HALFEN SUPPORT SYSTEMS FOR CURTAIN WALL
TECHNICAL PRODUCT INFORMATION
Connection Solutions.
The HALFEN Product range.

FIXING SYSTEMS, FRAMING SYSTEMS AND ACCESSORIES

- HSA Cast-in Channels
- HZA - DYNAGRAP Cast-in Channels
- HTA-CC Curved Solutions Channels
- HGB Balustrade Fixings
- HAS - Brick-in Channels
- HTU Cast-in Channels
- DEMU Sockets/Inlets
- HALFEN Framing Channels
- HALFEN Framing System/Accessories

REINFORCEMENT SYSTEMS

- HBS-65 Screw Connections
- MBT Reinforcing coupler
- HWT Rebend Connections
- HDB Shear Rails
- HIT ISO-Element
- HBb bi-Trapez-Box®
- HTF/WHT Impact Sound Insulation Elements
- HCC Column Shoe
- HSC Stud Connector

LIFTING SYSTEMS, CONCRETE PRE-CAST SYSTEMS, NATURAL STONE SYSTEMS, BRICKWORK SUPPORT SYSTEMS, ROD SYSTEMS

- DEHA Lifting Anchors and Socket Anchor System
- DEHA HD-Socket Lifting Anchor System
- FRIMEDA Lifting Anchor System
- PPA Precast Panel Anchors
- MVA Sleeve Sandwich Panel Anchors and Flat Anchors
- BA Body Anchor
- LIMA Grooved Anchors
- SUK Sub-structure
- HK4 Brickwork Support System
- DETAN Rod System

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HALFEN Curtain Wall Support Systems

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HALFEN Curtain wall system

Modern structures often demand high performance façades that can be reliably installed in a minimum time period to meet tight construction schedules.

Curtain wall façades are one of the façade systems increasingly selected by architects and their clients. Curtain walls can be constructed in a variety of materials - glass, metal or stone - supported by a steel or aluminium frame. The frame can be either pre-assembled in a factory as a finished element or assembled on-site immediately prior to installation to the main structure.

To maximise efficiency and reliability in installation, HALFEN Cast-in channels and HALFEN T-bolts are often the preferred method selected for connecting façade elements to a building’s superstructure.
Short project overview

Jin-Mao, Shanghai

Little Britain, London

Petronas Towers, Kuala Lumpur

Messeturm, Frankfurt

Mercedes Benz Centre, Munich

Peoplebuilding Hemel, UK

Sage Music Centre, Gateshead, UK
Main features of all HALFEN Channel systems:

- optimal reliability
- wide range of T-bolts
- wide range of channel profiles
- high quality materials and finishes
- simple and quick installation and adjustment
- independently tested and approved load capacities
- no power tools required → no vibration, dust or excessive noise
HALFEN CURTAIN WALL SUPPORT SYSTEMS

Installation Methods for HALFEN Cast-in Channels

Typical installation

HALFEN Cast-in channels can be installed using several methods. The selected method depends on the type of structure and the type of formwork used. A typical installation sequence in a wood based formwork is shown below.

HALFEN Cast-in channels installed in the top of a concrete slab; in this case an auxiliary construction is required to secure the HALFEN Cast-in channel in position. Two possible methods for installation are illustrated below.

HALFEN Cast-in channels for installation to the top of a slab secured to wood battens nailed to the side formwork.

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HALFEN CURTAIN WALL SUPPORT SYSTEMS
HALFEN Quality

Quality

The HALFEN production plant in Langenfeld/Germany is certified according to DIN EN ISO 9001. This includes continuous monitoring of all processes and maintenance of all machines. All procedures are according to HALFEN DIN EN ISO 9001 QS quality system. The HALFEN production plant is certified for welding according to international standard DIN EN ISO 3834-2 and according to German DIN 18800-7.

All incoming materials are monitored to ensure quality: DIN EN 10204 Certificates are required from all suppliers. All materials properties are monitored by HALFEN Quality Management, including chemical, mechanical properties, and dimensions. To ensure continuous quality, all products are randomly tested during production; this includes tensile failure tests and zinc coating testing to guarantee corrosion resistance.

Why chose HALFEN T-bolts and channels?

• guaranteed ductility; no sudden material failure
• tolerance coordinated channels and bolts
• purpose designed T-bolt head shape guarantees optimal fit for the bolt
• meticulous multi-process forge method carefully fashions the material to the correct head shape

Product safety; gives the customer what they expect.

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 German Lloyd Certification GmbH has verified that our quality management system meets the requirements of the DIN EN ISO 9001:2008 standard.

Destructive testing

Products are randomly selected and are subjected to failure tests to ensure all HALFEN products exceed minimal properties and requirements.

Non-destructive testing

Materials are checked using spectral analysis to ensure correct raw materials are used in the production of HALFEN products.
HALFEN CURTAIN WALL SUPPORT SYSTEMS

Installation Examples

Curtain wall connections installed to the top of floor slabs using HALFEN HTA-CE Cast-in channels.

Two channels used for high loads.

Curtain wall connections to the top of floor slab using HALFEN HTA-CE Cast-in channel.

Curtain wall connection on the top of floor slabs using serrated HALFEN HZA Cast-in channels. The serration in the channel prevent windload slippage. One or two channels can be used per bracket.
HALFEN CURTAIN WALL SUPPORT SYSTEMS

Installation Examples

Curtain wall connection to the edge of a post tensioned slab and thin slab using HALFEN Cast-in channels.

Sunscreen/maintenance gallery connected to top of a beam using HALFEN Cast-in channels.

Window connections to precast panels.
Façade connections vary according to their purpose and the type of structure. Four typical examples are shown below. Please contact your local HALFEN representative for more assistance.

**Application examples**

- **Typical detail; connection to top of slab**
  - Mullion
  - Curtain wall bracket
  - HALFEN Cast-in channel and T-head bolt

- **Typical detail; connection to metal rib-deck slab**
  - Metal rib-deck
  - HALFEN Cast-in channel HTA-CE or HTA-R
  - Edge trim or HALFEN PourStop

- **Base connection for curtain wall or shop front**
  - Slotted and serrated bracket
  - HALFEN Cast-in channel
  - Length and size of channel to suit load requirements.
  - Including HALFEN T-head bolt and nut.

- **Sliding head connection for curtain wall**
  - Final floor surface
  - Slotted and serrated bracket
  - HALFEN Cast-in channel.
  - Length and size of channel to suit load requirements.
  - Including HALFEN T-head bolt and nut.
  - Concrete slab/beam/metal deck
  - Minimal edge distance

Connection to structure, two-way adjustable, allows vertical movement in the façade for expansion, contraction and deflection.
Four typical examples illustrating types of connections used with curtain wall façades. Please contact your local HALFEN representative if you require more information.

Steel beam to concrete connection using HALFEN HZA Cast-in channel and beam clamps.

