HALFEN IN TUNNELS:
Fixing and Installation Technology

Safety is the only solution

HALFEN

YOUR BEST CONNECTIONS

FIXINGS IN TUNNEL PROJECTS

and the benefits for construction

A modern industrial society requires an efficient and reliable transport infrastructure. This applies equally to both road and rail systems.

Tunnel excavation projects place particularly high demands on geological assessment and on the structural design of the cross-section of the tunnel. Personal protection, fire prevention, corrosion protection, technical equipment and the durability of the structure require considerable forethought, which usually requires years of planning.
Thanks to high-performance tools, machines and construction materials which are available today, tunnels can be built in a much shorter time than only a few decades ago.

The long service life requirements of 100 years or more, depending on the various external influences (dynamic effects, impact loads, fire and corrosion) and the high demands on sustainability (maintenance and repair) also place the highest demands on the fixings in the tunnel.

HALFEN has many years of experience in fixing technology for the most diverse requirements in tunnel projects. On the one hand, experience in fixing of safety-relevant equipment, this includes overhead (catenary) lines, service supply systems, signalling systems, lighting equipment, doors, ventilation systems or accident recovery anchors, and on the other hand, experience in the various methods of the actual tunnel construction process.

This applies to the cut and cover and the traditional methods of construction, where a large number of reliable and efficient HALFEN Fixing systems have been installed to meet the stipulated project demands. HALFEN has a very large selection of system components for the concrete sector; this includes anchoring, reinforcement, lifting anchors and façade systems for permanent and positive load connections. To meet the rapidly growing demand, HALFEN also offers a large number of application solutions for transporting precast wall elements and base tubbing segments. Furthermore HALFEN has a wide range of façade element fixings as well as various products for efficient fixing of most precast elements.

HALFEN Framing channel technology with adaptable types of bolt connections and quick and easy adjustable fixings including pre-assembled connections provide a very economical system solution for the installation of tunnel equipment.

The HALFEN team of specialist tunnel engineers ensures there is technical support at all times.

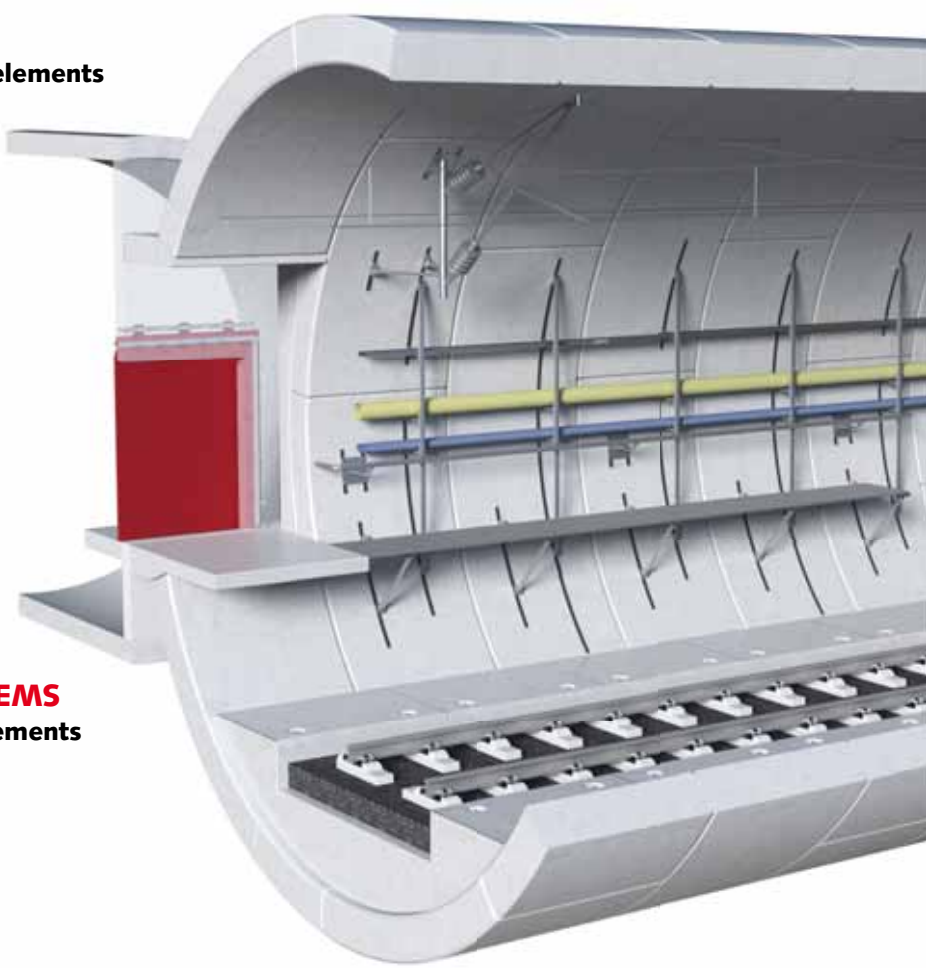
Contents

Title: © tomjasny.com

HALFEN Applications

APPLICATION IN RAIL TUNNELS

In this example the rail tunnel was designed using tubbing segments.
Most of the HALFEN solutions illustrated here are also suitable for use in cast-on-site concrete elements.



HALFEN CHANNELS

Fixing of building components to concrete elements

- Overhead cantenary systems
- Door fixings / emergency, cross passage doors
- Access walkways
- Hand rails/safety barriers
- Utility and service installations
- Signalling equipment
- Signage

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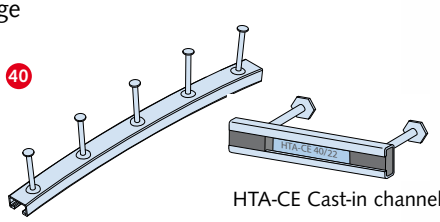

HTA-CE Cast-in channel

HTA-CS Curved cast-in channel

HALFEN TRANSPORT ANCHOR SYSTEMS

Transport and lifting of precast concrete elements

- Tubbing segments
- Ballastless tracks
- Façade elements
- Base segment

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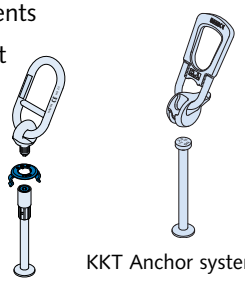


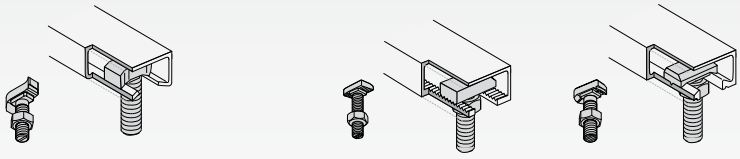
KKT Anchor system

HD Sleeve anchor system

Anchoring systems ▶ **HALFEN Channels** and **HALFEN Bolts** make up a **system** ◀ **Framing technology**

HALFEN special bolts are suitable for all HALFEN Channels:

- quick and simple installation of components without drilling
- subsequent installation or fixing of further components is always possible
- temporary fixings during construction

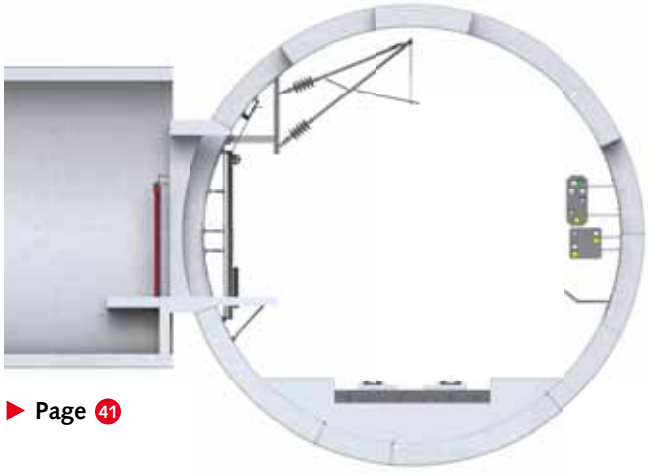


HS HALFEN Bolt with nut

HZS Bolt, serrated

HSR Bolt, nibbed

HALFEN HTA-CS Curved Solution:
Applications in section



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Section: Rail tunnel with cross passage door, HTA-CS Curved channel

HALFEN FRAMING CHANNELS

- Post-install fixings for maintenance
- Upgrade of technical equipment and production facilities
- Applications as for cast-in channels

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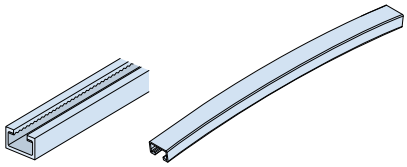

HALFEN Framing channels,
straight and curved

FLEXIBLE FRAMING SYSTEM
Quick installation in tunnels

- Heavy pipe systems
  (for example, emergency water supply, drainage pipes)
- Heavy cables (for example, electrical power cables)

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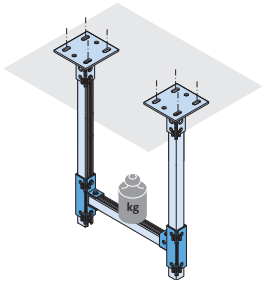

HALFEN POWERCLICK System

HALFEN BRACKETS

Supports for:

- Heavy pipe systems
  (for example, emergency water supply, drainage pipes)
- Heavy cables (for example, electrical power cables)
- Access paths

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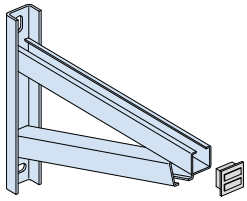


HALFEN Bracket including end cap

HALFEN PROJECT

Lötschberg Base Tunnel, Switzerland

Cast-on-site concrete, inner tunnel lining
© Elkuch Bator AG, Switzerland, www.elkuch.com

HALFEN Products: Anchoring systems

HALFEN HTA-CE CAST-IN CHANNELS
THE INTELLIGENT ALTERNATIVE TO DRILLING AND WELDING

HTA-CE
Standard HALFEN Cast-in channels

HALFEN Cast-in channels are the ideal basis for easy-to-assemble, adjustable fixings. Filler strips prevent the concrete seeping into the channel. Numerous types of secondary components can be connected or fixed to the HALFEN Cast-in channels.

APPLICATIONS:

- fixing of cross passage doors
- fixing of systems subjected to dynamic loads

Lötschberg and Gotthard Base Tunnel
Switzerland

The Lötschberg and Gotthard transit axes are at the heart of Europe's most important freight corridor, connecting Rotterdam (Netherlands) and Genoa (Italy); the so-called Rhine-Alps corridor. The Lötschberg base tunnel has a length of 34.6 km and has 174 cross passage doors. The connections through the cross passage doors are typically used as escape routes. The total length of the Gotthard Base Tunnel is 57 km (currently the longest tunnel in the world), it consists of two single-track tunnels with 350 sliding cross passage doors.

The cross passage doors are fixed to hot-rolled HALFEN Cast-in channels. The doors are subjected to fatigue related stresses caused by passing trains; these stresses in particular can be effectively absorbed by the hot-rolled channels.

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

CE European Technical Assessment ETA-16/0453 0432-CPR-00402-01

Further Information
Please refer to our Technical Product Information to find out more about HALFEN HTA-CE Cast-in channels.

www.halfen.com

Cross passage door, closed, Lötschberg Base Tunnel

Installed sliding cross passage door, Gotthard Base Tunnel

HALFEN PROJECT

Shenzen Metro Line, China

Tunnel boring machine (TBM) in use

HALFEN Products: Anchoring systems

HZA DYNAGRIP – SERRATED HALFEN CHANNELS

HZA DYNAGRIP

Serrated HALFEN Cast-in channels

The serration in the channels ensures positive locking anchorage in the longitudinal direction of the channel, even at high loads.

APPLICATION:

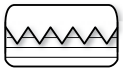
- fixing overhead cantenary systems
- fixing various equipment
- fixings subjected to dynamic loads

Shenzen Metro Line 9
Shenzen, China
Line 9 of the Shenzhen Metro has an overall length of approximately 25 km. The Metro starts in Hongshu Bay and ends in Wenjin, with 22 stations along the route.

The Shenzen Metro is one of many metro projects in which the advantages of HALFEN Cast-in channels are applied. In each tubbing-ring segment of the tunnel 16 metres of cast-in channels were installed to form a channel ring, to which the technical equipment, including the electrical conductor rail, was attached.

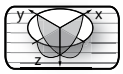
Hot-rolled, serrated cast-in channels were selected for this project as they meet all the requirements for loads in all directions, are suitable for dynamic loads and seismic loads and also fulfil the fire and corrosion protection requirements.

Safe and reliable. Quick and economical.

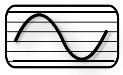


Serrated

officially App. No Z-21.4-1691 approved



3D loads



Suitable for dynamic loads

Further information
Please refer to our Technical Product Information to find out more about serrated HALFEN Channels.

www.halfen.com

HALFEN HZA 29/20 Channels cast into tubbing segments

Underwater storage of tubbing segments

HALFEN PROJECT

Finnetunnel, Germany

Tunnel constructed using precast tubbing segments with service equipment installed

HALFEN Products: Anchoring systems

HTA-CS – HALFEN CURVED CAST-IN CHANNELS

Finnetunnel

Finne (Saxony-Anhalt), Germany

Completed at the end of 2011, the newly constructed Deutsche Bahn AG (German railway company) Erfurt-Leipzig/ Halle line is part of the high-speed Berlin to Munich link, which in turn is part of the Trans-European rail network. The new rail link has been designed for a maximum speed of 300 km/h.

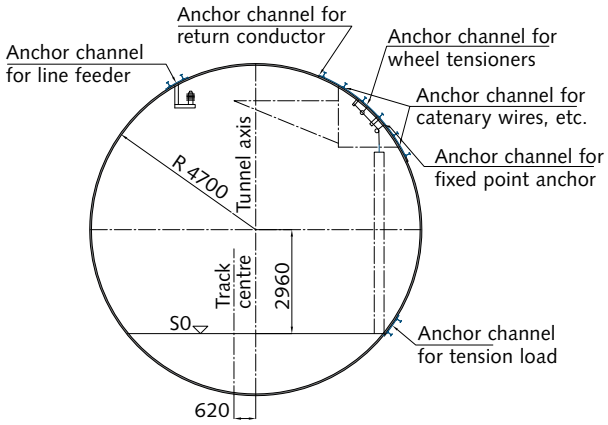
Approximately 48,000 tubbing segments were required for the tunnel length of approximately 6.9 km. Using cast-in channels eliminated the need to post-install a fixing system in the tunnel. Subsequently, all that was required was to install the actual service and operating systems.

HTA-CS – Curved Solution

As soon as building projects include curves, object specific specifications arise for any required components. In these cases HALFEN Cast-in channels can usually be curved according to demand. Curved channels can be manufactured as individual segments or, if requested, as complete rings.

APPLICATION:

- fixing overhead cantenary systems
- fixing various equipment
- fixings subjected to dynamic loads



Sample custom project: Support provided by HALFEN

Further information

Please refer to our Technical Product Information to find out more about curved HALFEN Cast-in channels.

www.halfen.com

Storage of tubbing segments with cast-in HALFEN Channels

HALFEN HTA-CS 52/34 Curved cast-in channels, as delivered

HALFEN PROJECT

Albaufstieg 'Alb ascend' tunnels
Stuttgart to Ulm, Germany

Tunnel in tubbing construction method during construction

HALFEN Products: Anchoring systems

ACCESSORIES FOR HALFEN CAST-IN CHANNELS: HALFEN FIXING CONE

Stuttgart–Ulm Rail project PFA 2.2 ***Albaufstieg, 'Alb ascend' railroad access to the 'ALB' region of Germany***

In the Stuttgart to Ulm rail project, the construction of the 'Alb ascend' tunnels was managed by a consortium of companies; these included PORR, G. Hinteregger, ÖSTU-STETTIN and SWIETELSKY. The 'Alb ascend' consists of the Bossler-tunnel (tubbing segment construction) and the Steinbühl-tunnel (on-site concrete construction), each of which is designed as two single-track tunnels.

