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

As experience shows, each project designed and built has a unique set of requirements, conditions and restrictions. To be constructed on time and within budget the building must be designed, engineered and executed with precision.

The glazed curtain wall, being the virtual skin of the building is often the most salient feature of many construction projects. However, for the curtain wall to perform "as designed" the fixing systems supporting it must also be carefully designed, engineered and installed. The comfort, well being and safety of the buildings’ occupants depend on them.

Today, curtain wall façades are increasingly selected by designers and clients. The curtain wall can comprise of glass, metal or stone elements supported by a steel or aluminium frame. The frame is either factory-assembled with the façade elements to form a panel, or is put together on site.

The design, engineering, manufacturing and installation of glazed curtain wall systems involves a variety of professionals and contractors. The fixing and bracket system used to transmit the loads from the curtain wall to the structure is a key component of the system. Just like the curtain wall itself, the fixing system used must be properly designed, engineered, manufactured and installed in order to perform.

HALFEN HCW brackets fixed using HALFEN channels and T-bolts are the preferred connection method between the façade and the building structure, maximising efficiency and reliability of installation.

For detailed cast-in channel information see the current HALFEN Cast-in Channel brochure.
For any given project there are a number of factors which may influence the choice of system:

- Type of curtain wall - unitised/stick
- Type of structure - Steel/Concrete
- Loads - Weight/Live/Wind/Snow/Seismic/Blast
- Slab design - Thickness/Strength/Obstructions/Post-tensioning/Rib Detail
- Architectural details - Vision/Spandrel glass/Raised floors

Brackets that make the connection between the mullion and the structure must be calculated to resist loads with an adequate safety factor. It is important to note that such brackets may significantly increase the resultant load at the fixing to the structure due to their eccentricity. Brackets are frequently required to allow for the thermal expansion and contraction of unitised panels.

Several recent developments have affected the design and engineering of facade anchoring systems. Building code updates have resulted in higher wind loads. Heavier curtain wall designs, often with insulated or laminated glass frequently result in higher dead loads. Blast loads are one more variable that many major projects must now consider. The static loads that the fixing system need to resist are dealt with by curtain wall contractors and fixing companies on a daily basis. Blast dynamics is a specialist subject which Halfen would be pleased to discuss on a job basis.
Façade fixing with HALFEN Cast-in channels

The HALFEN channel system comprises channels that are cast into the concrete frame of the structure, to which façade brackets can be connected by using special T-head bolts. The system provides an ideal method for the connection of façade systems.

Corner and edge installation

Façades often require multiple connections or connections close to corners and concrete edges. HALFEN provides product design assistance to ensure that loads are efficiently transferred into the structure and that channels can be accurately placed.

- **Welded Corner Assembly**: Factory fabricated assembly allows bolt fixings close to corner edge. Additional spacer straps may be added to help placing in the formwork.
- **Fabricated Channel Pair**: Factory manufactured to provide accurate channel spacing.
- **Fabricated “Ski” Assembly**: Factory fabricated assembly simplifies channel positioning on top of metal deck ribs & from slab edge.
- **Special Anchor Fabrications**: to allow positioning and fixing the channel to the base of the deck.

Nail channel securely to formwork.
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 provide convenient connection adjustment. High strength M12 bolts are required to the mullion with T-head bolts providing the connection to the 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 code</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>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>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>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>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>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>
</tbody>
</table>

serrated washers included
**Design windloads for type HCW-EW**

<table>
<thead>
<tr>
<th>Max. applied design load $F_{vd}$ [kN]</th>
<th>Size Bracket code</th>
<th>max. $F_{vd}$ [kN]</th>
<th>max. $F_{hd}$ [kN]</th>
</tr>
</thead>
<tbody>
<tr>
<td>small HCW-EW 1</td>
<td>0</td>
<td>± 8.5</td>
<td></td>
</tr>
<tr>
<td>medium HCW-EW 2</td>
<td>0</td>
<td>± 11.67</td>
<td></td>
</tr>
<tr>
<td>large 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 get the design action on the HALFEN T-head bolt connecting HALFEN Curtain wall bracket and HALFEN channel, the design loads $F_{vd}$ and $F_{hd}$ at the connection between 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, on the load direction and on the position of the bolt (see drawings right).

