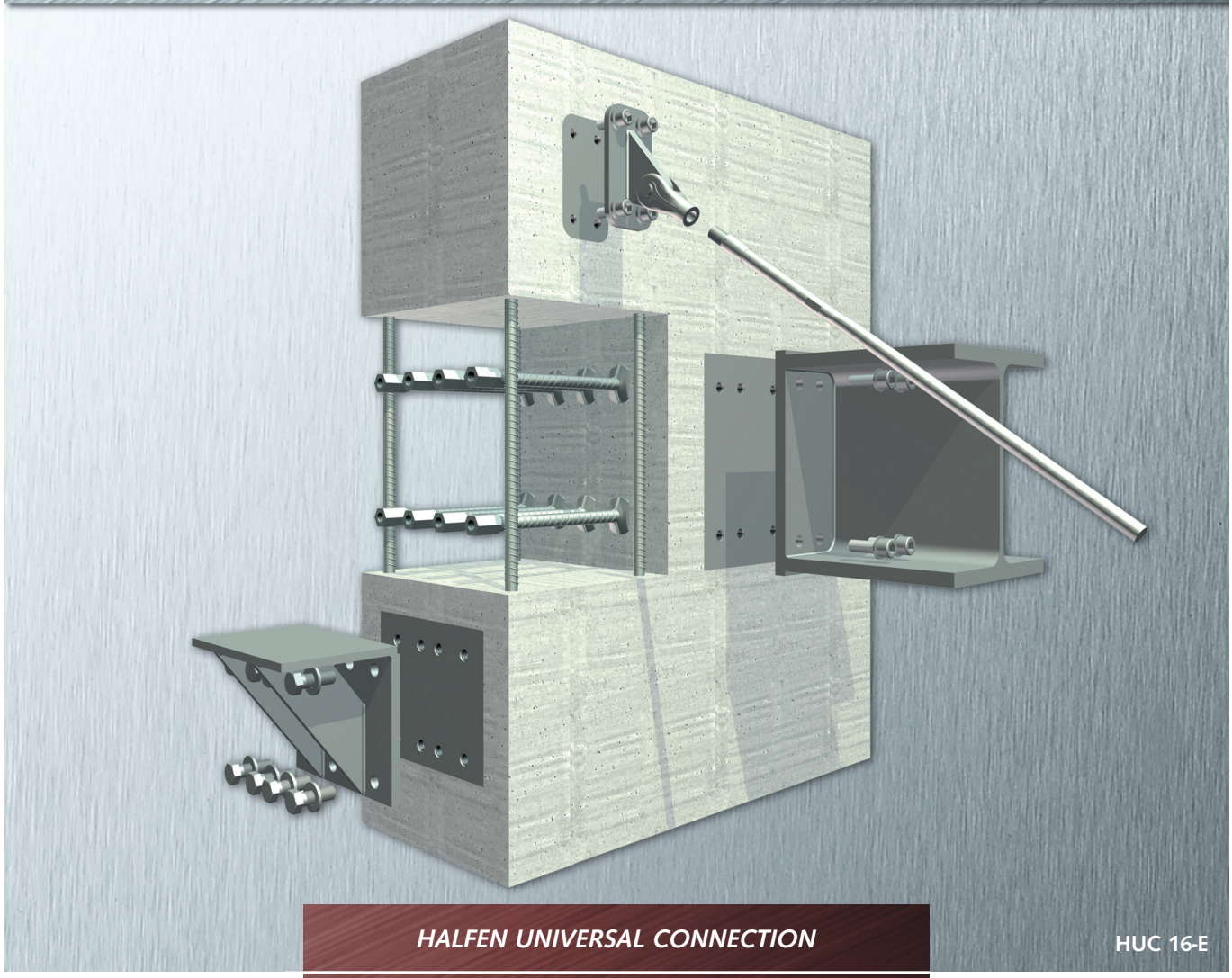
HALFEN HUC UNIVERSAL CONNECTION

TECHNICAL PRODUCT INFORMATION



HALFEN UNIVERSAL CONNECTION

HUC 16-E

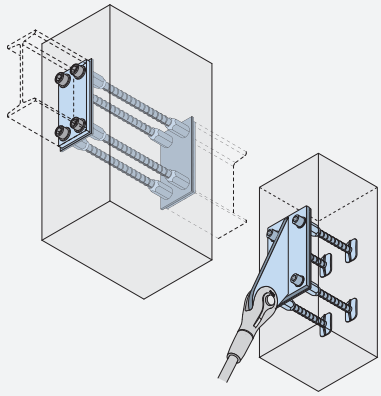
CONCRETE

HALFEN

YOUR BEST CONNECTIONS

HALFEN Universal connection system

The HALFEN HUC Universal connection system is an effective solution for transfer of high structural loads into concrete. The HUC system includes the cast-in concrete HSC-B Steel connection and the secondary connecting unit. For example, the HSCC Steel corbel.
The wide range of potential layouts for the HSC-B Sockets and the positive transfer of loads allow an extensive range of possible applications. For example, connections for steel beams, steel corbels, cable bracing systems or anchor points for the DETAN Rod system.



See page 3 for further application examples

German National Technical Approvals

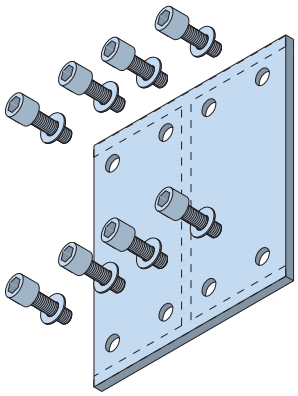
National Technical Approval Z-21.8-1974 for HALFEN HSC-B Concrete steel connector

Type test report S-WUE/110032 for HALFEN HSCC Steel corbels

National Technical Approval Z-21.8-1973 for HALFEN HSC Stud connector

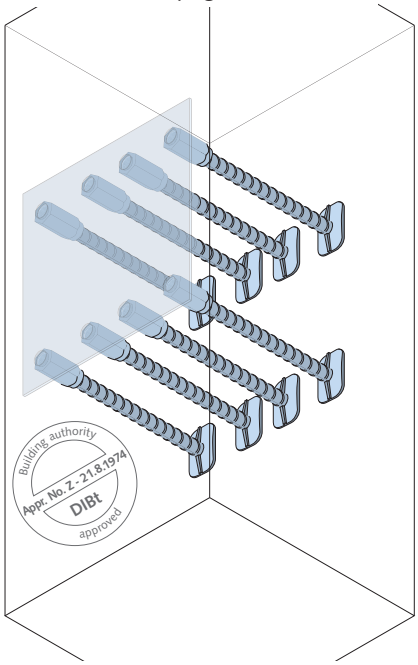
National Technical Approval Z-1.5-189 for HALFEN HBS-05 Screw connection

HALFEN HSC-B Concrete steel connection



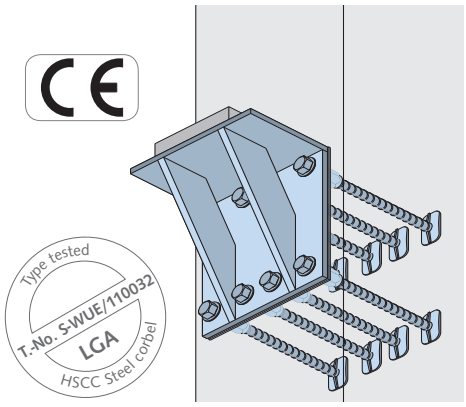
HSC-B FP Face plate
System face plate for beam connection, fin plate connections or other constructions.

HSC-B Concrete steel connection
Cast in component socket bars with positioning plate for accurate installation, see page 4.

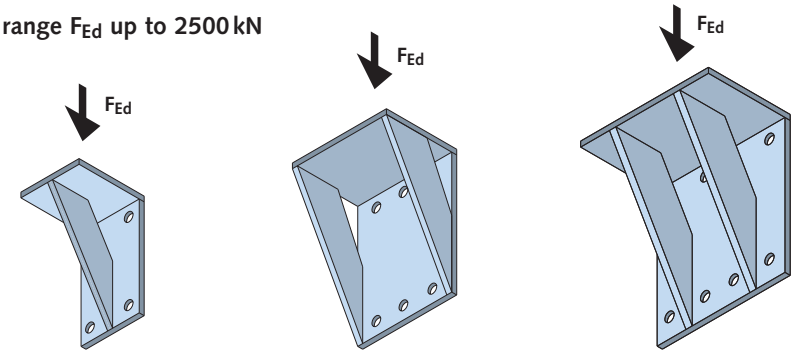


HALFEN HSCC Steel corbels

HALFEN HSCC Steel corbels
To optimize the planning process HALFEN has 34 type-tested HSCC Steel corbels available. In comparison, HSCC Steel corbels provide up to double the load capacity of concrete corbels. In combination with a chamfered beam the total installation height can be significantly reduced. This also reduces the construction height normally required for support corbels, see page 16.