To provide a secure fixing for the overhead catenary system HALFEN Cast-in channels were cast into the concrete of both tunnels. HALFEN Fixing cones were used to ensure precise positioning of the HALFEN Cast-in channels to the steel formwork during production of the tubbing segments, resulting in significant time savings. Once the concrete has cured, the tubbing segment is simply lifted out of the formwork as the plastic screw has a design breaking point; the cone remains fixed to the formwork for further use, if required.

HFK Fixing cone

The System includes:

Plastic bolt with A4 washer

- plastic bolt with design breaking point as failure element in the installation system

Fixing cone with spanner flats

- precise positioning of cast-in channels using fixing cones

M12 Sealing plugs

- for sealing drill holes in steel formwork; this allows the same formwork to be used to cast tubbing segments with or without cast-in channels.

APPLICATION:

- for simple, quick and adjustable fixing of cast-in channels to steel formwork
- suitable for easy accessibility for installation solely from above the formwork

Further information

Please refer to our Technical Product Information to find out more about our accessories for HALFEN Channels.

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Fixing HALFEN Cast-in channels to the formwork for a tubbing segment using HFK Fixing cones

Source: Herrenknecht Formwork

Lifting a tubbing segment at a precast production plant

HALFEN PROJECT

Allegheny North Shore Connector Tunnel
Pittsburgh/USA

Tubbing segment built tunnel with utilities system installed

HALFEN Products: Framing technology

HALFEN FRAMING CHANNELS – FLEXIBLE BOLT CONNECTIONS

Allegheny North Shore Connector Tunnel

Pittsburgh, United States of America

The Allegheny North Shore Connector tunnel is part of a 1.9 kilometer extension of the 40 kilometer long, urban rail link in Pittsburgh, Pennsylvania.

The tunnel under the Allegheny River connects downtown Pittsburgh to the north shore region of the city. This regional investment will significantly improve the potential for development in the Pittsburgh region.

In addition, the tunnel is part of the transformation of Pittsburgh's automobile orientated infrastructure to a public transport orientated system.

HALFEN Curved cast-in channels were installed to the precast segments in the tunnel. This provided a cost effective system for fixing heavy operating and service utilities, including firefighting equipment.

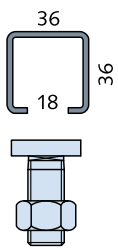
HALFEN Framing channels

HALFEN Framing channels together with the corresponding HALFEN Bolts (alternatively threaded plates) have all the advantages required of adaptable bolt connections and framing structures. The system's flexibility means the most economical solution can be selected for the specified requirements.

APPLICATION:

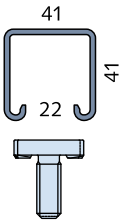
- fixing service and drainage pipes
- fixing firefighting equipment

▼ Light duty support system



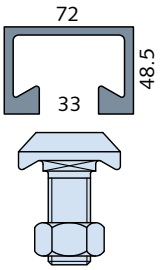
HM 36/36
with HS 38/17

▼ Medium duty support system



HM 41/41
with HZS 41/41

▼ Heavy duty support system



HM 72/48
with HS 72/48

Further information

Please refer to our Technical Product Information to find out more about HALFEN Framing channel systems.

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Fixing of pipe supports to galvanized, hot-rolled HM Channels

Fixing of pipe systems

HALFEN PROJECT

Brenner Base Tunnel, Austria

Installing base elements in an exploratory tunnel

© BBT SE

HALFEN Products: Transport anchor systems

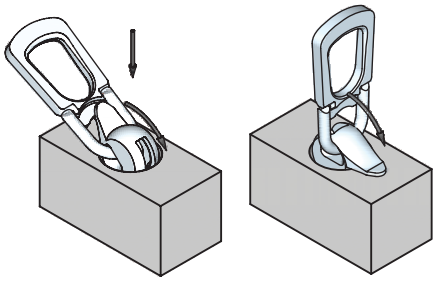
DEHA SPHERICAL HEAD ANCHOR WITH UNIVERSAL HEAD LIFTING CLUTCH

HALFEN Transport anchor systems

HALFEN Transport anchor systems are used when precast concrete elements need to be moved precisely and safely. A single transport anchor system consists of an anchor cast in the concrete element, a recess former and a load lifting clutch. The two components of a system are quickly connected for transport, either by simply screwing the respective lifting clutch into the anchor, or with the easy-to-attach universal head lifting clutch.

APPLICATION:

- tubbing segments
- base segment slabs
- ballastless tracks
- façade elements



- quick
- safe
- simple

Brenner Base Tunnel (BBT) Los Tulfes-Pfons, Exploratory tunnel, Ahrental-Pfons

Innsbruck, Austria

The Brenner Base Tunnel consists of two main tunnels, an east and a west tunnel, with a lower exploratory tunnel underneath. The tunnel project with a total length of 55 km, connects Innsbruck in Austria to Franzenfeste/Fortezza in Italy.

A branch tunnel to Tulfes on the Austrian side of the tunnel will result in a total length of 64 km after completion, making the BBT the longest tunnel in the world. In the Ahrental-Pfons exploratory tunnel the base element is designed as a drainage channel to drain mountain water, and is covered with a slab. Using KKT Spherical head anchors in this project to lift, transport and install the prefabricated cover slabs proved very time and cost effective.

Further information

Please refer to our Technical Product Information to find out more about DEHA Spherical head lifting systems.

www.halfen.com

Cover slab; each slab has four cast-in KKT Spherical head transport anchor points

Cross section showing the base segment in detail with cover slab in place

HALFEN PROJECT

Antwerp North-South Link (ASDAM), Belgium

Single track rail tunnel during construction

HALFEN Products: Framing technology

HALFEN FRAMING CHANNELS – FOR SPECIAL DEMANDS

North-South Link (ASDAM)
Antwerp, Belgium

This rail tunnel runs under the centre of Antwerp and consists of two single-track tunnels and was constructed using the tubbing segment method (7 segments plus 1 capstone with a thickness of 35 cm). The total length of the high-speed line is 2.5 km and the diameter of the tunnel is 8.27 m.
Special framing channels were produced for the permanent fixings for the tunnel service equipment. These framing channels were fitted where the screw connections in the transverse joints of the tubbing segments are normally located. Steel flanges with an appropriate bolt hole were welded onto the back of the curved framing channels. This allowed the channels to be fixed into the pockets of the prefabricated tubbing segments that are necessary for the fixing bolts to secure the individual tunnel elements.

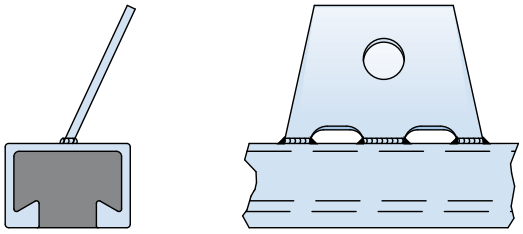
This solution was used in two further tunnels in Belgium: the Diabolo tunnel (approx. 2 km long), for the north rail link to Brussels Airport (finished in 2012), and the Liefkenshoek Rail Link (approx. 6 km long) for crossing under the river Schelde and the canal dock, which entered service at the end of 2014.

Framing channels:
Curved and weldable

Hot-rolled framing channels are particularly suitable for heavy loads, dynamic loads, and if weldability is an issue. This ensures that special customer specifications can also be realized to ultimately attain quick and efficient assembly at the construction site.

APPLICATION:

- for retrofit connections
- installing technical and service equipment
- high loads
- dynamic loads



Hot-rolled HALFEN HM 72/48 Channel
steel flange with predrilled bolt hole welded to back

Further information
Please refer to our Technical Product Information to find out more about HALFEN Framing systems.

www.halfen.com

HM 72/48 Framing channel bolted to transverse joint

Tunnel wall with additional fire protection layer between the framing channels.

HALFEN Application

APPLICATION IN UTILITY TUNNELS

In this example the utility tunnel was designed using tubbing segments.
Most of the HALFEN solutions illustrated here are also suitable for use in cast-on-site concrete elements.

HALFEN FRAMING CHANNELS

- Subsequent installations in upgrade and repair projects
- Expansion or upgrade of technical equipment and production facilities
- Applications as for cast-in channels

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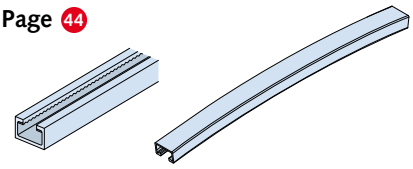

HALFEN Framing channels, straight and curved

HALFEN TRANSPORT ANCHORS

Transport and lifting of precast elements

- Tubbing segments
- Base slabs

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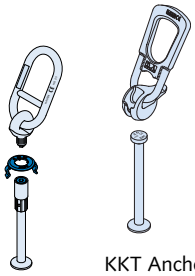

HD Sleeve anchor system

KKT Anchor system

Anchoring systems ▶ **HALFEN Channels and HALFEN Bolts make up a system** ◀ **Framing technology**

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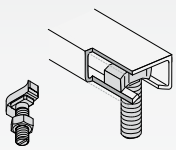
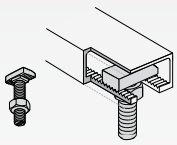
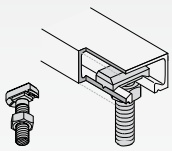


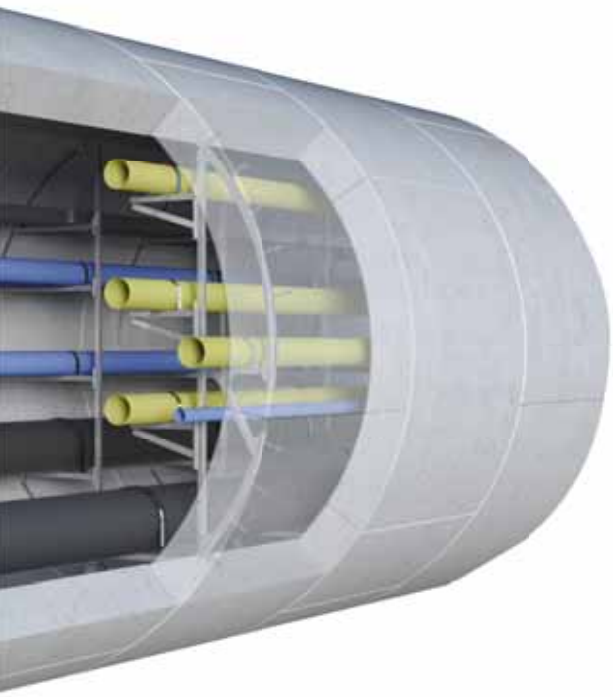
HS HALFEN Bolt with nut

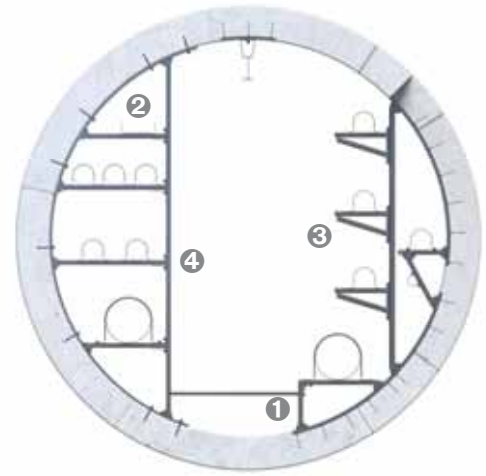


HZS Bolt, serrated



HSR Bolt, nibbed





❶ Cast in channels and
❷ Drill and dowel framing channels
❸ HALFEN Brackets
❹ Fexible framing systems

HALFEN CAST-IN CHANNELS

As a channel ring or channel segment for fixing suspended crane runway systems

- Cable and pipe installations
- Access paths
- Post and beam systems

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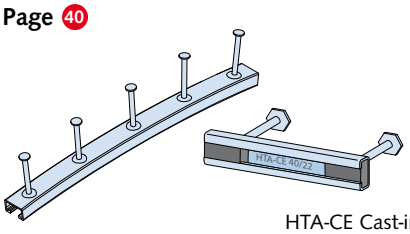

HTA-CE Cast-in channel

HTA-CS Curved cast-in channel

FLEXIBLE FRAMING SYSTEM

Quick installations in tunnels

- Heavy pipe systems (for example: emergency water supply, drainage pipes)
- Heavy cables (for example: electrical power cables)

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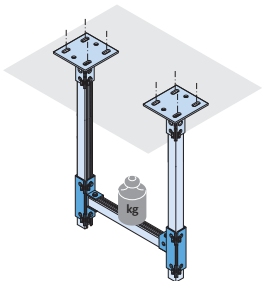

HALFEN Powerclick system

HALFEN BRACKETS

support for:

- Heavy pipe systems
  (for example: emergency water supply, drainage pipes)
- Heavy cables (for example: electrical power cables)
- Access paths

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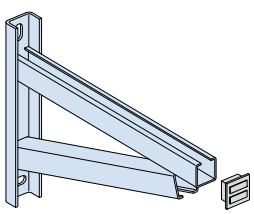


HALFEN Bracket including end cap

HALFEN PROJECT

Lausward Power Station, Germany

Culvert, constructed using precast pipe segments
© Planer Ingenieurbuero-Wendt

HALFEN Products: Framing technology

HALFEN FRAMING CHANNELS SYSTEM
THE FLEXIBLE FRAMING SYSTEM

Lausward Power Station

Düsseldorf, Germany

The world's most efficient steam turbine power station to date is located in Düsseldorf, Germany. With a production output of 600 Megawatts electricity and 300 MW district heating, the power station achieves an efficiency of 85%. The core of the system is a pipeline infrastructure made of high-performance reinforced concrete pipes. The walk-through culvert that supplies the district heating runs under the river Rhine and has been designed to accommodate 21 pipelines. The client insisted on installation without requiring drilling to retain the high quality of the pipes.
In this case, two serrated cast-in channels were installed to form a ring. The Powerclick Framing system was fixed to the channel ring to provide an adaptable flexible support.

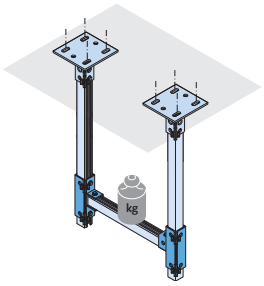
POWERCLICK Framing system

Projects of all sizes and for all load types are possible with just a few different components. Using Powerclick in your projects significantly reduces planning and assembly time.

The twelve types of multifunctional connection elements are delivered pre-assembled with quick assembly bolts, and are easily installed using basic tools.

APPLICATION:

- service and utility pipes
- cable trays



Application example; POWERCLICK

Further information

Please refer to our Technical Product Information to find out more about the HALFEN Powerclick system.

www.halfen.com

Reinforcement cage on steel formwork with serrated HALFEN channels

Prefabricated pipe segments with cast-in channels

HALFEN PROJECT

Turtmann Tunnel, Switzerland

Tension ring solution with GFRP plastic piping

HALFEN Products: Framing technology

HALFEN FRAMING CHANNELS SYSTEM
FLEXIBLE FRAMING SYSTEM

Utilities for the Martischejiu service station; A9 road tunnel
Turtmann project, Switzerland

The Turtmann Tunnel project with a total length of 1350 m also required utilities supply pipes. In this case, service utilities comprising of DN 2000 plastic pipes for drainage, hydrant supply pipes and electrical power lines for the Martischejiu service station.

