HALFEN CURTAIN WALL SYSTEM
The benefits at a glance

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

HCW-B2 Bracket

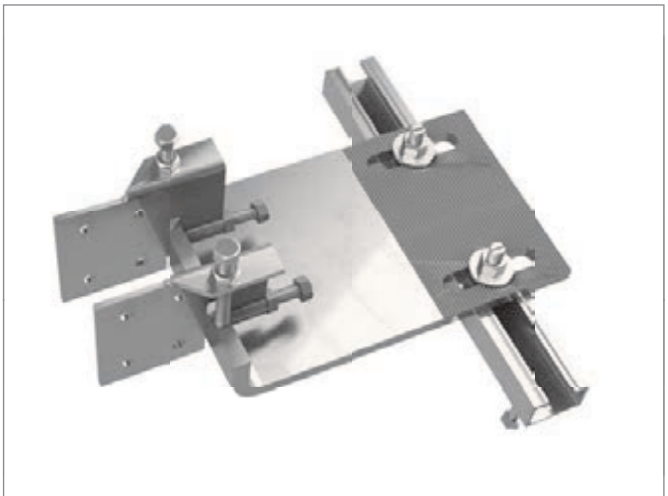
For modular façades. Anchored to the top surface of floor slabs.

Fast and cost-effective

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

HCW-ED/-EW Brackets

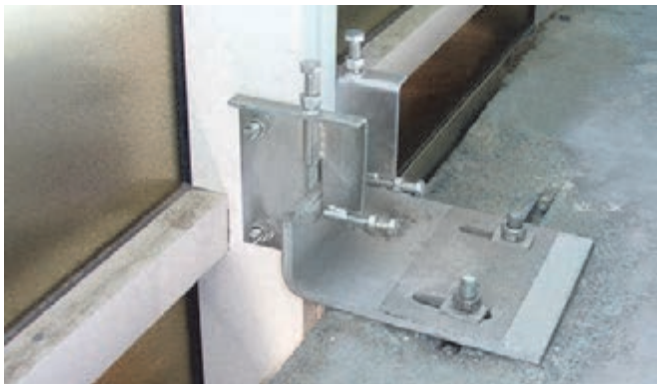
For post and beam façades. Anchored to the edges of slabs.



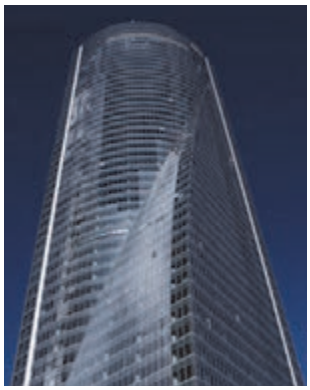
HCW-B1 Bracket

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

HALFEN CURTAIN WALL SUPPORT SYSTEMS
Application Examples


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

Liberty Life, Johannesburg


Torre Espacio, Madrid

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

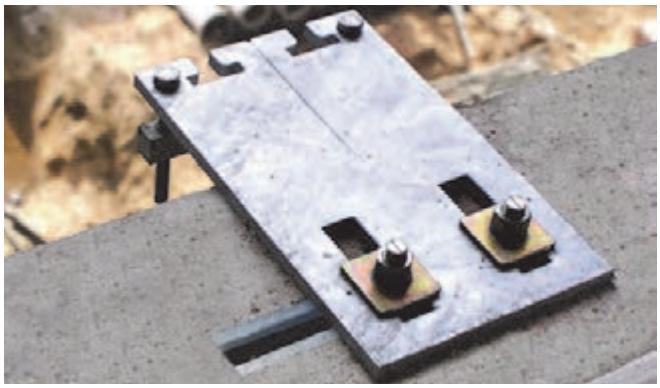
Post office Tower, Bonn

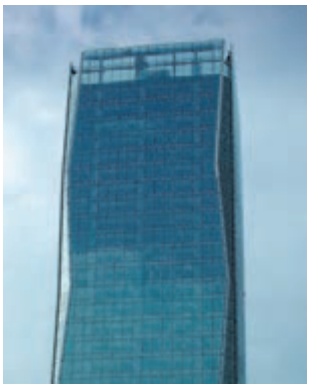
Sage Centre, Gateshead

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

Burj Chalifa, Dubai

Edificio Gas Natural, Barcelona


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


Westin Libertador Hotel, Lima

World Financial Center, Shanghai

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HALFEN CURTAIN WALL SUPPORT SYSTEMS
General Information

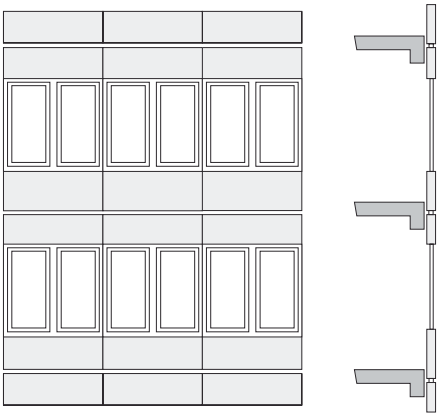
Halfen Curtain wall system

The curtain wall facade system gets its name from the fact that the construction hangs like a curtain in front of the floor slabs. (See figure 1 section)

The system is thin and lightweight, usually aluminum and glass. The façade is attached to the main structure of the building using only the required number of point-load connections. It is not structural, and by design, only able to carry its own weight, but it transfers load of wind and gravity to the structure of the building.

Specifically, this includes sufficient stability against wind loads, adequate ability to shrink and expand as well as insulation against frost in winter, heat in summer and against external noise.

In addition, various requirements must be met to protect against fire and other critical situations.



Curtain wall
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:

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

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.