The following tables show the multiplication factors for determination of the forces at the channel bolt to calculate with.

**Calculation example**

**Bottom position fixing bolt (position 3)**

<table>
<thead>
<tr>
<th>Bracket</th>
<th>dead load $S_x = \left(\frac{F_{vd}}{2}\right) \times s_x$</th>
<th>wind load $S_y = \left(\frac{F_{hd}}{2}\right) \times s_y$</th>
<th>combined load $45^\circ$ $S_z = \left(\frac{res. F_d}{2}\right) \times s_z$</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCW-ED 1</td>
<td>0.5 3.2 -1.0 -1.0 1.0 0.0 -0.3 3.0 -0.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HCW-ED 2</td>
<td>0.5 3.6 -1.0 -0.5 1.0 0.0 0.0 3.3 -0.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HCW-ED 3</td>
<td>0.5 4.0 -1.0 -0.4 1.0 0.0 0.1 3.5 -0.7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Top position fixing bolt (position 1)**

<table>
<thead>
<tr>
<th>Bracket</th>
<th>dead load $S_x = \left(\frac{F_{vd}}{2}\right) \times s_x$</th>
<th>wind load $S_y = \left(\frac{F_{hd}}{2}\right) \times s_y$</th>
<th>combined load $45^\circ$ $S_z = \left(\frac{res. F_d}{2}\right) \times s_z$</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCW-ED 1</td>
<td>0.6 1.3 -1.0 -1.0 3.6 0.0 -0.3 3.4 -0.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HCW-ED 2</td>
<td>0.6 1.6 -1.0 -0.5 3.1 0.0 0.0 3.4 -0.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HCW-ED 3</td>
<td>0.6 1.9 -1.0 -0.4 2.9 0.0 0.1 3.4 -0.7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Calculation basis**

**Load scheme for bolt connections between**

- Bracket / mullion
- Bracket / HALFEN channel

**Bottom position of fixing bolt (position 3)**

**Top position of fixing bolt (position 1)**

**Given:** slab thickness = 20 cm, width of mullion = 80 mm

projection a = 80 mm → p. 28, calculation basis)

design deadload $F_{vd} = +3.5$ kN
design windload (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 → p. 28) shows that the given loading is within the permitted load interaction area OK

**Determination of forces at each HALFEN T-head bolt**

**bottom bolt 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

**top bolt 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

⇒ resultant bolt load

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

**SELECTED ANCHOR CHANNEL:**

HTA-R 50/30 - 350 - 3 anchors - fv (see → page 22)

with $V_{yRd} = 2 \times 5.6$ kN $> 2 \times S_z = 2 \times 1.75$ OK
($a_z \geq 7.5$ 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 technical helpline: 01582 470375 www.halfen.co.uk
HALFEN CURTAIN WALL SUPPORT SYSTEMS
Top of slab brackets type HCW-B1

Support bracket for horizontal and vertical loads

HALFEN Top of slab brackets type HCW-B1 are available in two load ranges and three sizes, and are fabricated from high strength zinc plated steel. They are designed for high load façade connections requiring up to ±10 mm of vertical adjustment.

Combined with HALFEN cast-in channels they provide three dimensional adjustment for façade connections. Connecting plates are fastened to either side of the mullion using M8 fasteners (not included) and connections to the HALFEN channel are made using two M16 T-bolts (ordered separately). The connecting plates can be allowed to move laterally or locked in position on the bracket according to design requirements.

<table>
<thead>
<tr>
<th>Design load ranges</th>
<th>load range [kN]</th>
<th>dead load $F_{vd}$ [kN]</th>
<th>wind load $F_{hd}$ (suction + compression) [kN]</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/12</td>
<td>4</td>
<td>±12</td>
<td></td>
</tr>
<tr>
<td>7/24</td>
<td>7</td>
<td>±24</td>
<td></td>
</tr>
</tbody>
</table>

$F_{vd}, F_{hd}$: applied design loads using $\gamma_F = 1.35$ for dead loads and $\gamma_F = 1.5$ for wind loads.