With a post-installed channel system (designed as a tension ring) and a quick install system (pre-assembled parts), all utility pipes and cables could be fitted quickly and safely.

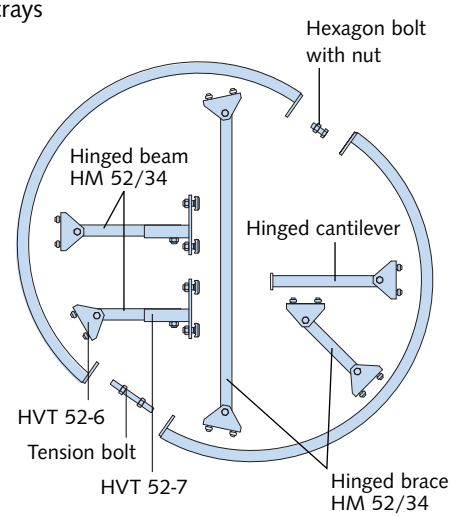
Framing channels are not only designed to be attached or dowelled to concrete components. They are also suitable for use on surfaces made of other materials, for example: metals, GFRP (carbon fibre reinforced plastic).
They can be braced against the tunnel wall, or also bolted into tubbing segment tunnels.

HALFEN Brackets and connection elements

The flexible HALFEN Framing channels are used for the quick assembly of support structures. Pre-assembled components ensure quick and easy assembly, even for challenging project conditions. The flexible bolt connections allow construction tolerances to be compensated for on-site.

APPLICATION:

- service and utility pipes
- cable trays



Further information
Please refer to our Technical Product Information to find out more about the flexible HALFEN Framing systems.

www.halfen.com

Round utility tunnel; service station, Switzerland
Application: Powerclick System

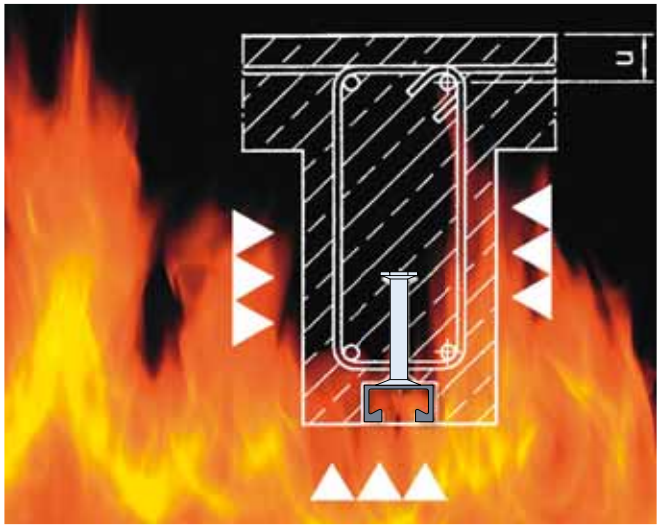
Sewer pipe support using brackets with pre-assembled fixings

HALFEN PROJECT

Bewag Tunnel (Berlin), Germany

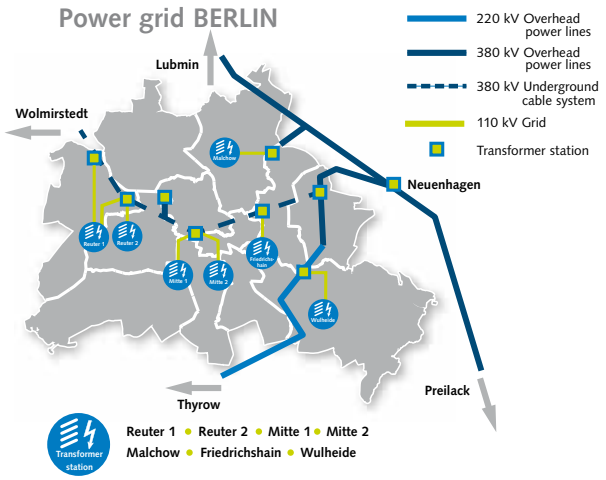
Utility tunnel with 380 kV power cables

HALFEN CHANNELS SUBJECTED TO FIRE



Bewag tunnel
Berlin, Germany
To connect three substations, Mitte, Friedrichshain and Marzahn in the city centre to the 380 kV high-voltage grid, a total of 11.5 km of cable tunnel was built approximately 25 to 30 m below ground. The tubbing segment section on its own has a length of 8.5 km (about 40,000 elements); the tunnel section with concrete pipes is 2.9 km.

The outer diameter of the tunnel is approximately 3.6 m and the inner diameter 3.0 m. To support the six 380 kV cables, HALFEN HTA 52/34 Cast-in channels were cast into the tubbing segments and the reinforced concrete pipes in the precast concrete plant. In addition to the power cables, HALFEN Cast-in channels were also used to attach the tunnel lights, the support channels, the overhead rail service car and the cable trays.



Overview, 380-kV supply, central distribution/transformer stations via Friedrichshain to Marzahn

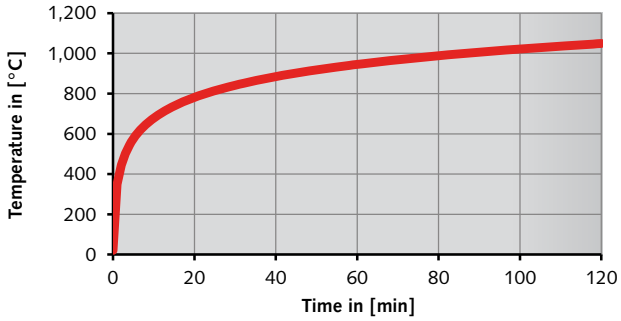
Designed for fire resistance

The design of anchorages for fire load must take into account the requirements of Technical Report TR 020 "Assessment of anchorages in concrete with regard to fire resistance". The corresponding characteristic values can be found in the annex of ETA-09/0339 and ETA-16/0453.

APPLICATION:

- reinforced components, for example: wall slabs, ceiling slabs, beams, columns
- fire resistance; up to R120
- fire exposure on one or more sides
- high dynamic and static point loads, e. g. caused by the attachment of overhead rail service cars or heavy power cables

Standard time temperature curve



Temperature of the STTC during tests

Further information
Please refer to our Technical Product Information to find out more about HALFEN Cast-in channels.

www.halfen.com

Overhead rail service car and heavy high power cables

HALFEN Applications

APPLICATION IN ROAD TUNNELS

The road tunnel in this illustration was planned using cast-on-site concrete.
Most of the HALFEN solutions illustrated here are also suitable for use in tubbing segments.

HBT REBEND CONNECTIONS

Connection of reinforced concrete elements in:

- Roofs
- Floors
- Walls

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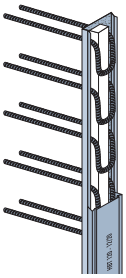

HBT Reinforced connection with approval

ACCIDENT RECOVERY SYSTEM

- For efficient accident recovery and removal of damaged vehicles and other objects.
- The HALFEN Accident recovery system consists of an anchor plate with ring-bolt, an anti-theft chain and a clutch.

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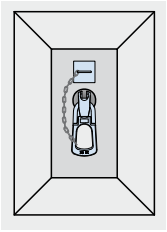
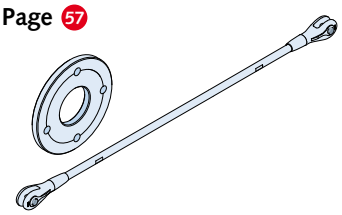


HALFEN Accident recovery anchor with DEHA Spherical head transport anchor

DETAN TENSION ROD SYSTEMS

- Suspension of ceilings (see example to the right)
- Suspension of bridges
- Bracing in support systems
- Bracing (lattice struts)
- as tension and compression rod system for suspension of false ceilings or fixing of wall elements

▶ **Page** 57



DETAN Tension rod with fork-head and anchor disc

DETAN is the right choice for **suspension of false ceilings**:

- for high steel load capacities
- for high demands on corrosion and fire prevention/protection
- for pre-assembled delivery requirements

HDB SHEAR RAILS

for increased shear load demands in:

- Roofs
- Floors
- Walls

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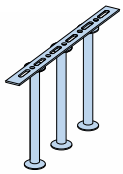

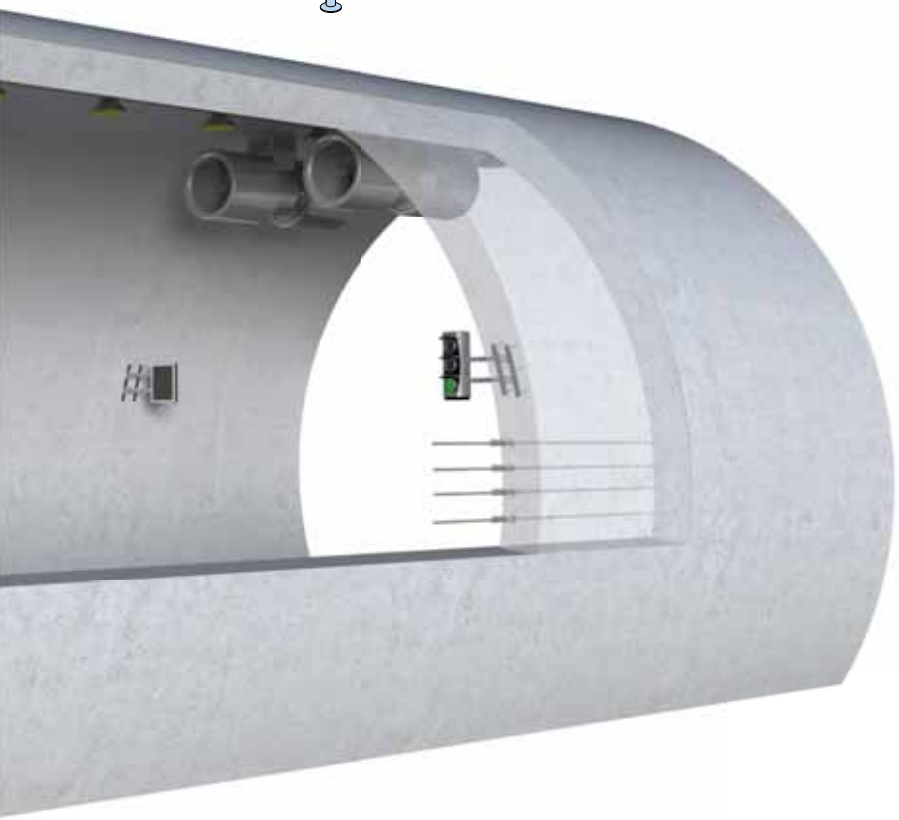

MBT REINFORCEMENT COUPLER

- Retrofitting and upgrades

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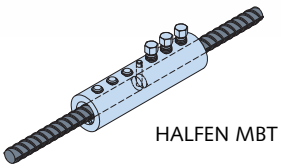
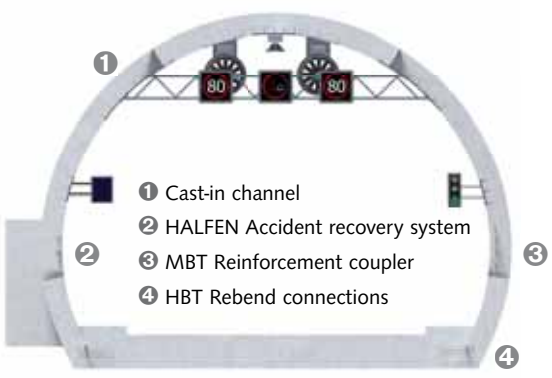


HALFEN MBT Standard coupler



HALFEN BRACKETS

Support of:

- Heavy pipe systems (for example, emergency water supply, drainage pipes)
- Heavy electrical cables
- Access paths

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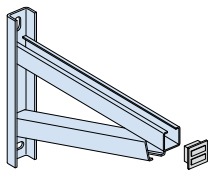

HALFEN Bracket including end cap

HSC Stud Connector

- For densely reinforced corbels and frame nodes

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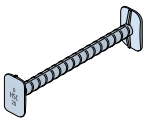
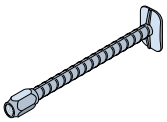


HALFEN HSC-HD



HALFEN HSC-S

HALFEN FRAMING CHANNELS

Retrofit fixings

- Refurbishment projects
- Upgrade of technical equipment and production facilities
- Applications as for cast-in channels

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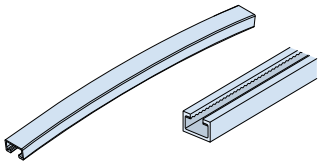

HALFEN Framing channels, straight and curved

HALFEN CHANNELS

Cast-in connections

- Lighting equipment
- Signalling equipment /signage
- Hand rails/hand rails
- Ventilation equipment
- Wall elements

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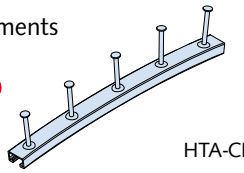
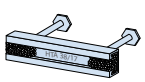


Curved HTA-CS cast-in channel



HTA-CE Cast-in channel

HALFEN PROJECT

Ulricehamn Tunnel, Sweden

Fair-face concrete wall elements inside the tunnel
© Vijay C / SE360

HALFEN Products: Rod systems

DETAN ROD SYSTEMS – EFFICIENT STRUCTURAL BRACING

DETAN in the Ulricehamn Tunnel, ***Sweden***

The Ulricehamn Tunnel is a 400 m long road tunnel in the south of Sweden. The tunnel is part of the E4/R40 road expansion project between Dållebo and Hester. It has two separate carriageway tunnels, both with two lanes in each direction. The purpose of the expansion is to improve road safety and improve traffic flow along this particular stretch of road. When this section is completed, the entire stretch of road between Stockholm and Gothenburg will be a dual carriageway.

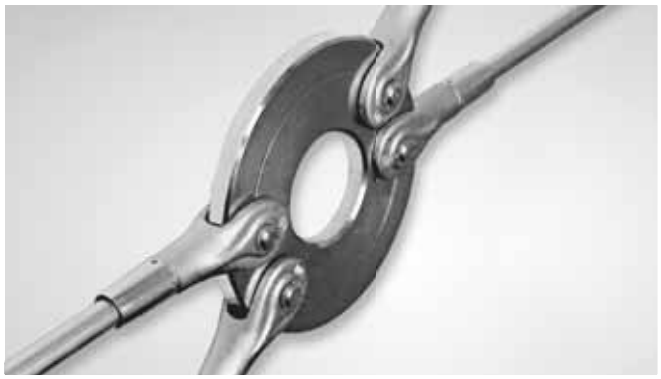
HALFEN supplied cast-in channels and the DETAN Rod System to attach the precast concrete elements along the rock wall; a perfect all in one solution with the highest quality standards.

DETAN Rod systems

The DETAN Rod system is suitable for tensile and compressive loads; with European Technical Approval. The individual components in the DETAN Rod system are available in two finishes: stainless steel or steel.

APPLICATION:

- anchoring of wall elements
- suspension of ceiling
- suspension of bridges
- bracing (in lactice supports)



Further information

Please refer to our Technical Product Information to find out more about DETAN Rod systems.