Typical detail; handrail stanchion anchorage

Typical detail; single or strip window element anchorage

Typical detail; anchoring of sunscreen/glazing using HALFEN Cast-in channels and DETAN Tension rod system (see page 32).
HALFEN CURTAIN WALL SUPPORT SYSTEMS
Advantages of the HALFEN Channel System

**HALFEN Channels**

- only simple tools needed for installation
- easy and quick to install
- easily adjustable connections
- no electrical power required during installation
- fully tested components with verified load capacities
- visual check sufficient to confirm correct installation
- no damage to the reinforcement
- no subsequent welding required
- no extra brackets required for connections
- high quality materials and quality galvanization protect components from corrosion
- no dowels are used: no drilling, therefore no noise, no vibration, no dust
- no additional costs; no electricity required, no wear and tear of tools

A torque wrench is the only tool required for installation.
HALFEN CURTAIN WALL SUPPORT SYSTEMS

Advantages of HALFEN Cast-in Channels Compared to Drilled and Welded Connections

**Drilled bolts**

- power tools cause vibration, noise and dust → work-safety hazards and reduced available installation time
- additional drilling required if adjustment is needed after initial installation → slower installation, drilling
- on-site check for installation quality is unreliable (depth of hole, hole diameter, critical torque) → higher risk
- drilling costs time and bolt installation requires further tests to verify quality → slower installation
- heavy electrical equipment, trailing cables and electricity → safety hazards
- drilling and the expansion forces from installed bolts may damage concrete and reinforcement → higher risk and potential high repair costs

**Welding**

- sparks from welding can start fires and damage glass and aluminium façades → high risk and high cost
- quality welding is difficult to achieve and verify on site → increased uncertainty
- welding takes time and requires testing to verify quality → slow installation and increased uncertainty
- heavy electrical equipment, trailing wires and electricity → safety hazards
- subsequent adjustment requires welds to be broken and rewelded → slow installation
- cast-in plates are designed per project and require testing to verify performance
- requires post-welding corrosion protection → poor corrosion protection, time consuming checking for damage to façade from dripping paint; hazardous to health

Vibration can also cause permanent health damage.

Welding requires moving heavy equipment and also requires a costly energy supply.

Welding is slow, is a fire risk, and needs to be closely monitored to ensure quality.
Load conditions and required HALFEN Channels

### Normal slab conditions
HALFEN Cast-in channels with bolt anchors

### Thin slab conditions with high shear loads and close edge distances
HALFEN (high load) Cast-in channel

### Thin slab conditions with high tension loads
HALFEN Cast-in channels with rebar anchors

### Serrated channels and bolts
<table>
<thead>
<tr>
<th></th>
<th>HZS 29/20 M12</th>
<th>HZS 38/23 M12 / M16</th>
<th>HZS 53/34 M16 / M20</th>
<th>HZS 64/44 M20 / M24</th>
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<tr>
<td></td>
<td>HZA 29/20</td>
<td>HZA 38/23</td>
<td>HZA 53/34</td>
<td>HZA 64/44</td>
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<tr>
<td></td>
<td>29</td>
<td>18</td>
<td>22,5</td>
<td>26</td>
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<td></td>
<td>60</td>
<td>76</td>
<td>80</td>
<td>80</td>
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<td>16</td>
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<tr>
<td></td>
<td>12</td>
<td>17</td>
<td>17</td>
<td>22</td>
</tr>
</tbody>
</table>

### High load channel and bolts
HS 50/30, M16, M20

### Serrated channels with rebar anchors and bolts
<table>
<thead>
<tr>
<th></th>
<th>HZS/HS 29/20 M10 / M12</th>
<th>HZS/HS 38/23 M12 / M16</th>
<th>HZS 53/34 M16 / M20</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>HZA-R 29/20</td>
<td>HZA-R 38/23</td>
<td>HZA-R 53/34</td>
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<td></td>
<td>29</td>
<td>38</td>
<td>52,5</td>
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<td></td>
<td>50</td>
<td>220</td>
<td>310</td>
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<td>≥125</td>
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HALFEN CURTAIN WALL SUPPORT SYSTEMS
Selecting the Correct HALFEN Cast-in Channel for Each Load Condition
HALFEN CURTAIN WALL SUPPORT SYSTEMS
Selecting the Ideal HALFEN Cast-in Channel for each Load Condition

Load conditions and required HALFEN Cast-in channels

Standard hot-rolled channels and bolts

<table>
<thead>
<tr>
<th>Size</th>
<th>HTA-CE 40/22</th>
<th>HTA-CE 50/30</th>
<th>HTA-CE 52/34</th>
<th>HTA-CE 55/42</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTA-CE 40/22</td>
<td>39,5</td>
<td>22</td>
<td>26.5</td>
<td>54.5</td>
</tr>
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<td>22</td>
<td>22</td>
<td>33</td>
<td>54.5</td>
</tr>
<tr>
<td>HTA-CE 52/34</td>
<td>12.4</td>
<td>22</td>
<td>33</td>
<td>54.5</td>
</tr>
<tr>
<td>HTA-CE 55/42</td>
<td>66.2</td>
<td>16.9</td>
<td>22.5</td>
<td>54.5</td>
</tr>
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</table>

Standard cold-rolled channels and bolts

<table>
<thead>
<tr>
<th>Size</th>
<th>HTA-CE 38/17</th>
<th>HTA-CE 40/25</th>
<th>HTA-CE 49/30</th>
<th>HTA-CE 54/33</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTA-CE 38/17</td>
<td>38</td>
<td>22</td>
<td>22</td>
<td>54</td>
</tr>
<tr>
<td>HTA-CE 40/25</td>
<td>40</td>
<td>33</td>
<td>33</td>
<td>54</td>
</tr>
<tr>
<td>HTA-CE 49/30</td>
<td>49</td>
<td>51</td>
<td>56</td>
<td>54</td>
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<tr>
<td>HTA-CE 54/33</td>
<td>54</td>
<td>11.9</td>
<td>33</td>
<td>54</td>
</tr>
</tbody>
</table>

Standard hot-rolled channels with rebar anchors and bolts

<table>
<thead>
<tr>
<th>Size</th>
<th>HTA-R 40/22</th>
<th>HTA-R 50/30</th>
<th>HTA-R 52/34</th>
</tr>
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<tbody>
<tr>
<td>HTA-R 40/22</td>
<td>39.5</td>
<td>22.5</td>
<td>33.5</td>
</tr>
<tr>
<td>HTA-R 50/30</td>
<td>29.5</td>
<td>30</td>
<td>30</td>
</tr>
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<td>33</td>
<td>33.5</td>
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Standard cold-rolled channels with rebar anchors and bolts

<table>
<thead>
<tr>
<th>Size</th>
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<td>38</td>
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<td>HTA-R 40/25</td>
<td>40</td>
<td>33</td>
<td>33</td>
<td>54</td>
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<tr>
<td>HTA-R 49/30</td>
<td>49</td>
<td>51</td>
<td>56</td>
<td>54</td>
</tr>
<tr>
<td>HTA-R 54/33</td>
<td>54</td>
<td>11.9</td>
<td>33</td>
<td>54</td>
</tr>
</tbody>
</table>
HALFEN CURTAIN WALL SUPPORT SYSTEMS

Calculation Example - How to Select the Right Channel

Example 1 - HZA

Given:

Working loads on the curtain wall bracket:
- working dead load (gravity) \( F_g = 6.00 \text{kN} \)
- working wind load \( F_w = 12.00 \text{kN} \)

The calculation example uses load and resistance factor design, applying partial safety factors \( \gamma_F \) on the load side (action).

