-21.4-1912, appendix 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]	appendix 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]	appendix 8	100	120	140	150
Minimum edge distance c_1 [mm] (channel axis to the upper and the lower edge of the concrete element)	appendix 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 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 component ②		10	10	10	10
Minimum distance a_2 [mm] from the outer edge of the anchor plate to the edge of the concrete component		40	45	45	45

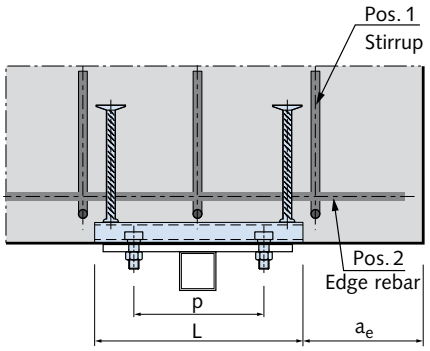
① The values in brackets apply when using M20 bolts
② In components with a weather groove, the bottom of the groove is regarded as the concrete element edge

Extract; HGB approval Z-21.4-1912, appendix 6

Table 7: Size and position of required minimum reinforcement

Description	Anchor channels			
	38/17	40/22 40/25	50/30 49/30	52/34 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 Z-21.4-1912, appendix 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, appendix 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)

Extract, HGB-approval Z-21.4-1912, appendix 8

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

Channel type		38/17	40/25	40/22	49/30	50/30	54/33	52/34
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	14.4	17.2	23.4	30.6	39.7
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	

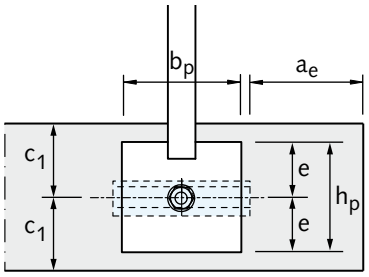
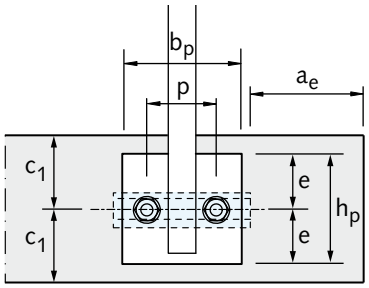


Table 8b: Design resistance of the channel using a two-bolt fixing

Profile		38/17	40/25	40/22	49/30	50/30	54/33	52/34
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	21.6	25.8	35.1	45.8	59.6
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 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

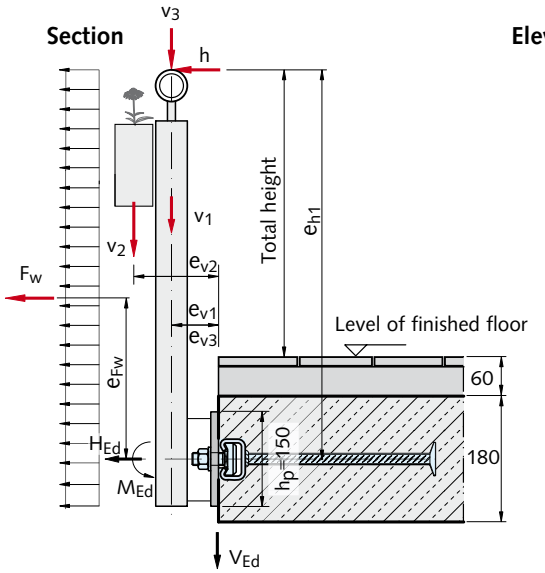
H_{Ed} = used to calculate the applicable horizontal effect

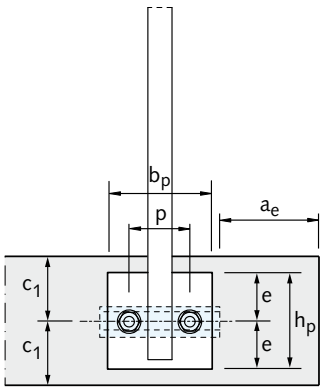
V_{Ed} = used to calculate the applicable vertical effect

h, F_w = horizontal load effects

v_1, v_2, v_3 = vertical load effects

b_p, h_p = anchor plate width and height





Calculation example

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

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

Bolt spacing	p = 80 mm
Concrete strength	C30/37

Load

Vertical loads:

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

Horizontal loads:

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 susceptible 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. 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 $\gamma_F = 1.5$
Banister	$H_{Ed} = 0.5 \cdot 1.5 \cdot 1.5 = 1.13$ kN with $\gamma_F = 1.5$
Dead load banister	$V_{1Ed} = 0.40 \cdot 1.5 \cdot 1.35 = 0.81$ kN with $\gamma_F = 1.35$
Load from flower box	$V_{2Ed} = 0.35 \cdot 1.5 \cdot 1.35 = 0.71$ kN with $\gamma_F = 1.35$
Vertical load on banister	$V_{3Ed} = 0.15 \cdot 1.5 \cdot 1.5 = 0.34$ kN with $\gamma_F = 1.5$

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

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

Load case 1: V + 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, stainless steel A4
Bolt spacing p = 80 mm
2 bolts HGB-M 50/30 M12, A4-70,
Required minimum reinforcement:
Stirrups 3 Ø 10, l_b = 300 mm
(see page 48 approval → app. 6, table 7),
Edge rebar 2 Ø 10

Splitting the moment into a load pair

$N_{Ed} = \frac{M_{Ed}}{(e - 0.41 \cdot x)} + H_{Ed}$ (see approval Z-21.4.1912 appendix 7)

$e = \frac{h_p}{2} = 75\,mm$

$x = 0.30 \cdot e = 0.30 \cdot 75 = 22.5\,mm$
see page 49 (appendix 8 / table 8b)
$e - 0.41 \cdot x = 75 - 0.41 \cdot 22.5 = 65.8\,mm$

Load case 1: V + 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 appendix 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 (appendix 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 (appendix 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 (appendix 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 / 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 / page 6)

HALFEN HTU Cast-in channels

The advantages at a glance

HTU cast-in channel
App. No Z-21.4-84
officially approved

The perfect technical solution for attaching trapezoidal steel sheet to concrete.
HALFEN HTU Cast-in channels and self-tapping screws have become a standard everyday solution in the construction industry.

Safe and dependable

- optimal shape of the anchoring elements means safe and low slip anchorage
- the polystyrene-filler prevents the drill or self-tapping-screws hitting concrete
- building authority approved

HALFEN HTU Cast-in channels
Anchor design A_N

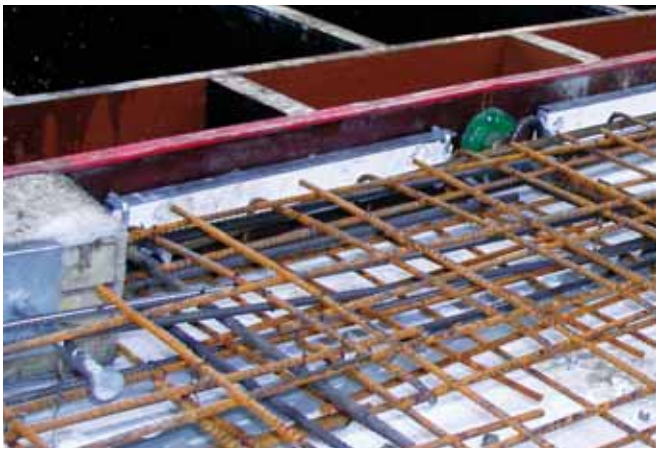
Quick and cost-effective

- simple installation
- quick and easy installation of trapezoidal sheeting
- two anchor designs, A_N and D for optimal adapting to planned reinforcement

HALFEN HTU Cast-in channels
Anchor design D

Application Examples

Trapezoidal roof sheet metal attachment



Installing HALFEN HTU Cast-in channels in the front face of a slab

Façade fixed using HALFEN HTU Cast-in channels

Vertical HALFEN HTU Cast-in channels for connecting façade panels

Assembly of trapezoidal sheet metal using self-tapping screws

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

General

The HALFEN Trapezoidal metal sheet installation channels were developed in cooperation with the Association for the light-weight steel construction industry (IFBS *Industrieverband für Bausysteme im Stahlleichtbau*). Made as a C-shaped channel in stainless steel or hot-dip galvanized steel with at least two welded anchors, and approved by the German Institute of Building Technology (DIBt Deutsches Institut für Bautechnik).

Approval no. Z-21.4-84

HTU cast-in channel
App. No Z-21.4-84
officially approved

HALFEN
Zul.-Nr. Z-21.4-84
DIBt
MPA NRW

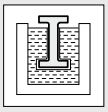
Connecting elements between channel and steel trapezoidal profiles must be designed according to IFBS guidelines "Connections for use with constructions made of steel sheet cold profiles" or the relevant manufacturer's ETA (European Technical Approval).

Approval no. Z-14.1-4

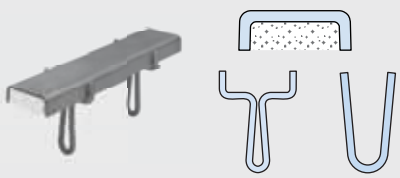
Material / Corrosion protection

Hot-dip galvanized FV:

Dipped in a galvanising bath at a temperature of approximately 460°C. This method is used primarily for open-profile channels.



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



	Steel		
	Material	Standard	Zinc coating
Channel profiles	1.0038 ■	EN 10 025-2	FV: ≥ 50 µm
Anchor A_N, D			

Connecting elements: Galvanized Steel according to (IFBS) approval no. Z-14.1-4 or the relevant manufacturer's ETA.

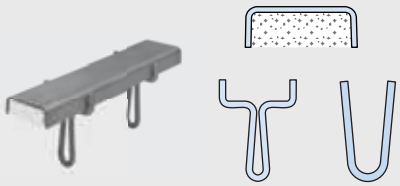
Stainless steel A4:

Chromium is the important 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. The result is the high corrosion resistance of stainless steel.

EDELSTAHL Rostfrei
Stainless Steel

■ **FV** = Hot-dip galvanized steel 1.0038
■ **A4** = Stainless steel 1.4571/1.4404

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



	Stainless steel A4		
	Material	Standard	Corrosion resistance class according to EN 1993-1-4, table A.3
Channel profiles	1.4404 or 1.4571 ■	EN 10 088	III
Anchors AN, D			

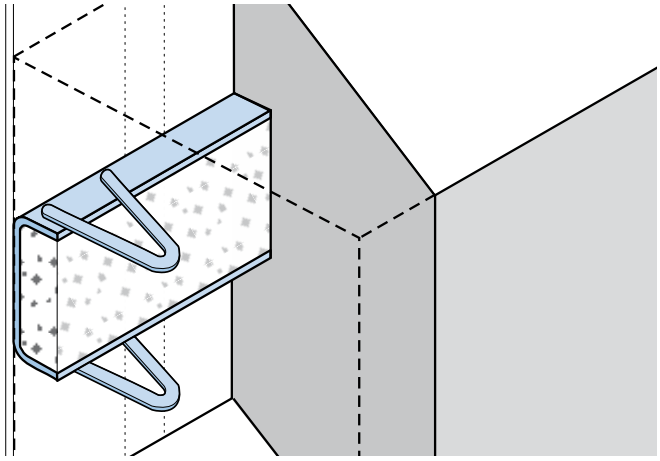
Connecting elements: Stainless steel as agreed and contracted from screw suppliers

Installation

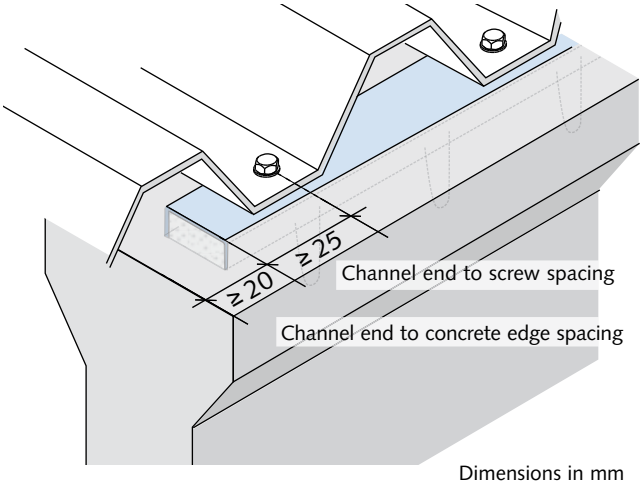
The ready-to-install HTU Channel is embedded flush with the final concrete surface. It is advisable to level the concrete surface and to apply a slight slope to the outer edge of the concrete. This is to ensure that the trapezoidal sheet metal rests only on the HTU Channel. According to German approval a heightened installation of up to 5 mm is also possible.

Alternatively, if the trapezoidal sheet metal manufacturer requires a minimal support width larger than 60 mm, this can be achieved through a flush channel installation and a flat concrete surface. Ensure that pre-stressed concrete trusses are properly aligned, centred and absolutely plane. Maintaining a 20 mm gap between individual channel ends is recommended.

Trapezoidal sheet metal fixing in wall applications

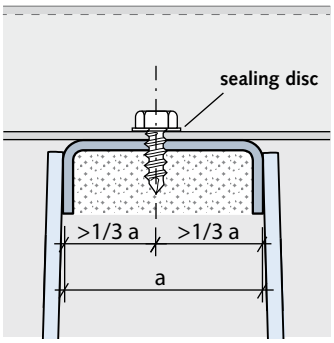


Trapezoidal sheet metal fixing in roof applications

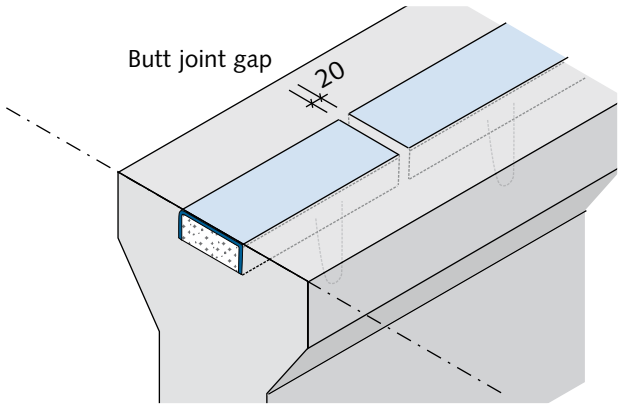


Dimensions in mm

Screw placement



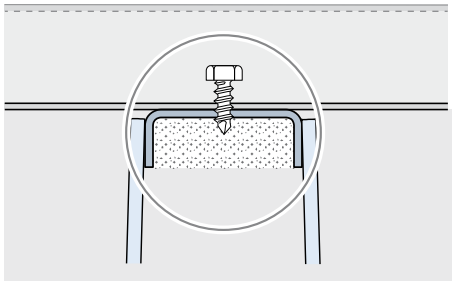
Recommended butt joint gap between two channels

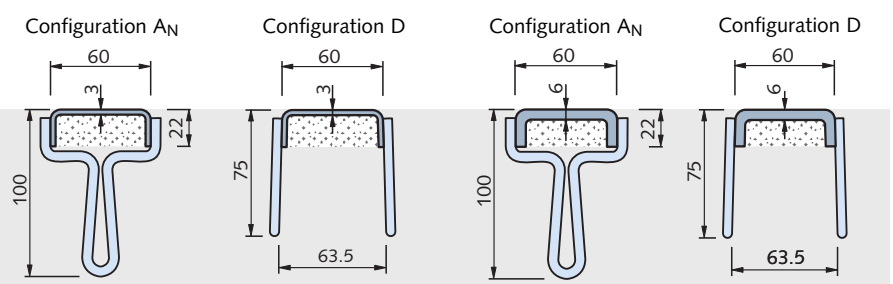


Assembly (with self-tapping screw)

- use a power-driver to fix the self-tapping screw; a pilot hole is not required. Even 4-fold overlapping at joints is not a problem with self-tapping screws
- use a power-driver with approximately 1500 rpm and a size 10 socket
- suitable tools for various screws can be obtained from the screw supplier
- the trapezoidal sheet metal must be attached in the central third of the channel back; Screws must be positioned at a minimum distance of 25 mm from the channel ends

Product Range





Profile cross-section A	2.81 cm²		4.94 cm²	
Moment of inertia I_y / Moment of resistance w_y	1.13 cm⁴ / 0.71 cm³		1.84 cm⁴ / 1.27 cm³	
Profile weight including anchors	2.49 kg/m	2.50 kg/m	4.25 kg/m	4.26 kg/m