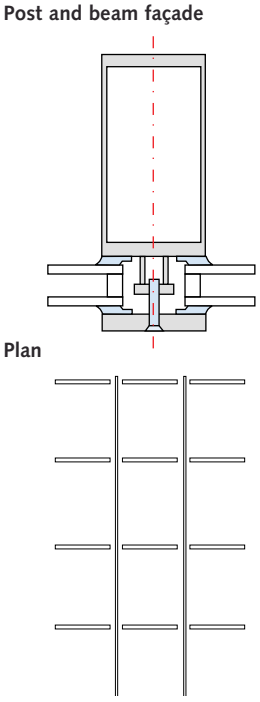


Figure 2

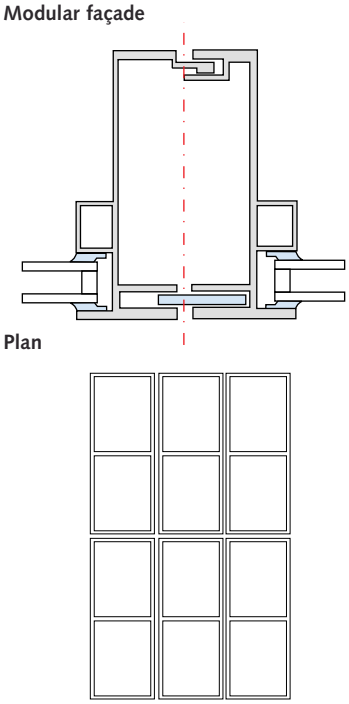


Figure 3

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

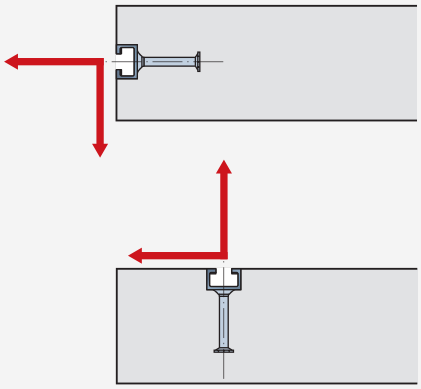
This method provides immediate weather protection and allows the building contractor to start interior work on the respective floor directly after the prefabricated modules have been installed.

Scaffolding is not required with this method of construction.

HALFEN CURTAIN WALL SUPPORT SYSTEMS
Product Range

Load conditions and required Halfen Cast-in channels

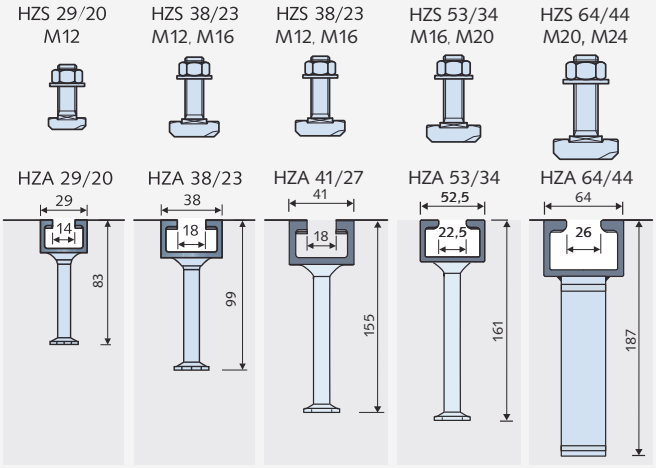
Standard slab thickness
with standard tensile and transverse tensile loads
Halfen Channels with bolt anchors or weld-on I-anchors



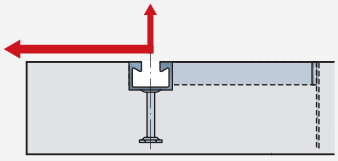
CE European Technical Assessment ETA-20/1081

see pages 18–38

Hot-rolled serrated channels and bolts



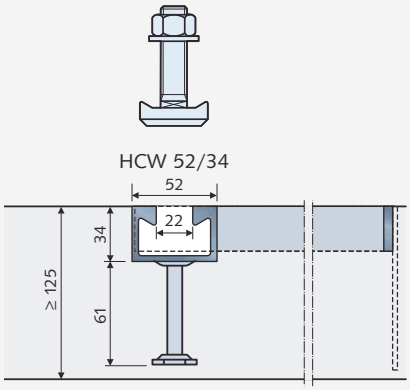
Thin slabs (thickness ≥ 12.5 cm)
with high transverse tensile loads
and small edge distance
Halfen Curtain wall channel
HCW 52/34
(not included in the HTA-CE approval)



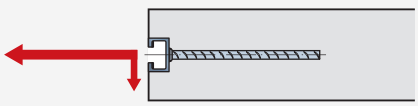
see pages 48–49

HCW 52/34 and bolt

HS 50/30, M16, M20
Grade 8.8

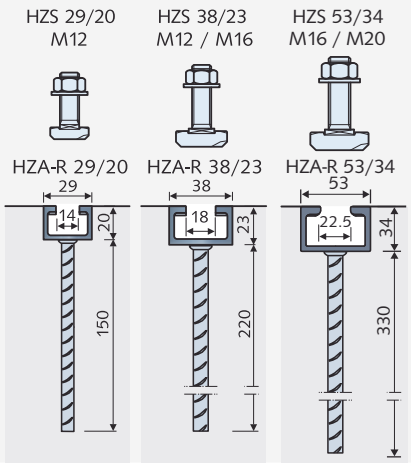


Thin slabs (thickness ≥ 10 cm)
with high tension loads
Halfen Channels HTA-R or HZA-R
with rebar anchors
(not included in the HTA-CE and
HZA approvals)



see page 50

Hot-rolled serrated channels with
rebar anchors and bolts



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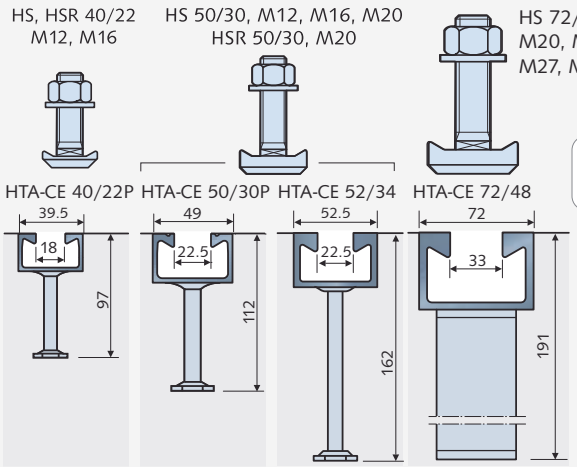
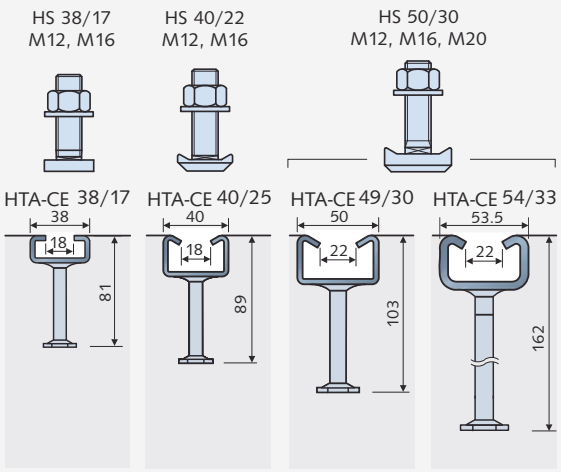
Hot-rolled (standard) channels and bolts