for dead loads: \( \gamma_F = 1.35 \) (acc. to German standard DIN 1045-1)
for wind loads: \( \gamma_F = 1.50 \) (acc. to German standard DIN 1045-1)

\[ \Rightarrow \]
- design dead load \( F_{gd} = \gamma_F \times F_g = 1.35 \times 6.0 \text{kN} = 8.1 \text{kN} \)
- design wind load \( F_{wd} = \gamma_F \times F_w = 1.5 \times 12.0 \text{kN} = 18.00 \text{kN} \)

Design forces, acting on the channel:

\[ N_{Ed} = (F_{gd} \times 70 + F_{wd} \times 30) / 130 = (8.1 \times 70 + 18.0 \times 30) / 130 = 8.51 \text{kN} \]
\[ V_{y,Ed} = F_{wd} = 18.0 \text{kN} \]

\[ \gamma = \arctan \left( \frac{N_{Ed}}{V_{y,Ed}} \right) = \arctan \left( \frac{8.51}{18.0} \right) = 25.3^\circ > 15^\circ \]

\[ N^*_{Ed} = \sqrt{N_{Ed}^2 + V_{y,Ed}^2} = \sqrt{(8.51)^2 + (18.0)^2} = 19.91 \text{kN} \]

\[ 2 \times 9.96 \text{kN} \]

SELECTED CHANNEL:

HZA 38/23 - 350 - 3 anchors with 2 bolts at 150mm centres (see page 20) according to expert report

required \( a_r = 150 \text{mm} \) (see page 20) \( \checkmark \) OK

\[ \Rightarrow V_{y,Rd} = 2 \times 9.8 > V_{y,Ed} = 2 \times 9.0 \checkmark \) OK

\[ N_{Rd} = 2 \times 14.0 > N_{Ed} = 2 \times 4.26 \checkmark \) OK

\[ N^*_{Rd} = 2 \times 14.0 > N^*_{Ed} = 2 \times 9.96 \checkmark \) OK

SELECTED BOLTS:

2 pieces HZS 38/23 M12×60 gv 8.8 (see page 21)

\[ \Rightarrow V_{y,Rd} = 27.2 > V_{y,Ed} = 9.0 \checkmark \) OK

\[ N_{Rd} = 27.2 > N_{Ed} = 4.26 \checkmark \) OK

\[ F_{SRd} = 27.2 > F_{S,Ed} = 9.96 \checkmark \) OK
Calculation Example - How to Select the Right Channel

Example 2 - HZA-R

Given:

Working loads on the curtain wall bracket
- working dead load (gravity) \( F_g = 2.00 \text{kN} \)
- working wind load \( F_w = 10.00 \text{kN} \)

The calculation example uses load and resistance factor design, applying partial safety factors \( \gamma_F \) on the load side (action).

for dead loads: \( \gamma_F = 1.35 \) (acc. to German standard DIN 1045-1)
for wind loads: \( \gamma_F = 1.50 \) (acc. to German standard DIN 1045-1)

\[ F_{gd} = \gamma_F \times F_g = 1.35 \times 2.0 \text{kN} = 2.7 \text{kN} \]
\[ F_{wd} = \gamma_F \times F_w = 1.5 \times 10.0 \text{kN} = 15.0 \text{kN} \]

Design forces, acting on the channel:

\[ N_{Ed} = Z_d = F_{wd} + F_{gd} \times \left(\frac{100}{35}\right) = 15.0 + 2.7 \times \left(\frac{100}{35}\right) = 22.7 \text{kN} \]
\[ V_{y,Ed} = Q_d = F_{gd} = 2.7 \text{kN} \]

\[ N^*_{Ed} = \sqrt{N_{Ed}^2 + V_{y,Ed}^2} = \sqrt{(22.7)^2 + (2.7)^2} = 22.86 \text{kN} \]
\[ \approx 2 \times 11.43 \text{kN} \]

SELECTED CHANNEL:

HZA-R 38/23 - 350 - 3 anchors with 2 bolts at 150mm centres (see page 22)

actual \( a_r \approx 60 \text{mm} \) (see page 22)
\[ V_{y,Rd} = 2 \times 3.7 > V_{y,Ed} = 2 \times 1.35 \quad \checkmark \text{OK} \]
\[ N_{Rd} = 2 \times 14.0 > N_{Ed} = 2 \times 11.35 \quad \checkmark \text{OK} \]
\[ N^*_{Rd} = 2 \times 14.0 > N^*_{Ed} = 2 \times 11.43 \quad \checkmark \text{OK} \]

SELECTED BOLTS:

2 pieces HS 38/17 M12×60 gv 4.6 (see page 23)

actual \( c = 150 \) > required \( c \geq 150 \) (see page 22) \( \checkmark \text{OK} \)
\[ V_{y,Rd} = 13.0 > V_{y,Ed} = 1.35 \quad \checkmark \text{OK} \]
\[ N_{Rd} = 13.0 > N_{Ed} = 11.35 \quad \checkmark \text{OK} \]
\[ F_{S,Rd} = 13.0 > F_{S,Ed} = 11.35 \quad \checkmark \text{OK} \]

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HALFEN CURTAIN WALL SUPPORT SYSTEMS
HALFEN Calculation Software HTA-CE

HALFEN Software

The following information is necessary to verify an anchor channel:

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

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

Technical support

Engineering services and technical support for your individual projects. Contact information can be found on page 35 of this catalogue.

Note:
A free, simple to use calculation software to simplify planning can be downloaded at www.halfen.de

If verification is negative, determine required additional reinforcement
If last verification is negative, determine required additional reinforcement

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HALFEN CURTAIN WALL SUPPORT SYSTEMS
HALFEN Calculation Software HTA-CE

HALFEN Software

The HALFEN Cast-in channel calculation program is based on ETA-09/0339 (European Technical Approval) and CEN/TS 1992-4 (Design standards of anchorages for use in concrete); the program provides the user with a convenient and very powerful calculation tool.

Although HALFEN Cast-in channels could previously be selected from tables according to their load bearing capacity, the ETA requires a wider range of verifications for cast-in channels in combination with the selected concrete. These verifications are processed by the user-friendly HALFEN software; in just a few seconds the user has 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 concrete component geometry, in particular the distances of the channel to the component edge

• various reinforcement layouts

• consideration of several dimensions or characteristic loads

• loads positioning with a definable adjustment range, and the option of moving the defined bolt layout 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. The entries are displayed immediately in a 3D graphic. The entries can also be manipulated 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 incomplete verifications are highlighted in red.

Visual control

All verifications for the current channel profile are listed in a tree structure. Green checkmarks indicate successful verifications. Red checkmarks indicate problem areas.