Connecting element HTU material stainless steel channel thickness 3 mm
e.g. JT3-3H-5,5x25-E16 with 4.5 mm pre-drilled or JZ7-6,3x22-E16 with 5.3 mm pre-drilled.
- no approval -
Coordination with the screw suppliers is required

Connecting element HTU material steel→ETA 10/0200:
Self-tapping screws 6.3x19
e.g. JT2-6-6,3-19-xE16 with sealing disc.
Connecting element is exposed to weather: JT3-6-6.3x25-E16 (Wall) or JZ3-6-6.3x25-E22 (Roof)

Connecting element HTU material steel→ETA 10/0200:
Self-tapping screws 6.3x22
e.g. JT2-6-6,3-x22-V16 with sealing disc or cartridge fired nails SBR-14.
Connecting element is exposed to weather: see left

Ordering example:

HTU 60/22/3 - D2 - FV - 3000 - Sf

- type / profile
- anchor configuration
- material / finish
- length [mm]
- polystyrene strip filler

HTU 60/22/3 □ = hot-dip galvanized	Number of anchors
HTU 60/22/3 - A_N2 - FV - 3000 - Sf	8
HTU 60/22/3 - D2 - FV - 3000 - Sf	8
HTU 60/22/3 - A_N3 - FV - 3000 - Sf	20
HTU 60/22/3 - D3 - FV - 3000 - Sf	20
□ = Stainless steel A4	
HTU 60/22/3 - A_N2 - A4 - 3000 - Sf	8
HTU 60/22/3 - D2 - A4 - 3000 - Sf	8
HTU 60/22/3 - A_N3 - A4 - 3000 - Sf	20
HTU 60/22/3 - D3 - A4 - 3000 - Sf	20

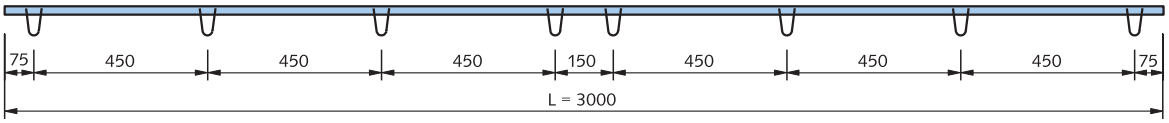
HTU 60/22/6 □ = hot-dip galvanized	Number of anchors
HTU 60/22/6 - A_N2 - FV - 3000 - Sf	8
HTU 60/22/6 - D2 - FV - 3000 - Sf	8
HTU 60/22/6 - A_N3 - FV - 3000 - Sf	20
HTU 60/22/6 - D3 - FV - 3000 - Sf	20

□ **FV** = Steel S235JR, hot-dip galvanized
□ **A4** = Stainless steel 1.4571/1.4404 ①

Anchor spacing:

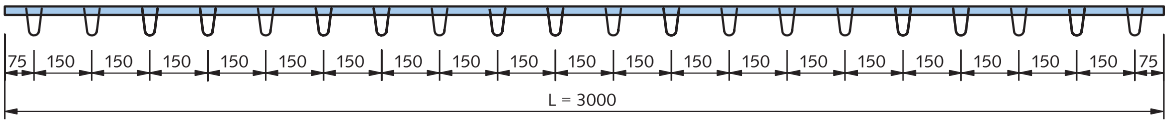
Type **D2** or **A_N2**

□ □ ①



Type **D3** or **A_N3**

□ □ ①

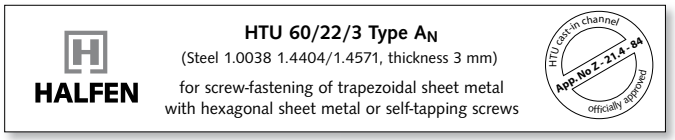


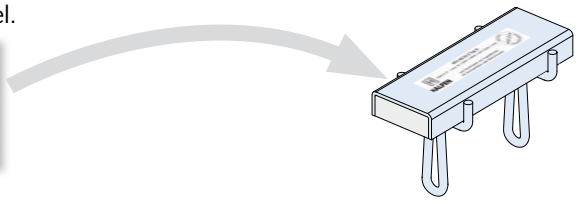
① Material A4 available only in 3 mm thickness

Dimensions in [mm]

Identification HTU

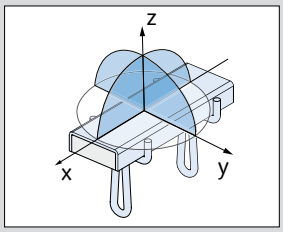
A yellow identification label is fixed to the back of each channel.

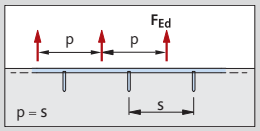


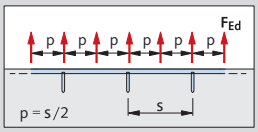


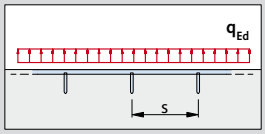
Dimensioning

Table 1 Maximum design load-carrying capacity F_{Ed}







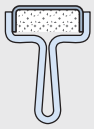
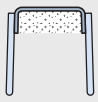


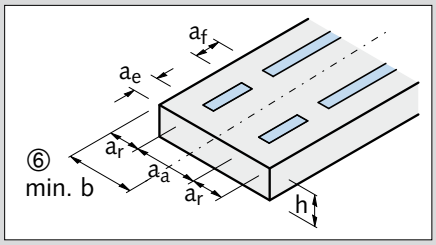
Profile **HTU**	Anchor spacing s [mm]	max. F_{Ed} [kN]		max. F_{Ed} [kN]		max. evenly distributed load q_{Ed} [kN/m]
60 / 22 / 3	450	p = s	4.6	$p = s/2$	3.5	15.5
	150		7.0		3.5	46.6
60 / 22 / 6	450		7.0		3.5	15.5
	150		7.0		3.5	46.6

$\sqrt{N_{Ed}^2 + V_{xEd}^2 + V_{yEd}^2} \leq$ max. F_{Ed}

Concrete ≥ C20/25

Table 2 Minimum distance when exploiting maximum load as in table 1

Profile		Minimum interaxial spacing and edge distance					
HTU { 60/22/3 / 60/22/6 }		a_a ① [mm]	a_r ② [mm]	a_e ③ [mm]	a_f ④ [mm]	h ⑤ [mm]	b ⑥ [mm]
	Type A_N	200	100	20	20	100 + nom c	200
	Type **D**	200	100	20	20	75 + nom c	200



① If the (trapezoidal sheet metal) channels are placed so that the anchors of adjacent channels are offset by at least 200 mm, the axial spacing a_a may be reduced to 80 mm.

② If not exploiting the maximum load capacity F_{Ed}, see table above, the edge distance a_r may be reduced. This applies only for central tensile stress N_{Ed}.

$$a_{r\ red.} = \frac{\text{actual } N_{Ed}}{\text{max. } F_{Ed}} \times a_r \geq 50\,\text{mm}$$

actual N_{Ed} = design rating of actual load

max. F_{Ed} = maximum load as in the table above

The edge distances must not be reduced if transverse stress (V_{xEd} , V_{yEd}) is present.

③ With full exploitation of maximum load F_{Ed} as in the table above, the last anchor must be at least 100 mm from the component edge.

④ When fully exploiting maximum load capacity F_{Ed}, see table above, the "last anchors" of adjacent channels must be at least 150 mm apart.

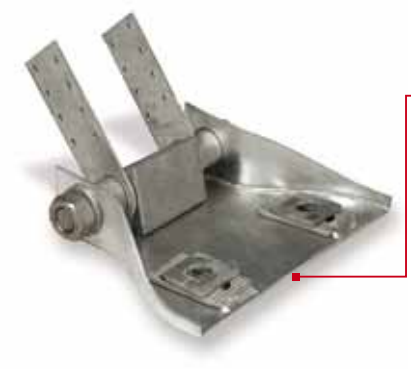
⑤ Depends on the anchor's size and the required concrete cover.

⑥ Minimum width of building component for a one channel layout.

Roof and Wall

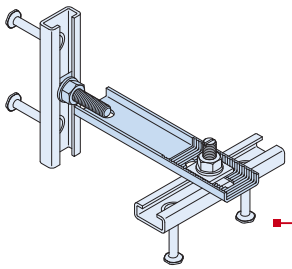
The advantages at a glance

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 Restraint ties
HALFEN SPV Turnbuckle restraint
For connection of tensile and compression loads from concrete walls elements.

HALFEN ML+BL Brick tie anchor system
For connection of tension and compression loads from concrete walls elements.

HALFEN HVL-M Precast connection
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 parking structures.

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

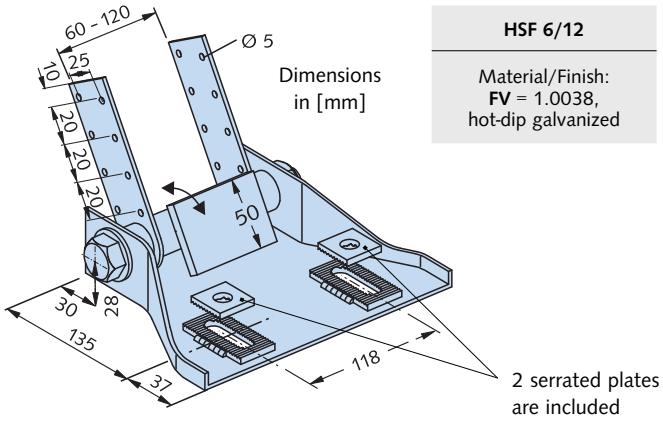
Connecting construction timbers to concrete using the HNA

Timber roof construction with HALFEN HNA Fixing straps

Corner guards in an industrial environment

HALFEN ML Brick-ties anchor system

HALFEN Rafter Shoe HSF



HSF 6/12

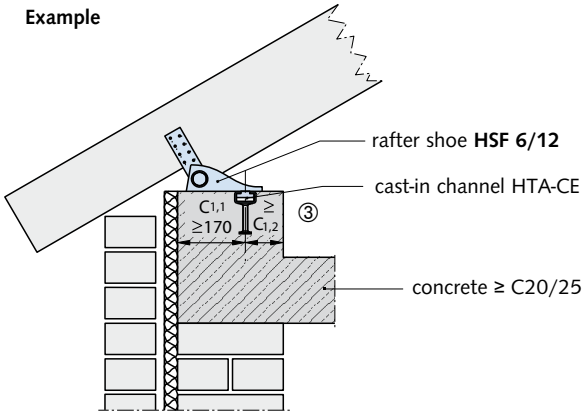
Material/Finish:
FV = 1.0038,
hot-dip galvanized

In modern wood constructions, rafter shoes type HSF 6/12 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
- clear statics with flexible rafter shoes
- complex and therefore costly support structures are not necessary
- simple and unproblematic roof constructions:
  a) adjustable support plate
  b) adjustable nailing brackets for vertical anchorage for various rafter widths from 60 to 120 mm
  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

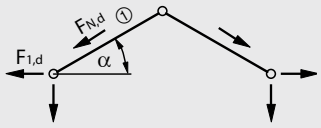


Definition $c_{1,1}$ and $c_{1,2}$ see page 15

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:

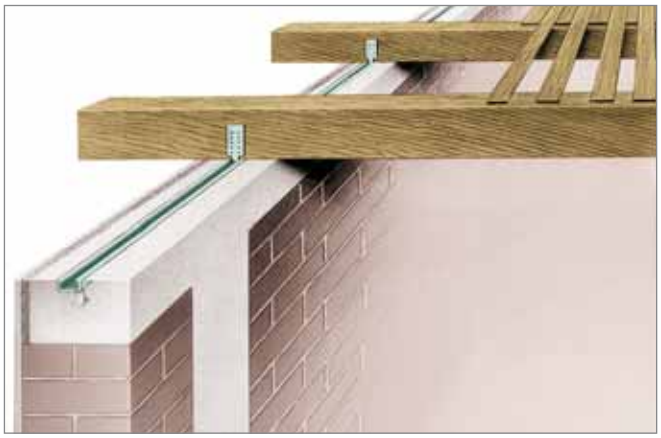
$F_{1,d} < F_{Rd}$



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 x 40
16.8	HTA-CE 40/22 HTA-CE 40/25	100	HS 40/22 - M16 x 50
19.6	HTA-CE 50/30 HTA-CE 49/30	150	HS 50/30 - M16 x 50

① The maximum rafter strength is limited by the design load of each individual component of 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 may 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.



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

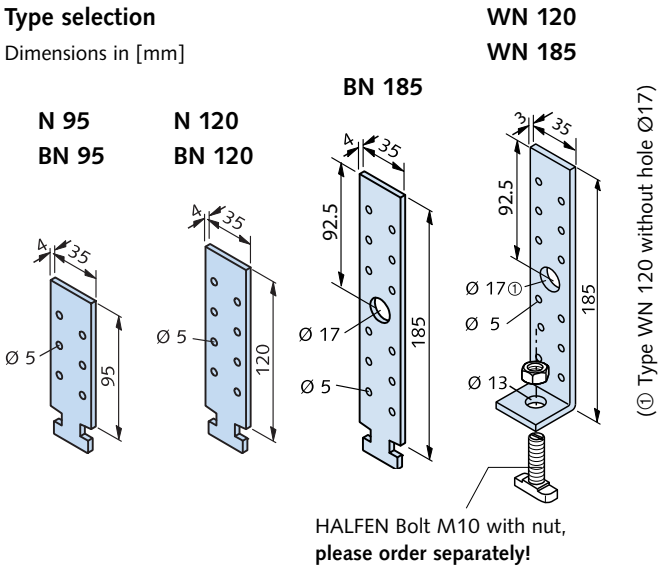
To provide an optimal base for roof framework, continuous HTA-CE HALFEN Cast-in channels or HTA-CE HALFEN Cast-in channel short elements are cast in the concrete; suitable for concrete ring beams or slabs. The type of HTA-CE HALFEN Cast-in channels, nailing straps and nails depend on the assumed loads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

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

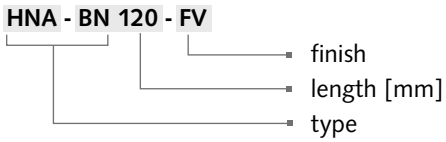
The timber fixing straps can be positioned on one or both sides of the timber beams or rafters. Refer to the following table for F_{Rd} load capacities. The beams / framework must be secured against twisting when straps are used only on one side of the beams, (e.g. by nailing to the upper wood roof boarding).

Type selection

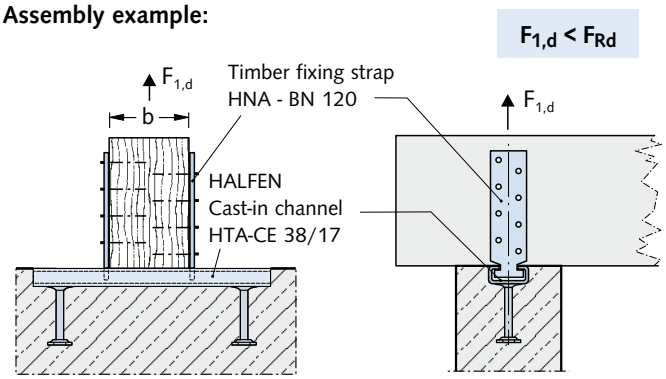
Dimensions in [mm]



Ordering example:



Assembly example:



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] per 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					

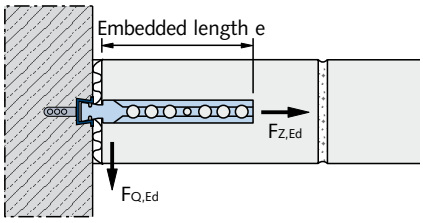
HALFEN ML and BL Brick tie anchors are tried and tested efficient installation systems for securing brick walls, masonry in-fills, partition walls, brick renders (with or without ventilation gap and heat insulation) to concrete walls, concrete supports, steel or wooden structures.

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

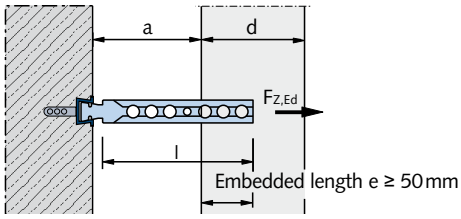
All HTA-CE and HMS profiles have a foam filling to prevent concrete ingress. The channels are attached to the formwork using standard nails.