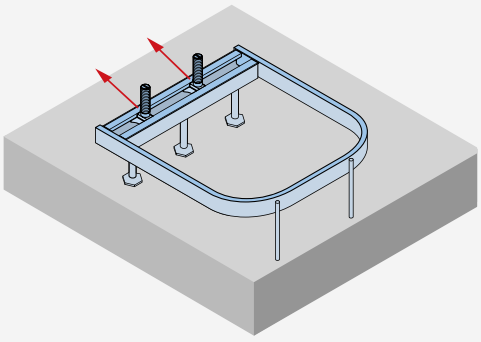


European Technical Assessment ETA-09/0339

HSR Bolt according to ETA with additional expert report for load capacity in channel longitudinal direction

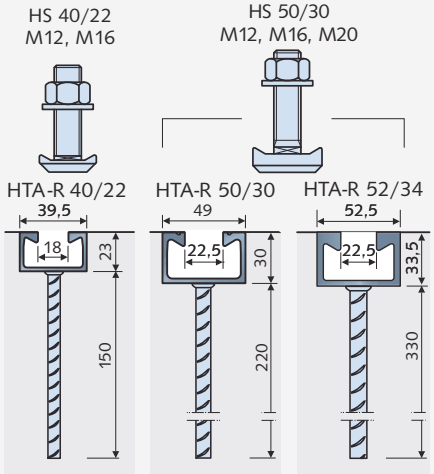
Cold-rolled (standard) channels and bolts



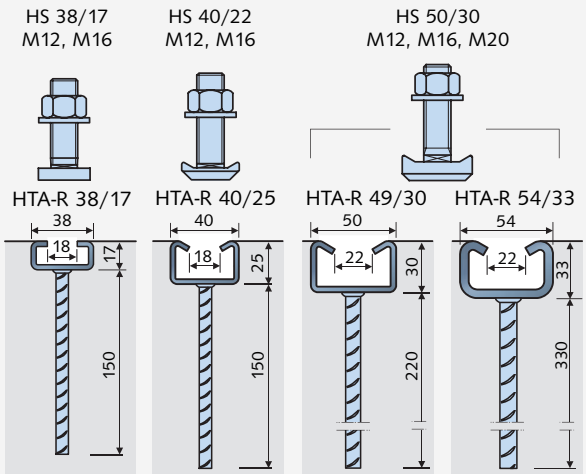


HCW 52/34 with bolts and bracket

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

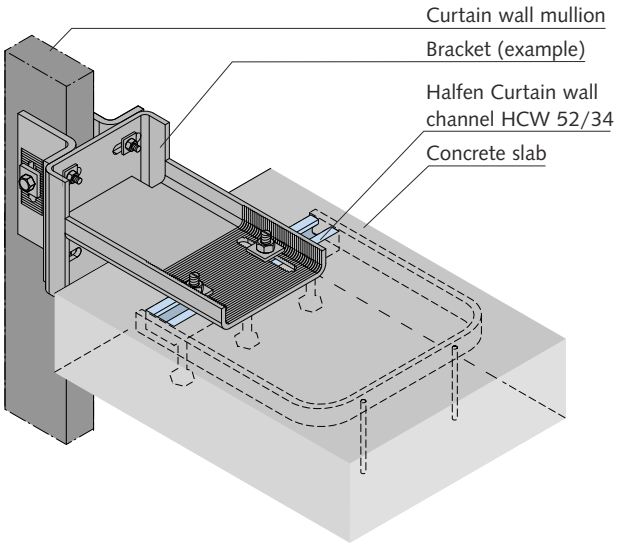


Cold-rolled (smooth) channels with rebar anchors and bolts



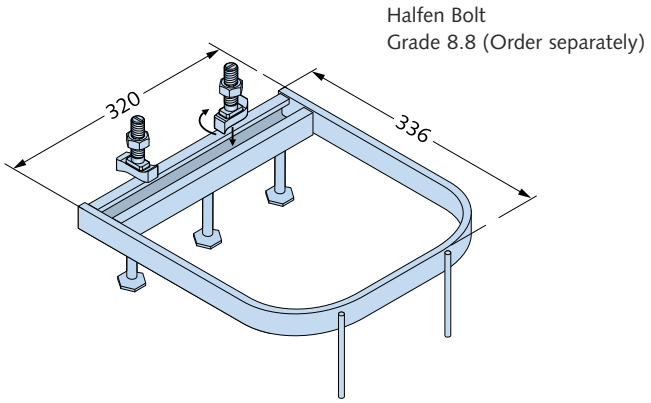
HALFEN CURTAIN WALL SUPPORT SYSTEMS
Halfen Channel HCW 52/34