Print-outs

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

All software can be found under: www.halfen.de → service → software/CAD
HALFEN CURTAIN WALL SUPPORT SYSTEMS
Hot-rolled Serrated Channels HZA DYNAGRIP

Factored design load conditions

1. Shear Material Resistance
   \[ V_{y, Rd} \geq V_{y, Ed} \]

2. Tension Material Resistance
   \[ N_{R,d} \geq N_{Ed} \]

3. Longitudinal Shear Material Resistance
   \[ V^{*}_{x,Rd} \geq \text{res. } V_{x,Ed} \]

4. Resultant Shear Material Resistance
   \[ V^{*}_{Rd} \geq V^{*}_{Ed} \quad (\gamma \leq 15^\circ) \]

5. Resultant Tension Material Resistance
   \[ N^{*}_{Rd} \geq N^{*}_{Ed} \quad (\gamma \geq 15^\circ \text{ or } \alpha \leq 150^\circ) \]

6. Dynamic Material Resistance
   \[ \Delta N_{Rd} \geq \Delta N_{Ed} \quad (\gamma = \arctan \left( \frac{N_{Ed}}{\text{res. } V_{Ed}} \right)) \]

HALFEN Cast-in channels HZA DYNAGRIP - material design resistance values

<table>
<thead>
<tr>
<th>HALFEN Channel type</th>
<th>Concrete compression strength</th>
<th>Material resistance</th>
<th>Factored design load</th>
</tr>
</thead>
<tbody>
<tr>
<td>HZA 29/20</td>
<td>f_{ck,cyl.} = 20 N/mm²</td>
<td>( N_{Rd} ) [kN] 2 \times 8.4</td>
<td>( V_{y,Ed} ) 2 \times 14.0</td>
</tr>
<tr>
<td></td>
<td>f_{ck,cube} = 25 N/mm²</td>
<td>( V_{y,Rd} ) 2 \times 8.4</td>
<td>( V^{*}<em>{Ed} ) ( \geq \text{res. } V</em>{x,Ed} )</td>
</tr>
<tr>
<td>250 mm 2 anchors</td>
<td></td>
<td>( V_{x,Rd} ) 2 \times 9.0</td>
<td>( V^{*}_{Rd} ) 2 \times 14.0</td>
</tr>
<tr>
<td>HZA 38/23</td>
<td></td>
<td>( N^{*}_{Rd} ) 2 \times 8.4</td>
<td>( V^{*}_{Ed} ) 2 \times 14.0</td>
</tr>
<tr>
<td>350 mm 3 anchors</td>
<td></td>
<td>( V^{*}_{x,Rd} ) 2 \times 8.4</td>
<td>( N^{*}_{Ed} ) 2 \times 9.0</td>
</tr>
<tr>
<td>HZA 53/34</td>
<td></td>
<td>( V^{*}_{x,Rd} ) 2 \times 8.4</td>
<td>( N^{*}_{Rd} ) 2 \times 9.0</td>
</tr>
<tr>
<td>350 mm 3 anchors</td>
<td></td>
<td>( V^{*}_{Ed} ) 2 \times 14.0</td>
<td>( N^{*}_{Ed} ) 2 \times 14.0</td>
</tr>
<tr>
<td>HZA 64/44</td>
<td></td>
<td>( V^{*}_{Ed} ) 2 \times 14.0</td>
<td>( N^{*}_{Ed} ) 2 \times 14.0</td>
</tr>
<tr>
<td>350 mm 3 anchors</td>
<td></td>
<td>( N^{*}_{Rd} ) 2 \times 9.0</td>
<td>( N^{*}_{Ed} ) 2 \times 9.0</td>
</tr>
</tbody>
</table>

Notes: Other channel sizes are available in 150 - 6070 mm lengths. Please see the Technical Product Information HALFEN Cast-in channels.

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HALFEN CURTAIN WALL SUPPORT SYSTEMS

Hot-rolled Serrated Channels HZA DYNAGRIP and T-head Bolts

Minimum spacings and edge distances [mm], for all concrete grades ≥ C20/25

<table>
<thead>
<tr>
<th>HALFEN Channel type</th>
<th>a₁</th>
<th>a₂</th>
<th>a₃</th>
<th>a₄</th>
<th>d ②</th>
</tr>
</thead>
<tbody>
<tr>
<td>HZA 64/44</td>
<td>250</td>
<td>500</td>
<td>225</td>
<td>450</td>
<td>187 + nom.c</td>
</tr>
<tr>
<td>HZA 53/34</td>
<td>200</td>
<td>400</td>
<td>175</td>
<td>350</td>
<td>177 + nom.c</td>
</tr>
<tr>
<td>HZA 38/23</td>
<td>150</td>
<td>300</td>
<td>130</td>
<td>250</td>
<td>99 + nom.c</td>
</tr>
<tr>
<td>HZA 29/20</td>
<td>100</td>
<td>200</td>
<td>80</td>
<td>200</td>
<td>83 + nom.c</td>
</tr>
</tbody>
</table>

Notes: ① The minimum dimensions given in the table apply to reinforced concrete. For non-reinforced concrete increase dimensions by 30%.
② Determined by channel height, anchor length and required concrete cover (as stated in DIN 1045-1).

HALFEN T-head bolts HZS - material design resistance per bolt

Structural analysis

\[
\begin{align*}
F_{Rd} & \geq F_{Ed} \\
N_{Rd} & \geq N_{Ed} \\
V_{x,Rd} & \geq V_{x,Ed} \\
F_{SRd} & \geq \Delta N_{Ed}
\end{align*}
\]

HALFEN Channel type | HZA 29/20 | HZA 38/23 | HZA 53/34 | HZA 64/44
---|---|---|---|---
HALFEN T-head bolt type | HZS 29/20 | HZS 38/23 | HZS 53/34 | HZS 64/44

<table>
<thead>
<tr>
<th>Material grade</th>
<th>Steel 8.8</th>
<th>Stainless steel A4-70</th>
<th>Steel 8.8</th>
<th>Stainless steel A4-70</th>
<th>Steel 8.8</th>
<th>Stainless steel A4-70</th>
<th>Steel 8.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bolt diameter and length (other bolt sizes see Technical Product Information HALFEN Cast-in channels)</td>
<td>M12</td>
<td>M16</td>
<td>M12</td>
<td>M16</td>
<td>M16</td>
<td>M20</td>
<td>M16</td>
</tr>
<tr>
<td>40</td>
<td>60</td>
<td>40</td>
<td>60</td>
<td>60</td>
<td>80</td>
<td>100</td>
<td>80</td>
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<tr>
<td>50</td>
<td>60</td>
<td>50</td>
<td>60</td>
<td>50</td>
<td>80</td>
<td>100</td>
<td>80</td>
</tr>
<tr>
<td>60</td>
<td>80</td>
<td>60</td>
<td>80</td>
<td>60</td>
<td>100</td>
<td>100</td>
<td>80</td>
</tr>
</tbody>
</table>

\[
N_{Rd} = V_{y,Rd} - F_{SRd} \quad [\text{KN}]
\]

\[
V_{x,Rd} \quad [\text{kN}]
\]

\[
\Delta N_{Rd} \quad [\text{kN}]\end{align*}

Notes: ⑧ Channel load capacity must not be exceeded ⑦ load side \(\Delta N_{Ed}\) calculated with partial safety factor 1.0 only

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HALFEN CURTAIN WALL SUPPORT SYSTEMS
HALFEN Channels with Reinforcing Bar Anchor HTA-R and HZA-R

Factored design load conditions
Thin slab conditions with high tension loads

Structure analysis

<table>
<thead>
<tr>
<th>Shear Material Resistance</th>
<th>Tension Material Resistance</th>
<th>Resultant Tension Material Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{y,Rd}$</td>
<td>$N_{Rd}$</td>
<td>$N_{Rd}^*$</td>
</tr>
<tr>
<td>$V_{y,Ed}$</td>
<td>$N_{Ed}$</td>
<td>$N_{Ed}^*$ $= \sqrt{N_{Ed}^2 + V_{y,Ed}^2}$</td>
</tr>
</tbody>
</table>

Notes: ① The minimum dimensions given in the table apply to reinforced concrete.