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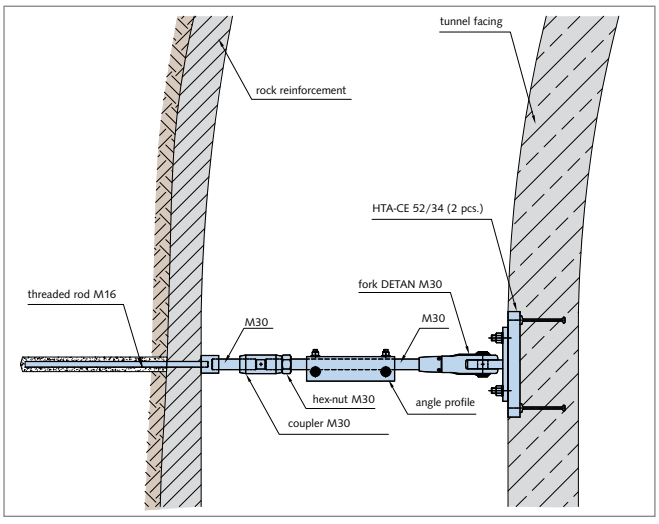
View of the tunnel approach, i. e. exit



Anchoring the tunnel wall elements using DETAN Tension rods

HALFEN PROJECT

Horental Road Tunnel, Switzerland

Formwork carriage

HALFEN HDB SHEAR RAILS – SHEAR PUNCHING REINFORCEMENT

HDB in the Horental Tunnel
Küttigen, Switzerland

The Horental road tunnel near Küttigen, in Switzerland with a length of approx. 700 m, is part of the new 'Staffeleggstraße' route. The tunnel was constructed using the open trench method (covered tunnel); due to the high horizontal loads expected, a shear reinforcement system was selected.

Traditional stirrup reinforcement is difficult to install because the stirrups have to be shaped and tied during installation. This is not only time-consuming but also inaccurate, resulting in the stirrups often not having sufficient concrete cover. HALFEN HDB-S Dowel rails were used in the tunnel lining to avoid these problems. This ensured speedy and precise installation and also helped to reduce construction time.

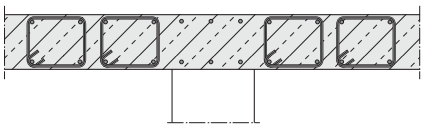
HALFEN HDB-S Shear rails

The HALFEN HDB Shear rails can be used as punching and shear reinforcement. This increases the load-bearing capacity of thin concrete elements. The symmetrical design of the HDB Shear rails guarantees correct installation.

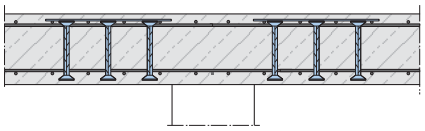
APPLICATION:

- tunnel shell/walls
- tunnel roofs

Uneconomical solution:
Complex installation of stirrup cage reinforcement



Our solution:
Support using HDB-S Shear load reinforcement



Further information
Please refer to our Technical Product Information to find out more about HALFEN Shear rails.

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Fixing the HDB element in the reinforcement for the tunnel shell

Prepared HDB Element before pouring the concrete

HALFEN PROJECT

Autobahn A1, Cologne Lövenich, Germany

Precast girder in the glass roof

HALFEN Products: Reinforcement technology

HALFEN HSC STUD CONNECTOR
THE EFFECTIVE ANCHOR REINFORCEMENT

Noise protection enclosure, Autobahn (Motorway) A1
Cologne Lövenich, Germany

The motorway tunnel was planned for a traffic volume of 120,000 vehicles per day and has a length of 1.5 km. The project has two tunnels; these were built without interfering with the flow of the traffic. The steel and glass roof structure is supported on prefabricated, reinforced concrete beams, which in turn are supported on reinforced concrete corbels. This results in very high loads in the reinforced concrete corbels.

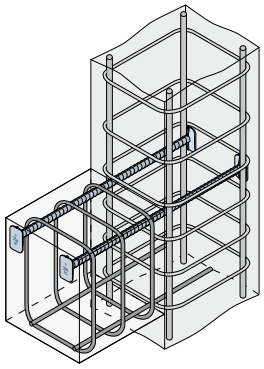
Using HALFEN HSC Stud connectors during the first construction phase enabled the walls to be cast together with the matching HSC Socket reinforcement bars. The corbels were cast in a second phase. Here the HSC Connector rods were screwed into the sockets as tensile reinforcement; this ensures a 100 percent positive tensile-load transfer.

HALFEN HSC Stud Connector

The HALFEN HSC Stud connector is a building authority approved reinforcement optimized for anchorage in concrete. The effective yield of the reinforcement bars is reached with extremely short bond lengths and therefore it is possible to significantly reduce the quantity of steel used.

APPLICATION:

- reinforcement in corbels
- reinforcement in frame nodes
- offset supports
- slabs supports
- beam supports



Application example; HALFEN HSC elements in a concrete corbel

Further information

Please refer to our Technical Product Information to find out more about the HALFEN HSC Stud Connector.

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Using HSC elements to post-installed reinforced concrete corbels

Supporting the prefabricated beams on the reinforced concrete corbels

HALFEN PROJECT

A1 Motorway, Cologne Lövenich, Germany

Aerial view of the noise protection enclosure
Photo: Knut Laubner, Bonn, Germany

CORROSION RESISTANT HALFEN ANCHORING SYSTEMS

Noise protection enclosure, Autobahn (Motorway) A1
Cologne Lövenich, Germany
The noise protection enclosure was designed in accordance with the required guidelines for equipment and the operation of road tunnels (RABT *Richtlinien für die Ausstattung und den Betrieb von Straßentunneln*) and additional technical contract specifications for engineering projects (ZTV-ING *zusätzliche technische Vertragsbedingungen für Ingenieurbauten*). The material specification for fastening the ventilation units specified (HCR) High Corrosion Resistant steel.

HALFEN Cast-in channels in stainless steel – HCR
Channels in HCR (High Corrosion Resistance) materials, such as the HALFEN Cast-in channels, are mandatory in environments with expected concentrations of chlorides, sulphur and nitrogen oxides; this is also the case in Germany.

HZM 38/23 channels in A4 steel used to attach the support structure of the steel roof to the top of the precast concrete roof beams

Corrosion protection

Stainless Steel A4 and HCR
Chromium is the most important alloy element used in stainless steels. A specific amount of chromium content causes a passivation layer to be formed on the surface of steel, therefore protecting the base material from corrosion. This is why stainless steels have high corrosion resistance.

FV = HDG = Hot-dip galvanized
During the hot-dip galvanizing process, HALFEN Channels are immersed in molten zinc (immersion process), with a temperature of approximately 460 °C. During this process the zinc alloys with the steel to form a protective layer on the steel, which increases the corrosion resistance.

APPLICATION:

- very high corrosion demands:
  HCR = High Corrosion Resistance Material
- medium corrosion demands:
  A4 Material
- enclosed and dry areas:
  FV (HDG) = Hot-dipped material with ≥ 50 µm

STAINLESS STEEL

Further information
Please refer to our Technical Product Information to find out more about HALFEN HTA-CE Cast-in channels.

www.halfen.com

HTA 38/17 in HCR as attachment point for the ventilation units fixed to the precast concrete roof beams

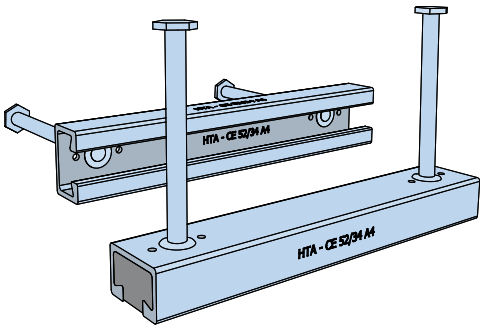
Contents

HALFEN PRODUCTS – TECHNICAL OVERVIEW

HTA-CE ANCHOR CHANNELS

In addition to excellent adjustability, HALFEN Cast-in channels save considerable installation time. The result: faster overall construction and therefore increased cost saving.

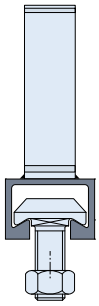
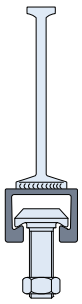
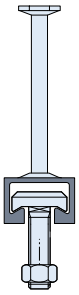
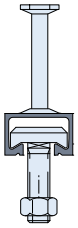
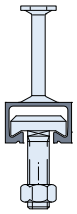
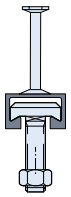
The channels are designed for high loads, for fixing in cracked and non-cracked concrete, for small edge distances, and for noise and dust free installation.
The channels have a high corrosion resistant coating, are suitable for dynamic loads and also fulfil fire prevention requirements. Further special quality features are regulated in approvals ETA-09/0339 and ETA-16/0453.



hot-rolled channel
suitable for dynamic loads

NEW:
HTA-CE 50/30P and HTA-CE 40/22P NEW!
P = Plus for extra load capacity.

PARAMETERS HTA-CE (HOT-ROLLED)

Channel type	HTA-CE 72/48	HTA-CE 55/42	HTA-CE 52/34	HTA-CE 50/30P	HTA-CE 50/30	HTA-CE 40/22P	HTA-CE 40/22
Hot-rolled							
HALFEN HTA-CE Channels							
Material	☐ ■	☐	☐ ■	☐ ■	☐ ■	☐ ■	☐ ■
Bolts	HS 72/48	HS 50/30	HS 50/30	HS 50/30	HS 50/30	HS 40/22	HS 40/22
Thread	M20–M30	M10–M24	M10–M20	M10–M20	M10–M20	M10–M16	M10–M16
N_{Rd} [kN] / V_{Rd} [kN]	55.6 / 72.2	44.4 / 57.8	30.6 / 39.7	21.7 / 21.7	17.2 / 22.4	16.1 / 16.1	11.1 / 14.4
Approved for fatigue relevant tensile stress/ steel	*	*	✔	✔	✔	✔	✔

Reliable and safe

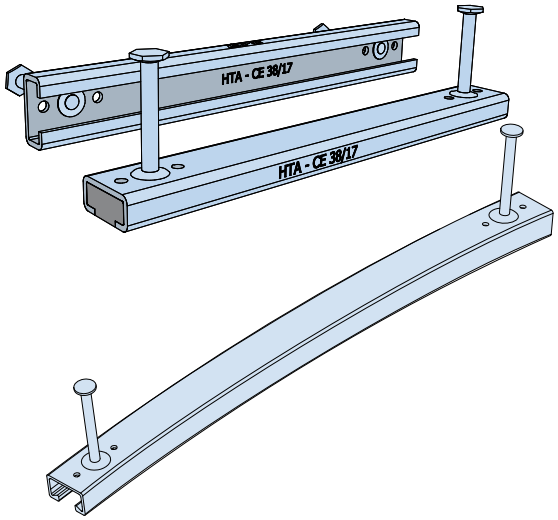
- no damage to load-bearing reinforcement
- suitable for components with fire prevention requirements
- suitable for installation in concrete compression and tension zone
- high corrosion resistant steels available (for cold-formed channels only)
- dynamic loadable hot-rolled profiles
- with (ETA) European Technical Approval/Assessments
- reliable calculation using HALFEN Software

Quick and economical

- adjustable anchorage
- bolts instead of welding
- maximum cost-effectiveness when installing bolts in rows
- cost-effective installation using simple tools
- effective pre-planning results in shorter construction time
- wide range of products for various requirements
- health and safety friendly due to vibration and noise free installation

CE marking

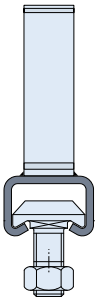
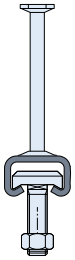
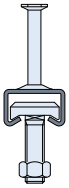
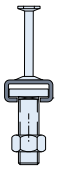
The CE in the name of this product signifies that the channel is CE compliant. By identifying its products in this way HALFEN as the manufacturer declares that it is responsible for the conformity of the product with its DoP (Declaration of performance), and that the specified performance and compliance with all relevant European legislation has been applied.



Product range

In addition to the standard version, curved HTA-CS HALFEN Cast-in channels are also available. Produced to customer specifications this type of channel avoids time consuming on-site modifications; drilling or thread cutting in installed, corrosion protected components is no longer required.

PARAMETERS HTA-CE (COLD-ROLLED)

Channel type	HTA-CE 72/49	HTA-CE 54/33	HTA-CE 49/30	HTA-CE 40/25	HTA-CE 38/17	HTA-CE 28/15
Hot-rolled						
HALFEN HTA-CE Channels						
Material	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐	☐ ☐
Bolts	HS 72/48	HS 50/30	HS 50/30	HS 40/22	HS 38/17	HS 28/15
Thread	M20 – M30	M10 – M20	M10 – M20	M10 – M16	M10 – M16	M6 – M12
N_{Rd} [kN] / V_{Rd} [kN]	55.6 / 55.6	30.6 / 39.7	17.2 / 17.2	11.1 / 11.1	10.0 / 10.0	5.0 / 5.0

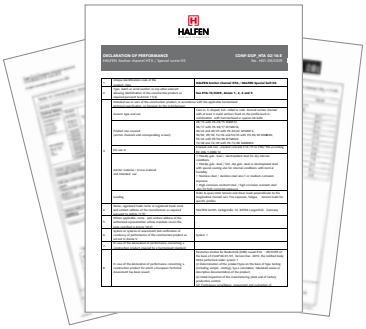
☐ **A4** = Stainless steel

☐ **FV** = Steel hot-dip galvanized

Further information

Please find the Declaration of Performance DoP and more Product information about HALFEN HTA-CE Cast-in channels on our website.

www.halfen.com



SERRATED HZA CAST-IN CHANNELS AND HZA DYNAGRIP

HALFEN HZA Cast-in channels are a further development for applications where high loads in the longitudinal direction of the channel also can be considered.

The special serration guarantees positive-locking load transfer. In addition, HZA DYNAGRIP HALFEN Cast-in channels can safely absorb fatigue relevant stress amplitudes up to 15.0 kN with a load cycle of N = 2 × 10^6 and therefore meet all requirements for reliable fixings as required for crane runways or for securing cross passage doors against suction caused by passing trains.

serrated

3D Loads

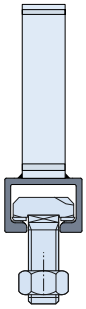
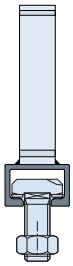
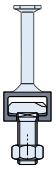
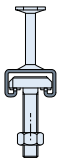
hot-rolled channel profile suitable for dynamic loads

officially App.-No Z-21.4-145 approved

officially App.-No Z-21.4-1691 approved

HALFEN

PARAMETERS HZA AND HZA DYNAGRIP

Channel type	**HZA 64/44** DYNAGRIP	**HZA 53/34** DYNAGRIP	**HZA 38/23** DYNAGRIP	**HZA 29/20** DYNAGRIP	**HZA 41/22**
	Hot-rolled				**Cold-rolled**
HALFEN HZA Channels					
Material	☐ ☐	☐ ☐	☐ ☐	☐ ✱	☐ ☐
Bolts	HZS 64/44	HZS 53/34	HZS 38/23	HZS 29/20	HZS 41/22
Thread	M20 – M24	M16 – M20	M12 – M16	M12	M12 – M16
N_{Rd} [kN] / V_{Rd} [kN]	37.8 kN All load directions	30.8 kN All load directions	16.8 kN All load directions	11.2 kN All load directions	7.0 kN All load directions
Approved for fatigue relevant tensile stress	✔	✔	✔	✔	✗

☐ **A4** = Stainless steel ✱ = **A4:** on request

☐ **FV** = Steel hot-dip galvanized

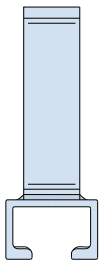
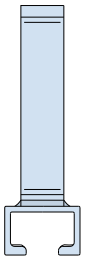
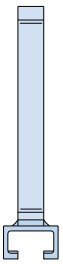
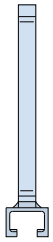
HOT-ROLLED HZA-PS CAST-IN CHANNELS

"PS" = "PowerSolution"
This HALFEN Cast-in channel is suitable for special application in safety-relevant areas subjected to internal or external load effects, for example in nuclear power plants.
All tests, which were carried out at the Technical University of Dortmund in Germany, were conducted in concrete with crack widths fluctuating by 1.0 mm up to 1.5 mm.
The results were summarized in evaluation report no. 09.05.18-E.

technische universität dortmund

- serrated
- 3D Loads
- suitable for dynamic loads
- suitable for seismic loads caused for example by earth-quakes
- suitable for use in safety-relevant areas in nuclear power plants or other nuclear facilities

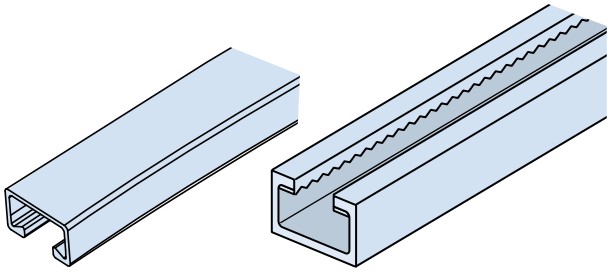
PARAMETERS HZA-PS: ACCORDING TO EVALUATION REPORT TU DORTMUND

Channel type	**HZA-PS 64/44** DYNAGRIP	**HZA-PS 53/34** DYNAGRIP	**HZA-PS 38/23** DYNAGRIP	**HZA-PS 29/20** DYNAGRIP
	Hot-rolled			
HALFEN HZA-PS Channels				
Material	☐ ■	☐ ■	☐ ■	☐ ✱
Bolts	HZS 64/44	HZS 53/34	HZS 38/23	HZS 29/20
Thread	M20 – M24	M16 – M20	M12 – M16	M12
N_{Rd} [kN] / V_{Rd} [kN]	37.8 kN All load directions	30.8 kN All load directions	16.8 kN All load directions	11.2 kN All load directions
Approved for fatigue relevant tensile stress	✔	✔	✔	✔

■ **A4** = Stainless steel ✱ = **A4:** on request
☐ **FV** = Steel hot-dip galvanized

HALFEN FRAMING CHANNEL SYSTEMS AND FLEXIBLE BOLT CONNECTIONS

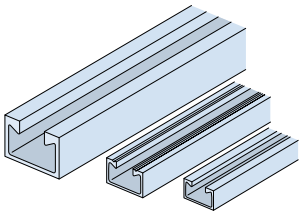
The flexible HALFEN Channel bolt system is an all-in-one support and fixing system.