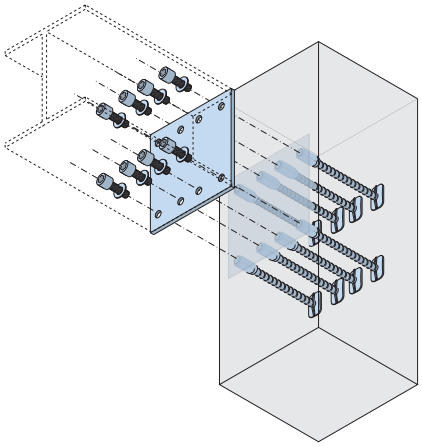


Load range F_{Ed} up to 2500 kN



Application examples for HALFEN HSC-B Concrete steel connector

The prefabricated laser-cut HSC-B Face plate allows structural steel components, especially steel beams, to be efficiently prepared in the factory. Connecting pre-fabricated steel components to the previously installed in-situ structure using the accurately cast-in socket bars together with suitable bolts is simple, quick and cost effective.



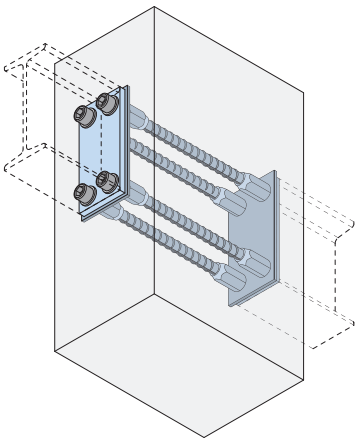
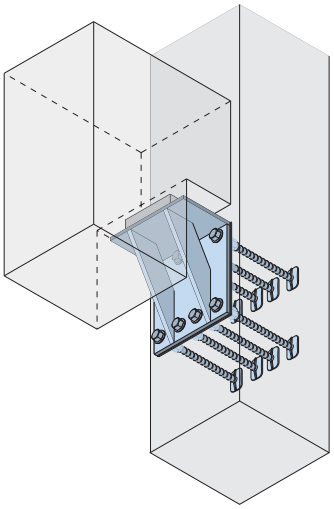
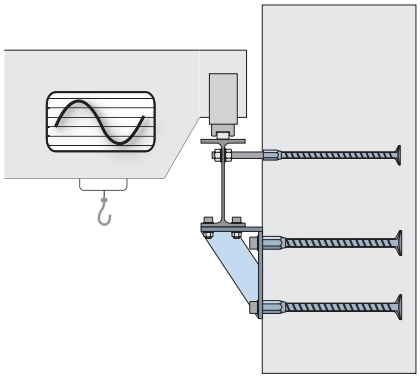


Figure: single- and double-sided steel beam connections to reinforced concrete elements

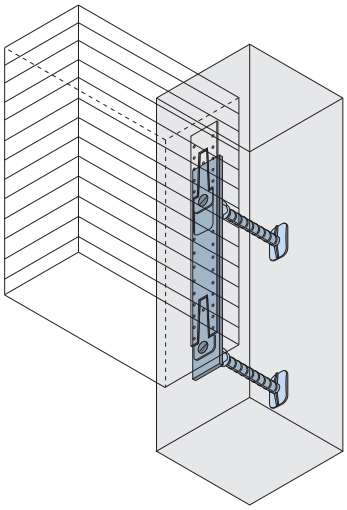
Further application examples for HALFEN HUC Universal connection



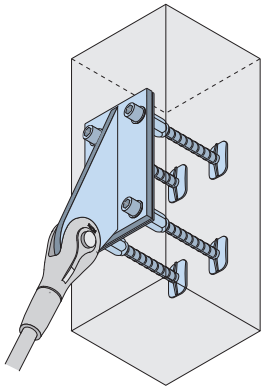
Reinforced concrete beam bearing on a HALFEN HSCC Steel corbel, see page 16



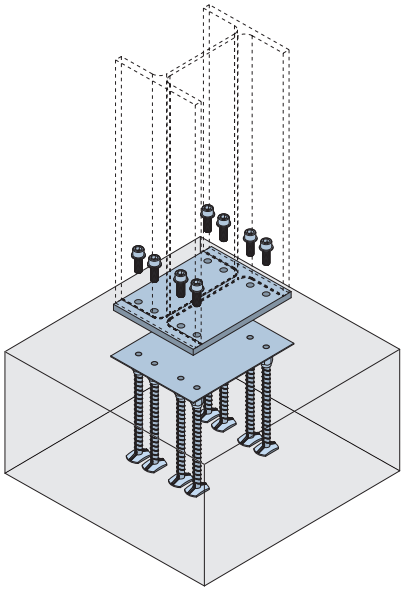
Made to customer's specifications; corbel / crane girder combination



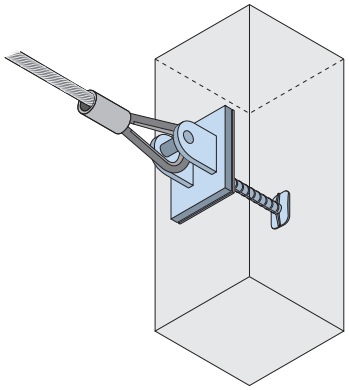
HSC-B System with connection for timber beams



HSC-B Face plate with welded fin for connecting DETAN Tension rod elements



Steel column connection to footing

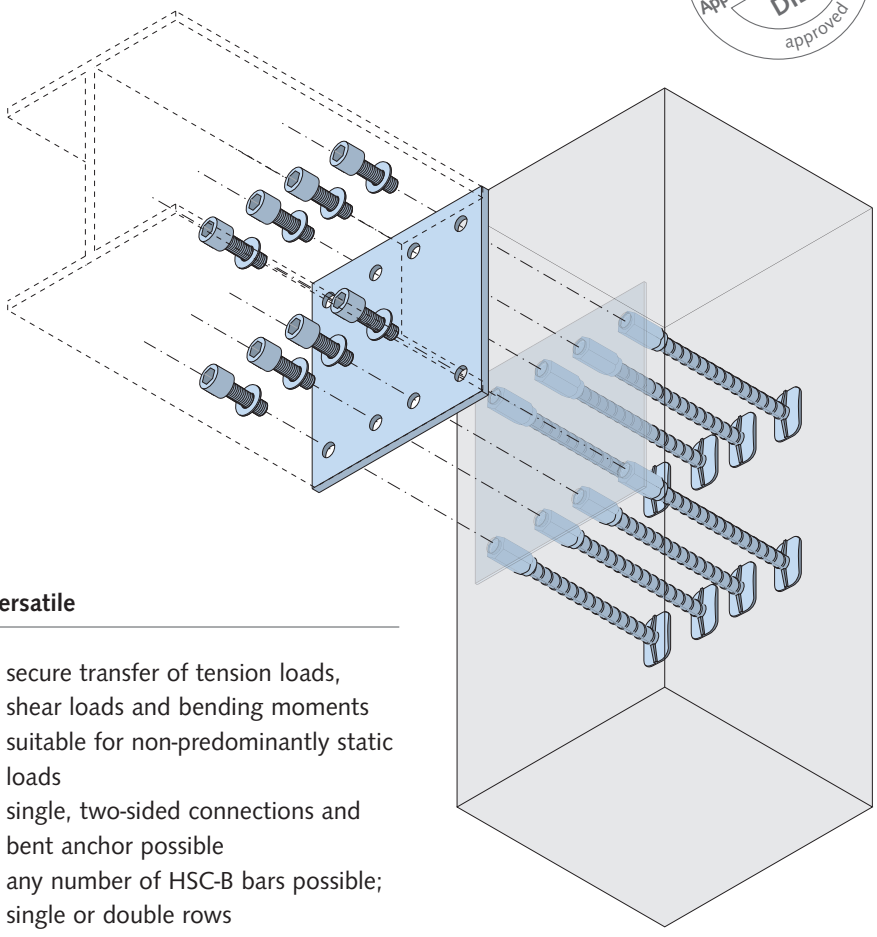


Tension cable connection using the HSC-B Concrete connection system

HALFEN HSC-B Concrete Steel Connection

The advantages at a glance

The HALFEN HSC-B Concrete steel connection is a German Building Authority approved high load solution for securely connecting structural steel components to concrete. The system is designed to securely support large loads, normal loads, shear loads and bending moments, individually or in combination.