The HALFEN Brick tie anchors are inserted at the recommended intervals (static requirements) in the brick wall during construction (see page 65). 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

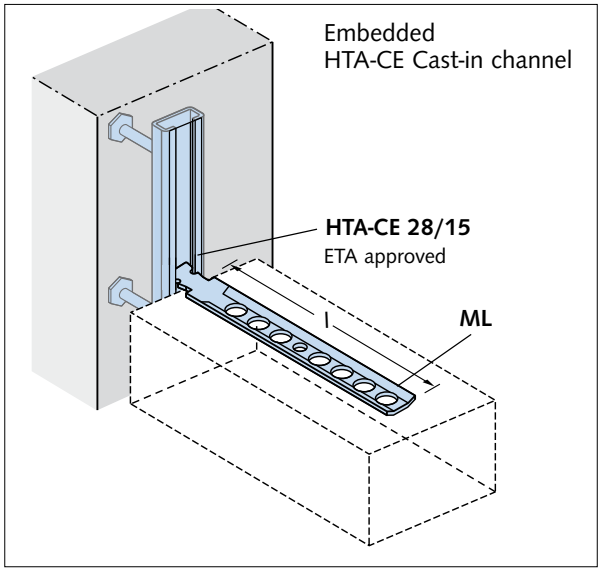


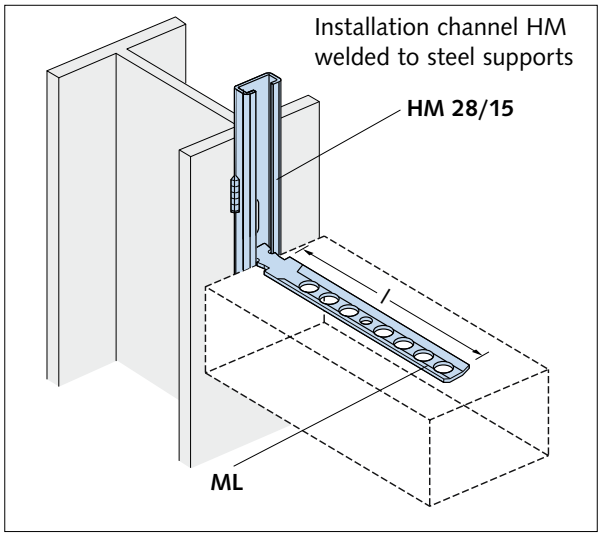
Plan view; facing brickwork attachment

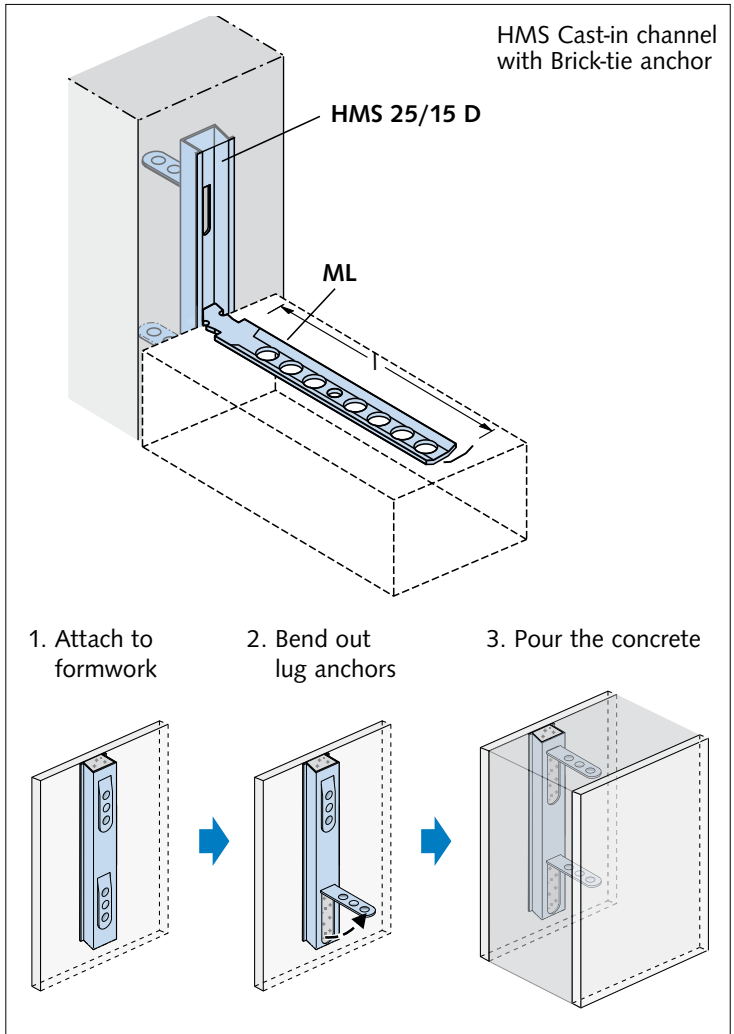


spacing a - see FM Catalogue

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

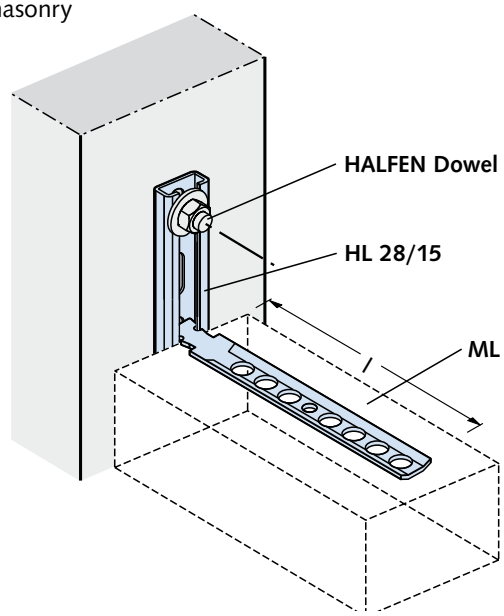




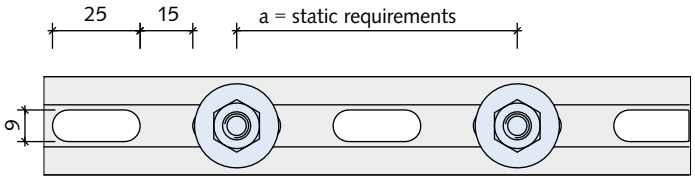


Lug anchors are bent out on site by hand every 250 mm to ensure secure anchorage in the concrete.

HL slotted framing channels anchored to concrete or masonry



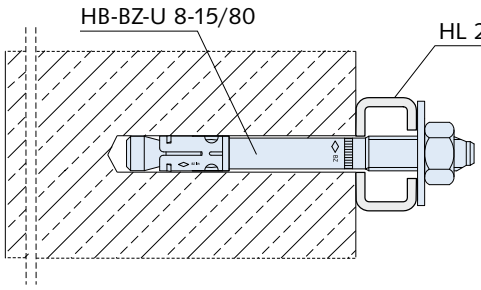
Top view



ETA-07/0250 ETA-07/0249

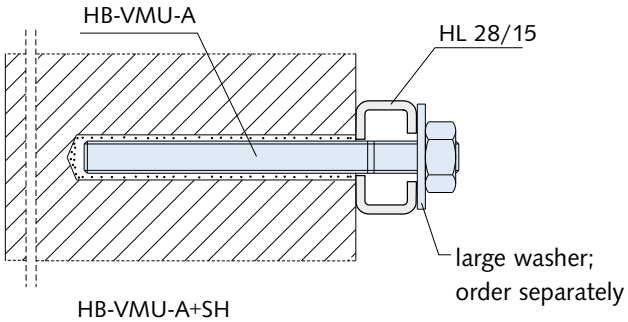
Bolt anchor HB-BZ-U

HALFEN Anchor bolt system: For more information on application and assembly see Technical Product Information **HALFEN HB**



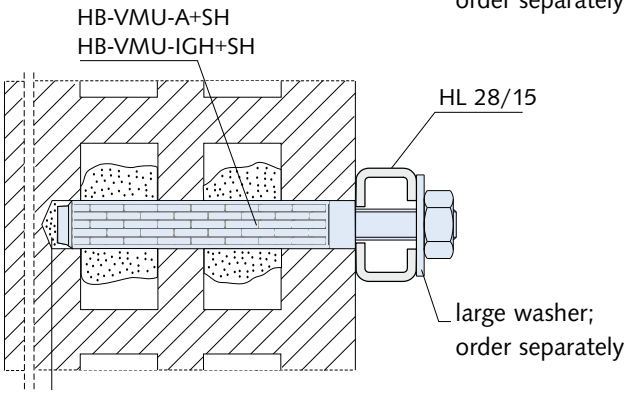
Bolt anchor HB-BZ-U 8-15/80

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



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

- galvanized or stainless steel (A4)
- approved for **monolithic masonry**
- with large washer DIN 9021/EN ISO 7093 (order separately)



Anchor rod HB-VMU-A 8-20/110 with Perforated sleeve HB-VMU-SH 14x100

or

Internal threaded sleeves HB-VMU-IGH M8 with Perforated sleeve HB-VMU-SH 16x100

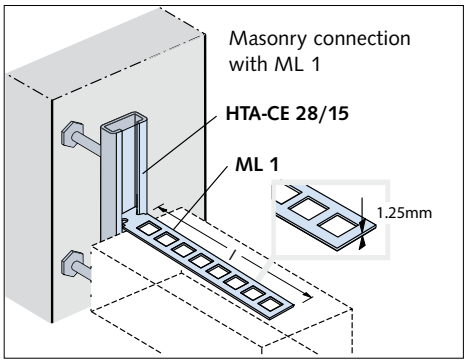
- galvanized or stainless steel (A4)
- approved for **perforated brick masonry**
- large washer, see above

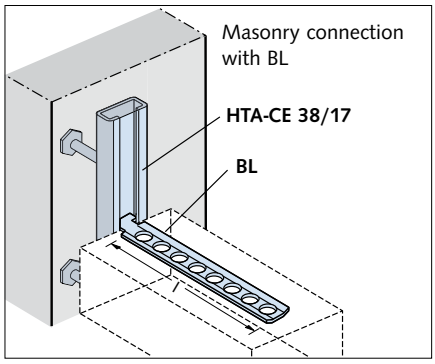
Brick tie anchors

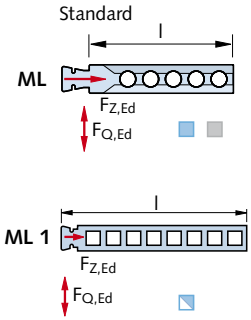
ML, BL
- max. load $F_{Z,Ed}$ = 0.32 kN per cm embedment length e
- max. $F_{Z,Ed}$ ≤ 3.2 kN= $F_{z,Rd}$
- max. $F_{Q,Ed}$ ≤ 2.7 kN= $F_{Q,Rd}$

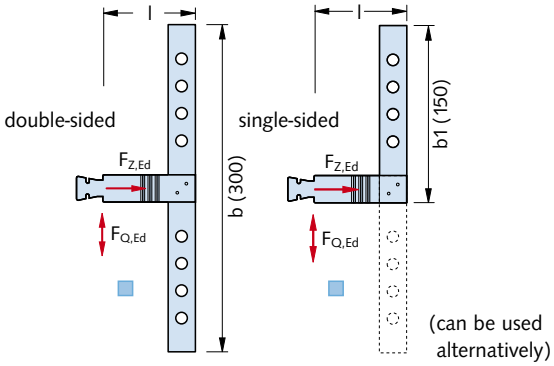
ML 1
- max. $F_{Z,Ed}$ ≤ 2.5 kN = $F_{z,Rd}$
- max. $F_{Q,Ed}$ ≤ 1.4 kN = $F_{Q,Rd}$

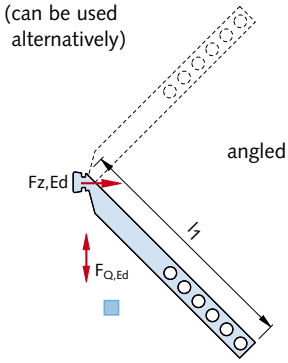
Observe profile load capacity!

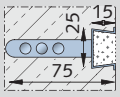
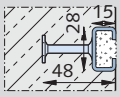
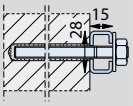
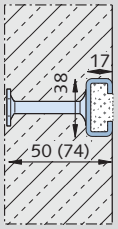








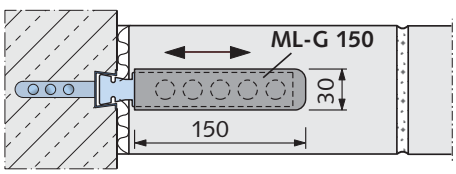


Brick tie anchor		Brick tie anchor				
		ML Standard 26 × 2 [mm]	ML 1 25 × 1.25 [mm]	MLQ - D ② Double-sided 25 × 3 [mm]	MLQ - E ② Single-sided 25 × 3 [mm]	MLS Slanted 22 × 3 [mm]
		Type / Length l [mm]	Type / Length l [mm]	Type / Length l [mm]	Type / Length l [mm]	Type / Length l_1 [mm]
	**HMS 25/15 D** L = 2500 mm					
	**HTA-CE 28/15** L = 1050 mm① L = 6070 mm①	**ML - 85**	**ML 1 - 125**	**MLQ-D - 85**	**MLQ-E - 85**	**MLS - 300**
	**HL 28/15** L = 6070 mm①	**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 mm① L = 6070 mm①	**BL** Standard 30 × 2 [mm] Type / Length l [mm] **BL - 85** **BL - 120** **BL - 180**	**BLQ - D ②** Double-sided 30 × 3 [mm] Type / Length l [mm] **BLQ-D - 85** **BLQ-D - 120** **BLQ-D - 180**	**BLQ - E ②** Single-sided 30 × 3 [mm] Type / Length l [mm] **BLQ-E - 85** **BLQ-E - 120** **BLQ-E - 180**		

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

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

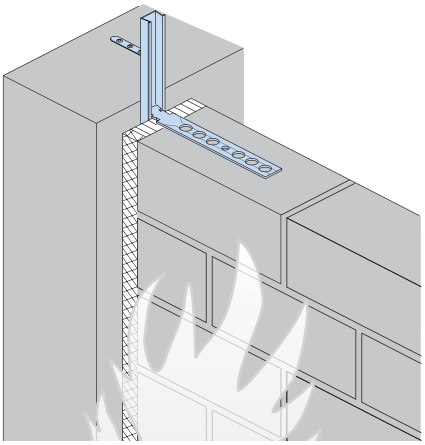


Permits movement in the longitudinal anchor direction, e.g. in long masonry bonds or partition walls adjoining concrete load bearing structures; prevents cracks forming.

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

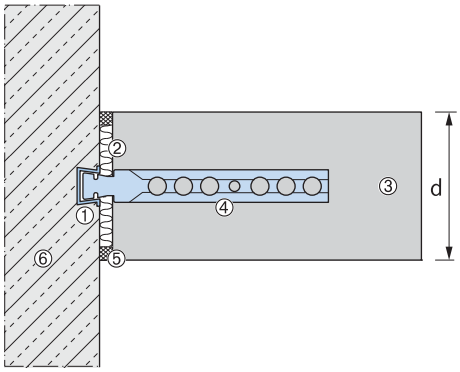
Firewall connection according to DIN 4102-4: 2016-05

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).