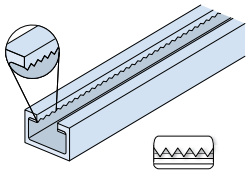
Advantages

- fully flexible positioning and dimensioning of the bolt connection
- flexible selection of corrosion protection:
  - a) strip-galvanized channels for **standard corrosion protection**
  - b) hot-dip galvanized channels for **high corrosion protection**
  - c) stainless steel channels (A2, A4, HCR) for **maximum corrosion protection**
- allows quick assembly and adjustment of the overall system and individual components
- simple modification or upgrade of a whole system without requiring machining
- no specialists required for on-site installation and modification
- on-site installation and modification are dust and noise free
- bolting does not damage the corrosion protection of system components
- a wide selection of standard channels with very high load-bearing capacities

Hot-rolled framing channels



HM Smooth channels



HZM Serrated channel

Hot-rolled framing channels are exceptionally suitable for:

- large loads
- dynamic stress
- welding

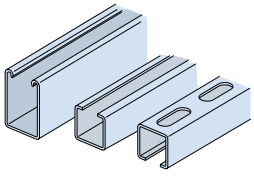
HM Smooth channel

- very high tensile loads can be transmitted
- loads in the longitudinal direction are also possible when using a HSR nib bolt (only for mild steel)

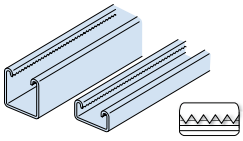
HZM Serrated channel

- the serration allows high longitudinal loads
- economic with a selection of five channel sizes

Cold-rolled framing channels



HM, HL Smooth channels



HZL, HZM Serrated channels

Cold-rolled channels are a cost effective solution for lower loads. These are available in slotted or non-slotted versions.

HM, HL Smooth channels

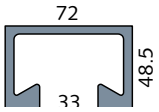
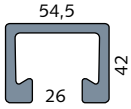
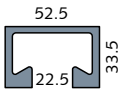
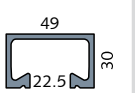
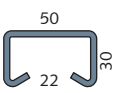
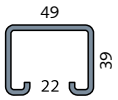
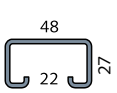
- larger product range; therefore very economic

HZL, HZM Serrated channels

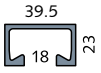
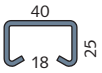
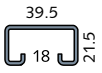
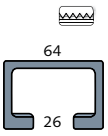
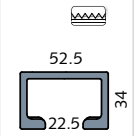
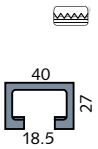
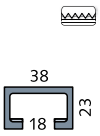
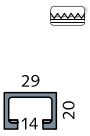
- for loads in the channel longitudinal direction
- slippage-safe connection for large channel loads

HALFEN FRAMING CHANNELS – HEAVY DUTY SUPPORT SYSTEM

LOAD CAPACITIES – HEAVY DUTY SUPPORT SYSTEM

Channel type	HM 72/48	HM 55/42	HM 52/34	HM 50/30	HM 49/30	HM 50/40 HL 50/40	HM 486
	Hot-rolled				Cold-rolled		
Dimensions Framing channels							
Material	☐ ■	☐	☐ ■	☐ ■	☐ ■ ☒	☐ ■	☐
Bolts	HS 72/48, HSR 72/48	HS 50/30	HS 50/30, HSR 50/30		HS 50/30		
Thread	M20 – M30	M10 – M24					
Max. possible point-load-bearing capacity* $F_{z,Rd}$ [kN]	65.8	54.0	36.3	20.2	6.9	7.6/7.6	4.7
Max. possible point-load-bearing capacity* allow. F_z [kN]	47.0	38.6	25.9	14.4	4.9	5.4	3.5

*observe bolt load bearing capacity

Channel type	HM 40/22	HM 40/25	HM 422	HZM 64/44	HZM 53/34	HZM 41/27	HZM 38/23	HZM 29/20
	Hot-rolled	Cold-rolled		Hot-rolled, serrated				
Dimensions Framing channels								
Material	☐ ■	☐ ■	☐	☐ ■	☐ ■	☐	☐ ■	☐
Bolts	HS 40/22, HSR 40/22	HS 40/22		HZS 64/44	HZS 53/34	HZS 38/23	HZS 38/23, HS 38/17	HZS 29/20, HS 28/15
Thread	M10–M16			M20 – M24	M16 – M20	M12 – M16		M12
Max. possible point-load-bearing capacity* $F_{z,Rd}$ [kN]	11.4	5.3	3.5	53.3	43.3	25.0	18.0	10.9
Max. possible point-load-bearing capacity* allow. F_z [kN]	8.2	3.8	2.5	38.1	30.9	17.8	12.8	7.8

*observe bolt load bearing capacity

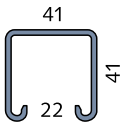
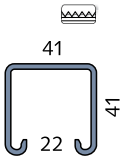
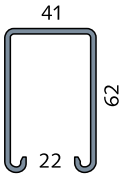
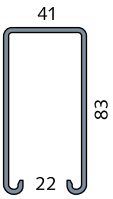
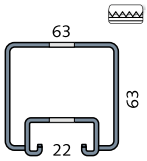
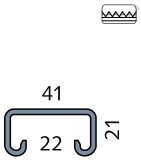
☐ **FV** = Steel hot-dip galvanized

■ **A4** = Stainless steel (austenitic structure)

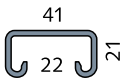
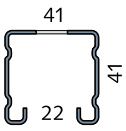
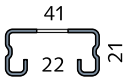
☒ **HCR** = Stainless steel "High Corrossion Resistant" (austenitic structure)

HALFEN FRAMING CHANNELS – MEDIUM DUTY SUPPORT SYSTEM

LOAD CAPACITIES – MEDIUM DUTY SUPPORT SYSTEM

Channel type	HM 41/41, HL 41/41	HZM 41/41, HZL 41/41	HM 41/62, HL 41/62	HM 41/83, HL 41/83	HZL 63/63	HZM 41/22, HZL 41/22
			Cold-rolled			
Dimensions Framing channels						
Material	☐ ▨ ■	☐ ■	☐ ▨	☐ ▨	☐	☐ ■
Bolts	HZS/HS 41/41, HZS 41/22					
Thread	M6 – M16	M12 – M16	M6 – M16		M12 – M16	M12 – M16
Max. possible point-load-bearing capacity* $F_{z,Rd}$ [kN]	7.8	7.8	7.8	7.8	7.8	7.8
Max. possible point-load-bearing capacity* allow. F_z [kN]	5.6	5.6	5.6	5.6	5.6	5.6

*observe bolt load bearing capacity

Channel type	HM 41/22, HL 41/22	HLL 41/41	HLL 41/22
	Cold-rolled		
Dimensions Framing channels			
Material	☐ ■	▨	▨
Bolts	HZS/HS 41/41, HZS 41/22		
Thread	M6 – M16		
Max. possible point-load-bearing capacity* $F_{z,Rd}$ [kN]	7.8	2.5	2.5
Max. possible point-load-bearing capacity* allow. F_z [kN]	5.6	1.8	1.8

*observe bolt load bearing capacity

☐ **FV** = Steel hot-dip galvanized
▨ **SV** = Steel sendzimir galvanized
▨ **A2** = Stainless steel (austenitic structure)
■ **A4** = Stainless steel (austenitic structure)
☒ **HCR** = Stainless steel, "High Corrossion Resistant" (austenitic structure)

HALFEN FRAMING CHANNELS – LIGHT DUTY SUPPORT SYSTEM

LOAD CAPACITIES – LIGHT DUTY SUPPORT SYSTEM

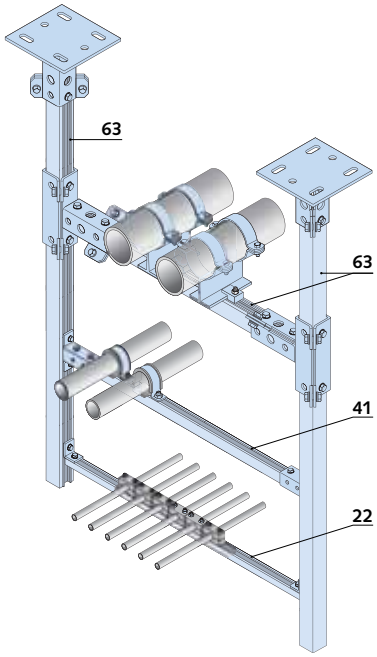
Channel type		HM 36/36, HL 36/36	HM 38/17	HM 28/28, HL 28/28	HM 26/26, HL 26/26	HM 28/15, HL 28/15	HM 315	HM 20/12, HL 20/12
Cold-rolled								
Dimensions Framing channels		36 / 18 / 36	38 / 18 / 17,5	28 / 12 / 28	26 / 12 / 26	28 / 12 / 15	30 / 16 / 15	20 / 10 / 12
Material		☐ ■	☐ ▨ ■ ☒	☐ ▨ ■	▨	☐ ▨ ■ ☒	☐	☐ ▨
Bolts		HS 38/17		HS 28/15			GWP 28/15	HS 20/12
Thread		M10 – M16		M6 – M12			M5 – M10	M6 – M8
Max. possible point-load-bearing capacity*	$F_{z,Rd}$ [kN]	6.2	6.7	4.2	1.54	5.5	2.32	3.14
	allow. F_z [kN]	4.4	4.8	3.0	1.1	3.9	1.66	2.24

*observe bolt load bearing capacity

Framing channels and matching HALFEN Bolts

HALFEN POWERCLICK FRAMING CHANNELS

The POWERCLICK system was developed by HALFEN for industrial pipeline projects. The modular system uses only a small number of multi-functional components to provide hundreds of different support structures.
With the POWERCLICK system you have the benefit of safety, efficiency and speed at all stages of a project.



Optimum support of pipe loads.
Larger pipe diameters are also possible if separate verification is provided

Product advantages

- time effective installation
- minimal number of multi-functional components
- all required smaller items are delivered preassembled

☐ FV = Steel hot-dip galvanized
☐ A4 = Stainless steel

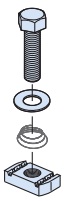
- Faster production start-ups and shorter downtimes
- Secondary components can be attached to the channels at any location in the system while still remaining fully adjustable

Three sizes – one system

Find the most economical solution quickly with three channel sizes that cover every load level. This allows different pipe diameters to be used in a single system.

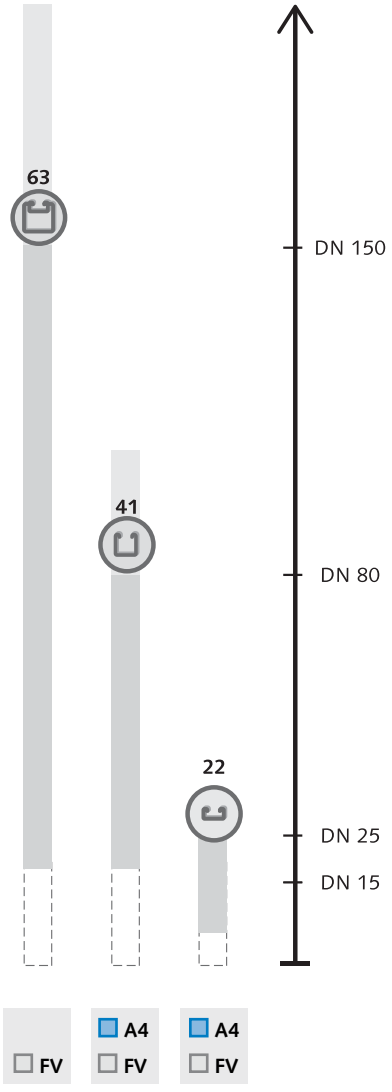
Three channel sizes…

…one POWERCLICK-Bolt…



…and extensive accessories - compatible with all components…

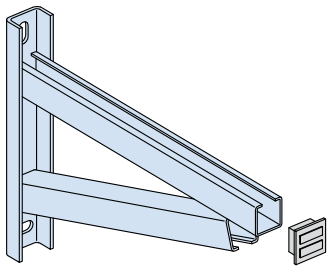
…make up ONE System: POWERCLICK by HALFEN



HALFEN BRACKETS

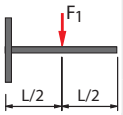
HALFEN Brackets are manufactured from standard HALFEN Channels and have the same advantages; fast, reliable and adjustable installation.

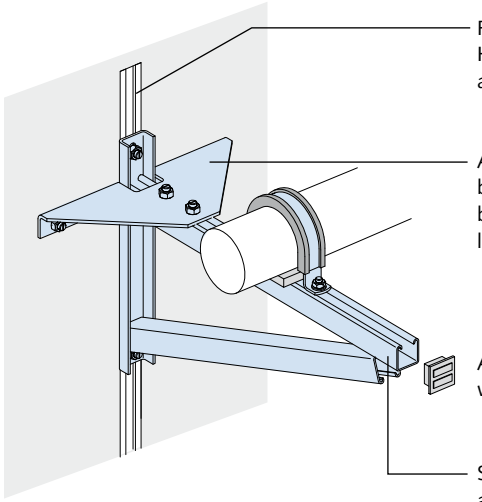
The brackets are used for the whole support elements. Bolt connections ensure the high-quality corrosion protection coating (hot-dip galvanized or stainless steel) is not damaged during installation.