Versatile

- secure transfer of tension loads, shear loads and bending moments
- suitable for non-predominantly static loads
- single, two-sided connections and bent anchor possible
- any number of HSC-B bars possible; single or double rows
- versatile connection for various types of structural component e.g. steel corbels, beams, DETAN Tension rods and tension cables

Easy calculation

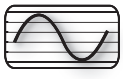
- Building Authority Approval for all components
- verification of load bearing capacity using tension-shear interaction diagrams
- system offers short anchor lengths and allows secure connections in thin concrete elements

Time and cost saving

- accurate and simple installation to the formwork with a positioning plate and bolts – drilling the formwork is not required
- no on-site welding. Precise laser-cut HSC-B steel face plates are preassembled and installed to the connecting structural steel elements in the factory
- simple bolt connections require no specialist tools

Sustainable architectural quality

- durable due to optional corrosion protection for sockets - available in hot-dip galvanized (fv), zinc galvanized (gv) or in stainless steel (A4)
- the screw connection allows easy demolition, dismantling and recycling of building material

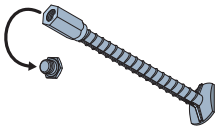


Suitable for non-predominantly static loads

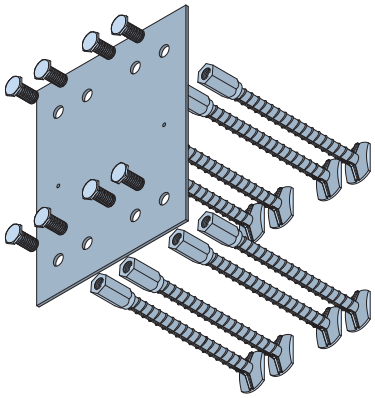
Installation example

HALFEN HSC-B Concrete steel connector with 2 × 4 HSC-B SH socket bars for connecting a steel beam to a reinforced concrete column.

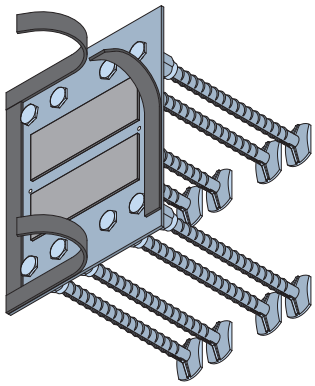
1. Remove the thread protector.



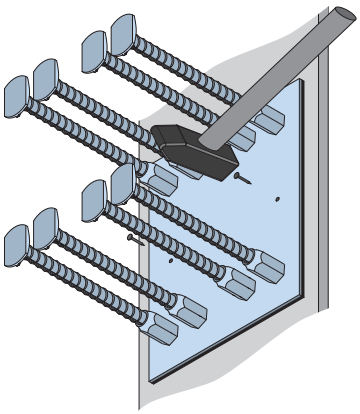
2. Connect the HSC-B SH socket bars to the positioning plate using pan head screws (3 mm head). Further accessories see page 8.



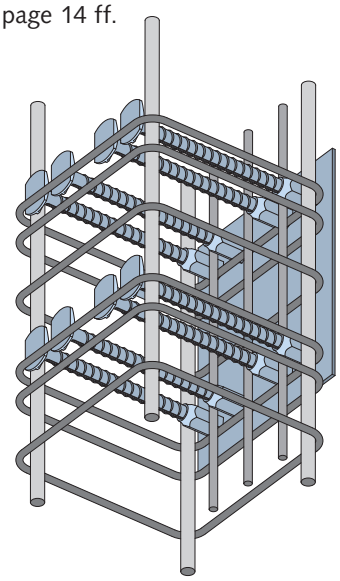
3. Cut and attach self adhesive foam stripes to form a recess at the connection location and to prevent concrete seepage. Place a magnet in the centre of the positioning plate to secure when using steel formwork. See page 8 for further accessories.



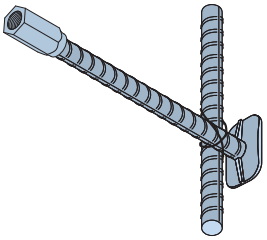
4. The positioning plate with its attached socket bars is secured either with a magnet to steel formwork or with nails to timber formwork.



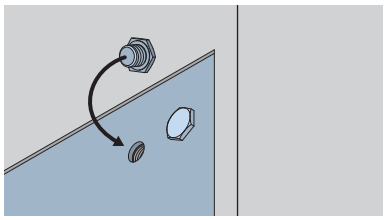
5. Place the column reinforcement and any additional reinforcement according to the structural engineer's specifications, see also page 14 ff.



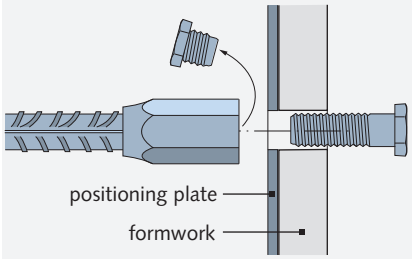
6. The socket bars are wired securely to the column reinforcement.



7. Pour the concrete. Remove the formwork after the concrete has sufficiently hardened. Replace the thread protectors to prevent corrosion until final installation.

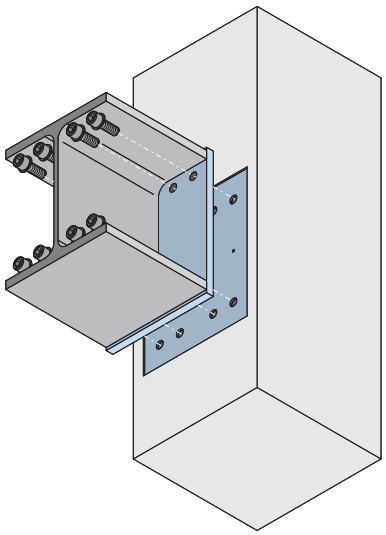


Variant:
Flush mounted positioning plate; screw penetrating the formwork.

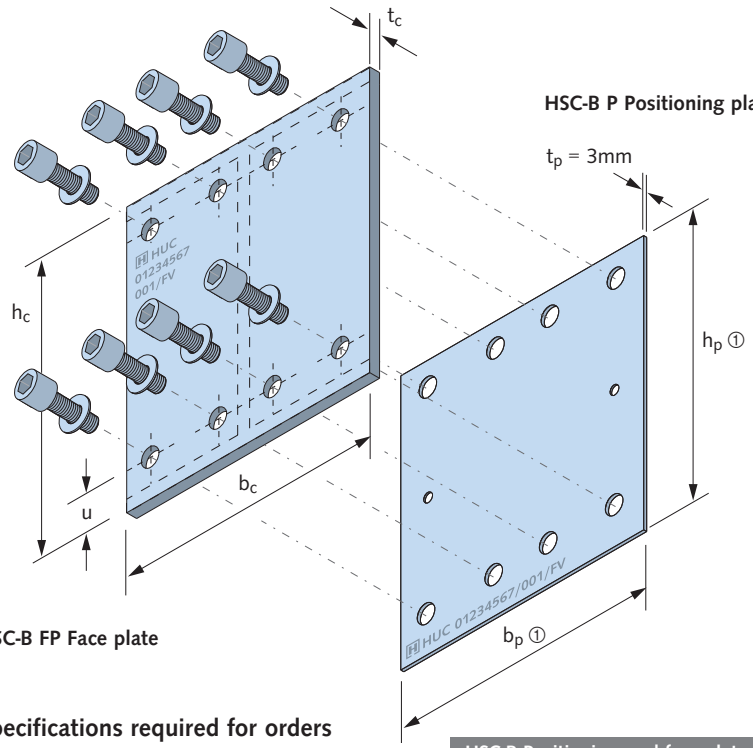


Further information including details on anchor placement can be found in the HUC assembly instructions. Available at www.halfen.com.

8. The load bearing steel beam with welded HSC-B Face plate can be bolted into position.



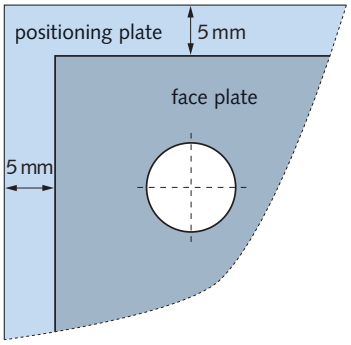
Product overview



HSC-B P Positioning plate

HSC-B FP Face plate

Different edge distances for the bolt holes in the positioning and in the face plate.



① For easy installation use a positioning plate with a slightly larger footprint than the face plate.
For example; $b_p = b_c + 10$ mm, $h_p = h_c + 10$ mm gives 5 mm clearance on all edges.

Specifications required for orders (please supply detailed drawings):
Positioning plate:
b_p, h_p, position and diameters of bolt-holes, corrosion-protection, position and diameter of nail-holes
Face plate:
b_c, h_c, t_c, position and diameters of bolt-holes, material.