HALFEN Cast-in channels HTA-R and HZA-R - material design resistance values

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>HTA-R 38/17*</th>
<th>HTA-R 40/25 (1)</th>
<th>HTA-R 40/22 (2)</th>
<th>HZA-R 29/20 (3)</th>
<th>HTA-R 49/30 (4)</th>
<th>HTA-R 50/30 (5)</th>
<th>HZA-R 38/23 (6)</th>
<th>HTA-R 54/33 (7)</th>
<th>HTA-R 52/34 (8)</th>
<th>HZA-R 53/34 (9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a_e [mm]</td>
<td>40</td>
<td>49</td>
<td>54</td>
<td>38</td>
<td>29</td>
<td>38</td>
<td>23</td>
<td>52.5</td>
<td>33.6</td>
<td>33.6</td>
</tr>
<tr>
<td>a_e [mm]</td>
<td>22</td>
<td>30</td>
<td>30</td>
<td>150</td>
<td>220</td>
<td>220</td>
<td>220</td>
<td>220</td>
<td>220</td>
<td>220</td>
</tr>
<tr>
<td>F_{Rd} [kN]</td>
<td>2 × 7.0</td>
<td>2 × 9.1</td>
<td>2 × 14.0</td>
<td>2 × 24.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V_{y,Rd} [kN]</td>
<td>2 × 2.4</td>
<td>2 × 3.7</td>
<td>2 × 4.9</td>
<td>2 × 5.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material: hot-dipped galvanized channel</td>
<td>W1.0038</td>
<td>W1.0038(a)(2), W1.0044(3)</td>
<td>W1.0038(4)(5), W1.0044(6)</td>
<td>W1.0976(7), W1.0038(8), W1.0044(9)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material: stainless steel anchor</td>
<td>B500B carbon steel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material: stainless steel anchor</td>
<td>W1.4571©/ 1.4404©</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material: stainless steel anchor</td>
<td>B500B carbon steel*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: Other channel lengths 150 – 6070 mm are available. Please refer to the HALFEN Cast-in channels catalogue.
* for profile 38/17; only permitted for use in dry interior environments
© not available for profile HZA-R 29/20

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HALFEN CURTAIN WALL SUPPORT SYSTEMS
HALFEN Channels HTA-R, HZA-R and T-head Bolts

HALFEN T-head bolts HS - material design resistance per bolt ☞

Structural analysis

<table>
<thead>
<tr>
<th>HALFEN Channel type</th>
<th>HTA-R 38/17</th>
<th>HTA-R 40/25, HTA-R 40/22</th>
<th>HTA-R 49/30, HTA-R 50/30, HTA-R 54/33, HTA-R 52/34</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material grade</td>
<td>Steel 4.6</td>
<td>Stainless steel A4-50</td>
<td>Stainless steel A4-50</td>
</tr>
<tr>
<td>Bolt diameter and length (see catalogue B-E for other bolt sizes)</td>
<td>M12</td>
<td>M16</td>
<td>M12</td>
</tr>
<tr>
<td></td>
<td>40 60 80</td>
<td>40 60 80</td>
<td>50 60 80</td>
</tr>
<tr>
<td>HALFEN Cast-in channels</td>
<td>HS 38/17</td>
<td>HS 40/2</td>
<td>HS 50/30</td>
</tr>
<tr>
<td></td>
<td>HS 38/17</td>
<td>HS 40/2</td>
<td>HS 50/30</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$F_{Rd}$</td>
<td>$V_{y,Rd}$</td>
</tr>
<tr>
<td>$F_{Ed}$</td>
<td>$N_{Rd}$</td>
</tr>
<tr>
<td>$F_{Srd}$</td>
<td>$N_{Srd}$</td>
</tr>
</tbody>
</table>

Design bending moment $M_{Rd}$ [Nm]

<table>
<thead>
<tr>
<th>Material grade</th>
<th>Steel 4.6</th>
<th>Stainless steel A4-50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bolt diameter and length (see catalogue B-E for other bolt sizes)</td>
<td>M12</td>
<td>M16</td>
</tr>
<tr>
<td></td>
<td>40 60 80</td>
<td>40 60 80</td>
</tr>
<tr>
<td>HALFEN Cast-in channels</td>
<td>HS 38/17</td>
<td>HS 40/2</td>
</tr>
<tr>
<td></td>
<td>HS 38/17</td>
<td>HS 40/2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$F_{Rd}$</td>
<td>$V_{y,Rd}$</td>
</tr>
<tr>
<td>$F_{Ed}$</td>
<td>$N_{Rd}$</td>
</tr>
<tr>
<td>$F_{Srd}$</td>
<td>$N_{Srd}$</td>
</tr>
</tbody>
</table>

Notes:
- ☞ Channel load capacity must not be exceeded
- Stainless steel A4-50
- Available in stainless steel material on request
- ** recommended values; only to be used for thin face applications

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HALFEN CURTAIN WALL SUPPORT SYSTEMS
HALFEN High Load Channel HCW 52/34 for Curtain Wall Connections

Typical installation

Product description

Product code: HCW 52/34
Material: W1.0038, hot-dipped galvanized

Reinforcement requirements

Dimensions in mm

Channel dimensions and positioning

Dimensions in mm
Subject to change

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HALFEN CURTAIN WALL SUPPORT SYSTEMS
HALFEN High Load Channel HCW 52/34 for Curtain Wall Connections

Channel load data

A series of three tests produced the following average ultimate loads:

\[
\begin{align*}
F_V \text{ ultimate} & = 142.3 \text{ kN} \\
F_N \text{ ultimate} & = 47.4 \text{ kN} \\
F_{\text{result, ultimate}} & = \sqrt{F_V^2 + F_N^2} = 150.0 \text{ kN}
\end{align*}
\]

The adjacent load deformation diagram can 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:

- A concrete slab ≥ 125 mm thick and reinforced according to the diagram on the previous page.
- Concrete compression strength ≥ C 20/25 N/mm² (cylinder/cube) with normal weight aggregate.
- Load equally distributed to the channel via two HALFEN T-bolts (ordered separately) spaced at ≥ 150 mm centres. See below for sizes and load capacities.

A typical calculation method is shown below.

The factors used in the calculation example are just an example. Actual factors used on a project basis must be checked according to local or national building regulations. These calculations also make no allowance for load increase due to load eccentricities. These must be included according to the project design of the connection.

Contact us if further information and help is required here.

Calculation example: Assumed safety factor 3 applied to the ultimate test load.

Ultimate test load:

\[
F_{\text{result, ultimate}} = 150.0 \text{ kN}
\]

\[
\begin{align*}
F_V \text{ ultimate} & = 142.3 \text{ kN} \\
F_N \text{ ultimate} & = 47.4 \text{ kN}
\end{align*}
\]

Required working loads:

\[
F_V \text{ work.} = 35 \text{ kN}, \quad F_N \text{ work.} = 10 \text{ kN}
\]

Allowable load at 3:1 safety factor:

\[
\begin{align*}
F_{\text{result, allowable}} & = 50.0 \text{ kN} \\
F_V \text{ allowable} & = 47.4 \text{ kN} \\
F_N \text{ allowable} & = 15.8 \text{ kN}
\end{align*}
\]

Checking:

\[
\begin{align*}
F_V \text{ work.} & = 35 \text{ kN} < 47.4 \text{ kN} \quad \checkmark \quad \text{OK} \\
F_N \text{ work.} & = 10 \text{ kN} < 15.8 \text{ kN} \quad \checkmark \quad \text{OK} \\
F_{\text{result, work.}} & = \sqrt{(10)^2 + (35)^2} = 36.4 \text{ kN} < 50 \text{ kN} \quad \checkmark \quad \text{OK}
\end{align*}
\]

Displacement at working load < 1 mm (see diagram).