DIMENSIONS AND LOAD CAPACITIES

Brackets 52			KON 52/2		Brackets 41		KON 41/1	KON 41/D	KON 41/2	Brackets 28/36		KON 28/1	KON 36/1	KON 36/2
Length L [mm]	Height H [mm]	Length L_S [mm]	F [kN]	F_1	Length L [mm]	F [kN]	F_1			Length L [mm]	F [kN]	F_1		
500	450	330	allow. load	9.0	175	allow. load	5.35	–	–	100	allow. load	2.70	–	–
			F_{Rd}	12.6		F_{Rd}	7.49				F_{Rd}	3.78		
600	475	380	allow. load	8.0	325	allow. load	2.65	5.60	7.50	200	allow. load	1.35	–	–
			F_{Rd}	11.2		F_{Rd}	3.71	7.84	10.50		F_{Rd}	1.89		
700	500	430	allow. load	7.0	475	allow. load	1.75	3.70	5.00	300	allow. load	0.90	2.00	5.00
			F_{Rd}	9.8		F_{Rd}	2.45	5.18	7.00		F_{Rd}	1.26	2.80	7.00
800	550	480	allow. load	6.0	625	allow. load	–	2.80	3.50	400	allow. load	0.70	1.50	4.15
			F_{Rd}	8.4		F_{Rd}		3.92	4.90		F_{Rd}	0.98	2.10	5.80
900	600	530	allow. load	5.5	775	allow. load	–	–	2.65	500	allow. load	–	1.20	3.15
			F_{Rd}	7.7		F_{Rd}			3.71		F_{Rd}		1.68	4.40
1000	650	630	allow. load	5.0	**All Brackets are available in:**					600	allow. load	–	1.00	2.55
			F_{Rd}	7.0	☐ **FV** = Steel hot-dip galvanized						F_{Rd}		1.40	3.60
1100	700	730	allow. load	4.5	☐ **A4** = Stainless steel					700	allow. load	–	–	2.10
			F_{Rd}	6.3							F_{Rd}			2.95



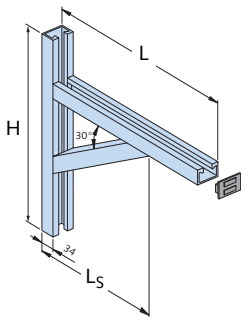


Fixing using dowels or HALFEN Cast-in channels and HALFEN Bolts

A combination of HALFEN brackets and bracing plates can be used to absorb loads in the longitudinal direction of a pipe

All bracket are delivered with end caps

Standard HALFEN Channel are used in cantilever brackets; therefore all HALFEN Bolts, connections and accessories can be used for further fixings



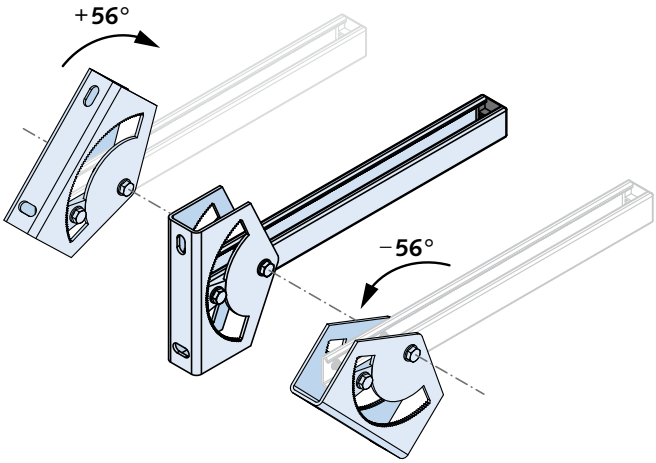
Note:

All lengths **L** and heights **H** listed here refer to our standard elements. Custom solutions are available on request.

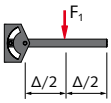
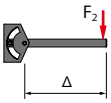
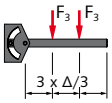
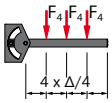
HALFEN ADJUSTABLE CANTILEVER

The HALFEN flexible cantilever can be pivoted with an angle of ±56°. This allows the cantilever to be installed quickly and securely in the correct position even with curved or inclined walls.

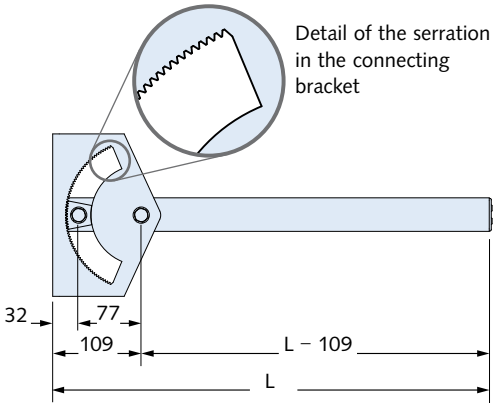
A positive load transfer into the main building component is always guaranteed within the specified angle range of ±56°. The bracket consists of a flexible connection bracket and a HM 41/41 framing channel and is manufactured without requiring welding. The flexible connection bracket (HVT) can also be used separately without a framing channel for the 41 mm system.



DIMENSIONS AND LOAD CAPACITIES

Length L [mm]	F [kN]	 F_1	 F_2	 F_3	 F_4
257	allow. load	5.55	2.89	2.77	1.85
	F_{Rd}	7.76	4.04	3.88	2.59
357	allow. load	3.44	1.72	1.72	1.15
	F_{Rd}	4.82	2.41	2.41	1.61
507	allow. load	2.15	1.07	1.07	0.72
	F_{Rd}	3.00	1.50	1.50	1.00

All brackets are available in: ☐ **FV** = hot-dip galvanized steel ☐ **A4** = stainless steel



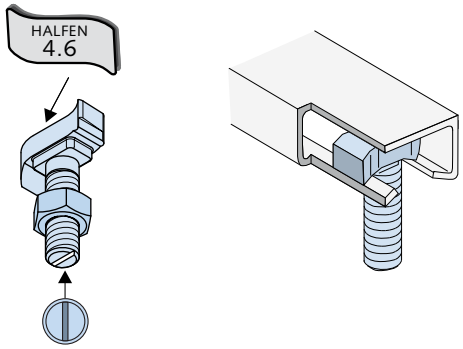
❶ Pipe, standard application
❷ Pipe, suspended application
❸ Freely movable cable tray

HALFEN BOLTS HS, HSR AND HZS

**HALFEN Channels and HALFEN Bolts are part of a system;
When used together they guarantee maximum safety and reliability.**

HALFEN Bolts HS, smooth

- suitable for all profiles
- suitable for loads in all directions
- identification on bolt tip with **one notch**



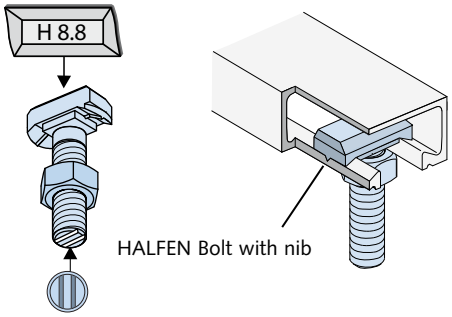
HALFEN 4.6 — Strength class 4.6/8.8
galvanized with special coating Chrome (VI)-free (GVs)
or hot-dipped (FV)

HALFEN A4-70 — Strength class 70
Stainless steel A4
corrosion resistance class III / medium

HALFEN HCR50 — Strength class 50
Stainless steel HCR = high corrosion resistance (1.4529/1.4547)
corrosion resistance class V / very high

HALFEN HSR Bolt, nibbed

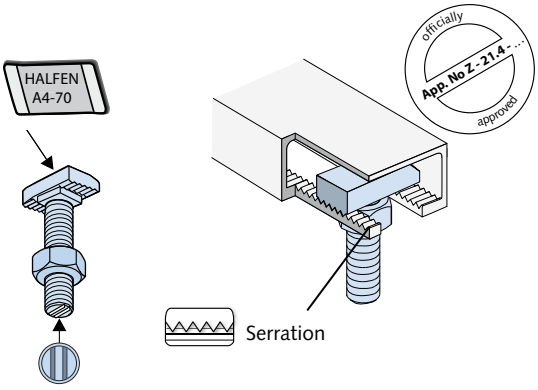
- only for hot-rolled Profile
  40/22P, 50/30P, 52/34, 72/48
- only for standard mill finish and hot-dip galvanized steel
- nibbed bolts; therefore loadable in all directions
- the hook head design of the bolt prevents unwanted loosing of the bolt under vibration.
- suitable for loads in longitudinal direction of the channel; according to an expert report
- indentification on bolt tip with **two notches**



H 8.8 — Strength class 4.6 / 8.8
galvanized with special coating Cr (VI)-free (GVs)
or hot-dipped (FV)

HALFEN HZS Bolt, serrated

- the serrated channel ensures positive locking even in the longitudinal direction: This eliminates slippage in the connection.
- indentification on bolt tip with **two notches**



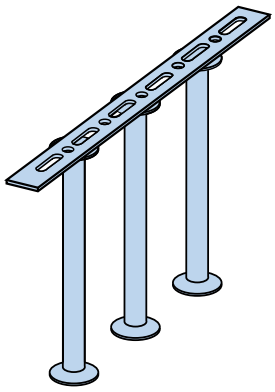
HALFEN A4-70 — Strength class 70
Stainless steel A4
corrosion resistance class III / medium

HALFEN 8.8 — Strength class 4.6 / 8.8
galvanized with special coating Cr (VI)-free (GVs)
or hot-dipped (FV)

HALFEN FA 70 — Strength class 70
Stainless steel FA = Ferritic Austenitic (Duplex stainless steel, 1.4462)
corrosion resistance class IV / high

HALFEN HDB SHEAR RAIL

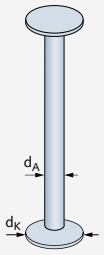
The HDB element consists of a number of double-headed studs welded on to a spacer bar. The elements are used as shear and punching reinforcement.



System elements are available with short delivery times or custom elements can be made to order on request. HDB-S Shear rail elements are preferred for installation from above after the main top and bottom reinforcement has been installed. It is not necessary to enclose the longitudinal reinforcement and simple visual inspection of the installed elements is guaranteed.

PRODUCT CHARACTERISTICS

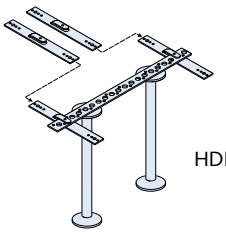
- double-headed studs; available with 10 mm to 25 mm diameters
- custom elements with 2 to 10 double-headed studs
- individual studs spacing on request for pre-defined reinforcement spacing
- approved by the DIBt Berlin for all shear stressed components
- spacers for 15 – 40 mm concrete cover available



ONE SYSTEM; FOUR INSTALLATION VARIANTS A SUITABLE SOLUTION FOR EACH APPLICATION

HDB/HDB-S Elements

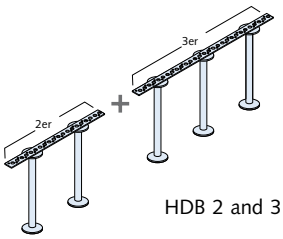
- the double-headed studs are welded firmly to a spacer bar
- clip bars can be attached anywhere on the spacer bar to secure the shear rail to the reinforcement



HDB-S

HDB/HDB-S System elements

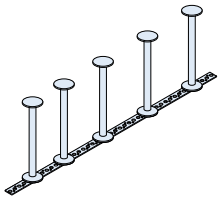
- available as 2 and 3 anchor elements, can be placed one after another to form a row
- standard elements with short delivery time



HDB 2 and 3 anchor elements

HDB/HDB-S Custom (pre-assembled) elements

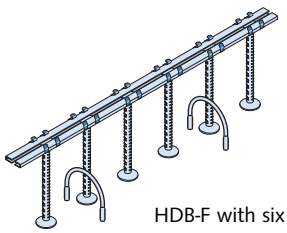
- from 2 to 10 studs welded to a spacer bar



HDB-S with five anchors

HDB-F Custom elements for precast manufactures

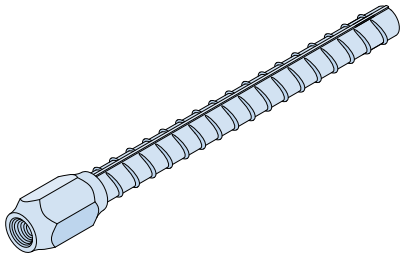
- from 2 to 8 studs welded to a spacer bar
- with temporary fixing for semi-precast elements



HDB-F with six anchors

HALFEN HBS-05 SCREW CONNECTIONS

With the HALFEN HBS-05 Screw connection reinforcement connections are made by simply screwing together the appropriate socket and connecting bars. This versatility allows nearly every type of reinforcement connection to be made.



HALFEN HBS-05 fulfils national and international calculation standards. Extensive certificates and test reports prove suitability even for extreme loads.

The advantages

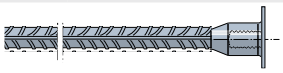
- optimal solutions for all types of connections in reinforced concrete elements
- maximum ductility; HBS-05-Seismic meets the requirements for cyclic alternating loads 
- various types including accessories

Scope of delivery

The lengths, diameters and materials listed in the table refer to our standard elements. Further types are available on request.

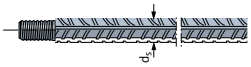
Bar loads F_{sd} = 49.2 – 349.7 kN (d_s = 12 – 32 depends on the bar diameter).

HBS-05-B – Socket bar with nailing flange



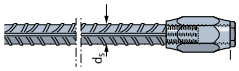
Bar-d_s	L ①	Thread
B-12	400	M12
	610	
	860	
	1300	
B-14	400	M14
	1370	
B-16	400	M16
	1110	
	1570	
B-20	400	M20
	1380	
B-25	400	M25 × 2,5 special thread
	1730	
B-28	400	M28 × 2,5 special thread
	1930	

HBS-05-A – Connection bar



Bar-d_s	L ①	Thread
A-12	380	M12
	590	
	840	
	1160	
A-14	970	M14
	1350	
A-16	375	M16
	1085	
	1545	
A-20	370	M20
	1350	
A-25	360	M25 × 2,5 special thread
	1690	
A-28	360	M28 × 2,5 special thread
	1890	
A-32	①	M32 × 3 special thread

HBS-05-S – Socket bar with screw socket



Bar-d_s	L ①	Thread
S-12	400	M12
	610	
	860	
	1180	
S-14	990	M14
	1370	
S-16	400	M16
	1110	
	1570	
S-20	400	M20
	1380	
S-25	400	M25 × 2,5 special thread
	1730	
S-28	400	M28 × 2,5 special thread
	1930	
S-32	①	M32 × 3 special thread

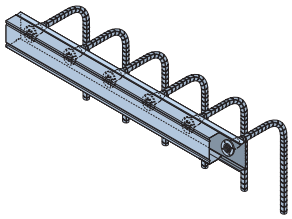
① Please state required length L [mm] when ordering or choose standard element.

The HBS-05-Box and its main features

- profiled backing of the steel box provides optimal transfer of shear loads
- u-shaped box cover made of galvanized sheet steel
- standard box length: 1250 mm (other lengths on request)
- HBS-05 Socket bars pre-installed in the HBS-05-Box available with 12 mm/14 mm/16 mm bar diameters

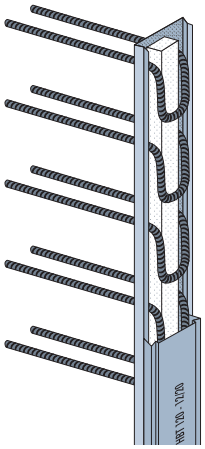
Application:

- cost effective formwork ancillary aid for row installation
- recess to form a keyed joint for shear loads
- with sliding formwork



HALFEN HBT REBEND CONNECTION

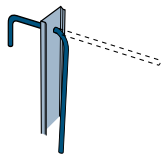
The HALFEN Rebend connection is used for efficient connection of concrete components which are cast in separate stages and need to be connected. With over 50 combinations of rebar types and box widths, optimum connections are possible for a wide range of applications.