Typical installation



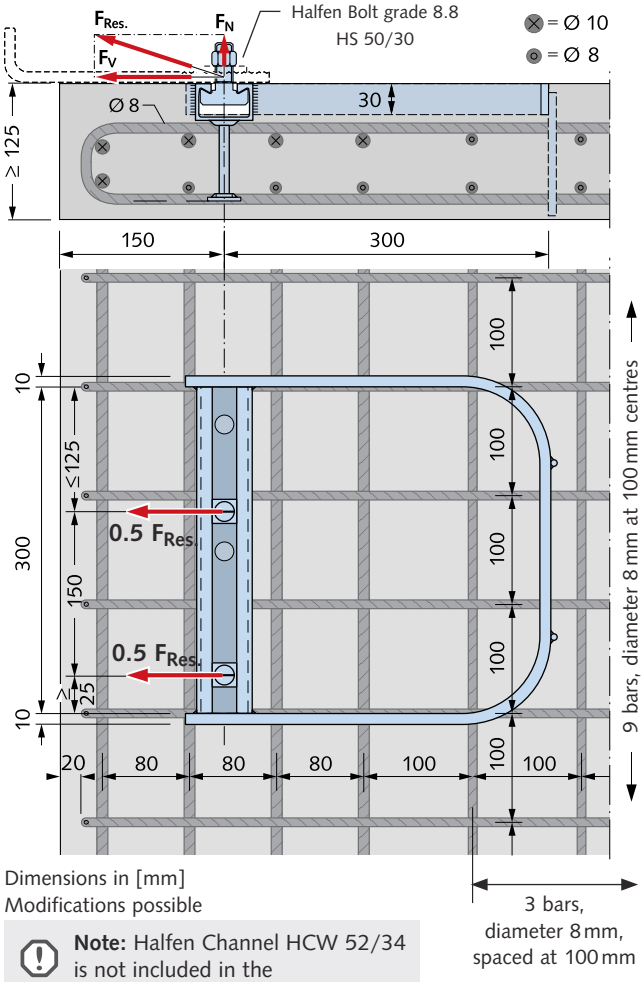
Product description

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



Dimensions in [mm]

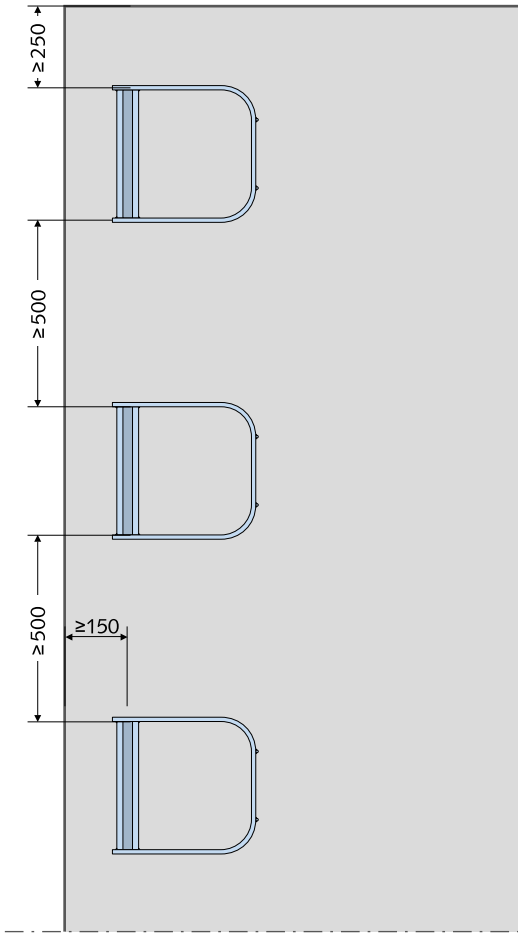
Reinforcement requirements



Dimensions in [mm]
Modifications possible

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

Edge and element spacing



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Halfen Cast-in Channel HCW 52/34

Channel load data

The following load failure were averaged from three tests:

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

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

- tensile and transverse loads were increased at a ratio of 1:3 up to breaking point
- concrete slab thickness ≥ 125 mm and reinforcement as shown on page 48
- concrete strength class ≥ C 20/25 N/mm²
- load is transferred into the channel via two HALFEN Bolts HS 50/30 M20 Grade 8.8. The bolt spacing is 150 mm. A sample calculation is shown below.

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

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

Average failure load from the tests:

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

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

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

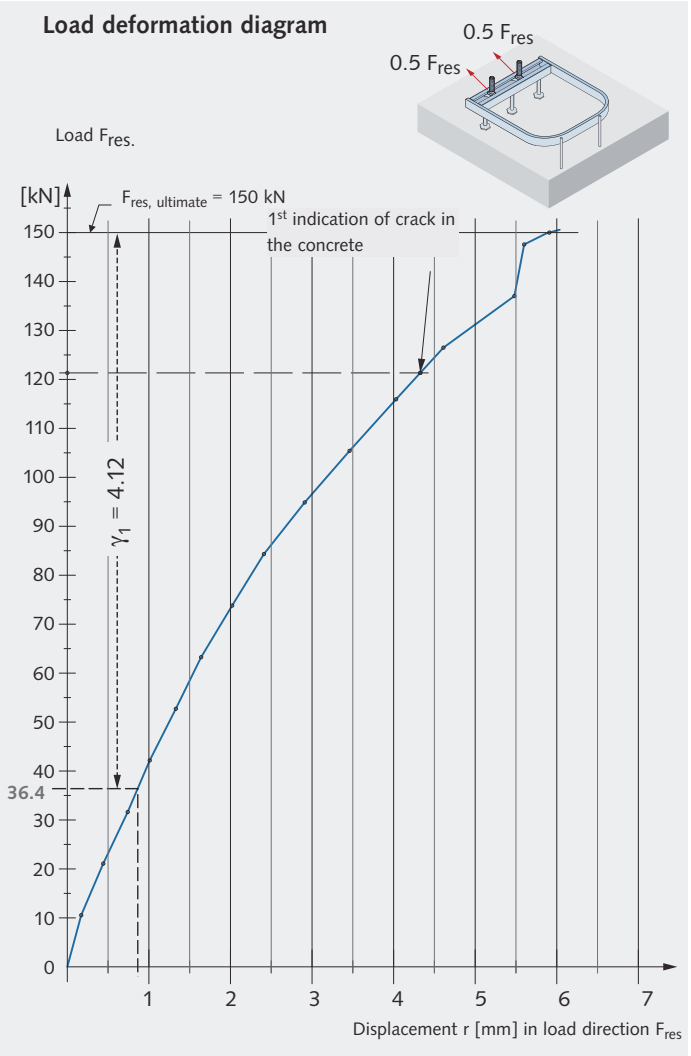
Allowable load with v = 3 against average ultimate load from tests:

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

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

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

Load deformation diagram



Corresponding Halfen Bolts HS 50/30

Depending on the load size, we also recommend using HALFEN Bolts HS 50/30 M16 or M20, grade 8.8 in combination with HALFEN Cast-in channel HCW 52/34.