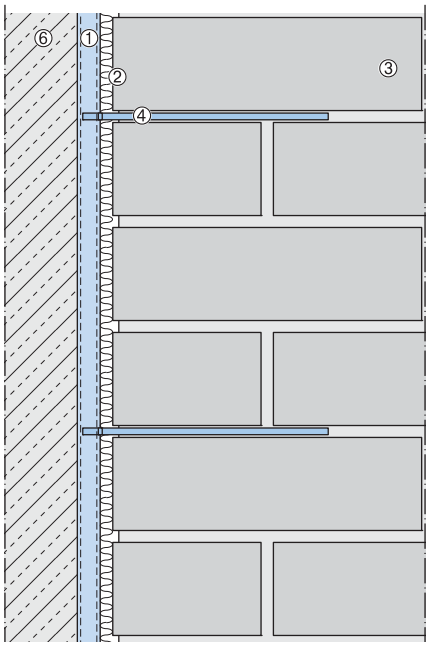


Connection of a load bearing masonry wall as a fire wall according to DIN 4102-4 section 9.8.4 (figure 9.13) or according to EN 1996-1-2: 2011-04 (figure E.4B)

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**

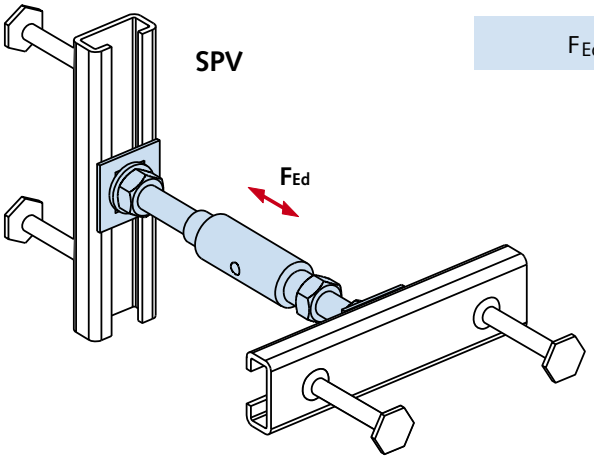
⑥ **Concrete**

Product information

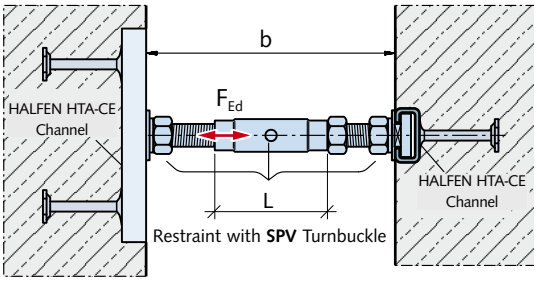
HALFEN Cast-in channel type ①	④ Brick tie anchor (see page 62 ff.)	
	for standard grout	for thin mortar
HMS 25/15 D	ML	ML 1
HTA 28/15	ML	ML 1
HTA 38/17	BL	–

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

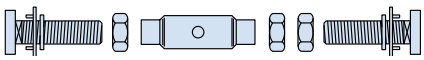


Ensure adequate screw depth:
M12 → ≥ 10 mm
M16 → ≥ 13 mm

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 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 locking washers SIC

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

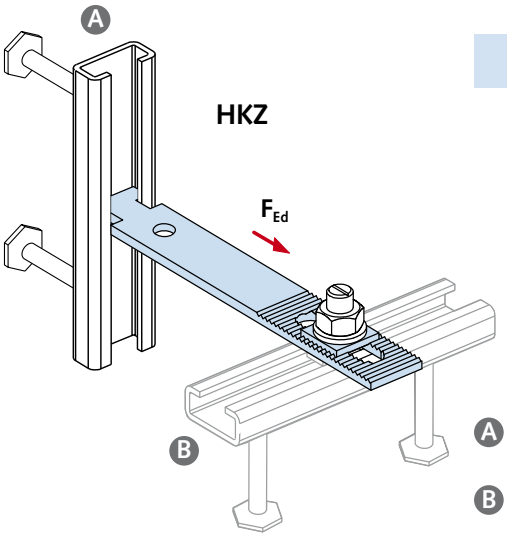
HALFEN SPV Restraint with turnbuckle

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		

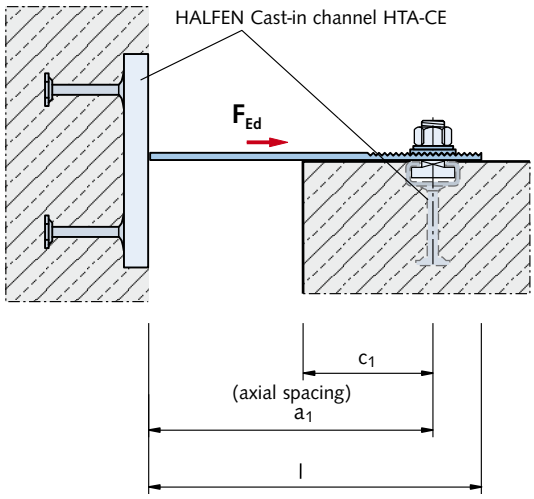
① Short elements 150, 200 and 250 ② With F_{Rd} -load group 9.8 kN restricted to negative tolerance

For further concrete façades accessories see **Catalogue Concrete Façade FB**

Restraint Tie HKZ



F_{Ed} = load



Ⓐ **HALFEN Channel suitable for HKZ-Restraint ties**

Ⓑ **HALFEN Channel or permitted 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 to each other 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**

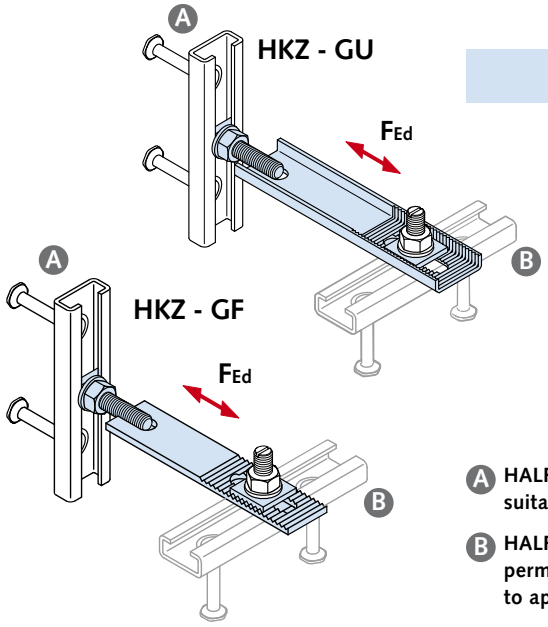
- type
- clearance a_1
- material / finish

HALFEN HKZ Restraint tie

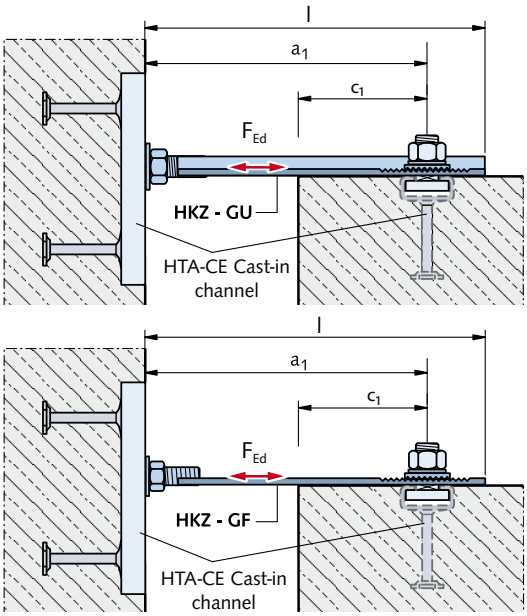
Characteristics: ① Load capacity F_{Rd} [kN]	Type selection: GV = galvanized. Not suitable for façades with ventilation gaps. Type	a_1 [mm]	Type selection: A4 = Stainless steel grade 1.4571/1.4404. Type	a_1 [mm]	Dimensions: Length l [mm]	Spacing a_1 [mm]	Tolerance [mm]	Holes [mm]
+4.9 (tension only)	HKZ 28/15 - 50 - GV		HKZ 28/15 - 50 - A4		90	50	a_1 ±20	LL 11 x 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 x 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 x 55
	HKZ 38/17 - 100 - GV		HKZ 38/17 - 100 - A4		140	100		LL 13 x 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 channels Ⓐ and the fixings Ⓑ must be verified case by case, depending on the concrete strength, the reinforcements and the edge distance c_1.

Restraint Tie HKZ - GF / GU



F_{Ed} = load



Ⓐ **HALFEN Channel suitable for HKZ-Restraint ties**

Ⓑ **HALFEN Channel or permitted dowel according to 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; connection is three-dimensionally adjustable.

Ordering example:

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

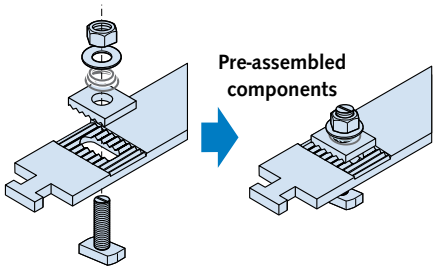
- HKZ - GF 38/17 - 125 - GV
- type
- axial spacing a_1
- material/ GV/A4

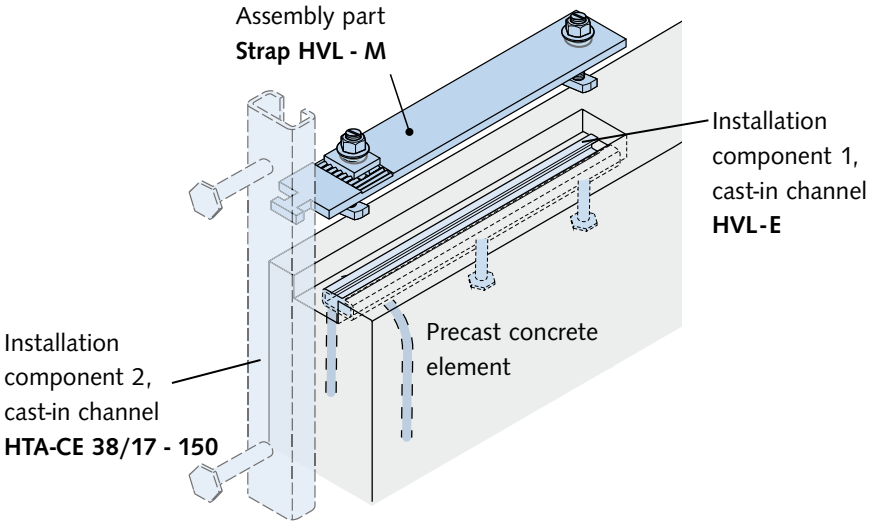
HALFEN Restraint ties type HKZ-GF and type HKZ-GU

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 x 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 x 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 x 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 x 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 channels Ⓐ and the fixings Ⓑ must be verified case by case, depending on the concrete strength, the reinforcements and the edge distance c_1.

Assembly:
The connecting strap is delivered ready to be installed: The screw 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 x 50+ washer + tapered compressed spring)

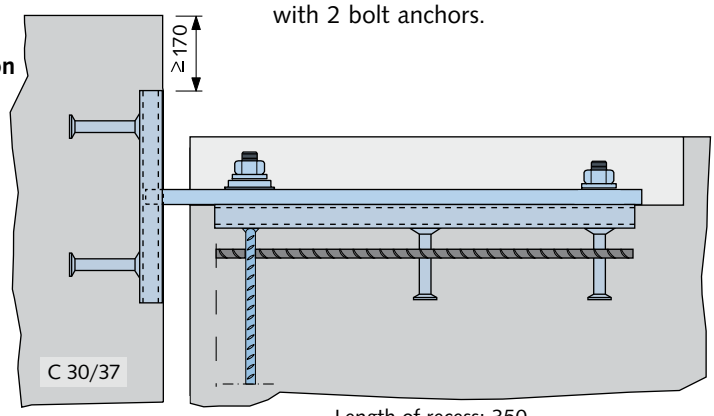
Installation component 1 HVL-E:
HALFEN Cast-in channel
HTA 38/17-300-SK with 2 bolt anchors and one loop end anchor.

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

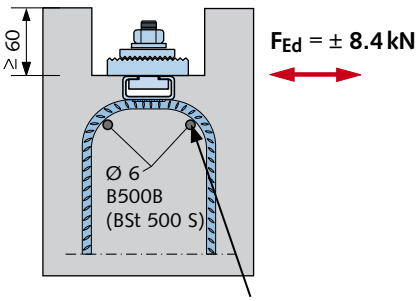
Corrosion protection
- hammer-head strap, cast-in channel: hot-dip galvanized
- HALFEN Bolts, nuts, washers and springs: galvanized

These parts are covered by mortar after installation.

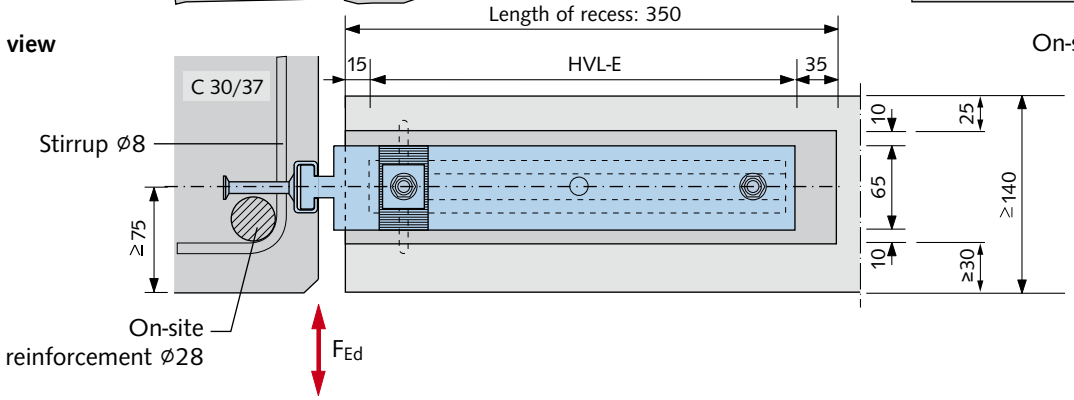
Longitudinal section



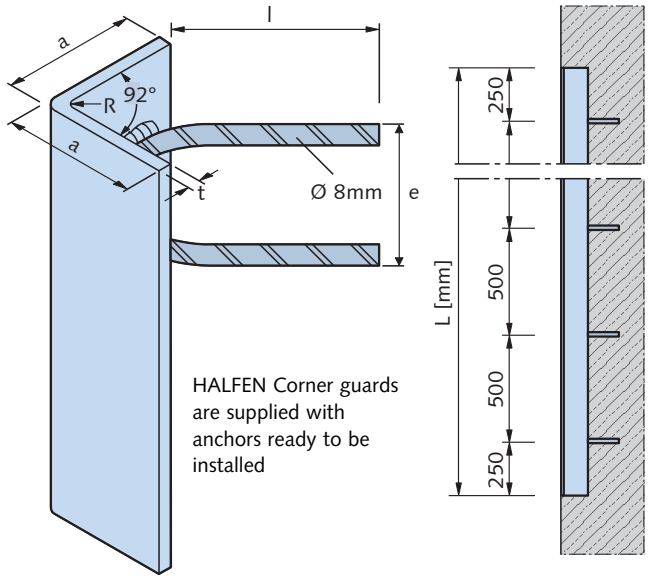
Cross section



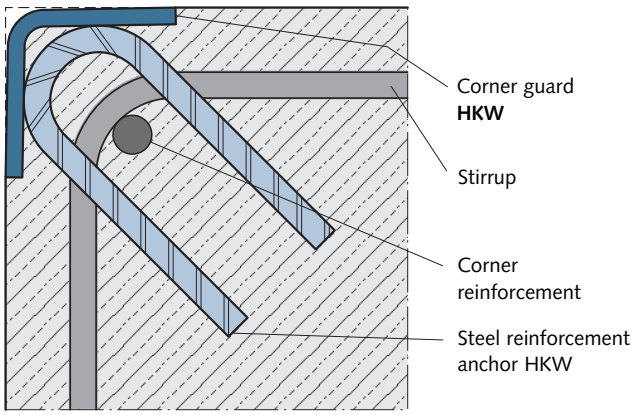
Plan view



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 x 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 x 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 x 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 interfere with 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:

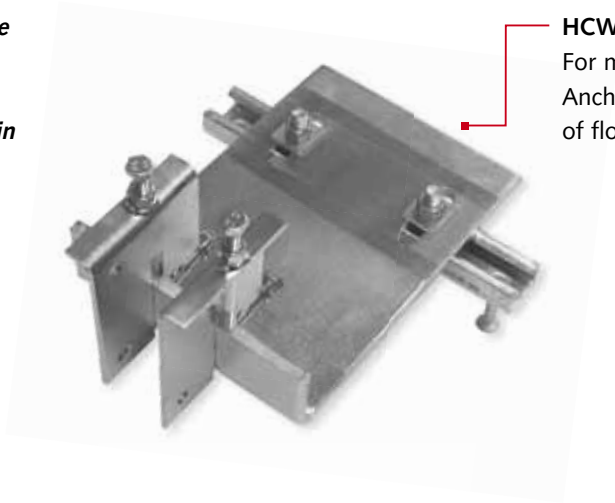
HKW 50/5 - A2 - 2000/4

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

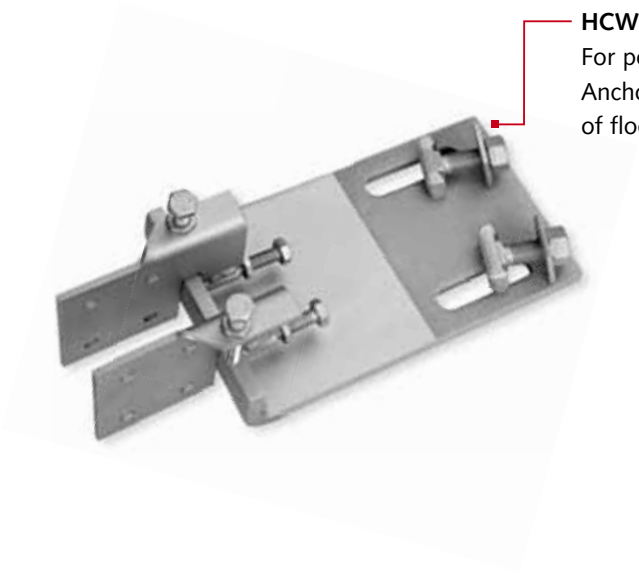
Curtain Wall HCW

The advantages at a glance

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



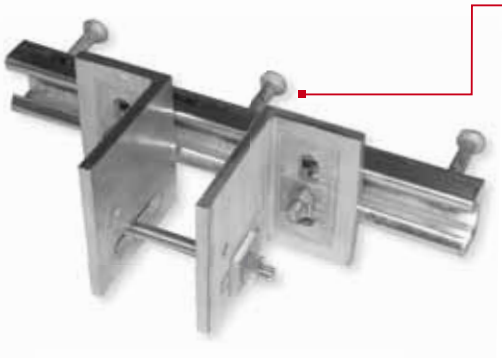
HCW B2
For modular façades.
Anchored to the top surface of floor slabs.