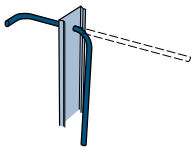
The case is made of galvanized sheet steel with a special corrugated backing and a pre-punched hole in the cover, which serves as a handle, allowing easy removal from the case after installation.
The anchorage and overlap lengths are verified in accordance with Eurocode 2, taking existing bond conditions into account.

- general building authority approved and type-tested
- B500B reinforcing steel (⌀ 8 mm, 10 mm, 12 mm)
- suitable for both transverse and longitudinal loads with standard case types
- case back in galvanized and special corrugated sheet steel
- sturdy, galvanized sheet steel cover with pre-punched hole for easier removal after striking the formwork.
- single-row and double-row types available
- three box widths for single-row types; five box widths for double-row types

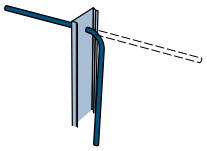
Type 1



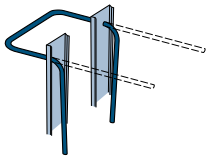
Type 2



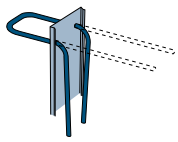
Type 3



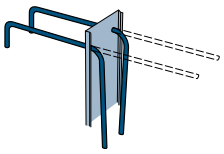
Type 4



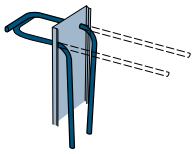
Type 5



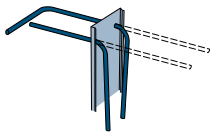
Type 11



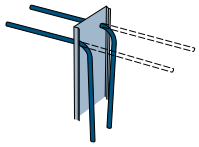
Type 22



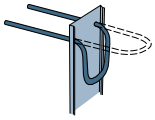
Type 23



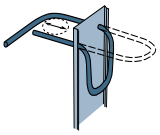
Type 33



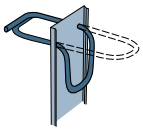
Type 6



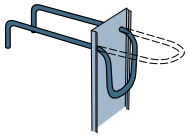
Type 7

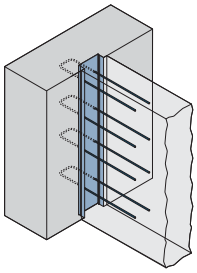


Type 8

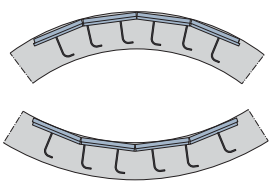


Type 9

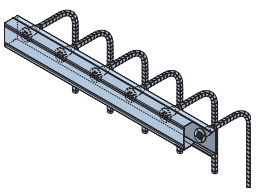




Application example:
HALFEN HBT as a wall connection



HBT Element fitted to a convex / concave curvature
Curvature; radius ≥ approx. 3.00 m; a smaller radius is achieved with more incisions.

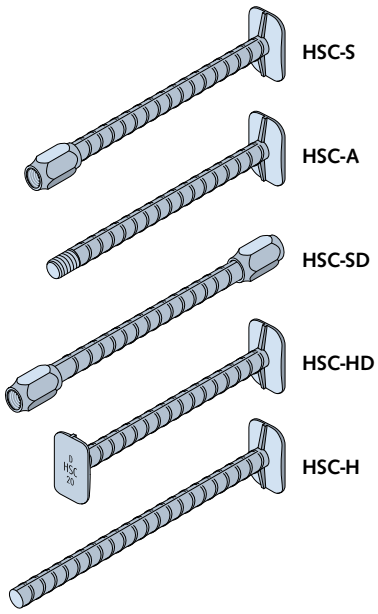


Note:
For 90° angled reinforcement needs; see also HBS-05 Box.

HALFEN HSC STUD CONNECTOR

The HALFEN HSC Stud Connector is a building authorities approved reinforcement, developed specially for cost effective tensile reinforcement in corbels and frame nodes.
The full yield of the reinforcement is already possible with extremely short anchorage lengths.

The HALFEN HSC Stud connector is especially beneficial where dense reinforcement occurs such as in corbels and beam to column connections. The problems and resulting costs that occur in conventional layout of reinforcement and the anchorage of bar loads are avoided.
The amount of reinforcement steel is considerably reduced and the reinforcement layout is simpler.

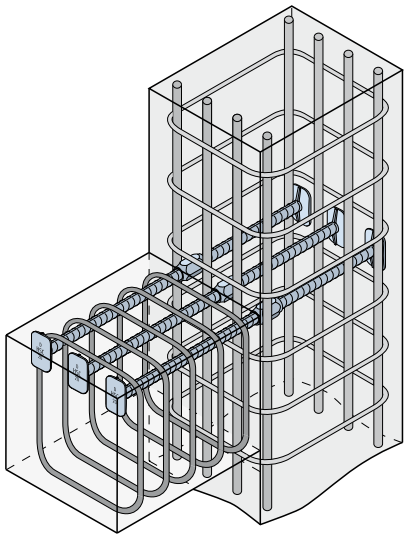


Product range

Dimensions HALFEN HSC Stud Connector

Bar Type	⌀ d_s / ≥ Length L [mm] ①			
Socket bar, single-headed				
HSC-S -	12 / ≥ 155	16 / ≥ 180	20 / ≥ 200	25 / ≥ 230
Connector bar, single-headed				
HSC-A -	12 / ≥ 130	16 / ≥ 150	20 / ≥ 160	25 / ≥ 190
Double socket bar				
HSC-SD -	12 / ≥ 205	16 / ≥ 215	20 / ≥ 230	25 / ≥ 275
Double-headed bar				
HSC-HD -	12 / ≥ 175	16 / ≥ 175	20 / ≥ 175	25 / ≥ 180
Single-headed anchor bar				
HSC-H -	12 / ≥ 130	16 / ≥ 150	20 / ≥ 160	25 / ≥ 190

① Please state required length L [mm] when ordering, or select standard element.

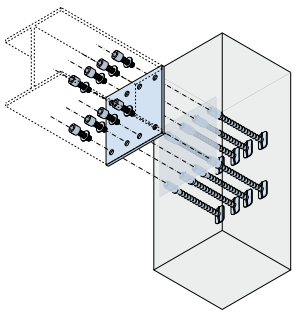


Application example: HSC-A and HSC-S

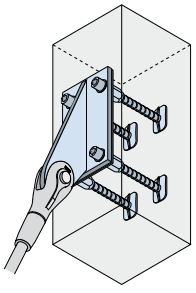
Accessory products

Numerous connection options with the HALFEN HUC Universal connection system:

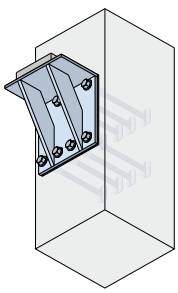
- HALFEN HSC-B Steelwork connections
- HALFEN HSCC Steel corbels



HSC-B with steel girder



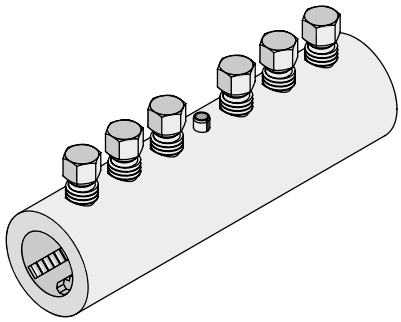
HSC-B with DETAN Connection



HSC-B with HSCC Corbel

HALFEN MBT REINFORCING COUPLER

The HALFEN MBT Reinforcement coupler is a mechanical coupler for B500B reinforcing steel with a diameter of 10 to 40 mm.
Form closure to ensure the positive transfer of tension and compression loads in the rebar is achieved by tightening the bolts until the heads break off at the design shear-off point.



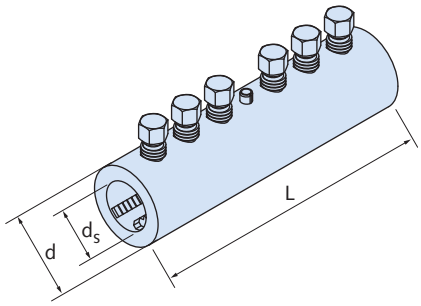
No preparation of the bars is required:

- no thread cutting
- no swaging
- no crimping

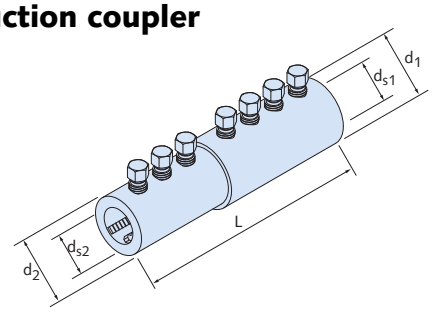
PRODUCT ADVANTAGES

No welding; only standard tools are required to install HALFEN MBT Reinforcement couplers.

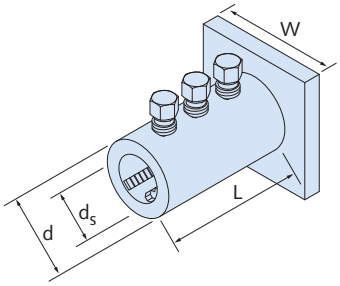
MBT Standard coupler



MBT Reduction coupler



MBT Head coupler



DIMENSIONS OF THE MBT STANDARD COUPLER

Identification	T10*	T40*
Rebar diameter [mm]	**10**	**40**①
Outer diameter socket d [mm]	33.4	81.0
Socket length L [mm]	100	484
Spanner size [mm]	13	19
Number of bolts	4	14
Weight [kg]	0.52	11.30

① couplers with these diameters are not included in the approval (Z-1.5-10).

DIMENSIONS OF THE MBT REDUCTION COUPLER

Identification	RDZ 16/12*	RDZ 40/32*
Rebar diameter [mm]	**16/12**	**40/32**
Outer diameter socket d [mm]	42.2	81.0
Outer diameter socket d2 [mm]	26.4	71.0
Socket length L [mm]	160	335
Length a–b [mm]	80–80	178–157
Spanner size a–b [mm]	13–13	19–16
Number of bolts a–b	3–3	5–5
Weight [kg]	1.30	7.47

DIMENSIONS OF THE MBT HEAD COUPLER

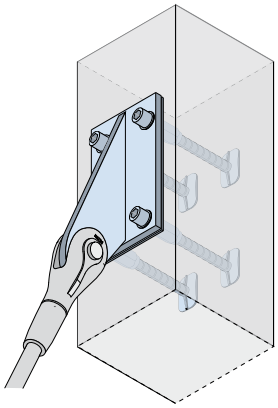
Identification	EV 10*	EV 40*
Rebar diameter [mm]	**10**	**40**
Outer diameter socket d [mm]	33.4	81.0
Socket length L [mm]	55	247
Total length L_o [mm]	65	262
Slab thickness t [mm]	10	15
Slab a × a [mm]	70	150
Spanner size [mm]	13	19
Number of bolts	2	7
Weight [kg]	0.64	8.30

*listed types are the smallest and largest versions, intermediate sizes on request

DETAN ROD SYSTEM

The DETAN Tension rod system from HALFEN is an innovative product solution that meets safety and quality requirements, and also fulfils the highest aesthetic demands.

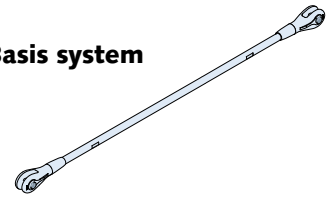
This technically advanced system has a high level of installation ease, can be used for both filigree load-bearing structures as well as in heavy weight construction, and also has European Technical Approval.



PRODUCT RANGE

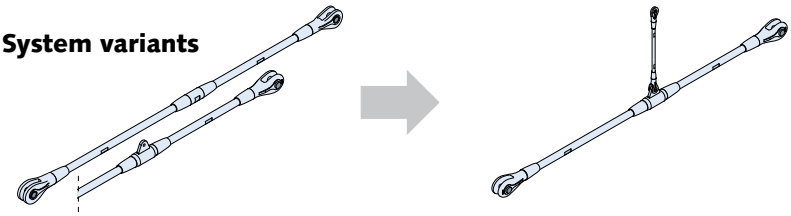
Tension and compression rod system in round steel bars with accessories, fork-heads, nuts, couplers, anchor discs and cross bracings; in steel and stainless steel. With special system components the system is also suitable for pressure loading.

Basis system



DETAN Tension Rod or
DETAN Compression Rod (not illustrated)

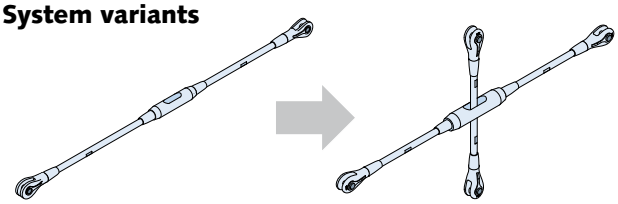
System variants



Suspension, consisting of a system variant with couplers with lug and a basic system

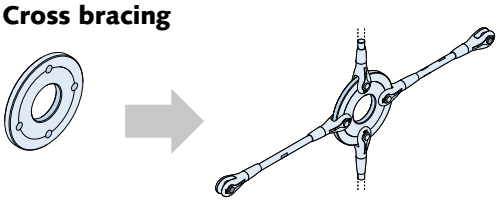
couplers or couplers with lug

System variants



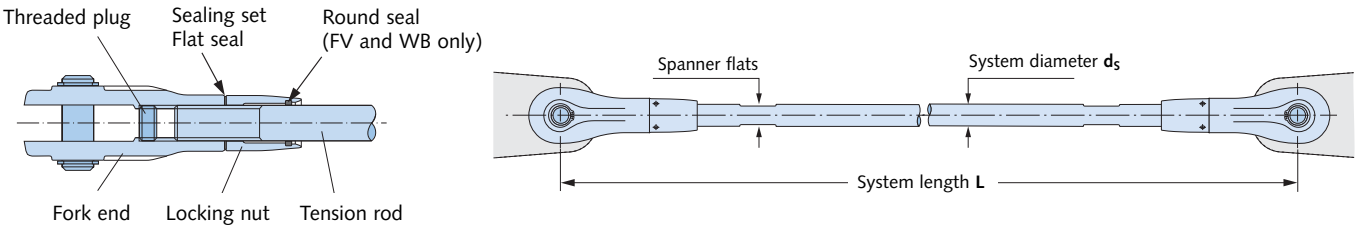
with cross coupler for cross bracing

Cross bracing



Anchor disc for cross bracing

Fork



SYSTEM DETAN-S460, EUROPEAN TECHNICAL APPROVAL ETA-05/0207

System diameter d_S [mm]	10	12	16	20	24	27	30	36	42	48	52	56	60	76	85	95
Available **minimal system length L** [mm]																
Rod, hot-dipped*	250	310	360	440	520	560	600	700	810	940	990	1050	1160	1480	1640	1810
Available **maximal system length L** with one rod [mm]																
Rod, hot-dipped*	6060	6070	12080	12100	12120	12140	12140	12170	12220	12260	12270	12290	12320	15430	15480	15530

*stainless steel version also available on request

HALFEN TRANSPORT ANCHOR SYSTEM

Transport anchors are used in precast concrete building elements to enable safe and easy lifting and transport of the elements to their intended position.

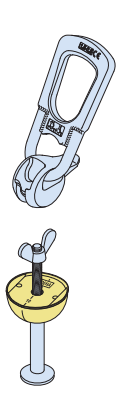
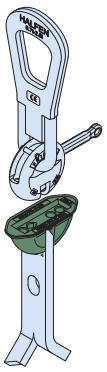
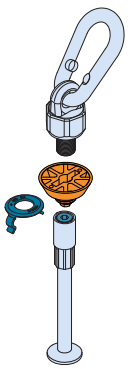
HALFEN has four reliable and proven transport anchor systems, which are used depending on the area of application and the type of load lifting equipment available.