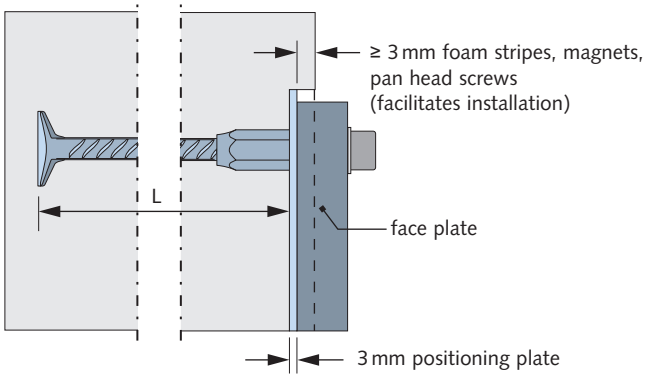
HSC-B Positioning- and face plates P /FP

Type	Finish	Order no.
Positioning plates		
HSC-B P	Hot-dip galvanized [FV] / Zinc galvanized [GV]	**1060.409-00001**
HSC-B P	Stainless steel A4	**1060.409-00003**
Face plates		
HSC-B FP	Mill finish	**1060.409-00002**
The manufacturing tolerance for the hole position is ± 0.1 mm. For the face plate max. d_L, see page 9		

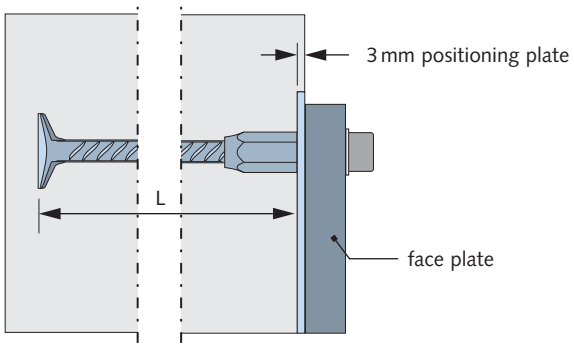
Components may be ordered as a set **(order no. 1060.009-00001)** or separately. The advantage when ordering seperately is that the face plates are delivered directly to the steel manufacturer and the positioning plate with the anchors to the precast plant.

Installation variations

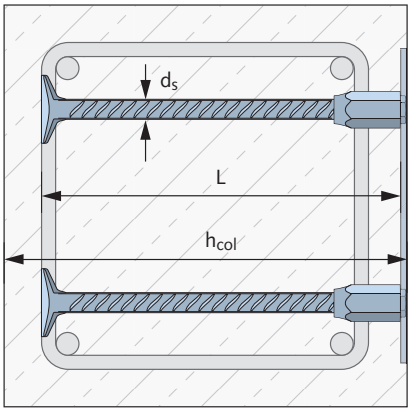
Application with sliding formwork:
Positioning plate is installed recessed with flat headed bolts.



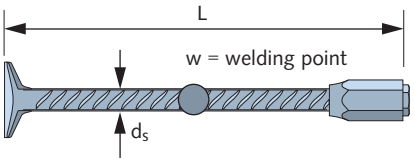
Application with drilled formwork:
Positioning plate is installed flush to formwork.



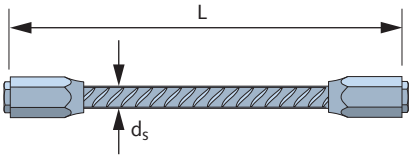
Product overview



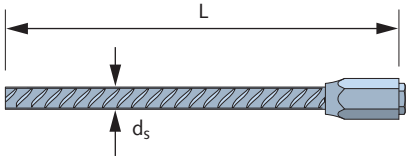
HSC-B SH
Standard length. In-stock standard size.



HSC-B SH with forged head.
Especially suitable for short anchor lengths.



HSC-B SD
Especially suited for double-ended connections to columns or walls.



HSC-B S
Especially suited for installation in slabs with sufficient anchor depth.

HSC-B SH Single headed female bar (standard lengths)
rebar material; reinforcement steel B500B

Product name: HSC-B SH – d_s / standard length L [mm]	For column dimensions ① h_{col} [mm]	Socket material Order no. Hot-dip galvanized [FV]	Stainless steel [A4]	Zinc galvanized [GV]
HSC-B SH-16 / 360	**400**	**1060.010-00001**	**1060.020-00001**	**1060.030-00001**
HSC-B SH-16 / 460	**500**	**1060.010-00002**	**1060.020-00002**	**1060.030-00002**
HSC-B SH-20 / 360	**400**	**1060.040-00001**	**1060.050-00001**	**1060.060-00001**
HSC-B SH-20 / 460	**500**	**1060.040-00002**	**1060.050-00002**	**1060.060-00002**

HSC-B SH Single headed female bar (customer specified anchor length)
rebar material; reinforcement steel B500B

Product name: HSC-B SH – d_s / customer specified length L ③ [mm]	Min L [mm]	Socket material Order no. Hot-dip galvanized [FV]	Stainless steel [A4]	Zinc galvanized [GV]
HSC-B SH-12 / ... ②	**155**	**1060.710**	**1060.720**	**1060.730**
HSC-B SH-16 / ...	**180**	**1060.010**	**1060.020**	**1060.030**
HSC-B SH-20 / ...	**200**	**1060.040**	**1060.050**	**1060.060**
HSC-B SH-25 / ...	**230**	**1060.070**	**1060.080**	**1060.090**

HSC-B SH Single headed female bar (customer specified anchor length)
rebar material; reinforcement steel B500B

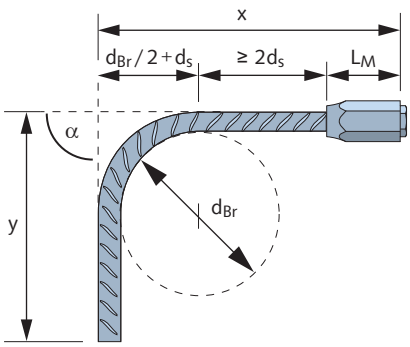
Product name: HSC-B SD – d_s / customer specified length L ③ [mm]	Min L [mm]	Socket material Order no. Hot-dip galvanized [FV]	Stainless steel [A4]	Zinc galvanized [GV]
HSC-B SD-12 / ... ②	**205**	**1060.770**	**1060.780**	**1060.790**
HSC-B SD-16 / ...	**215**	**1060.210**	**1060.220**	**1060.230**
HSC-B SD-20 / ...	**230**	**1060.240**	**1060.250**	**1060.260**
HSC-B SD-25 / ...	**275**	**1060.270**	**1060.280**	**1060.290**

HSC-B SH Single headed female bar (customer specified anchor length)
rebar material; reinforcement steel B500B

Product name: HSC-B S – d_s / customer specified length L ③ [mm]	Socket material Order no. Hot-dip galvanized [FV]	Stainless steel [A4]	Zinc galvanized [GV]
HSC-B S-12 / ... ②	**1060.810**	**1060.820**	**1060.830**
HSC-B S-16 / ...	**1060.310**	**1060.320**	**1060.330**
HSC-B S-20 / ...	**1060.340**	**1060.350**	**1060.360**
HSC-B S-25 / ...	**1060.370**	**1060.380**	**1060.390**

① For concrete cover $c_{nom} \approx 3.5$ cm
② On request the 12mm diameter HSC-B Socket bar is also available in reinforcement steel B500 NR with a stainless steel [A4] socket.
③ Please specify required length L [mm] when ordering.

Product overview



HSC-B SB
Especially suited for connections to columns or walls.

HSC-B SB Concrete steel connector, bent (customer specified anchor length) rebar material; reinforcement steel B500B

Product name: HSC-B SB – d_s / Dimension x / Dimension y / d_{Br} – angle α [mm or radius] ①	Socket material Order no. Hot-dip galvanized [FV]	Stainless steel [A4]	Zinc galvanized [GV]
HSC-B SB-12 / ... / ... / ... - ... ②	**1060.740**	**1060.750**	**1060.760**
HSC-B SB-16 / ... / ... / ... - ...	**1060.110**	**1060.120**	**1060.130**
HSC-B SB-20 / ... / ... / ... - ...	**1060.140**	**1060.150**	**1060.160**
HSC-B SB-25 / ... / ... / ... - ...	**1060.170**	**1060.180**	**1060.190**

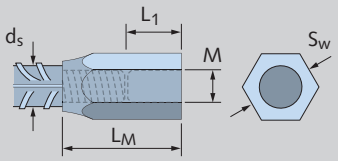
① Please specify bend shape and dimensions x / y / d_{Br} / α when ordering; (unless otherwise specified) the bend angle α = 90°. Recommendation: $d_{Br} \geq 10\ d_s$.
② On request the 12mm diameter HSC-B Socket bar is also available in reinforcement steel B500 NR with a stainless steel [A4] socket.

Order example: **HSC-B SB - 16 / 625 / 500 / 240 - 90**

- rod type
- rod diameter [mm]
- length x socket end [mm]
- length y anchor end [mm]
- bending roll diameter [mm]
- bending angle

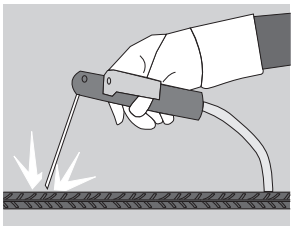
Socket geometry

Dimensions HSC-B Sockets



M	d_s [mm]	S_w [mm]	L_M [mm]	L_1 [mm]
M12	12	19	36	16.5
M16	16	24	48	22.5
M20	20	30	60	28.5
M27	25	41	75	36.0

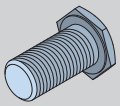
Welding note



Flash butt welding in accordance with EN ISO 17660-1 is mandatory for factory-welded butt-joints on HSC anchors when welding special lengths and designs.
The EN ISO 17660-1 guidelines are generally only valid for predominantly static loads. For fatigue susceptible building elements a distinct decrease in fatigue strength of the B500B reinforcement should be taken into account.
Please contact HALFEN Technical Support if you require technical assistance for your individual projects.