HCW B1
For post and beam façades.
Anchored to the top surface of floor slabs.

Fast and cost-effective

- 3-dimensional adjustable connection when used with anchor channels
- uses bolts instead of welds
- fast assembly reduces installation time



HCW-ED/EW
For post and beam façades.
Anchored to the front surface of floor slabs.

HALFEN CURTAIN WALL SUPPORT SYSTEMS HCW

Application Examples

Fixing of curtain wall system using HCW-B2 Brackets connected to HTA-CE Anchor channels

Liberty Life, Johannesburg

Torre Espacio, Madrid

Fixing of a post and beam façade using HCW-ED Brackets on HTA-CE Channels

Post Tower, Bonn

Sage Centre, Gateshead

Fixing of a modular façade using HCW-ED Brackets on HTA-CE Channels

Burj Chalifa, Dubai

Edificio Gas Natural, Barcelona

Typical curtain wall fixing with HTA-CE Anchor channels

Westin Libertador Hotel, Lima

World Financial Center, Shanghai

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.

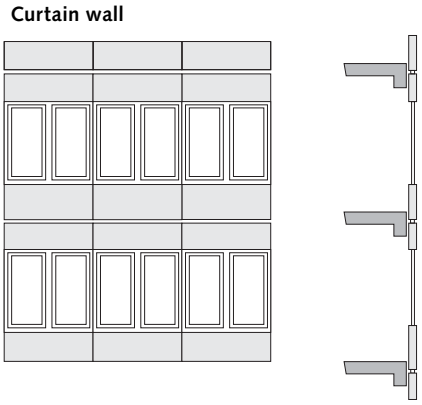


Figure 1 partial view of a façade section

Post and beam façade and the modular façade

Basically, we distinguish between two methods of curtain wall façades constructions: the **post and beam façade** and the **modular façade**.

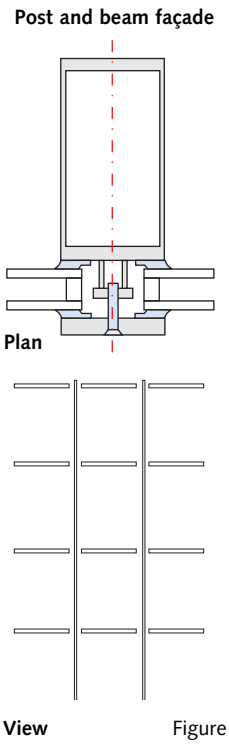


Figure 2

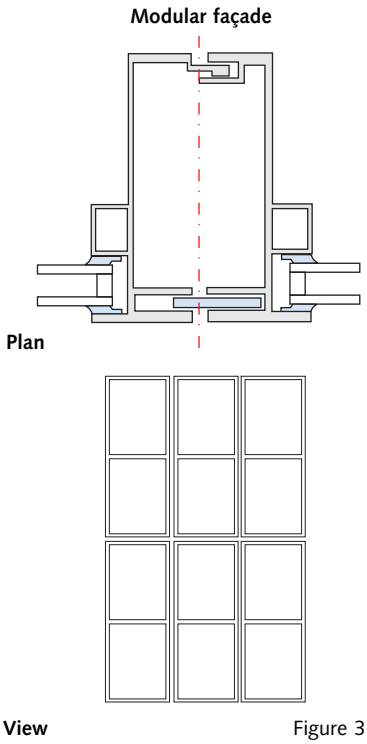


Figure 3

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.

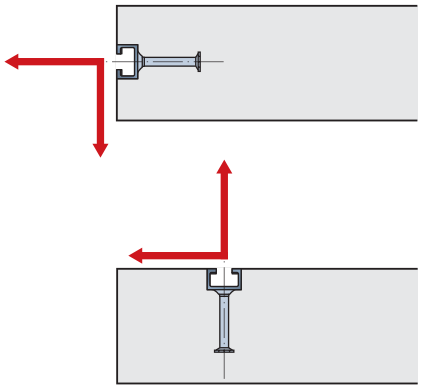
The respective longitudinal and transverse connections have an expandable joint. The filler elements (glass or panel) installed in a post and beam structure permit movement within the tolerance of the designed expansion joint. The glass and filler elements are delivered separately and are then installed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

Load conditions and required HALFEN Cast-in channels

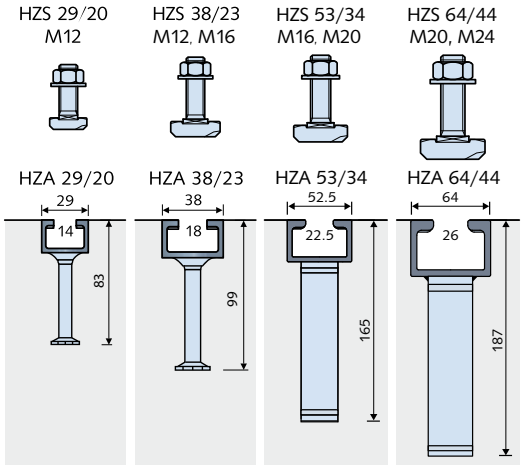
Standard slab thickness
with standard tensile and transverse tensile loads
HALFEN Channels with bolt anchors and weld-on I-anchors



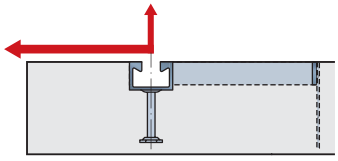
officially App.No.Z-21.4-1691 approved

see pages 16–17, 31

Hot-rolled serrated channels and bolts

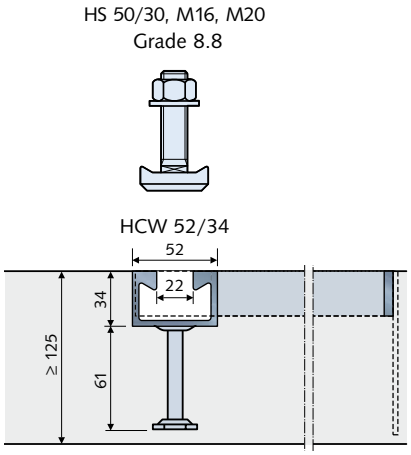


Thin slabs (thickness ≥ 12.5 cm)
with high transverse tensile loads
and small edge distance
HALFEN Curtain wall channel
HCW 52/34
(not included in the HTA-CE approval)

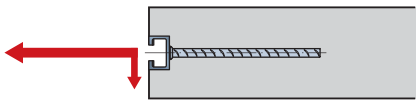


see pages 76–77

HCW 52/34 and bolt

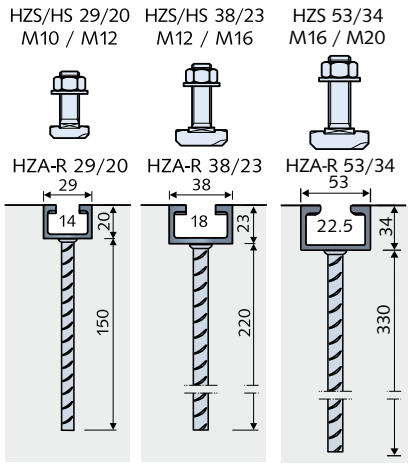


Thin slabs (thickness ≥ 10 cm)
with high tension loads
HALFEN Channels HTA-R or HZA-R
with rebar anchors
(not included in the HTA-CE and
HZA approvals)



see page 78

Hot-rolled serrated channels with rebar anchors and bolts

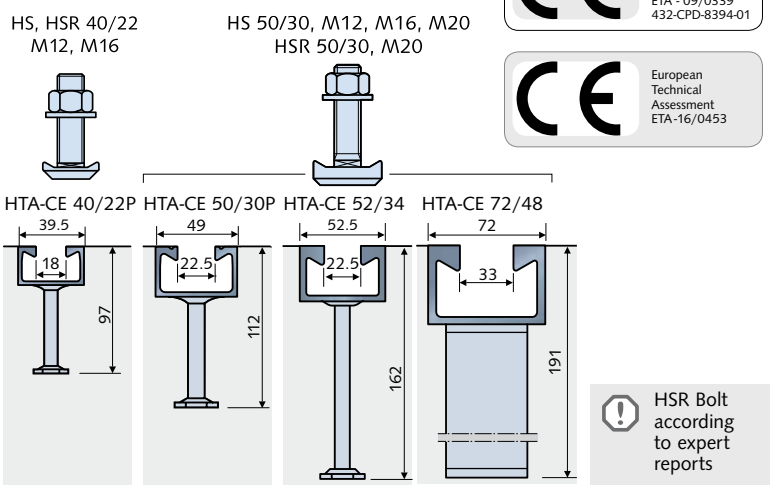


Load cases and required HALFEN Channels

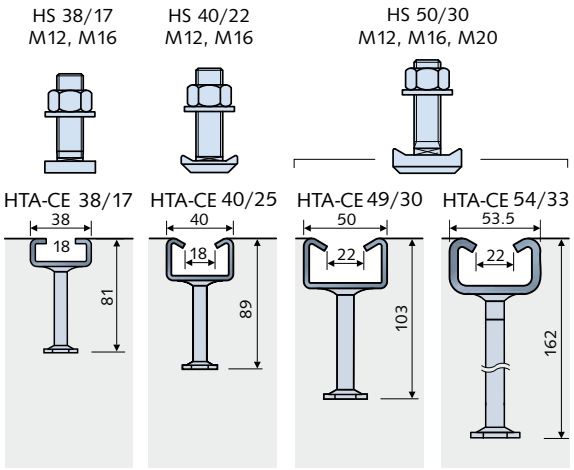
Hot-rolled (standard) channels and bolts

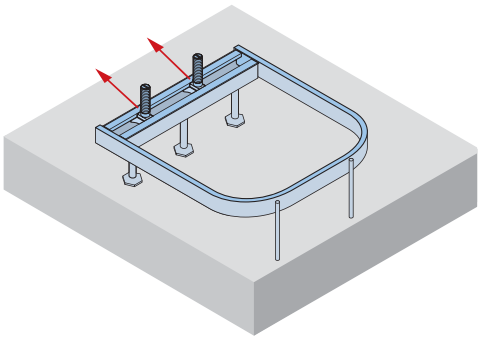
European Technical Approval ETA - 09/0339 432-CPD-8394-01

European Technical Assessment ETA-16/0453



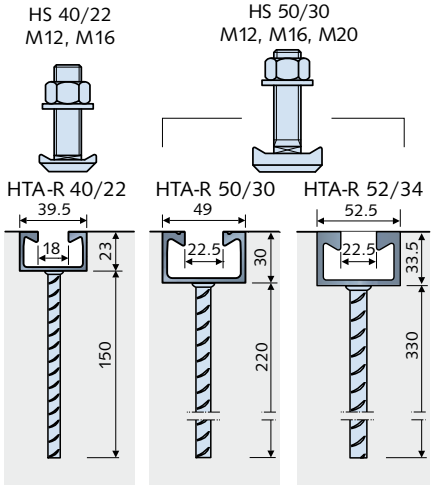
Cold-rolled (standard) channels and bolts



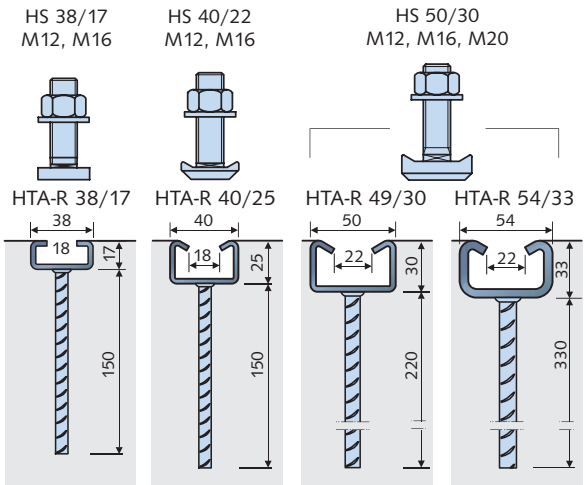


HCW 52/34 with bolts and bracket

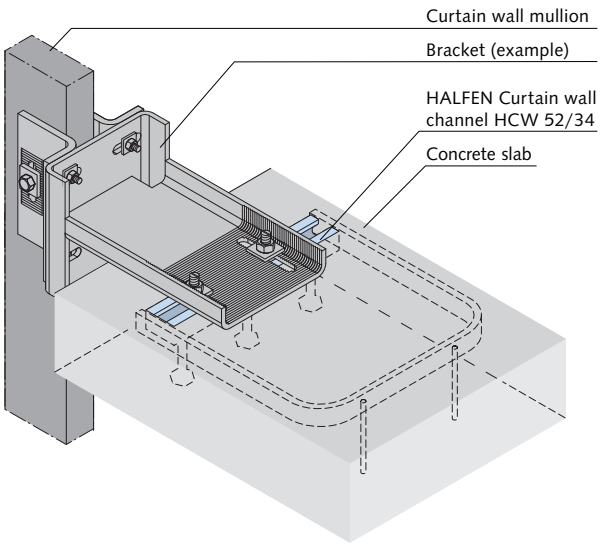
Hot-rolled (smooth) channels with rebar anchors and bolts



Cold-rolled (smooth) with rebar anchors and bolts

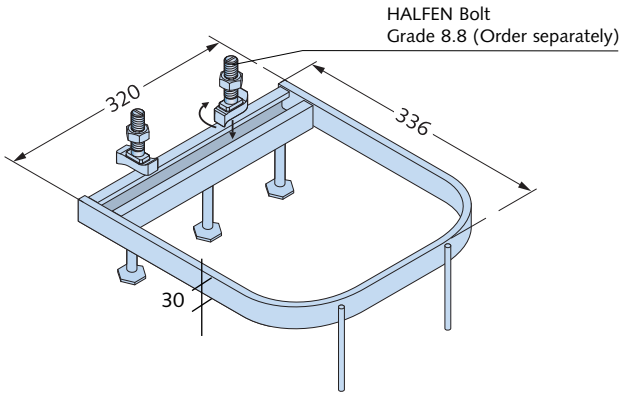


Typical installation



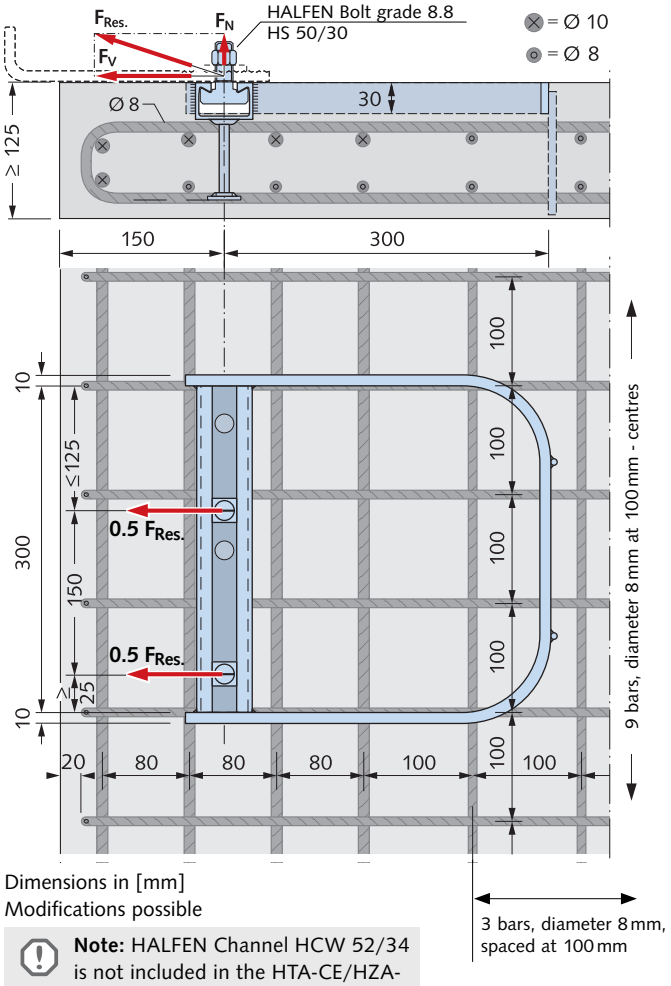
Product description

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



Dimensions in [mm]