The bolts stated below are hot-dip galvanized. Other bolt sizes and materials can be supplied. Please contact us for detailed information. Addresses can be found at the end of this catalogue.

Type selection HALFEN Bolts HS 50/30 FV Grade 8.8

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

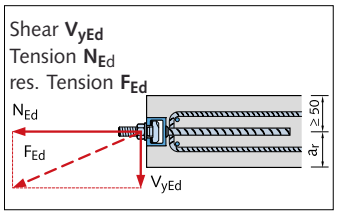
If the bolt is stressed in the direction of a slot its load capacity must be verified taking bolt flexure into account.

HALFEN CURTAIN WALL SUPPORT SYSTEMS
Halfen Cast-in Channels with Rebar Anchor HTA-R and HZA-R

Design basics

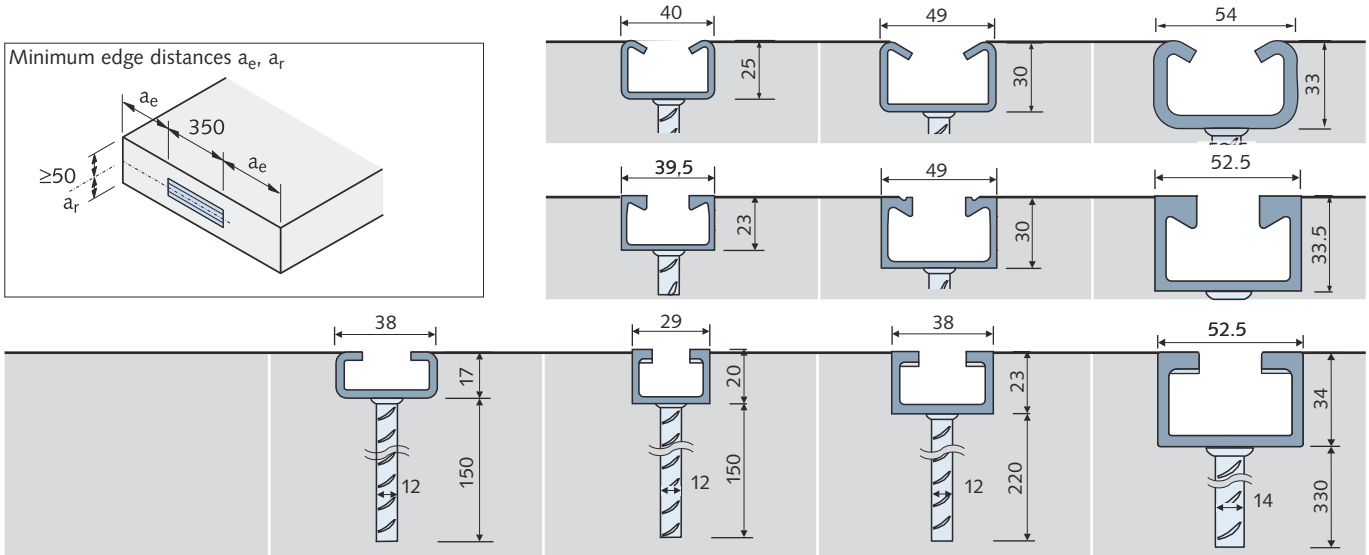
Structural analysis

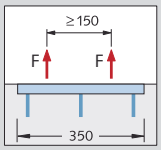
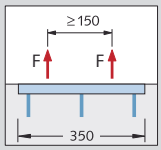
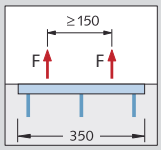
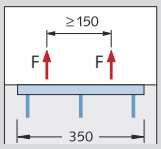
	Material resistance		Design load	
Material resistance shear	V_{yRd}	≥	V_{yEd}	
Material resistance tension	N_{Rd}	≥	N_{Ed}	
Material resistance resulting diagonal pull	F_{Rd}	≥	F_{Ed}	$= \sqrt{N_{Ed}^2 + V_{y,Ed}^2}$



Halfen Channels HTA-R and HZA-R — Design values for material resistance

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



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

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

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Edge of Slab Brackets HCW-ED Post and Beam Façades

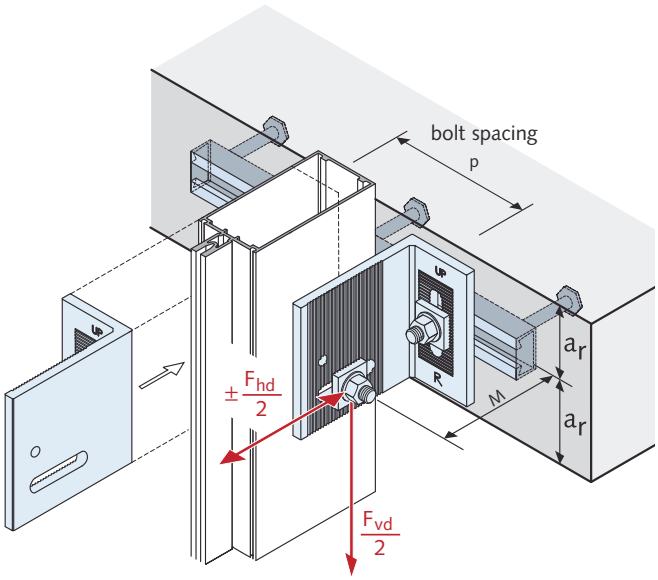
Application example

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

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

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

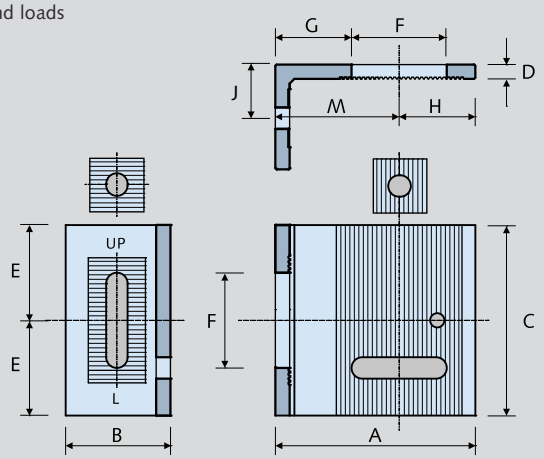
The brackets are made of high quality aluminium material. Special nylon discs are placed between the "Wind load" Bracket HCW-EW and support post.