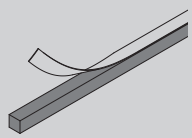
Accessories

HSC-B FI Pan head screw for positioning plate – 3 mm head



Article-name: type nominal size	Order no.	Bolt length L [mm]	Head height [mm]
HSC-B FI M12	**1060.410-00004**	20	3
HSC-B FI M16	**1060.410-00001**	25	3
HSC-B FI M20	**1060.410-00002**	25	3
HSC-B FI M27	**1060.410-00003**	30	3

HSC-B SE Sealing accessories for concrete



Article name	Order no.	Description
HSC-B SE	**1060.420-00001**	Self adhesive foam tape 15 x 15 mm, length 1000 mm

Design and dimensioning according to approval Z-21.8-1974

DIN EN 1992-1-1 and DIN EN 1993-1-1 are applicable for design and calculation. The German Approval regulates the layout, calculation and structural requirements for HSC-B connecting elements in concrete components. The following illustrates the use of the HSC-B; this information applies to both single as well as double ended connections. Building Authority Approval requirements must be observed. Verification of connected steel elements and the bolts must also be provided. Transfer of expected loads into the reinforced concrete must also be verified.

Materials

- regular concrete, strength class C20/25 up to C70/85
- HSC-B-bar: B 500 B diameters 12 - 16 - 20 - 25 mm B 500 B NR at d_s = 12

Socket corrosion protection

- hot-dip galvanized (FV)
- stainless steel (A4)
- zinc galvanized (GV)

Stress and resistance

- predominantly and non-predominantly static loads
- yield strength of reinforcement steel

$$f_{yd} = \frac{f_{yk}}{\gamma_s} = \frac{500\,N/mm^2}{1.15} = 435\,N/mm^2$$

HSC-B Socket bars; fatigue resistance values

- stress ranges for $N = 2 \cdot 10^6$:
  $\Delta\sigma_{RSK} = 80\,N/mm^2$ for $d_{HSC\text{-}B}$ = 12, 16 and 20 mm
  $\Delta\sigma_{RSK} = 70\,N/mm^2$ for $d_{HSC\text{-}B}$ = 25 mm
- Wöhlerline stress exponents:
  $k_1 = 3.5$ for $N \le 2 \cdot 10^6$
  $k_1 = 3$ for $2 \cdot 10^6 \le N \le 10^7$
  $k_2 = 5$

Dynamic loads

The use of spring washers for installation of face plates is recommended if the HSC-B is subjected to dynamic loads.

Preload stress, bolts

Maximum preload stresses [kN]	
M 12	31.1
M 16	58.6
M 20	91.6
M 27	173.3

Hole layout

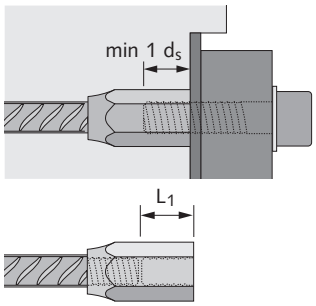
Depending on requirements, the number of HSC-B is freely selectable. Single row and multi row anchorage is possible. Minimum spacings must be observed (see table). The positioning plate should have a slightly larger footprint than the face plate, see page 6. The maximum hole diameters in the face plates of attached components should also not be exceeded.
See adjacent table.

Screw length

When calculating the screw length, the minimal screw depth of 1 d_s for final installation must be observed. The maximum bolt screw-depth L_1 (see table) is determined by the anchor socket size.

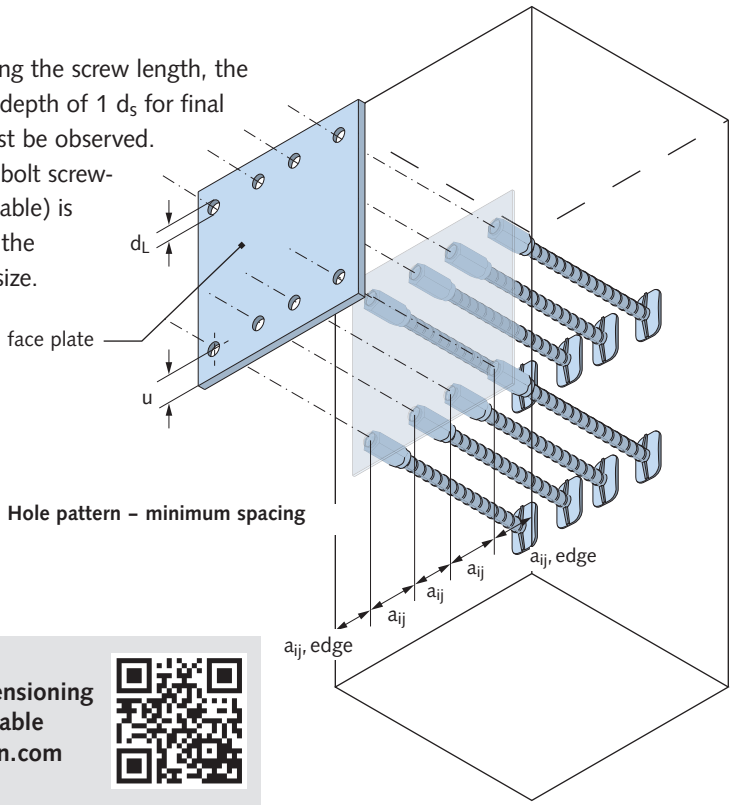
Dimensions, geometric requirements

HSC-B d_s [mm]	Bolt [-]	Minimum distances $a_{ij,edge}$ [mm]	Minimum distances a_{ij} [mm]	Minimum distances u [mm]	Hole diameter max d_L [mm]
12	M 12	40	30	21	13
16	M 16	50	38	21	17
20	M 20	63	48	27	21
25	M 27	86	66	36	28.5



Maximum bolt screw depth

HSC-B d_s [mm]	L_1 [mm]
12	16.5
16	22.5
20	28.5
25	36.0

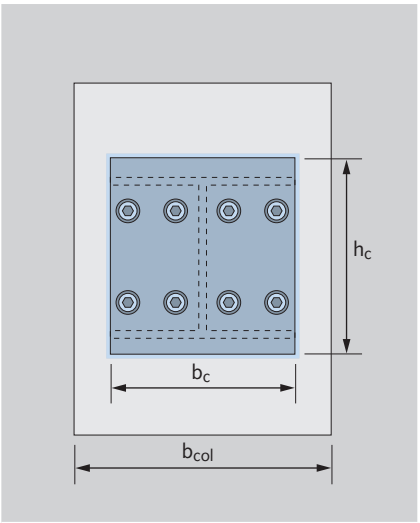


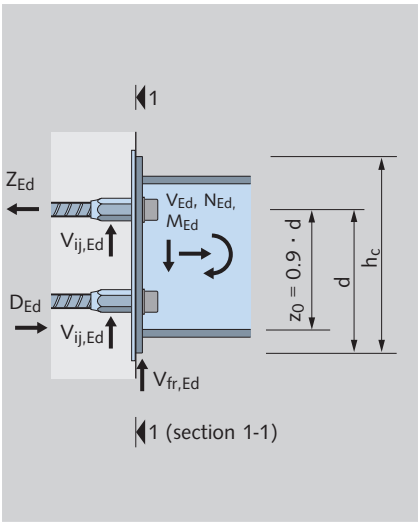
Hole pattern – minimum spacing

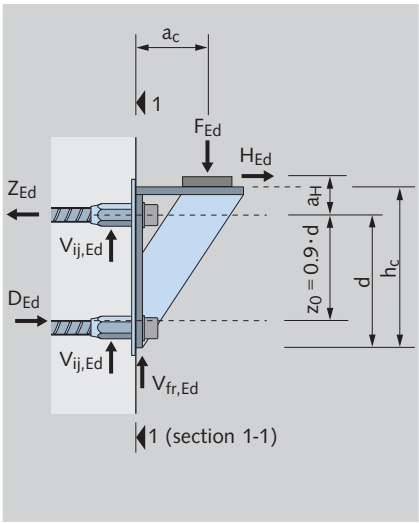
Detailed dimensioning example available at www.halfen.com

Design and dimensioning according to approval Z-21.8-1974

Geometry







Actions on the joint
The static forces in the joint between the positioning and the face plate (section 1-1) have to be determined.