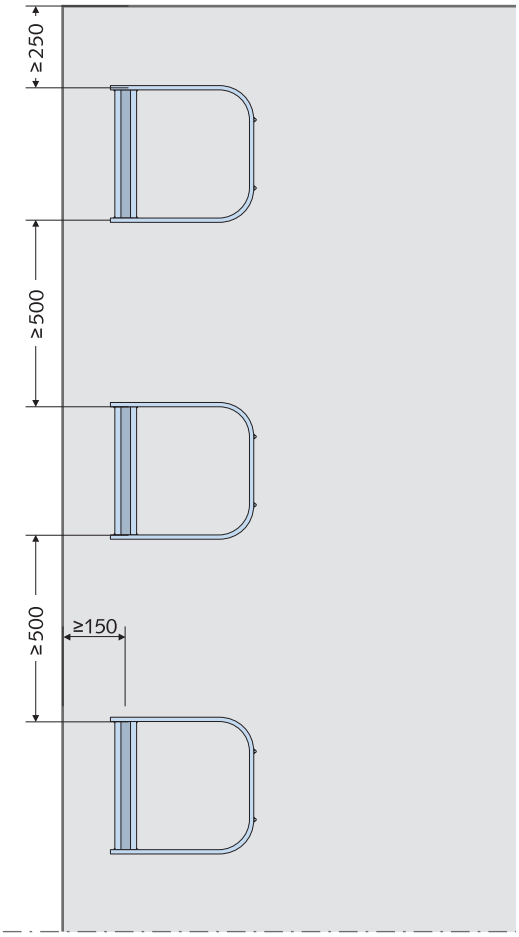
Reinforcement requirements



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



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 76
- 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 stress 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:

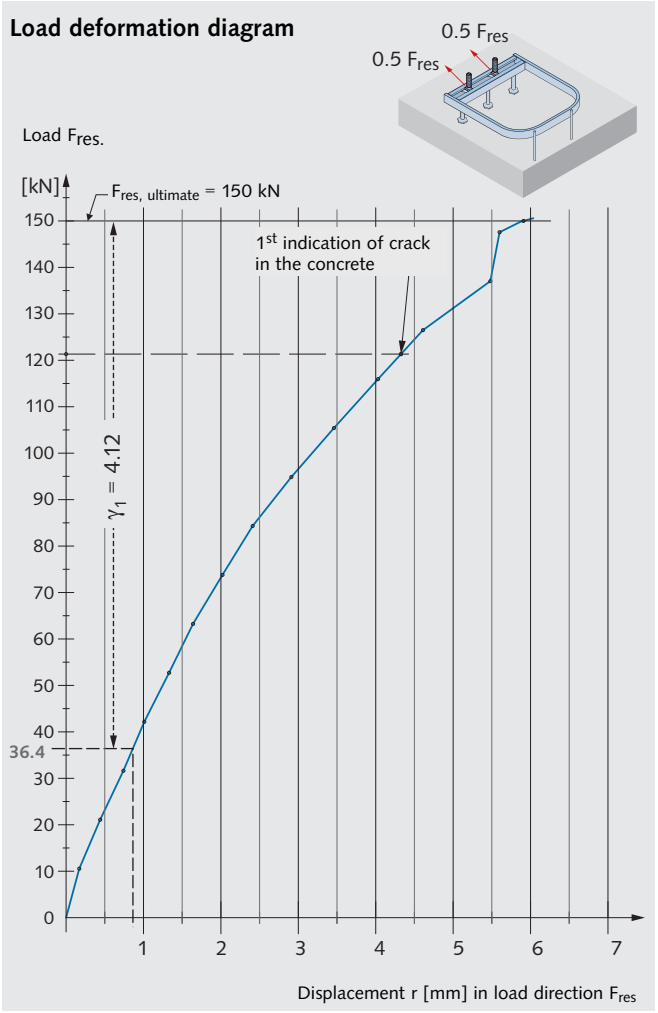
perm. F_V	=	142.3 / 3	= 47.4 kN
perm. F_N	=	47.4 / 3	= 15.8 kN
perm. F_{res}	=	150 / 3	= 50.0 kN

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 recommend the use of 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.

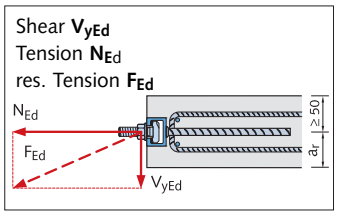
For interior use this design is considered equivalent to a hot-dip galvanized design. Other bolt sizes and materials can be supplied. Please contact us for detailed information. Addresses can be found on page 91.

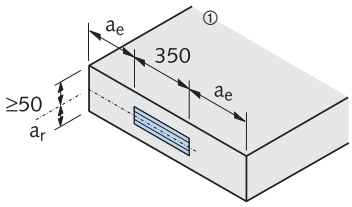
Type selection HALFEN Bolts HS 50/30 GV Grade 8.8

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.

Design basics



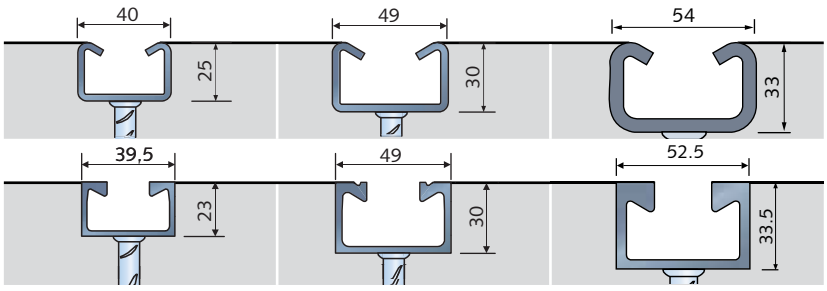


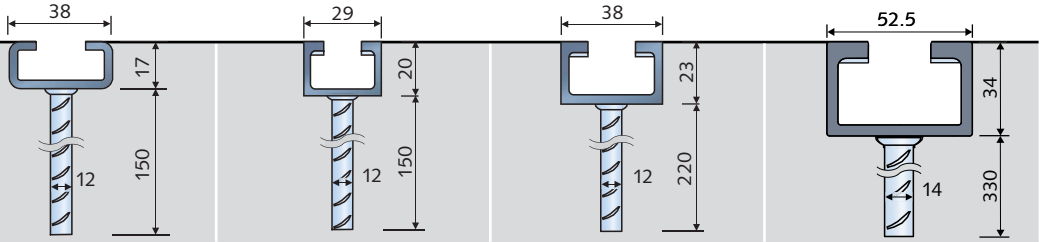
① The minimum edge distance shown in the table applies to reinforced concrete

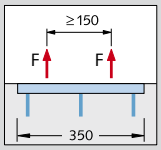
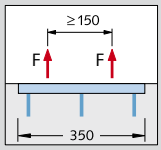
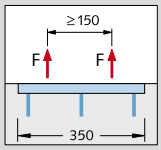
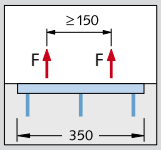
Structural analysis

	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 Cast-in channels HTA-R and HZA-R - Material design resistance values





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
Concrete strength grade ≥ C20/25 $f_{ck,cyl.}$ = 20 N/mm² $f_{ck,cube}$ = 25 N/mm²	350 mm 3 anchors	350 mm 3 anchors	350 mm 3 anchors	350 mm 3 anchors
				
$F_{Rd} = N_{Rd}$ [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

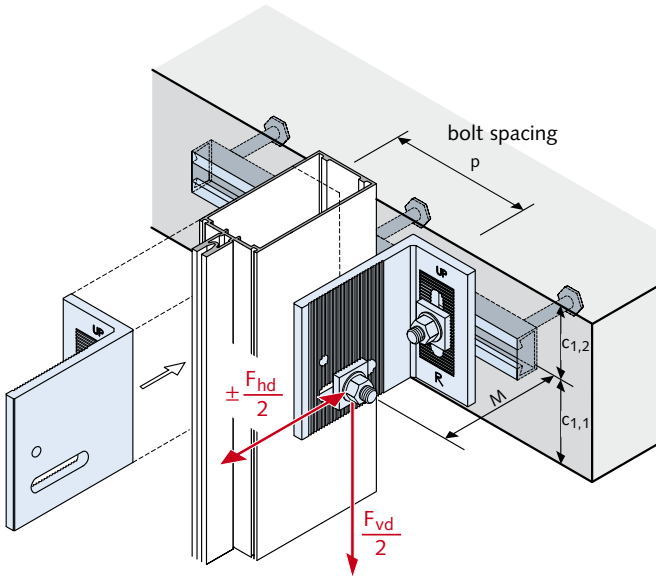
Application example

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 **horizontal** wind loads only.

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; example: temporary fixing of brackets to support post with self-tapping screws until the final connection is made.

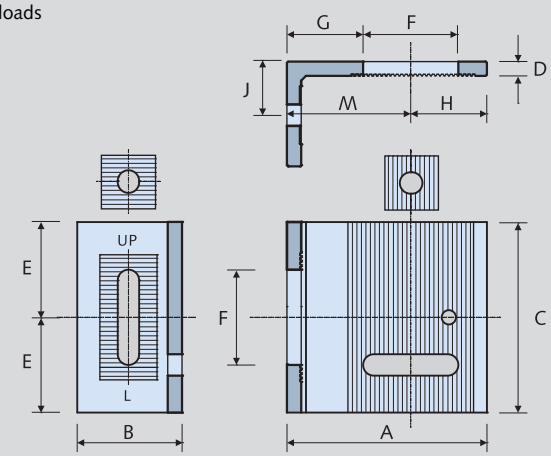
The brackets are made of high quality aluminium material. Special nylon discs are placed between the "Wind load" Bracket HCW-EW and support post.



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

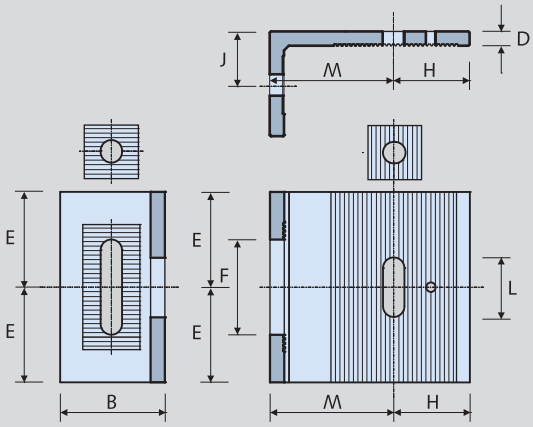
Bracket dimensions [mm]

HCW-ED Brackets
for dead loads
and wind loads



Serrated washers included in delivery

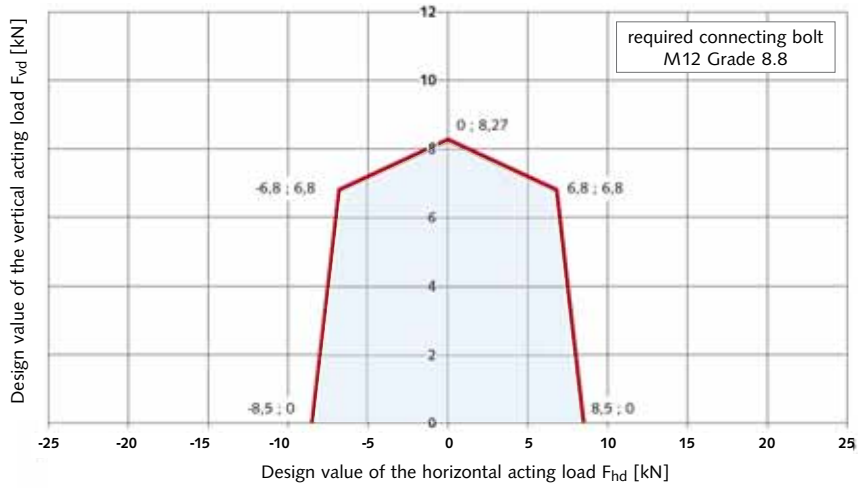
HCW-EW Brackets
wind loads only



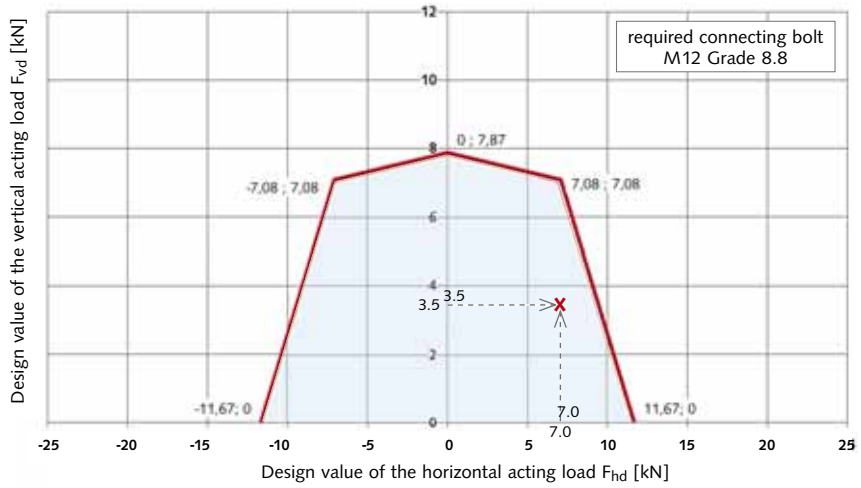
Serrated washers included in delivery

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 HCW-EW 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

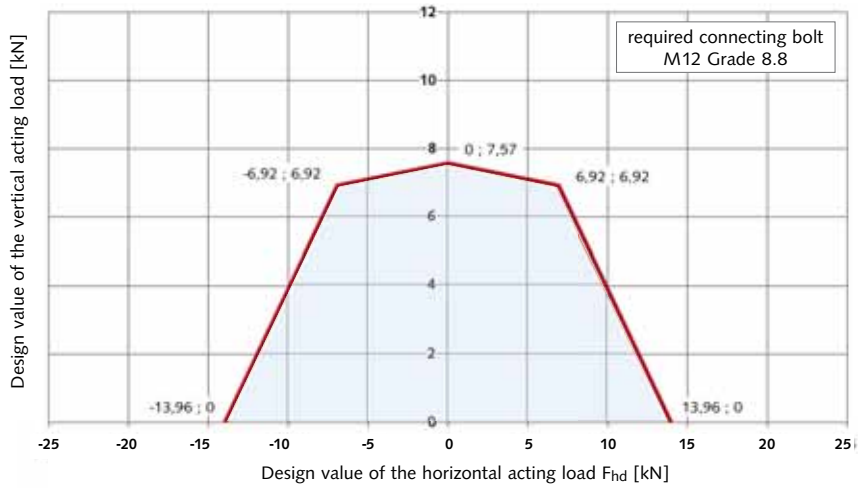
Interaction diagram for type HCW-ED1 (small)



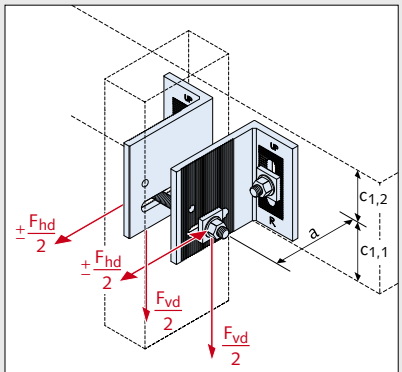
Interaction diagram for type HCW-ED2 (medium)



Interaction diagram for type HCW-ED3 (large)



Calculation basis



Definition of loads at bracket / post connection

Permitted load interaction area

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
Medium	**HCW-EW 2**	0	11.67
Large	**HCW-EW 3**	0	13.96

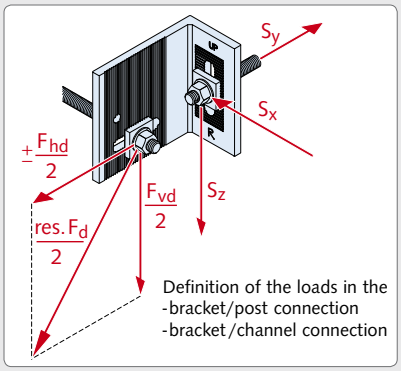
HCW-EW Brackets are only suitable for wind loads.