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

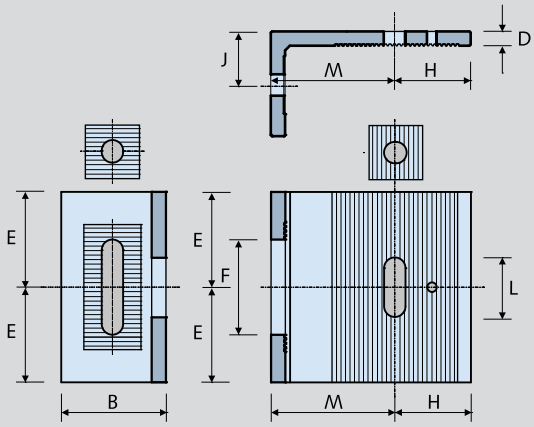
Bracket dimensions [mm]

HCW-ED Brackets
for dead loads
and wind loads



Serrated washers must be ordered separately

HCW-EW Brackets
wind loads only

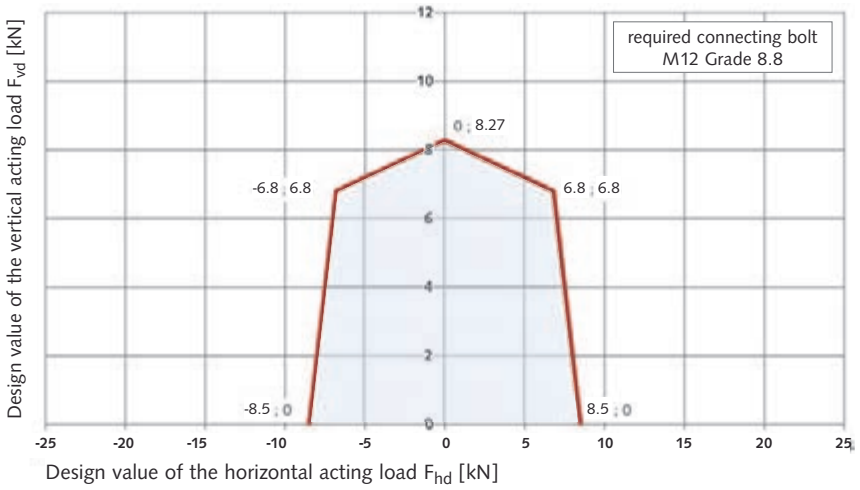


Serrated washers must be ordered separately

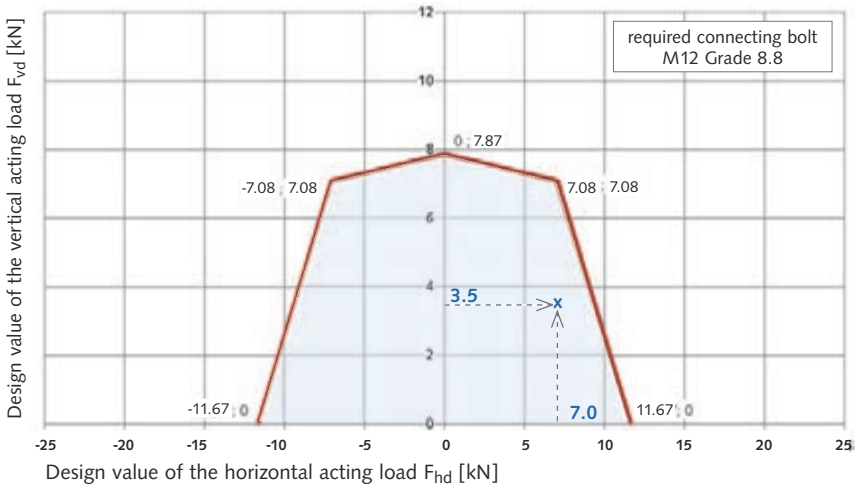
Size	Bracket code	A	B	C	D	E	F	G	H	J	L	M
Small	**HCW-ED 1 HCW-EW 1**	108	70	114	10	57	64	25	51	36	40	57
Medium	**HCW-ED 2**	133	70	127	10	64	64	51	51	36	40	82
Large	**HCW-ED 3 HCW-EW 3**	159	70	140	10	70	64	76	51	36	40	108

HALFEN CURTAIN WALL SUPPORT SYSTEMS
Dimensioning

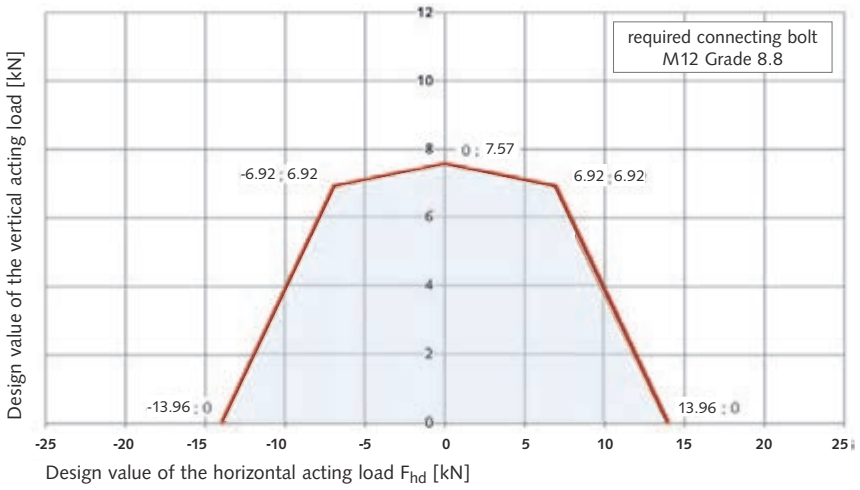
Interaction diagram for type HCW-ED1 (small)