Universal steel element
V_{Ed}
N_{Ed}
M_{Ed}

Corbel as attached structural element
$V_{Ed} = F_{Ed}$
$H_{Ed} \geq 0.2 \cdot F_{Ed}$ (if friction forces resulting from restraint deformations cannot be excluded)

Tensile force Z_{Ed}, compressive force D_{Ed}

cantilever of internal forces
$z_0 = 0.9 \cdot d$

$$Z_{Ed} = \frac{M_{Ed}}{z_0} + N_{Ed} \cdot \frac{(0.5 \cdot h_c - 0.1 \cdot d)}{z_0}$$

$$D_{Ed} = \frac{M_{Ed}}{z_0} - N_{Ed} \cdot \frac{(d - 0.5 \cdot h_c)}{z_0}$$

$$Z_{Ed} = V_{Ed} \cdot \frac{a_c}{z_0} + H_{Ed} \cdot \frac{(a_H + z_0)}{z_0}$$

$$D_{Ed} = V_{Ed} \cdot \frac{a_c}{z_0}$$

Positioning plate
The positioning plate is not included in the static calculation. Standard thickness is 3 mm. A hole ≥ 4 mm in diameter is required to vent air trapped during the (concrete) casting process. The plate should have at least temporary corrosion protection.

Dimensioning of the connected structural element: The connected element should be designed according to the appropriate standard, for example: DIN EN 1993-1-1. See page 9 for additional information.

Durable corrosion protection is achieved with hot-dip galvanization according to DIN EN ISO 1461.

Friction
The load bearing proportion of friction $V_{fr,Ed,inf}$ may only be assumed if the surfaces of the positioning plate and the face plate are suitable for friction transfer. For special constructions without positioning plates friction values for concrete to steel are valid.

$V_{fr,Ed,inf} = D_{Ed} \cdot \mu_{inf}$
for verification of bolts, threaded sockets, and local concrete failure.

$V_{fr,Ed,sup} = D_{Ed} \cdot \mu_{sup}$
for verification of concrete edge failure.

Friction coefficients for verifications in ULS

	Steel/steel		Concrete/steel	
	μ_{inf}	μ_{sup}	μ_{inf}	μ_{sup}
Friction applicable	0.1	0.2	0.2	0.45
Friction not applicable	0		0	

Design and dimensioning according to approval Z-21.8-1974

$N_{ij,Ed}$ = Tension load per threaded socket from the bolt
$V_{ij,Ed}$ = Shear load per threaded socket from the bolt
n_{tie} = Number of bolts in tension
n_{tot} = Total number of bolts
A_{sp} = Cross section per bolt
γ_{M2} = Partial safety factor = 1.25

Cross section of the bolts	
Diameter	A_{sp} [cm²]
M12	0.84
M16	1.57
M20	2.45
M27	4.59

Resistance parameters of the bolts		
Classification	f_{ub} [kN/cm²]	α_v
4.6	40	0.60
5.6	50	0.60
8.8	80	0.60
10.9	100	0.50

Static forces: $N_{ij,Ed} = \frac{Z_{Ed}}{n_{tie}}$ $V_{ij,Ed} = \frac{(V_{Ed} - V_{fr,Ed,inf})}{n_{tot}}$

Dimensioning of the bolts (N-V interaction according to DIN EN 1993-1-8)

Resistances: $N_{ij,Rd} = k_2 \cdot \frac{f_{ub}}{\gamma_{M2}} \cdot A_{Sp}$ $V_{ij,Rd} = \alpha_v \cdot \frac{f_{ub}}{\gamma_{M2}} \cdot A_{Sp}$

Interaction verification: $\left(\frac{N_{ij,Ed}}{N_{ij,Rd}}\right)^2 + \left(\frac{V_{ij,Ed}}{V_{ij,Rd}}\right)^2 \leq 1.0$

Recommendation: pre-select the number of bolts from the graphs shown on pages 11 and 12.

Threaded socket dimensioning
(elastic - plastic method according to DIN EN 1993-1-1)

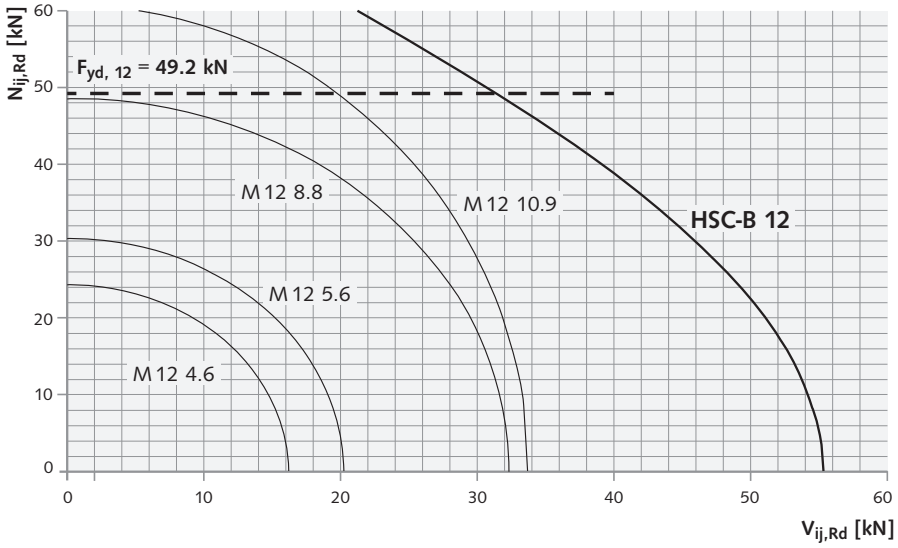
The capacity of the threaded sockets has been confirmed if the variables Vij,Ed, Nij,Ed from the calculation values are within the area of the diagram between the coordinates axis and the specific diameter curve. The load bearing capacity of connecting reinforcement bars has to be verified.

Pre-selection

To simplify pre-selection, the limits are combined in the following graphs. The performance **of each HSC-B threaded socket** is determined by:

- nominal bar diameter of HSC-B
- load capability of the bolt used to connect the structural component to the threaded socket
- load capability of the socket

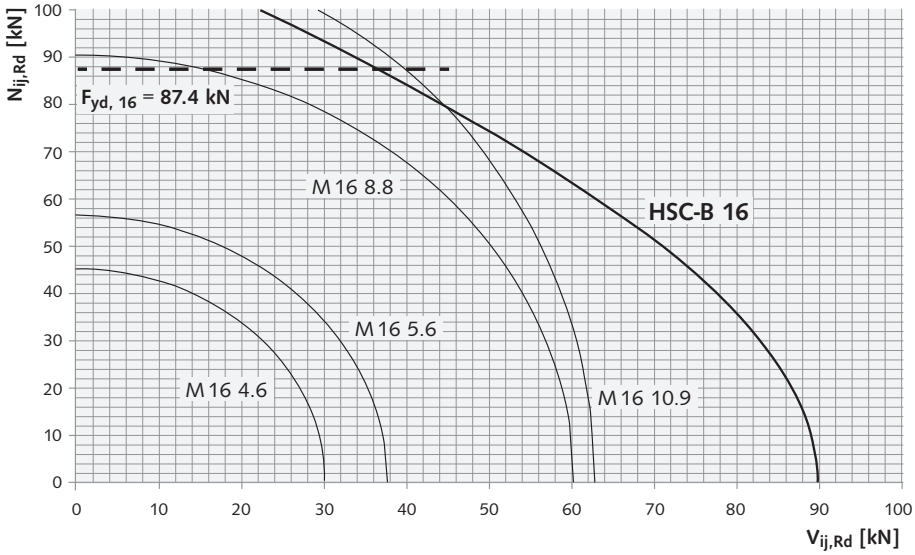
The load capacity of the connection is limited by the load capacity of the sockets and bolts as well as by the capacity of the reinforcement bar. The yield force of the reinforcing bar anchor is determined by f_{yd} = 435 N/mm², the load bearing capacity of the bolts is according to DIN EN 1993-1-1, see page 11.