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

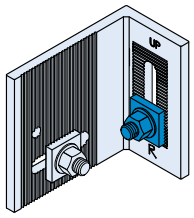
The design reaction forces components in the HALFEN Bolts at connection curtain wall bracket to HALFEN Cast-in channel are calculated by multiplying the design loads F_{vd} and F_{hd} at connection curtain wall bracket and façade support post with the factors s_x, s_y and s_z.
The factors are dependent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

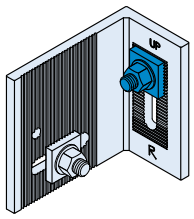
Calculation basis



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 80) 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 78

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

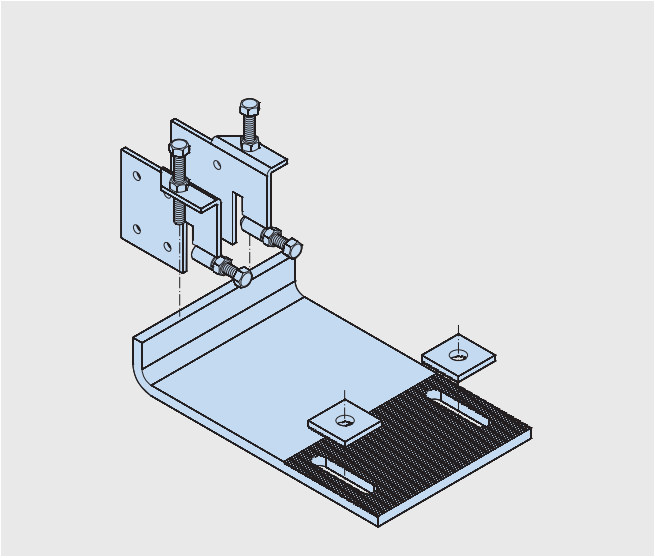
Check: bolt spacing: P = 80 + 2 × 36 = 152 mm > 150 mm ✔

Selected HALFEN Channel:

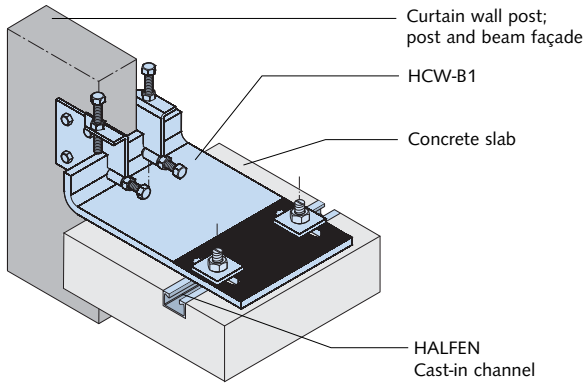
HS 50/30 - M12 × 60 GV 8.8

Requirement according to interaction diagram see page 80

Support brackets for horizontal and vertical loads



Typical installation



HALFEN Brackets HCW-B1

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

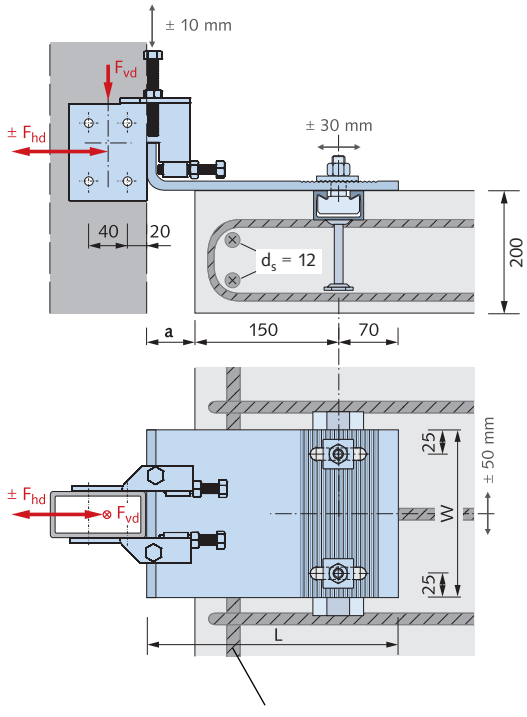
The brackets are made in grade S355 quality galvanized steel. Vertical adjustability is ±10 mm.

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

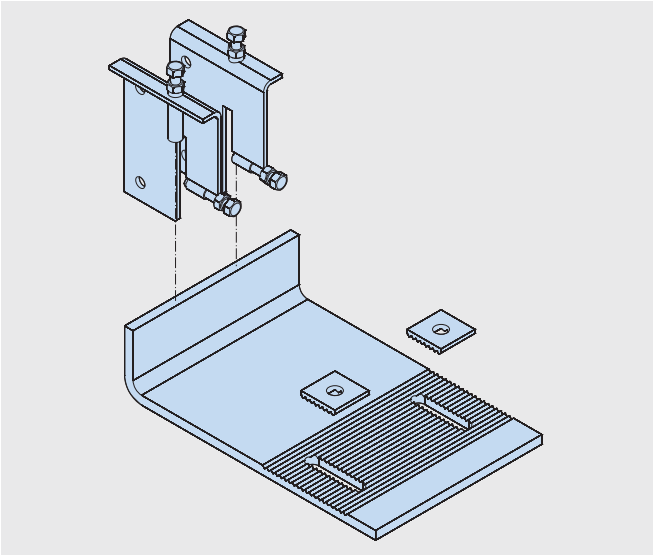
F_{vd}, F_{hd}: allowable design loads with a partial safety factor γ_F = 1.35 for dead load and γ_F = 1.5 for wind load.

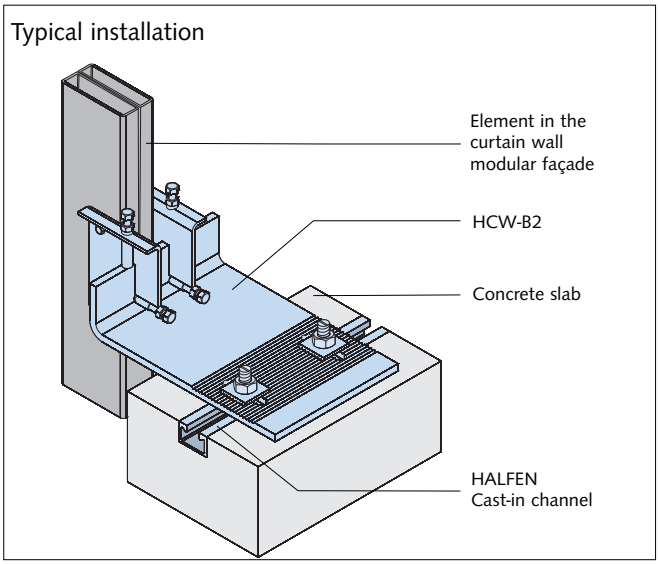
Type selection

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

Brackets for horizontal and vertical loads

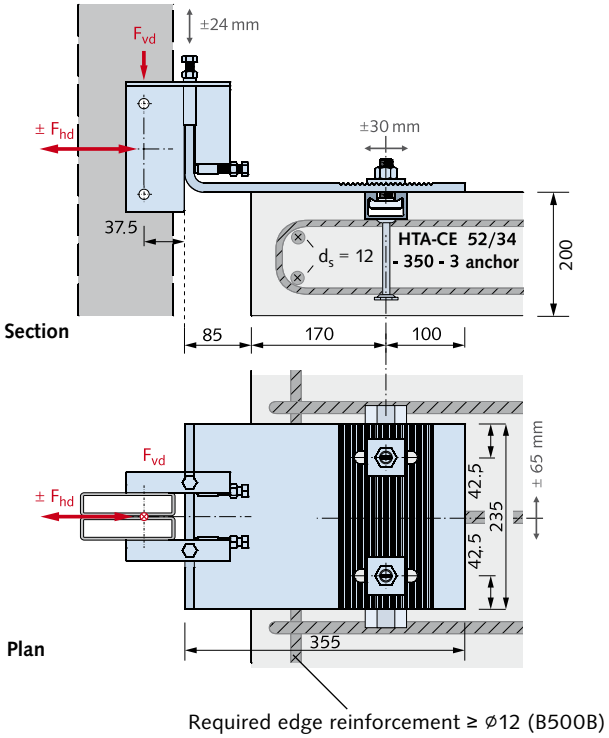




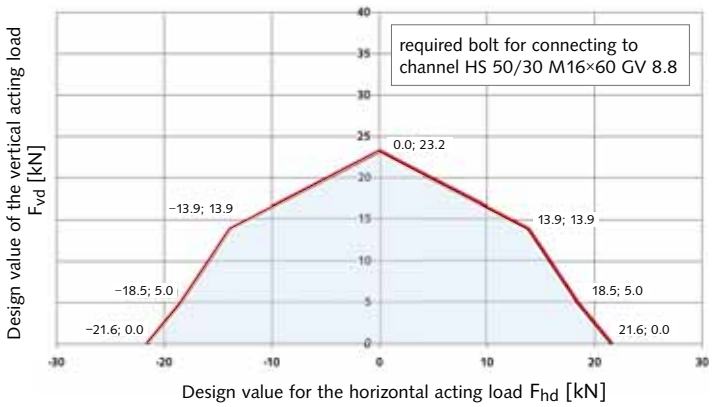
HALFEN Brackets HCW-B2

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

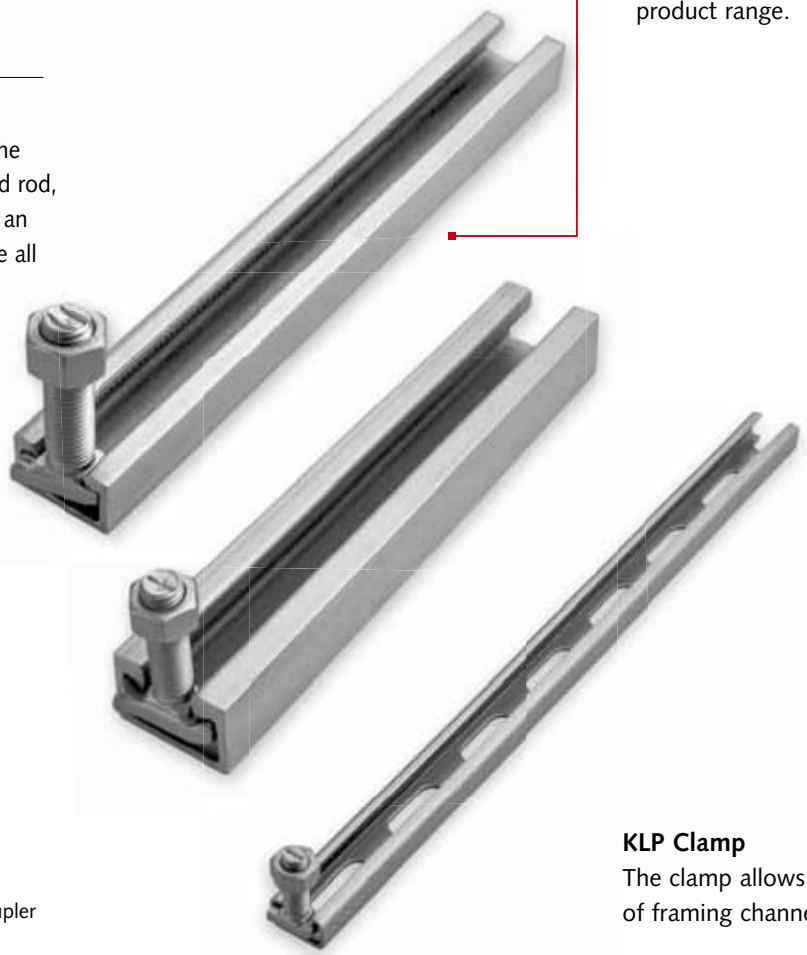
The advantages at a glance

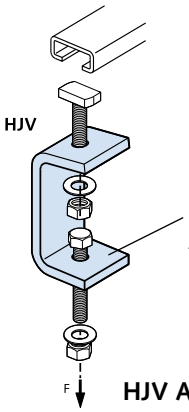
To complement the product range HALFEN offers a wide range of accessories. Everything from one source.

The product range

Everything you need from the framing channel right down to the nut, the locking washer, threaded rod, locking and threaded plate even an adjustable connector; we provide all you need for your project.

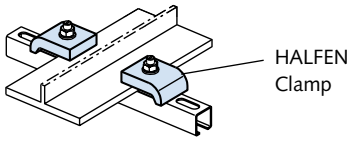
HALFEN Framing channels
You are guaranteed to find an economical solution for your projects in the extensive HALFEN Framing channels product range.





HJV Adjustable coupler
Allows free height adjustment in suspended installations.

KLP Clamp
The clamp allows fast connection of framing channels to I-beams.

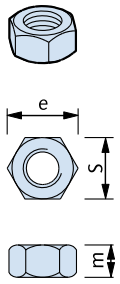


The whole range of framing system products can be found at www.halfen.de
MT-FBC (Flexible bolt connections) or **MT-FFC** (Flexible framing connections).

Accessories: Nuts, Washers

MU

Hexagonal nuts
EN ISO 4032/
DIN 934



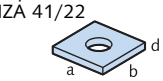
GV galvanized FK 8 thread	A4 stainless steel thread	S/m DIN [mm]	S/m ISO [mm]	e [mm]
M6	M6	10/ 5	10/ 6	11.5
M8	M8	13/6.5	13/7.5	15.0
M10	M10	17/ 8	16/9.5	19.6
M12	M12	19/10	18/12	21.9
M16	M16	24/13	24/15.5	27.7
M20	M20	30/16	30/19	34.6
M24		36/19	36/22	41.5

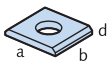
FV hot-dip galvanized thread	A2 stainless steel A2 thread	S/m DIN [mm]	S/m EN [mm]	e [mm]
M6, M8	M8	13/6.5	13/7.5	15.0
M10	M10	17/8	16/9.5	19.6
M12	M12	19/10	18/12	21.9
M16	M16	24/13	24/15.5	27.7

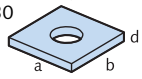
VUS

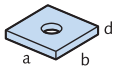
Square washers

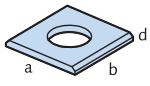
	FV hot-dip galvanized for bolt	A4 stainless steel for bolt	a × b × d [mm]
VUS 40/25 for profile 40/25; HZA 41/22	M10	M10	40 × 40 × 5
	M12	M12	40 × 40 × 5
	M16	M16	40 × 40 × 5
VUS 49/30 for profile 54/33, 49/30	M10	M10	37 × 37 × 5
	M12	M12	37 × 37 × 5
	M16	M16	37 × 37 × 5
	M20	M20	37 × 37 × 5
VUS 52/34 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
	M 30	M 30	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





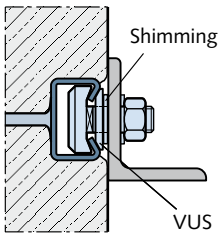






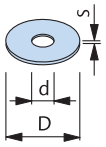
Ordering example: **VUS 52/34 - FV - M20**

Application VUS:
For shimming non-flush installations



US

Washer
DIN 9021
EN ISO
7094/
DIN 440

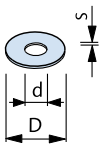


DIN	GV galvanized for bolt	A4 stainless steel for bolt	D [mm]	d [mm]	s [mm]
440	M6		22	6.6	2
9021	M8	M8	24	8.4	2
9021	M10	M10	30	10.5	2.5
440	M12		45	13.5	4
9021	M12	M12	37	13	3
9021	M16	M16	50	17	3
440	M20		72	22	6