Actual safety factor to ultimate test load: \( \gamma_1 = (150 / 36.4) = 4.12 \)

Fastener information

HALFEN T-bolts type HS 50/30 8.8 grade, M16 and M20 suitable for the required load are recommended for use with HALFEN Cast-in channel HCW 52/34. The loads \( F_{\text{allow}} \), see table below, are per bolt and based on applied safety factors of approximately 2.5 : 1; other factors may be applied according to appropriate regulations and project requirements.

Please note that fastener performance may be limited by channel capacity. The sizes shown result from salt spray tests with a special coating equivalent to hot-dipped galvanization. T-bolts in other sizes and materials are available if required. Please contact us for more details.

<table>
<thead>
<tr>
<th>Thread size</th>
<th>Material grade</th>
<th>Available lengths L [mm]</th>
<th>Bolt load (pull, angled pull and shear) ( F_{\text{allow}} ) [kN]</th>
<th>Allowable bending moment ( M_{\text{allow}} ) [Nm]</th>
<th>Recommended initial torque ( T_{\text{init}} ) [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>M 16</td>
<td>8.8</td>
<td>40, 60, 80, 100</td>
<td>36.1</td>
<td>111</td>
<td>180</td>
</tr>
<tr>
<td>M 20</td>
<td>8.8</td>
<td>45, 60, 80, 100</td>
<td>56.4</td>
<td>216</td>
<td>360</td>
</tr>
</tbody>
</table>

The capacity of the T-bolts should be checked for allowable bending moment if slotted holes are used in the bracket to achieve tolerance transverse to the channel.
HALFEN CURTAIN WALL SUPPORT SYSTEMS
HALFEN Cast-in Channels HTU for Self-tapping Screws

Cast-in channels HTU, self anchoring

HALFEN HTU Cast-in channels provide an ideal method for connecting window frames, door frames, sheeting rails and metal cladding panels to concrete using self-tapping screws. They are easy to install and allow two dimensional adjustment for the connection. HTU self-anchoring channels are available pre-galvanized in lengths of six metres. For details of HTU Channels with welded anchors see below.

<table>
<thead>
<tr>
<th>Channel type</th>
<th>HTU 40/25/2.5 - sv (IT)</th>
<th>HTU 60/25/2.5 - sv (FR)</th>
<th>HTU 80/25/3.0 - sv (FR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design resistance $F_{rd}$</td>
<td>1.8 kN / 250 mm</td>
<td>1.8 kN / 250 mm</td>
<td>1.8 kN / 250 mm</td>
</tr>
</tbody>
</table>

Minimum concrete dimensions [mm]
| $a_a$ | 140 | 160 | 180 |
| $a_r$ | 70 | 80 | 90 |
| $a_e$ | 20 | 20 | 20 |
| $a_f$ | 20 | 20 | 20 |
| $d$ | 25 + cover | 25 + cover | 25.5 + cover |

Notes:
1. Suitable for pull-out, shear and resultant loads. Minimum required concrete strength C20/25 N/mm². Fixtures must be capable of supporting the loads, and be installed according to manufacturer’s recommendations.
2. Concrete must be of sufficient depth to transfer loads from the channel and provide adequate cover.

Cast-in channels HTU, welded anchors

All HALFEN Cast-in channels type HTU 60/22 are available hot-dipped galvanized in 3 m lengths. HTU 60/22/3 is also available in A4 stainless steel. Anchors are spaced at 450 mm or 150 mm.

<table>
<thead>
<tr>
<th>Channel type</th>
<th>HTU 60/22/3</th>
<th>HTU 60/22/6</th>
</tr>
</thead>
<tbody>
<tr>
<td>$c$ [mm]</td>
<td>$e$ [mm]</td>
<td>Design resistance $F_{rd}$ 1</td>
</tr>
<tr>
<td>225</td>
<td>450</td>
<td>4.6 kN / 450 mm</td>
</tr>
<tr>
<td>75</td>
<td>150</td>
<td>7.0 kN / 150 mm</td>
</tr>
<tr>
<td>225</td>
<td>450</td>
<td>3.5 kN / 225 mm</td>
</tr>
<tr>
<td>75</td>
<td>150</td>
<td>3.5 kN / 75 mm</td>
</tr>
</tbody>
</table>

Minimum concrete dimensions [mm]
| $a_a$ | 200 | 200 | 200 | 200 |
| $a_r$ | 100 | 100 | 100 | 100 |
| $a_e$ | 20  | 20  | 20  | 20  |
| $a_f$ | 20  | 20  | 20  | 20  |
| $d$ | 100 + cover | 75 + cover | 100 + cover | 75 + cover |

Notes:
Self-tapping fixtures and the structure must be capable of supporting the loads. Fixtures should be positioned in the centre third of the rail width and no closer than 25 mm from the end of the channel. For pure tensile loads edge distances may be reduced to a minimum of 50 mm with a corresponding reduction in allowable load according to the formula: Reduced $a_r$ = (Reduced load x $a_r$) / recommended load.
Further design information is available in the HALFEN Cast-in channels, Technical Product Information.
HALFEN CURTAIN WALL SUPPORT SYSTEMS

Edge of Slab Brackets HCW-ED / -EW

Application example

HALFEN Edge of slab brackets are connected in pairs to either side of the mullion and are available in two types:

• HCW-ED brackets are designed to support both vertical and horizontal loads.
• HCW-EW brackets are designed to support horizontal wind loads only.

The brackets connections are easy to adjust.
T-head bolts M12 grade 8.8 connections are required for the mullion and cast-in channel. Pilot holes are also provided in the bracket if it is preferred to temporarily position the bracket prior to drilling the mullion for the main connection.

The brackets are manufactured from high strength aluminium. Nylatron shims are available as low-friction shims for windload brackets.
HCW-ED brackets are marked ‘R’ (right) and ‘L’ (left) with ‘UP’ at the top. Care should be taken to orientate the brackets correctly to avoid overloading the connections.