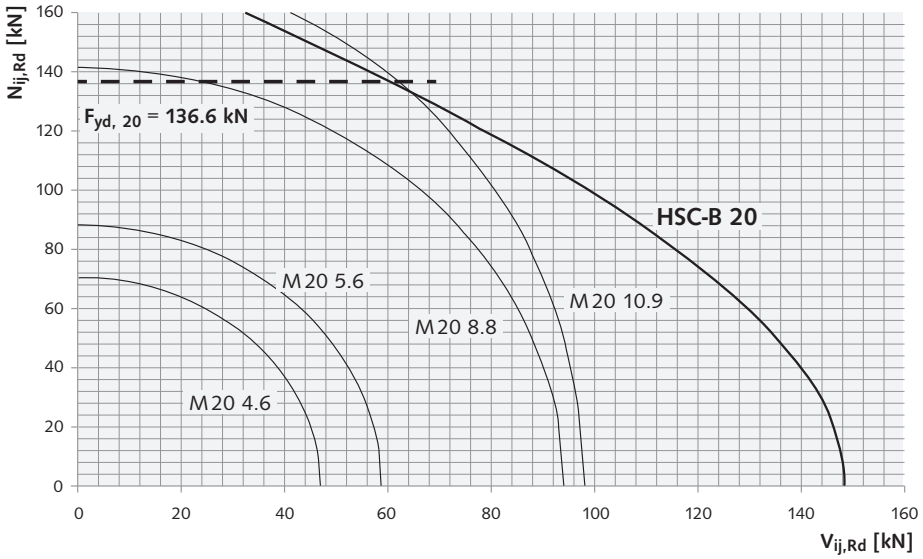
HSC-B 12 load range graph
Displays limits including bolt capacities and forces in the reinforcement

Pre-selection

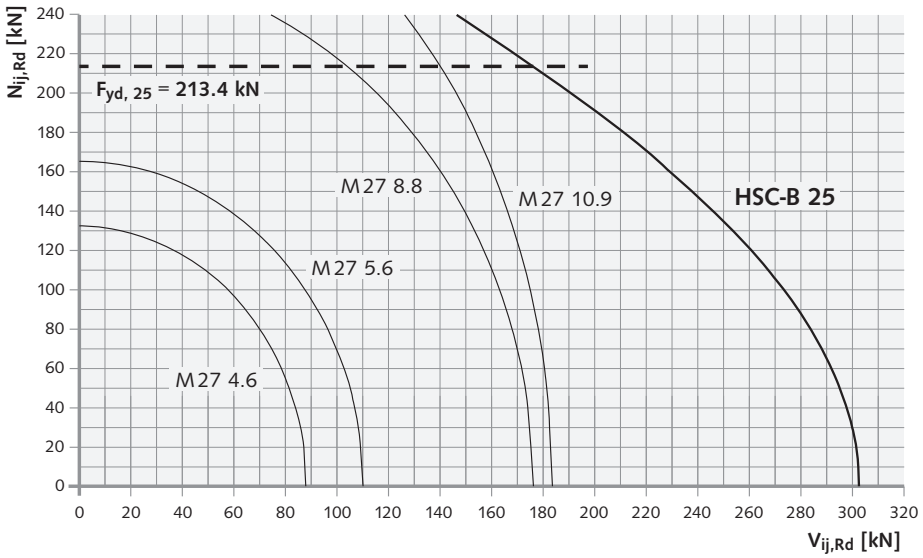
HSC-B 16 load range graph
Displays limits including bolt capacities and forces in the reinforcement



HSC-B 20 load range graph
Displays limits including bolt capacities and forces in the reinforcement



HSC-B 25 load range graph
Displays limits including bolt capacities and forces in the reinforcement



Concrete design and dimensioning acccording to approval Z-21.8-1974

Local concrete failure

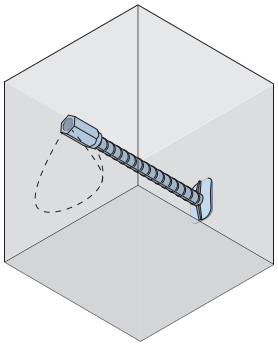
Action: shear force per socket $V_{ij,Ed}$ (see page 11)

Resistance per socket: $$V_{ij,c,loc,Rd} = \frac{1.44}{\gamma_c} \cdot S_w^2 \cdot (f_{ck} \cdot R_{p,0.2})^{0.5}$$

γ_c = 1.5
S_w = spanner size, (see table)
f_{ck} ≤ 50 N/mm²

$R_{p,0.2}$ = 440 N/mm² (socket material; characteristic tensile yield strength)

Verification: $\frac{V_{ij,Ed}}{V_{ij,c,loc,Rd}} \leq 1.0$



Local concrete failure

Concrete edge failure

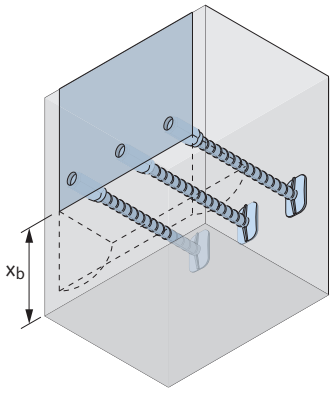
Action: $V_{con,Ed} = \frac{(V_{Ed} + V_{fr,Ed,sup})}{2}$

Friction proportion $V_{fr,Ed,sup}$ (see page 10)

Resistance: $V_{con,Rd} = 15 \cdot \frac{\alpha}{\gamma_c} \cdot b_c \cdot L_M \cdot f_{ck}^{0.25}$ [N]

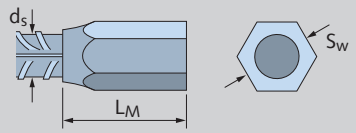
α = 0.85
γ_c = 1.5
f_{ck} ≤ 50 N/mm²
b_c = face plate width of connecting component [mm]
L_M = socket length [mm], (see table)
x_b ≥ 15 L_M (recommended distance to the concrete edge in shear load direction)

Verification: $\frac{V_{con,Ed}}{V_{con,Rd}} \leq 1.0$



Concrete edge failure

HSC-B Threaded socket dimensions



d_s [mm]	S_w [mm]	L_M [mm]
12	19	36
16	24	48
20	30	60
25	41	75

Max V_{Ed} in kN per metre face plate width

d_s	C20/25	C30/37	C50/60
12	1294	1432	1627
16	1726	1910	2170
20	2157	2387	2712
25	2696	2984	3390

Depending on the resulting forces (M_{Ed}, N_{Ed}) and on friction proportion μ_{sup} (see page 10), these table values have to be reduced by:

$$\frac{\mu_{sup}}{0.9 \cdot d} \cdot (M_{Ed} - N_{Ed} \cdot (d - 0.5 \cdot h_c))$$

The maximum shear force capacity of the steel connection max V_{Ed} is determined by the load capacity of the concrete edge.

Concrete design and dimensioning according to approval Z-21.8-1974

1. Primary splitting reinforcement

The primary splitting reinforcement are stirrups placed directly below the socket anchors in both the tensile and in the compression zone.

$$A_{sw,1} = 0.25 \cdot \frac{V_{Ed}}{n_{tot}} \cdot \left(1 - \frac{S_w}{a_{ij,max}}\right) \cdot \frac{1.15}{f_{yk}}$$

n_{tot} = total number of bolts
S_w = spanner size, see table on page 13
$a_{ij,max}$ = maximum space between two socket heads in one row

Minimum diameter for stirrups and longitudinal reinforcement

HSC-B [mm]	$d_{sw,2}$ [mm]	$d_{sl,edge}$ [mm]	$d_{sl,bet}$ [mm]
12	6	12	10
16	6	12	10
20	8	12	12
25	12	20	20

2. Secondary splitting reinforcement

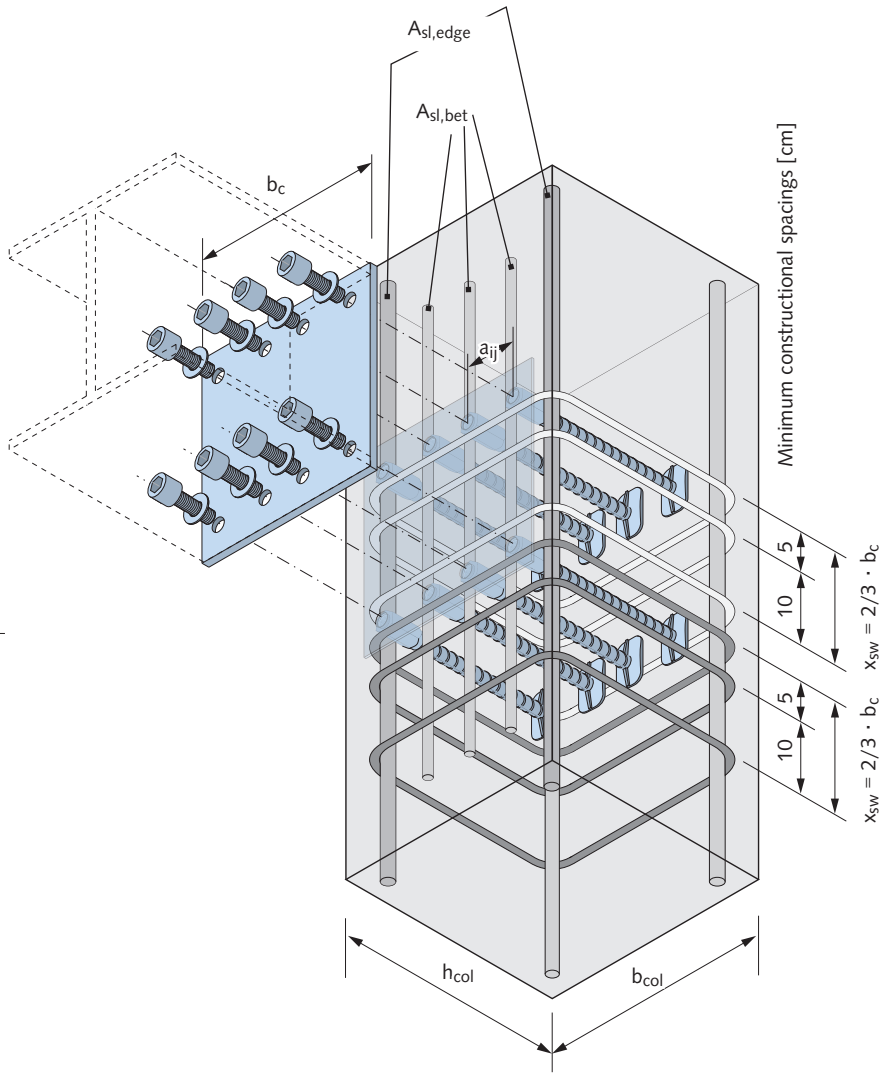
Secondary splitting reinforcement is placed below the socket heads in x_{sw} respecting the minimum required spaces, see illustration. Refer to table above for minimum stirrup diameters $d_{sw,2}$.