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

US

Washers
EN ISO 7089/
DIN 125



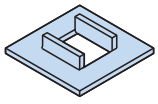
GV galvanized for bolt	A4 stainless steel for bolt	D [mm]	d [mm]	s [mm]
M6	M6	12	6.4	1.6
M8	M8	16	8.4	1.6
M10	M10	21	10.5	2
M12	M12	24	13	2.5
M16	M16	30	17	3
M20	M20	37	21	3
M24		44	25	4

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

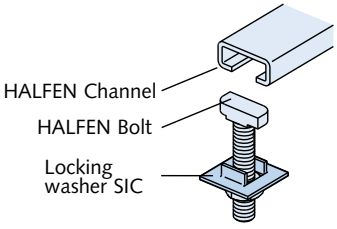


GV galvanized	A4 stainless steel A4	Suitable for HALFEN Bolts type	dimensions
SIC - 50/30 - GV	SIC - 50/30 - A4	50/30	M16, M20
SIC - 40/22 - GV	SIC - 40/22 - A4	38/17 40/22	M16
SIC - 38/23 - GV		38/23	M16
SIC - 29/20 - GV		29/20	M12
SIC - 38/17 - GV	SIC - 38/17 - A4	38/17 40/22	M12, M10
SIC - 28/15 - 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 SIC:
For securing HALFEN Bolts; prevents bolts turning when tightening nuts

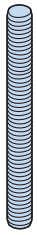
Assembly scheme:



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

GWS

Threaded rods
DIN 976-1

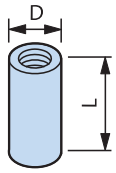


GV galvanized FK 4.6 thread	A4 stainless steel thread	Length [mm]	F_{Rd} ① [kN]	perm. F [kN]
M6	M6	1000	3.1	2.2
M8	M8	1000	5.6	4.0
M10	M10	1000	9.0	6.4
M12	M12	1000	13.0	9.3
M16	M16	1000	24.2	17.3
M20	M20	1000	37.8	27.0
M24		1000	54.3	38.8

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

VBM

Coupler sleeves, round

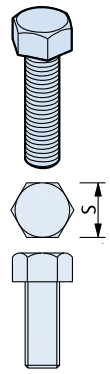


GV hot-dip galvanized thread	A4 stainless steel thread	D [mm]	L [mm]	F_{Rd} ① [kN]	perm. F [kN]
M6	M6	10/10	15	3.1	2.2
M8	M8	12/14	20	5.6	4.0
M10	M10	13/16	25	9.0	6.4
M12	M12	16/20	30	13.0	9.3
M16	M16	21/25	40	24.2	17.3
M20	M20	26/32	50	37.8	27.0

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

HSK

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

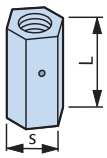


Hex bolts are used in combination with HALFEN Threaded plates

GV 8.8 galvanized FK 8.8 dimensions	A4 stainless steel thread	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		

SKM

Hexagonal coupler sleeves with view holes

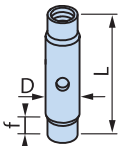


FV hot-dip galvanized thread	A4 stainless steel thread	S [mm]	L [mm]	F_{Rd} ① [kN]	perm. F [kN]
M10	M10	13	40	9.0	6.4
M12	M12	17	40	13.0	9.3
M16	M16	22	50	24.2	17.3

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

SPH

Turnbuckle with right- and left-hand thread



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

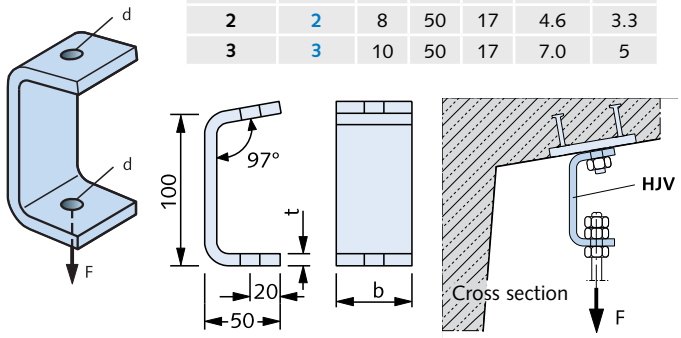
A4 stainless steel thread **M12** × length L [mm]	A4 stainless steel thread **M16** × length L [mm]	D for M12 [mm]	D for M16 [mm]
M12 × 60	**M16 × 60**	16	22
M12 × 75	**M16 × 75**	16	22
M12 × 95	**M16 × 95**	16	22
M12 × 115	**M16 × 115**	16	22
M12 × 135	**M16 × 135**	16	22
perm. F = 5 kN F_{Rd} = 7 kN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

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

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



RM

Ring nut
DIN 582
edition 2010-09

GV C 15E, 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

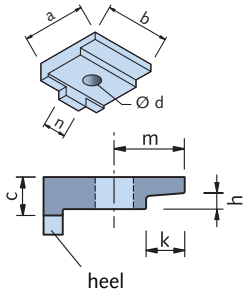
Ordering example: **RM - GV - M12**

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

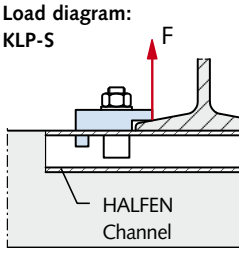
KLP-S Rail clips, steel 1.0038 forged

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	–
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	50.0	52	18	22	8	15.0	22.0	10.0	160 – 240	7 – 9	S24 – S49

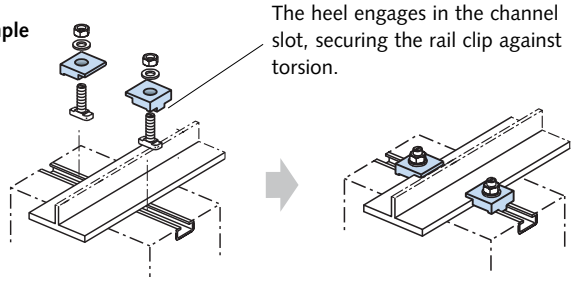
Ordering example: **KLP - S - Nr. 26 - FV**



Load diagram:
KLP-S



Assembly example
KLP-S



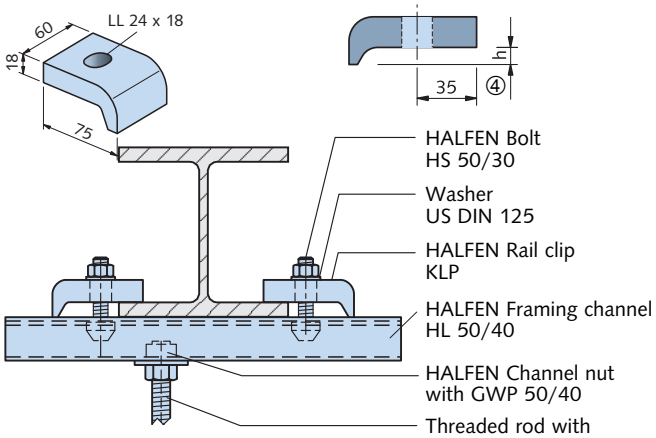
The heel engages in the channel slot, securing the rail clip against torsion.

KLP - 60 rail clips

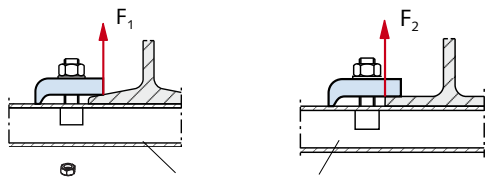
FV Hot-dip galvanized	Clamping height h [mm]	Allowable load ② [kN]	Preferred for use with Standard profile I	Standard profile IPB	Crane and running tracks ④
60/10	10	F_1 = 7.0 HALFEN Bolt M16 × 60, Grade 4.6	120 – 160	100	A65, S33, S41
60/12	12		220 – 240	140	A100, S49, A75
60/14	14		240 – 280	160 – 180	A120, S54
60/16	16	F_2 = 11.25 HALFEN Bolt M16 × 60, Grade 8.8	300 – 340	200 – 220	S64
60/18	18 ③		360 – 380	240 – 260	–
60/20	20 ③		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!

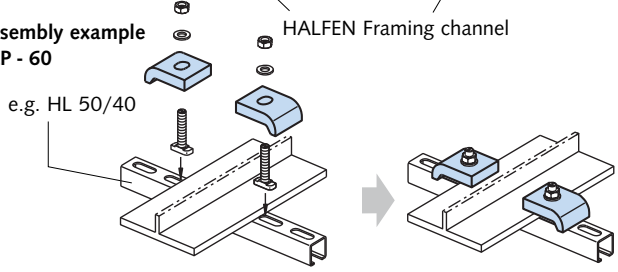
Order example: **KLP - 60/10 - FV**



Load diagram
KLP - 60



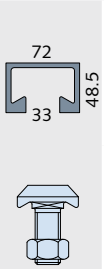
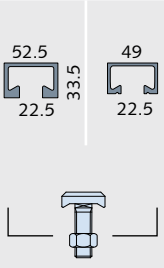
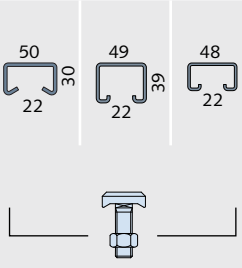
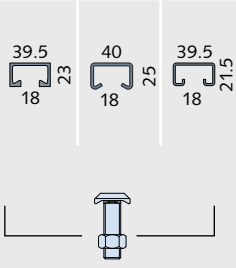
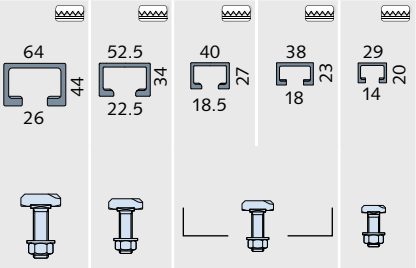
Assembly example
KLP - 60



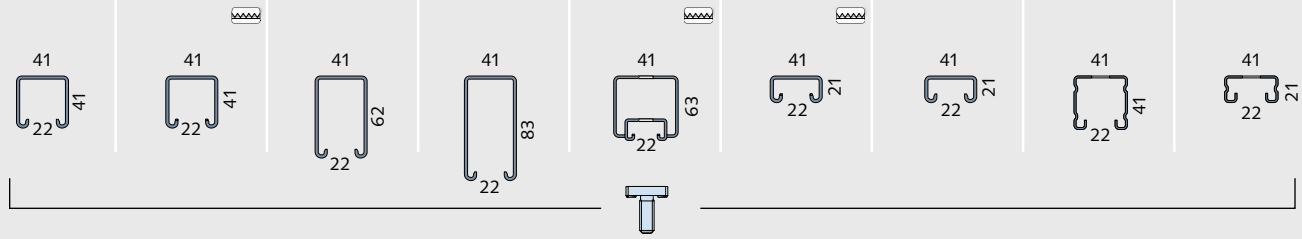
ACCESSORIES

Framing Channels HM/HZM/HL/HZL –Type Overview

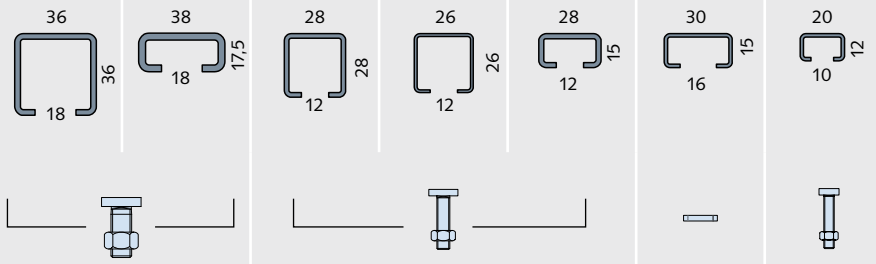
Heavy Duty Framing System

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 26/26, HL 26/26	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:

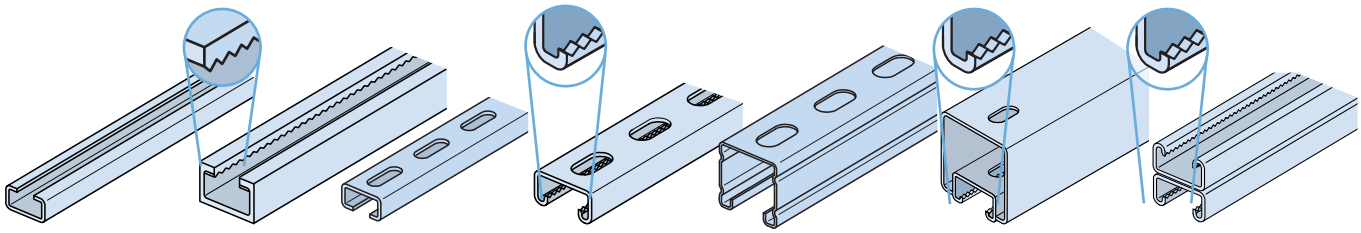
- Steel hot-dip galvanized FV or Steel mill finished WB
- Steel, sendzimir galvanized SV
- Stainless steel A4 1.4571/1.4404
- Stainless steel A2 1.4307
- Stainless steel HCR 1.4547/1.4529

For information on materials → see page 11

serrated profiles HZM/HZL

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

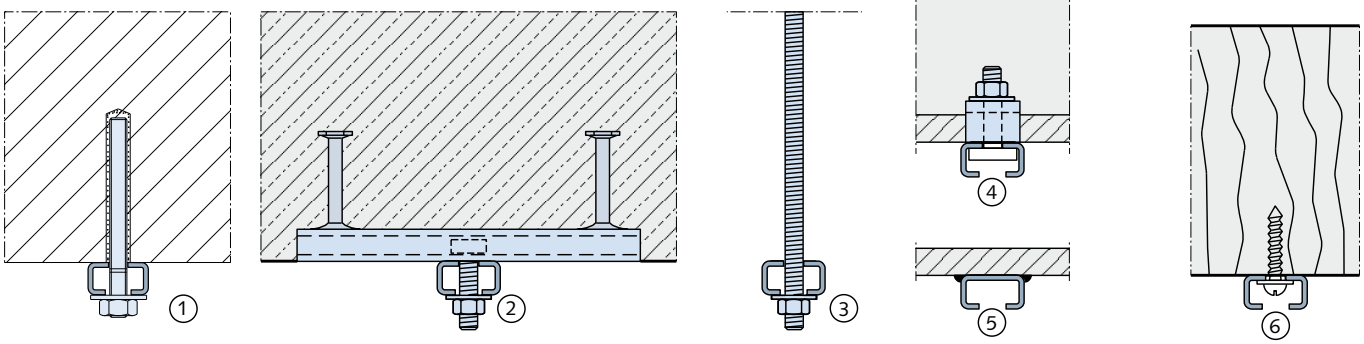
Application Examples

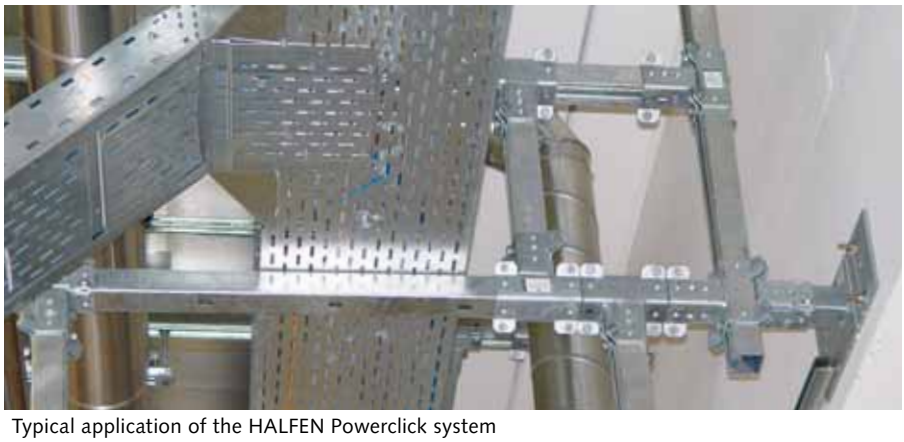
HALFEN Framing channels HM/HZM and slotted HALFEN Framing channels HL/HZL can be attached to a substructure in a number of ways:

① fastened to concrete or masonry with wedge anchors HB-VMU plus
② bolted to HALFEN Cast-in channels type HTA-CE and HZA
③ connected to threaded rods
④ clamped to steel profile supports
⑤ welded to steel components
⑥ screwed or nailed to wooden 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 product range for framing system applications can be found in the following Technical Product Informations: **HALFEN Flexible bolt connections, HALFEN Flexible framing connections** or **HALFEN Powerclick System.**

APPENDIX

Index

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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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