Bracket dimensions [mm]

<table>
<thead>
<tr>
<th>Size</th>
<th>Bracket type</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>J</th>
<th>L</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>small</td>
<td>HCW-ED 1</td>
<td>108</td>
<td>70</td>
<td>114</td>
<td>10</td>
<td>57</td>
<td>64</td>
<td>25</td>
<td>51</td>
<td>36</td>
<td>40</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>HCW-EW 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>medium</td>
<td>HCW-ED 2</td>
<td>133</td>
<td>70</td>
<td>127</td>
<td>10</td>
<td>64</td>
<td>64</td>
<td>51</td>
<td>51</td>
<td>36</td>
<td>40</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td>HCW-EW 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>large</td>
<td>HCW-ED 3</td>
<td>159</td>
<td>70</td>
<td>140</td>
<td>10</td>
<td>70</td>
<td>64</td>
<td>76</td>
<td>51</td>
<td>36</td>
<td>40</td>
<td>108</td>
</tr>
<tr>
<td></td>
<td>HCW-EW 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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HALFEN CURTAIN WALL SUPPORT SYSTEMS

Design Loads using two Bracket Types HCW-ED

**Interaction diagram type HCW-ED1 (small)**

- Design value of the horizontal applied load $F_{hd}$ [kN]
- Design value of the vertical applied load $F_{vd}$ [kN]
- Required connection bolts: M12 grade 8.8

**Interaction diagram type HCW-ED2 (medium)**

- Design value of the horizontal applied load $F_{hd}$ [kN]
- Design value of the vertical applied load $F_{vd}$ [kN]
- Permitted load interaction area

**Interaction diagram type HCW-ED3 (large)**

- Design value of the horizontal applied load $F_{hd}$ [kN]
- Required connection bolts: M12 grade 8.8

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Design Windloads for Brackets Type HCW-EW, Forces at the Bolt for HCW-ED

### Design windloads for type HCW-EW

<table>
<thead>
<tr>
<th>Max. applied design load $F_{vd}$ [kN]</th>
<th>Size</th>
<th>Bracket code</th>
<th>max. $F_{vd}$ [kN]</th>
<th>max. $F_{hd}$ [kN]</th>
</tr>
</thead>
<tbody>
<tr>
<td>small</td>
<td>HCW-EW 1</td>
<td>0</td>
<td>± 8.5</td>
<td></td>
</tr>
<tr>
<td>medium</td>
<td>HCW-EW 2</td>
<td>0</td>
<td>± 11.67</td>
<td></td>
</tr>
<tr>
<td>large</td>
<td>HCW-EW 3</td>
<td>0</td>
<td>± 13.96</td>
<td></td>
</tr>
</tbody>
</table>

HCW-EW brackets are for carrying windloads only

### Forces acting on the T-head bolts at the channel

To calculate the reaction force on the HALFEN T-head bolt in the connection HALFEN Curtain wall bracket to the HALFEN Cast-in channel, the design loads $F_{vd}$ and $F_{hd}$ at the connection between the curtain wall bracket and façade mullion can be multiplied with the factors $s_x$, $s_y$ and $s_z$. These factors depend on the bracket’s geometry, the load direction and the position of the bolt (see illustrations on the right). The multiplication factors to calculate the forces on the channel bolt can be found in the following table.

#### Bottom position fixing bolt (position 3)

<table>
<thead>
<tr>
<th>Bracket</th>
<th>dead load</th>
<th>wind load</th>
<th>combined load 45°</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$S_x = (F_{vd} / 2) \times s_x$</td>
<td>$S_y = (F_{hd} / 2) \times s_y$</td>
<td>$S_z = (F_{hd} / 2) \times s_z$</td>
</tr>
<tr>
<td>HCW-EW 1</td>
<td>0.5</td>
<td>3.2</td>
<td>-1.0</td>
</tr>
<tr>
<td>HCW-EW 2</td>
<td>0.5</td>
<td>3.6</td>
<td>-1.0</td>
</tr>
<tr>
<td>HCW-EW 3</td>
<td>0.5</td>
<td>4.0</td>
<td>-1.0</td>
</tr>
</tbody>
</table>

#### Top position fixing bolt (position 1)

<table>
<thead>
<tr>
<th>Bracket</th>
<th>dead load</th>
<th>wind load</th>
<th>combined load 45°</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$S_x = (F_{vd} / 2) \times s_x$</td>
<td>$S_y = (F_{vd} / 2) \times s_y$</td>
<td>$S_z = (F_{hd} / 2) \times s_z$</td>
</tr>
<tr>
<td>HCW-EW 1</td>
<td>0.6</td>
<td>1.3</td>
<td>-1.0</td>
</tr>
<tr>
<td>HCW-EW 2</td>
<td>0.6</td>
<td>1.6</td>
<td>-1.0</td>
</tr>
<tr>
<td>HCW-EW 3</td>
<td>0.6</td>
<td>1.9</td>
<td>-1.0</td>
</tr>
</tbody>
</table>

### Calculation example

**Given:**
- slab thickness = 20 cm, width of mullion = 80 mm
- projection $a = 80$ mm (see page 28, calculation basis)
- design dead load $F_{vd} = + 3.5$ kN
- design wind load (suction) $F_{hd} = + 7.0$ kN

**Selected:**
- HALFEN Bracket type HCW-ED 2

- possible projection $M = 82 \pm 25$ mm OK
- interaction diagram type HCW-ED 2 (see page 28) proves that the given load is within the permitted load interaction area OK

**Calculation of action at each HALFEN T-head bolt**

#### Bottom position fixing bolt (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
- $S_z = (3.5/2) \times (-1.0) = - 1.75$ kN

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

**Resultant bolt load**

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

**Top position fixing bolt (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
- $S_z = (3.5/2) \times (-1.0) = - 1.75$ kN

- $S_d = \sqrt{(-0.70)^2 + (13.65)^2 + (-1.75)^2} = 13.78$ kN per bolt

### SELECTED ANCHOR CHANNEL:

- HTA-R 50/30 - 350 - 3 anchors - fv (see page 22)
- with $V_{Rd} = 2 \times 5.6$ kN $>$ $2 \times |S_z| = 2 \times 1.75$ OK
- $a = 7.5$ cm
- $N^*_{Rd} = 2 \times 14.0$ kN $>$ $2 \times$ res. $S_d = 2 \times 13.78$ kN OK

### SELECTED BOLTS:

- HS 50/30 - M12 $\times 60$ gv 8.8
HALFEN Brackets HCW-B1 for top of slab are available in two load ranges and three sizes. The brackets are made of S355 grade quality galvanized steel. 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 (ordered separately).

Use HALFEN Bolts M16 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 to allow lateral expansion or as a fixed point.

### Dimensioning / Type selection

#### Design load ranges

<table>
<thead>
<tr>
<th>Load range</th>
<th>dead load $F_{vd}$ [kN]</th>
<th>wind load $F_{vd}$ [kN]</th>
<th>(wind-suction + compression)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/12</td>
<td>4</td>
<td>± 12</td>
<td></td>
</tr>
<tr>
<td>7/20</td>
<td>7</td>
<td>± 20</td>
<td></td>
</tr>
</tbody>
</table>

$F_{vd}$, $F_{hd}$: allowable design loads with a partial safety factor $\gamma_{F} = 1.35$ for dead loads and $\gamma_{F} = 1.5$ for wind loads.

#### Type selection

<table>
<thead>
<tr>
<th>Load range</th>
<th>$a$ [mm]</th>
<th>Item name</th>
<th>$L$ [mm]</th>
<th>$W$ [mm]</th>
<th>HALFEN Channel</th>
<th>Recommended HALFEN Bolt</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/12</td>
<td>50</td>
<td>4/12-50</td>
<td>270</td>
<td>150</td>
<td>HTA-CE 40/22</td>
<td>HS 40/22 M16+60 8.8</td>
</tr>
<tr>
<td></td>
<td>75</td>
<td>4/12-75</td>
<td>295</td>
<td>150</td>
<td>2 Anchors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>4/12-100</td>
<td>320</td>
<td>150</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7/20</td>
<td>50</td>
<td>7/20-50</td>
<td>270</td>
<td>175</td>
<td>HTA-CE 50/30-100</td>
<td>HS 50/30 M16+60 8.8</td>
</tr>
<tr>
<td></td>
<td>75</td>
<td>7/20-75</td>
<td>295</td>
<td>175</td>
<td>3 Anchors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>7/20-100</td>
<td>320</td>
<td>200</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$\circledast$ Recommended HALFEN Cast-in channel exploiting full load capacity of the bracket.
HALFEN Brackets HCW-B2 are made of S355 grade quality galvanized steel. The vertical adjustability is ± 24 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 M12 screws (ordered separately).