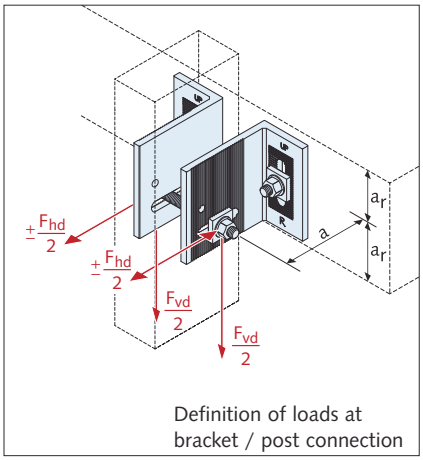
Interaction diagram for type HCW-ED2 (medium)



Interaction diagram for type HCW-ED3 (large)



Calculation basis



Definition of loads at bracket / post connection

Permitted load interaction area

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

Design wind loads for type HCW-EW

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

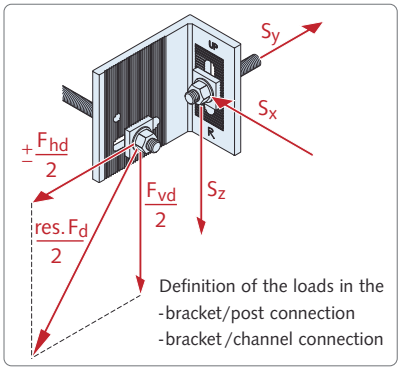
HCW-EW Brackets are only suitable for wind loads.

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

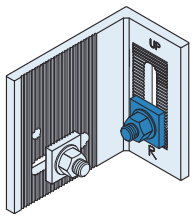
The components of the design-reaction forces in the HALFEN Bolts at the connection of the curtain wall bracket to HALFEN Cast-in channel, are calculated by multiplying the design loads F_{vd} and F_{hd} at connection curtain wall bracket and façade support post with the factors s_x, s_y and s_z. The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

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

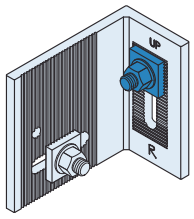
Calculation basis



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



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



Calculation example

Assumed: slab thickness = 200 mm, width of mullion = 80 mm, projection a = 80 mm (install. position see page 50)
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 52) 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

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

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

Selected HALFEN Channel:

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

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 > $2 \times$ res. $S_d = 2 \times 13.78$ kN

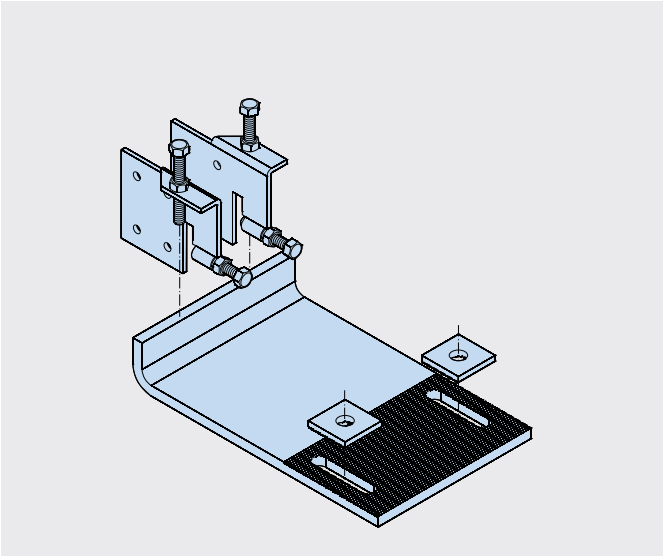
Check: bolt spacing: P = 80+2 × 36 = 152 mm
Selected HALFEN Channel: > 150 mm ✔

HS 50/30 - M12 × 60 FV 8.8

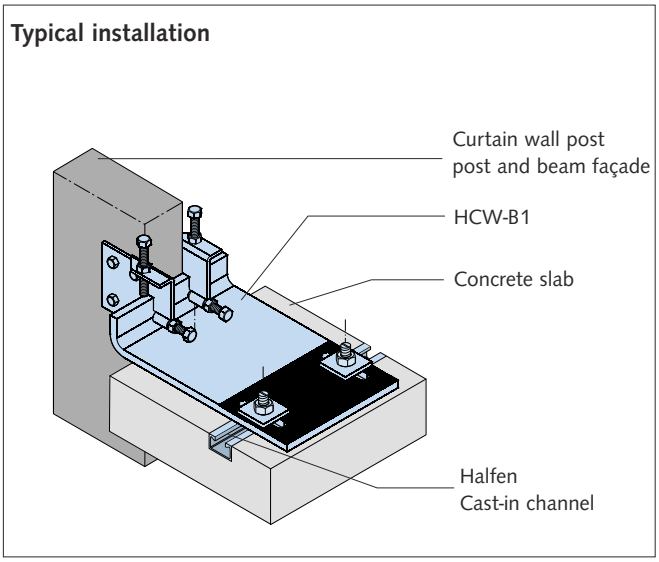
Requirement according to interaction diagram see page 52

HALFEN CURTAIN WALL SUPPORT SYSTEMS
Top of Slab Brackets HCW-B1

Support brackets for horizontal and vertical loads



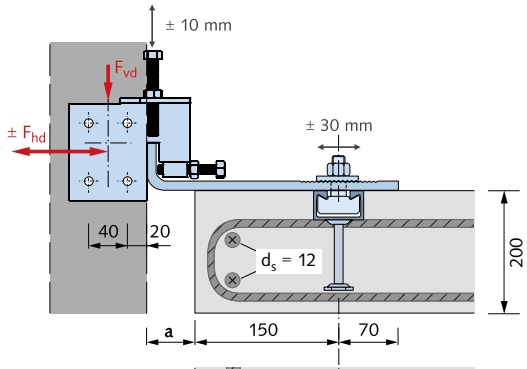
Typical installation



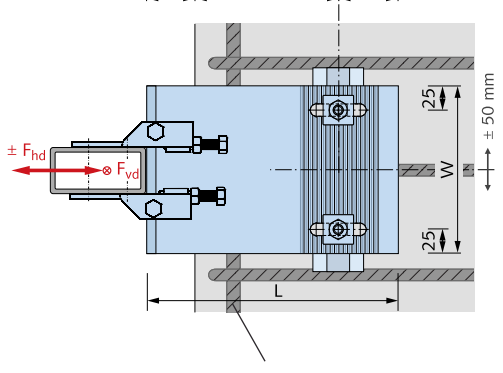
Halfen Brackets HCW-B1

Halfen Brackets HCW-B1 for installing to the top of concrete slabs, are available in two load ranges and three cantilever sizes.
The brackets are made in grade S355 quality galvanized steel. Vertical adjustability is ±10 mm.
Three-dimensional adjustability is ensured when used in combination with Halfen HTA-CE Cast-in channels.