<table>
<thead>
<tr>
<th>Type selection</th>
<th>load range [kN]</th>
<th>a [mm]</th>
<th>designation</th>
<th>L [mm]</th>
<th>W [mm]</th>
<th>HALFEN channel</th>
<th>recomm. T-head bolt</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/12</td>
<td>50</td>
<td>HCW-B1-4/12-50</td>
<td>270</td>
<td>150</td>
<td></td>
<td>HTA 40/22*</td>
<td>HS 40/22 M16x60 8.8</td>
</tr>
<tr>
<td></td>
<td>75</td>
<td>HCW-B1-4/12-75</td>
<td>295</td>
<td>150</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>HCW-B1-4/12-100</td>
<td>320</td>
<td>150</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7/24</td>
<td>50</td>
<td>HCW-B1-7/24-50</td>
<td>270</td>
<td>150</td>
<td></td>
<td>HTA 50/30*</td>
<td>HS 50/30 M16x60 8.8</td>
</tr>
<tr>
<td></td>
<td>75</td>
<td>HCW-B1-7/24-75</td>
<td>295</td>
<td>175</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>100</td>
<td>HCW-B1-7/24-100</td>
<td>320</td>
<td>200</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Recommended HALFEN cast-in channel at fully loaded bracket

* Channel could be hot rolled or cold folded
* Channel length and anchors agreed on job basis
* Bolts could be grade 4.6 or 8.8 as agreed on job basis
HALFEN CURTAIN WALL SUPPORT SYSTEMS
Top of slab brackets type HCW-B2

Support bracket for horizontal and vertical loads

HALFEN Top of slab brackets type HCW-B2 are fabricated from high strength zinc plated steel. They are designed for high load façade connections requiring up to ± 24 mm of vertical adjustment.

Combined with HALFEN cast-in channels they provide three dimensional adjustment for façade connections. Connecting plates are fastened to either side of the mullion using M12 fasteners (not included) and connections to the HALFEN channel are made using two M16 T-bolts (ordered separately). The connecting plates can be allowed to move laterally or locked in position on the bracket according to design requirements.

* Channel profile used as example only, other channels are suitable, please consult Halfen

Other types of bracket are available to accommodate different load capacities and situations. Please consult Halfen
The New Street Square development in London EC4 included 46,000 square metres of curtain walling.

Installation systems fixed to Halfen channels enabled around 25 curtain wall panels to be installed per day.

A monorail system, comprising a beam on cantilevered brackets, was fixed to Halfen channels cast into the reinforced concrete floor slab. The beam assembly was fixed up to 5 floors above the level at which the curtain wall panels were to be installed. The system, which has a safe load capacity of 1 ton, was used to raise the panels and swing them out into position on the outside of the building, ready for installation. The panels were then fixed in position to brackets that had been pre mounted, lined and levelled on Halfen channel cast into the floor slab.

When all the panels below the monorail had been installed, the system was demounted from the cast in channels, moved up another 5 floors and reinstalled. The channels that had just been used to secure the monorail lower down the building were then used to fix the brackets for the next level of panels. This re-use of the Halfen cast in channel provided an adjustable fixing point which removed the need for repeated drilling and the associated problems of noise, vibration and dust.

The monorail system means that the curtain wall contractor does not have to depend on weather conditions and the availability of on-site cranes. If winds are too strong to work safely on one side of the building, they can move to another side of the building and continue installation. They can also work on more than one elevation at a time.
HALFEN CURTAIN WALL SUPPORT SYSTEMS

Advantages of the HALFEN Channel system

HALFEN Channel

Cast-in Channel Advantages

- No reduction in working time due to noise, vibration, dust or drill operator safety restrictions
- No risk of damaging concrete due to blows from power tools
- No damage to reinforcement
- No concerns about oversize diameter or shallow holes being drilled, reducing load capacities
- Can be cast-in close to concrete edges
- Multiple fixings at close spacings
- Very fast and easy to install with little dependence on skill of operator
- Instant loading without waiting for chemical resin anchors to harden
- Reduced installation times for subsequent fixings and no need for power supply
- Channel accepts wide range of ties, t-bolts and locking plates
- Channels available in galvanised steel or stainless steel
- Engineered solution gives confident load performance
- Once cast-in, channel may be used by multiple trades ie temporary fixings, hand rails etc
- Can be re-used during life of the building
Other products from Halfen:

- Cast-in channels
- Kwikastrip reinforcement continuity
- Brickwork support and restraint
- HIT insulated balcony connector
- Precast lifting
- CRET shear dowel connector