Use HALFEN Bolts M16 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 to allow lateral expansion or as a fixed point.
DETAN - The perfect system for supporting curtain wall systems

DETAN Tension rods are engineered to a high standard and aesthetically finished to give complete creative freedom in the design of glass and metal façades. DETAN Tension rods are used for both bracing and support of most façade elements and other architectural features. The system components are outlined below. Further details are available in the DETAN catalogue.
A typical installation can consist of some or all of the standard components as shown. Please note how the system length \( L \) is defined.
## DETAN Components in carbon steel and stainless steel

### Anchor discs
- Anchor disc with 4 tension rods
- Maximum of 8 rod connections per disc
- Cross coupler

### Cross coupler dimensions [mm]: Material specification: Steel strength grade S355J2, hot-dip galvanized

<table>
<thead>
<tr>
<th>System diameter d_s</th>
<th>16</th>
<th>20</th>
<th>24</th>
<th>27</th>
<th>30</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coupler length L_M</td>
<td>142</td>
<td>166</td>
<td>200</td>
<td>222</td>
<td>242</td>
<td>284</td>
</tr>
<tr>
<td>Coupler diameter d_M</td>
<td>32</td>
<td>39</td>
<td>46</td>
<td>52</td>
<td>57</td>
<td>70</td>
</tr>
<tr>
<td>Crossing rod Ø d_g</td>
<td></td>
<td>16</td>
<td>20</td>
<td>24</td>
<td>27</td>
<td>30</td>
</tr>
</tbody>
</table>

### Anchor disc dimensions [mm]: Material specification: Steel strength grade S355J2, hot dip galvanized

<table>
<thead>
<tr>
<th>System - Ø d_s</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>16</th>
<th>20</th>
<th>24</th>
<th>27</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective diameter Ø f</td>
<td>200</td>
<td>210</td>
<td>240</td>
<td>260</td>
<td>310</td>
<td>360</td>
<td>420</td>
<td>450</td>
<td>490</td>
</tr>
<tr>
<td>Anchor disc diameter Ø g</td>
<td>120</td>
<td>146</td>
<td>186</td>
<td>238</td>
<td>280</td>
<td>318</td>
<td>346</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Anchor disc dimensions [mm]: Stainless steel A4, strength grade S235

<table>
<thead>
<tr>
<th>System - Ø d_s</th>
<th>10</th>
<th>12</th>
<th>16</th>
<th>20</th>
<th>24</th>
<th>27</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective diameter Ø f</td>
<td>90</td>
<td>110</td>
<td>140</td>
<td>180</td>
<td>210</td>
<td>240</td>
<td>260</td>
</tr>
<tr>
<td>Anchor disc diameter Ø g</td>
<td>120</td>
<td>146</td>
<td>186</td>
<td>238</td>
<td>280</td>
<td>318</td>
<td>346</td>
</tr>
</tbody>
</table>

### Couplers
- Available with or without lug for suspension connection

### Dimensions [mm]: Material: Stainless steel A4 (1.4404 / 1.4571), strength grade S355

<table>
<thead>
<tr>
<th>System - Ø d_s</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>16</th>
<th>20</th>
<th>24</th>
<th>27</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coupler length L_M</td>
<td>34</td>
<td>40</td>
<td>40</td>
<td>50</td>
<td>62</td>
<td>78</td>
<td>94</td>
<td>104</td>
<td>120</td>
</tr>
<tr>
<td>Coupler - Ø d_M</td>
<td>12</td>
<td>15</td>
<td>20</td>
<td>22</td>
<td>28</td>
<td>35</td>
<td>42</td>
<td>47</td>
<td>53</td>
</tr>
<tr>
<td>Screw-in depth a_m</td>
<td>10.5</td>
<td>12.5</td>
<td>15.0</td>
<td>18.5</td>
<td>22.5</td>
<td>27.0</td>
<td>34.0</td>
<td>37.5</td>
<td>42.5</td>
</tr>
<tr>
<td>Screw-in adjustment ø</td>
<td>4.5</td>
<td>4.5</td>
<td>5.0</td>
<td>6.5</td>
<td>7.5</td>
<td>8.0</td>
<td>11.0</td>
<td>12.5</td>
<td>12.5</td>
</tr>
<tr>
<td>Suspension system size - Ø d_M</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>6</td>
<td>6</td>
<td>8</td>
<td>8</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Hole position k_M</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>27.5</td>
<td>33.0</td>
<td>37.0</td>
<td>44.0</td>
<td>50.5</td>
<td>57.5</td>
</tr>
</tbody>
</table>

### Dimensions [mm]: Material: Steel strength grade S355J2 Hot dip galvanized

<table>
<thead>
<tr>
<th>System - Ø d_s</th>
<th>10</th>
<th>12</th>
<th>16</th>
<th>20</th>
<th>24</th>
<th>27</th>
<th>30</th>
<th>36</th>
<th>42</th>
<th>48</th>
<th>52</th>
<th>56</th>
<th>60</th>
<th>67</th>
<th>85</th>
<th>95</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coupler length L_M</td>
<td>40</td>
<td>50</td>
<td>62</td>
<td>78</td>
<td>94</td>
<td>104</td>
<td>120</td>
<td>140</td>
<td>158</td>
<td>180</td>
<td>195</td>
<td>210</td>
<td>245</td>
<td>328</td>
<td>370</td>
<td>450</td>
</tr>
<tr>
<td>Coupler - Ø d_M</td>
<td>20</td>
<td>22</td>
<td>28</td>
<td>35</td>
<td>42</td>
<td>47</td>
<td>53</td>
<td>64</td>
<td>75</td>
<td>87</td>
<td>93</td>
<td>98</td>
<td>104</td>
<td>155</td>
<td>180</td>
<td>195</td>
</tr>
<tr>
<td>Screw-in depth a_m</td>
<td>15.0</td>
<td>18.5</td>
<td>22.5</td>
<td>27.0</td>
<td>34.0</td>
<td>37.5</td>
<td>42.5</td>
<td>51.0</td>
<td>55.0</td>
<td>62.5</td>
<td>70.5</td>
<td>77.5</td>
<td>85.0</td>
<td>115</td>
<td>130</td>
<td>155</td>
</tr>
<tr>
<td>Screw-in adjustment ø</td>
<td>5.0</td>
<td>6.5</td>
<td>7.5</td>
<td>8.0</td>
<td>11.0</td>
<td>12.5</td>
<td>12.5</td>
<td>14.0</td>
<td>15.0</td>
<td>17.5</td>
<td>20.0</td>
<td>22.5</td>
<td>25.0</td>
<td>39</td>
<td>45</td>
<td>60</td>
</tr>
<tr>
<td>Suspension system size - Ø d_M</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>16</td>
<td>16</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>Spacing bolts. k_M</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>230/10</td>
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<td></td>
</tr>
</tbody>
</table>

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