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



Section



Plan

Required edge reinforcement ≥ ⌀12 (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

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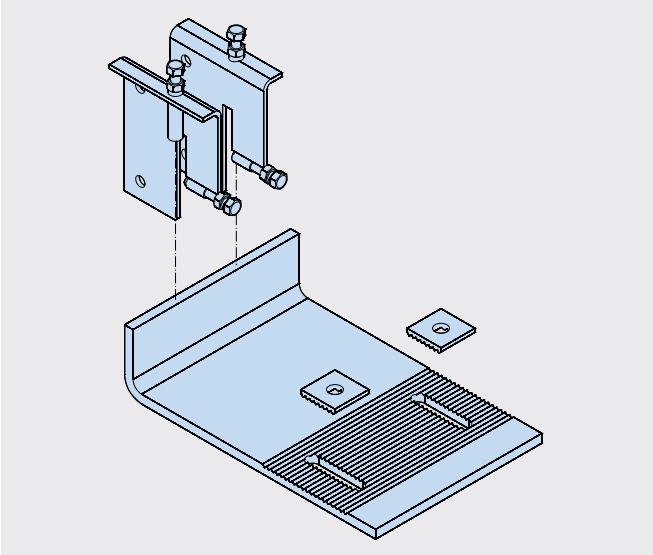
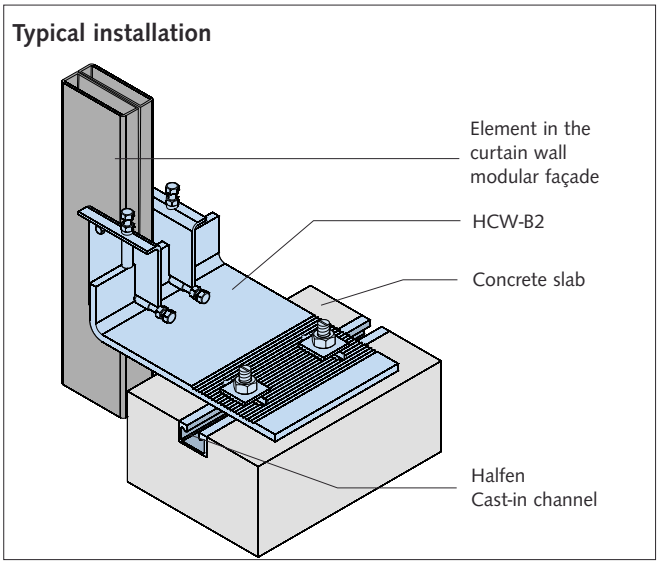
Top of Slab Brackets HCW-B2

Brackets for horizontal and vertical loads



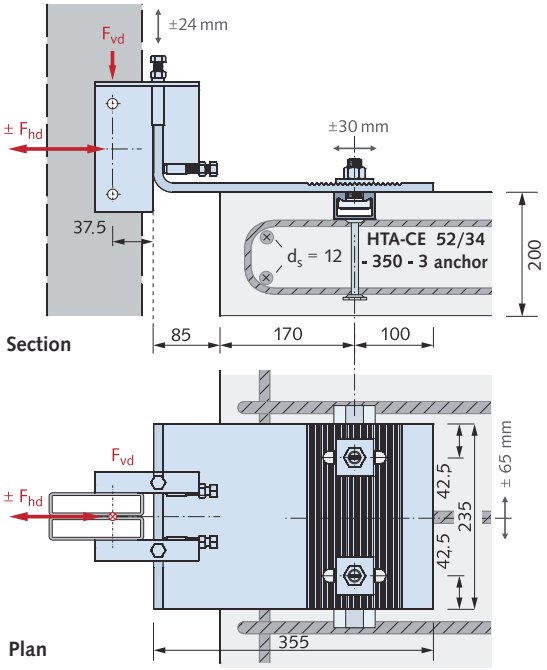
Typical installation



Halfen Brackets HCW-B2

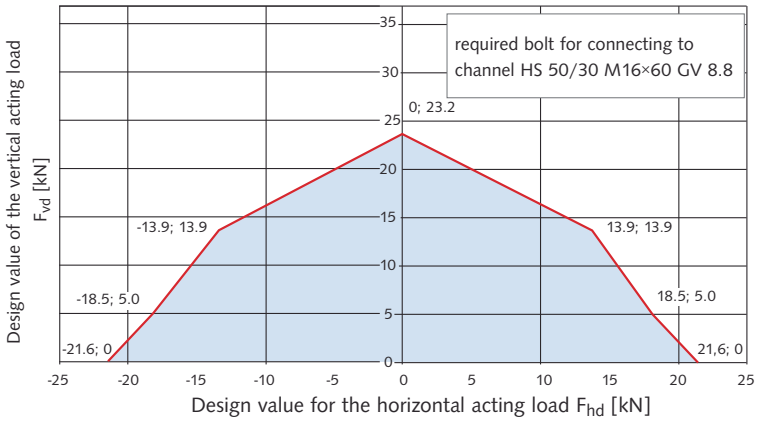
Halfen Brackets HCW-B2 are made in grade S355 quality galvanized steel. The vertical adjustability is ±24 mm. Three-dimensional adjustability is ensured when used in combination with Halfen Cast-in channels HTA-CE.
The lateral connecting plates are connected to the façade posts using M12 screws (not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

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



Required edge reinforcement ≥ ø12 (B500B)

Dimensioning



Allowable load interaction area