Each of these systems consists of an anchor which remains in the concrete, a recess former (creates a recess in the concrete and is used to hold the anchor in place during production of the precast element) and a lifting head suitable for the selected anchor.

Benefits of using transport anchors and corresponding load lifting equipment;

- safe and reliable transport and lifting of heavy concrete elements, even at great heights
- no protruding steel parts due to the use of recess formers
- exact positioning of the anchors in the building element
- specified load-bearing capacity for the transport anchors for different boundary conditions and concrete strength
- workers are protected against incorrect application by dedicated load handling equipment
- prevents damage / cracks on finished elements
- durable load handling devices

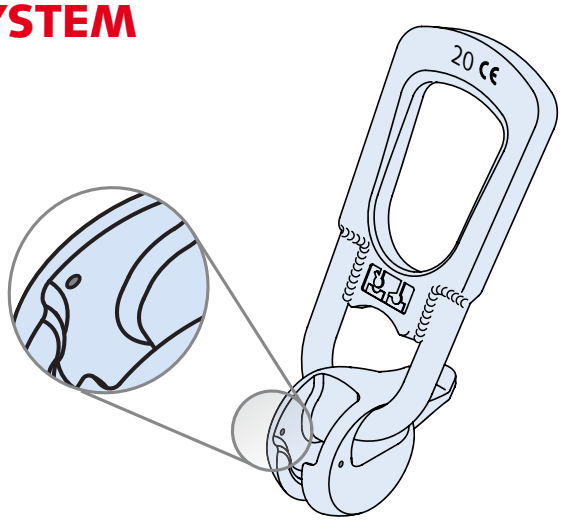
OVERVIEW OF HALFEN TRANSPORT ANCHOR SYSTEMS

Transport anchor system		**KKT** DEHA Spherical head anchor system	**TPA** FRIMEDA Transport anchor system	**HD** HALFEN HD Anchor system	**HA** DEHA Socket anchor system
Advantages		High load capacity Quick attachment and release	Specialist for tilting concrete elements Lifting link with remote release available	Small socket diameter with high load capacity Integrated thread protection	Lifting loops are available as an inexpensive lifting link
Lifting link/Clutch Recess former/ Identification cap Transport anchor					
Material (Anchor)	Steel	■	■	■	■
	A4	■	■	■	■
Load classes		1,3 to 45,0	1,3 to 26,0	1,3 to 25,0	0,5 to 12,5

HALFEN ACCIDENT RECOVERY SYSTEM

The accident recovery unit is installed as a precautionary measure in road tunnels. In the event of an accident crashed vehicles can be recovered quickly and effectively.

Increasingly, emergency and accident recovery services demand that suitable accident recovery units are installed every 100 metres in suitable recesses in tunnel walls. The HALFEN Recovery anchor system is a cast-in stainless steel spherical head anchor, load class 20,0, with a freely pivoting standard lifting link attached. The lifting link is similar to the type used for moving precast concrete elements. A securing bolt is provided to prevent unintentional removal of the lifting link.
Recommendation: A chain welded to the anchor plate protects the clutch from theft.



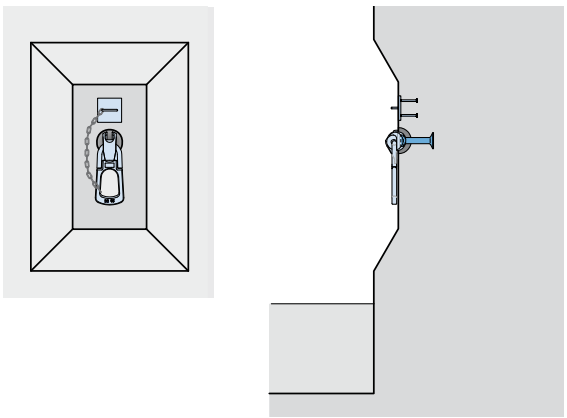
Load device with pre-drilled hole
(Universal head lifting clutch 6104-20),
not illustrated: locking pin

HALFEN ACCIDENT RECOVERY ANCHOR FOR USE IN ROAD TUNNELS

Description / Components	HALFEN Article name	HALFEN Order number
Spherical head transport anchor, stainless steel, load class 20,0	6000-20,0-0180 A4	0735.009-00003
Recess former round, with threaded rods and wing-nut	6232-20,0 ①	0736.020-00008
Load device with provision for locking pin to prevent unintentional removal (without chain)	6104-20	0738.070-00001
Chain (to prevent unauthorized removal)	Provided by customer	
Anchor plate with bolt anchor/U-shaped bar, weldable	Provided by customer	

① The recess formers are reusable. Please order as many as needed for one concreting section.

Wall recess with accident recovery anchor and clutch



HALFEN Accident recovery system (Transport anchor with installed clutch)

A SELECTION OF TUNNEL PROJECTS WITH HALFEN PRODUCTS

GERMANY
- Elbtunnel 4th tunnel tube
- Suburban railway tunnel, Hamburg
- Herrentunnel, Lübeck
- Service tunnel, Uniklinik Eppendorf
- Road tunnel, Hemelingen
- Katzenbergtunnel
- U 2 Suburban rail
- Pragsattel B10 Stuttgart
- Hornberg Tunnel
- Neu-Ulm 21
- Stuttgart 21
- Schwarzkopftunnel
- Noise protection enclosure, Hösbach
- Audi Tunnel, Ingolstadt
- Tunnel, Geisberg
- Tunnel, Frankfurter Kreuz
- North and South Wandersmanntunnel
- Tunnel, Breckenheim
- Tunnel, Idstein
- Tunnel, Montabaur
- Suburban rail, Ostentor/Dortmund
- Relief road tunnel, Gevelsberg
- Suburban rail system, Bochum
- Suburban rail system, Dortmund
- Noise protection enclosure A2, Gelsenkirchen-Erle
- Lange Issel Tunnel
- Troisdorf Tunnel, ICE (Intercity route)
- Siegauen Tunnel, ICE (Intercity route)
- Dickheck Tunnel, ICE (Intercity route)
- Wahnscheid Tunnel, ICE (Intercity route)
- Himmelberg Tunnel, ICE (Intercity route)
- Rottbitze Tunnel
- Aegidienberg Tunnel
- Ittenbach Tunnel
- Günterscheid Tunnel
- Underground 3, Nürnberg
- Underground, Fürth
- Lehrter Railwaystation Tunnel, Berlin
- Tram tunnel, Railwaystation, Rostock
- Motorway tunnel, BAB 113
- Ems Tunnel / Leer
- Underground, Düsseldorf
- Tunnel, Farchant A95
- Tunnel, Allach
- Underground, Munich
- Underground, Hamburg

BELGIUM
- Tunnel, Antwerp ASDAM-HAST
- Tunnel, Zelzate-Knokke
- Antwerp underground
- Tunnel de Cointe, Liège
- Tunnel E5/E9, Liège
- Antwerp Metro
- Brussels Metro
- Cointe Tunnel
- Tunnel, Gestel
- Rolo Tunnel
- CEE Tunnel, Brussels
- Kennedy Tunnel, Antwerp
- Chaleroi Metro

LUXEMBURG
- Tunnel de Gousselerbierg
- Tunnel de Markusbierg
- Tunnel Howald

ITALY
- Variante di valcio autostrada FI-BO
- Tunnel at Caselle Airport
- Tunnel Monte Bianco

SWITZERLAND
- Tunnel de Sauges, A5, Neuchatel
- Connecting tunnel Bettmerhorn-Fischeralp
- Quarten Tunnel A3
- Eggflue Tunnel J18
- Utlisberg Tunnel A4
- Hauenstein Tunnel
- Metro Alpine Tunnel
- Rosenberg Tunnel, St.Gallen
- Islisberg Tunnel
- Hafnerberg Tunnel
- Chienberg Tunnel
- Seelisberg Tunnel
- Lötschberg Tunnel
- Gotthard Base Tunnel

NETHERLANDS
- Zeeburg Tunnel, Amsterdam
- Sophia Tunnel
- Tunnel, Pannerdens Kanaal
- Geldersepoort
- Schiphol Tunnel
- Heijnenoord Tunnel
- Wijker Tunnel

AUSTRIA
- Chain of tunnels, Semmering
- Chain of tunnels, Kalus Phyrna Motorway
- Plabutsch Tunnel
- Karawanken Tunnel, Kärnten
- Inntal Tunnel
- Sausenstein Tunnel
- Vienna Metro

CZECHIA
- Tunnel Praha-Mrazovka
- Tunnel Jihlava / Circular relief road
- Motorway tunnel Prag-South Bohemia

SWEDEN
- Södra Länken, Tunnel near Stockholm
- Railway Tunnel, Malmö
- Hallands Tunnel (Railway)

GREAT BRITAIN
- Channel Tunnel
- Tunnel A1, Hatfield

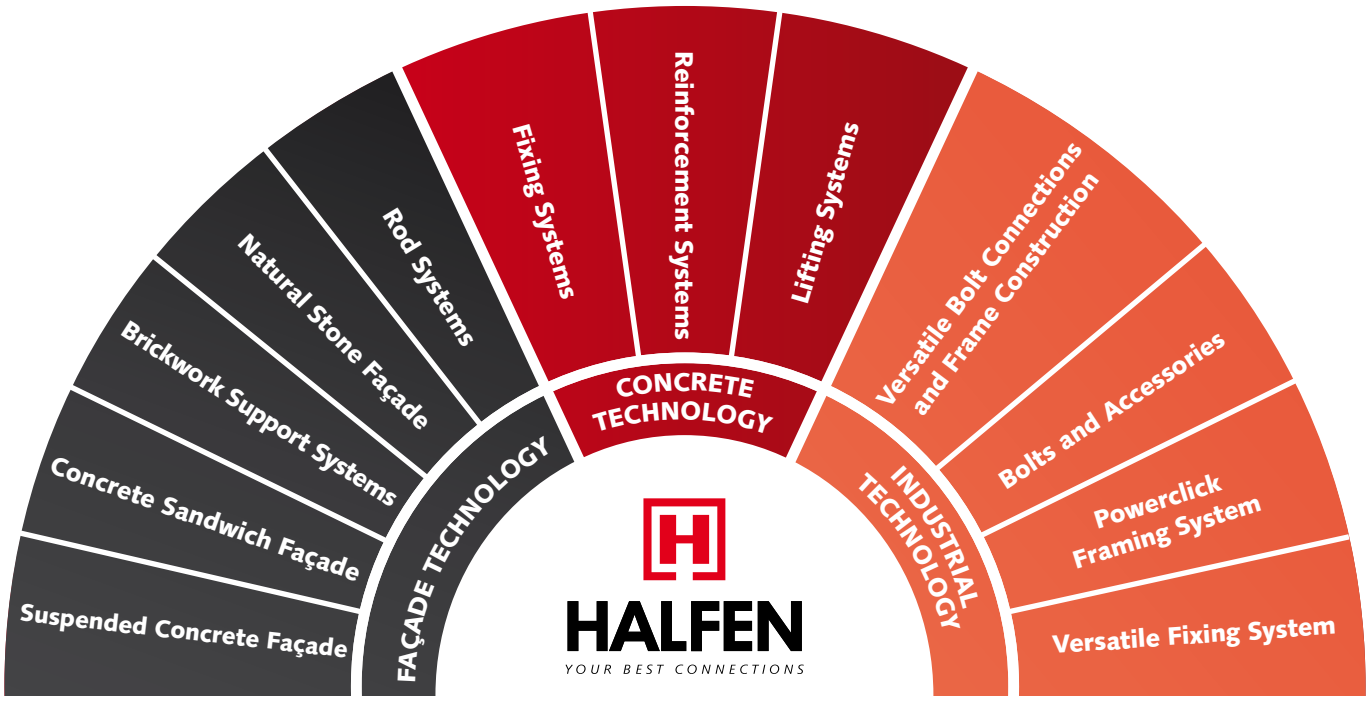
FRANCE
- Paris Metro
- Lille Metro
- Eurotunnel, Calais
- Tunnel de Villejust
- Tunnel du Puymorens
- Tunnel de l'Épine
- Tunnel du Landy
- Tunnel de Tartaiguille
- Tunnel du Prado-Carenge

SINGAPORE
- Circle Line MRT

SOUTH KOREA
- Railway tunnel Seoul-Pusan

MALAYSIA
- Kuala Lumpur Storm Water Management and Road Tunnel

FURTHER PROJECTS
- Metro Cairo, Egypt
- Metro Taipeh, Taiwan
- Great Belt tunnel, Denmark
- Tunnel Route 5, Hongkong
- Junk Bay Tunnel, Hongkong
- Riyadh Metro, Saudi Arabia



FAÇADE TECHNOLOGY

SUSPENDED CONCRETE FAÇADE

- Precast panel anchors: FPA
- Horizontal anchors: DS, HKZ, ULZ, SPV, HVL, WDK, WDI, HFV
- Adjustable restraint: LD
- Parapet corbels: BRA
- Top fixing dowels: WPA

CONCRETE SANDWICH FAÇADE

- Sandwich panel anchors: SP-SPA
- Sleeve sandwich panel anchors: SP-MVA
- Flat anchors: SP-FA

BRICKWORK SUPPORT SYSTEMS

- Brickwork support: HK5, KM
- Brackets: HW, KW, KWL
- Ties for pre-cast lintel: HK5-S, FSW, HSL
- Cavity wall ties: LSA, HEA, HPV
- Scaffold anchor: HGA
- Wall ties: ML, BL

NATURAL STONE FAÇADE

- Body anchors: HRM, HRC, DT, BA, DH
- Grout-in anchors: UMA, UHA
- Sub-structure system: SUK, UKB

ROD SYSTEMS

- DETAN Rod system: S-460
- DETAN Rod system stainless steel
- DETAN Compression rod system

CONCRETE TECHNOLOGY

FIXING SYSTEMS

- HALFEN Cast-in Channels: HTA, HZA
- Balustrade fixings: HGB
- Profiled sheets fixing channel: HTU
- Corner guards: HKW
- DEMU Fixing anchors: T-FIXX®, Bolt anchor
- Lift-Box: HLX
- Mechanical anchor bolt systems
- Chemical anchor bolt systems

REINFORCEMENT SYSTEMS

Physical structural products

- Balcony connection: HIT
- Impact sound insulation units: HBB, HTT, HTF, HTPL

Reinforcement connections

- Screw connection: HBS-05
- Universal connection: HUC
- Stud Connector: HSC
- Reinforcement coupler: MBT
- Precast coupler: HEK
- Loop Box: HLB
- Rebend connection: HBT

Reinforcement technology

- Anchor rail: HDB
- Column shoe: HCC, HAB
- Betojuster: HBJ
- Shear dowel: HSD

LIFTING SYSTEMS

Quick coupling systems

- DEHA Spherical head lifting system: KKT
- FRIMEDA Lifting anchor system: TPA

Threaded lifting systems

- HD Anchor system: HD
- Fixing anchor system: HA

INDUSTRIAL TECHNOLOGY

VERSATILE BOLT CONNECTIONS AND FRAME CONSTRUCTION

- Framing channels: HM, HL, HZM, HZL
- Connecting parts: HVT
- Cantilevers: KON
- Pipe clamps: HRS
- Pipe supports: HRG, HCS
- Pipe base: RUK
- Lift-off safety device: AHS

BOLTS AND ACCESSORIES

- HALFEN Bolts: HS, HSR, HZS
- Threaded plates: GWP

POWERCLICK FRAMING SYSTEM HCS

- System 63
- System 41 + 22

VERSATILE FRAMING SYSTEM

- HALFIX: HFX

HALFEN INTERNATIONAL

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