$$A_{sw,2,tie} = 0.25 \cdot \frac{V_{Ed}}{2} \cdot \left(1 - \frac{\sum a_{ij}}{b_{col}}\right) \cdot \frac{1.15}{f_{yk}}$$

$$A_{sw,2,strut} = 0.25 \cdot V_{con,Ed} \cdot \left(1 - \frac{\sum a_{ij}}{b_{col}}\right) \cdot \frac{1.15}{f_{yk}}$$

with:
a_{ij} = space between two sockets in one row
b_{col} = reinforced concrete width

$V_{con,Ed}$ see page 13



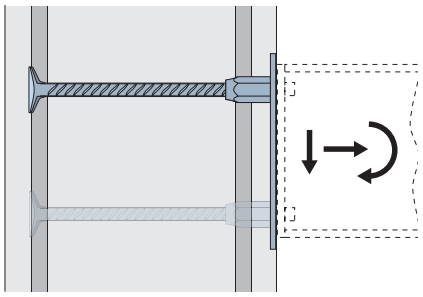
Layout of longitudinal reinforcement and splitting reinforcement

Longitudinal reinforcement

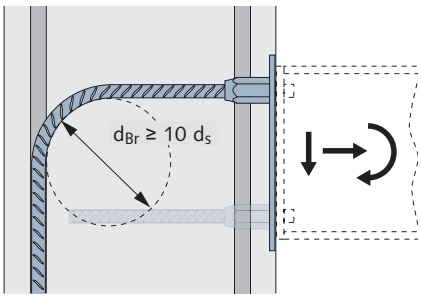
At minimum, longitudinal reinforcement $A_{sl,edge}$ and $A_{sl,bet}$ must be placed between the socket bars in the concrete element. Minimum bar diameters are shown in the table above. This reinforcement has to be anchored above and below the steel element.

Concrete reinforcement design and dimensioning according to approval Z-21.8-1974

Anchoring the tension reinforcement
For one sided connection (single corbels) ensure that the tension reinforcement is securely anchored.
Recommendation: use socket bars with anchor heads according to approval Z-21.8-1973. See separate catalogue HALFEN HSC Stud connector. Download the catalogue at www.halfen.com.



Position of headed socket anchor as tension connection



Position of bent socket anchor as tension connection

See table for minimal spacing for HSC Anchor heads according to approval Z-21.8-1973.

Mimimum dimensions according to approval Z-21.8-1973

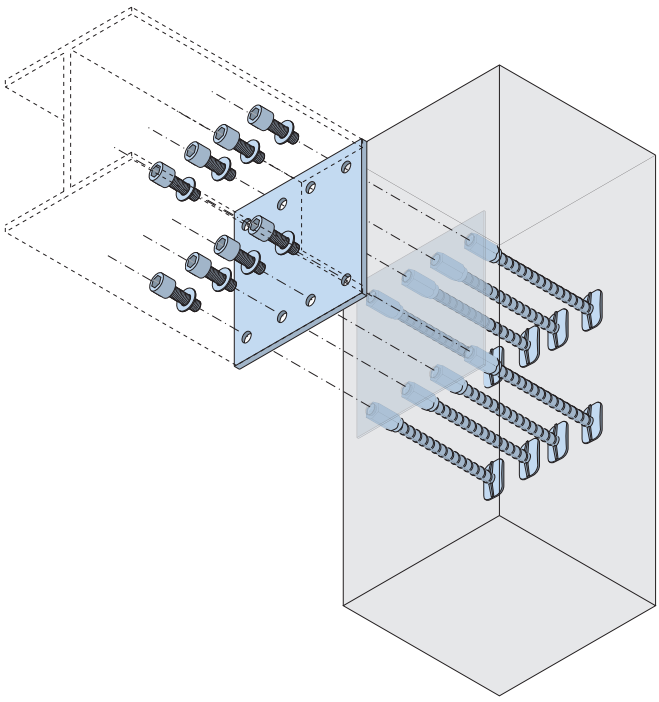
Anchor-Ø d_{HSC} [mm]	Concrete strength class	Column dimensions [mm] $b_{col,min}$	$h_{col,min}$	Column longitudinal reinforcement [mm] $d_{s,col,min}$
12	C20/25 - C70/85	240	240	12
16	C20/25 - C70/85	240	240	12
20	C20/25 - C35/45	300	300	16
	C40/50 - C70/85	240	240	
25	C20/25	300	400	20
	C25/30 - C30/37	300	350	
	C35/45 - C70/85	300	300	

Tender specification; example text

HALFEN HSC-B Steel connection with socket bars to transfer and anchor bar forces, with positioning plate for exact socket positioning in the formwork; including face plate for exact steel connection,
with National Technical Approval Z-21.8-1974; suitable for connecting standard steel elements subjected to normal loads, shear and bending loads to concrete elements;
for predominantly static and non-predominantly static loads,

Type steel connection HSC-B
with
number of bars ...,
bar type ... (-SH / -S / -SD / -SB),
bar diameter [mm] ... (12 / 16 / 20 / 25),
bar length [mm] ... (according to drawing),
corrosion protection; sockets ... (GV / FV / A4),
bar material ... (B500B)
... (B500B NR for d_s = 12 mm),
positioning plate according to drawing (corrosion protection GV / FV / A4),
face plate according to drawing (mill finish),

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

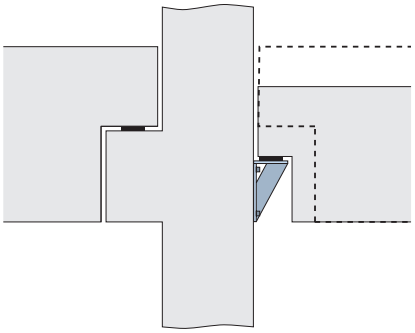


Example: HALFEN HSC-B Concrete steel connection with steel beam

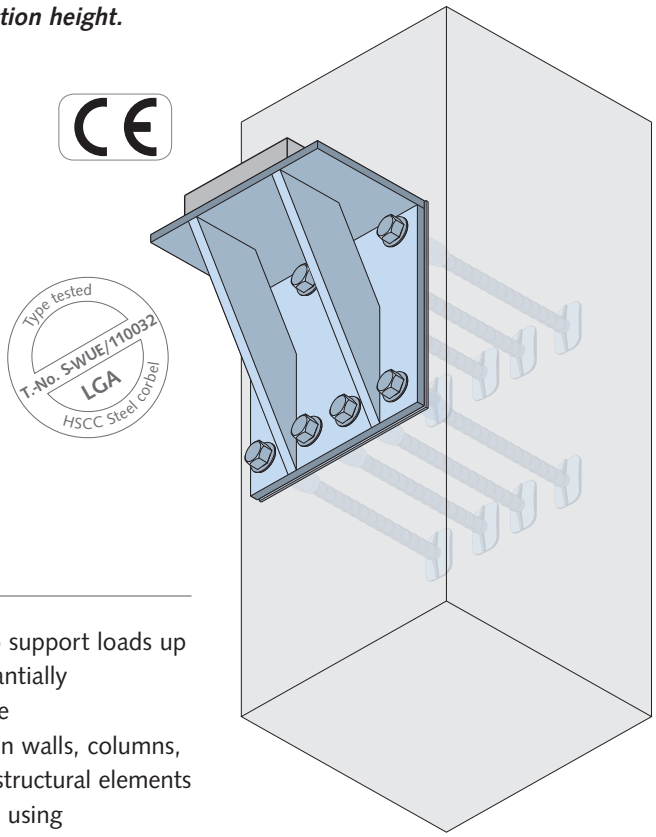
HALFEN Steel Corbel Connection

The advantages at a glance

HALFEN HSCC Steel corbel connections are type tested standard corbels used in combination with HSC-B Concrete steel connections. Tension and shear loads are securely transferred into adjacent structural components.
HSCC Steel corbels have up to double the load capacity of reinforced concrete corbels.
HALFEN HSCC Steel corbel connections allow chamfered connection and therefore reduced construction height.



Chamfered connection and therefore reduced construction height



Versatile application

- type tested types to support loads up to 2500 kN – substantially reducing design time
- flexible application in walls, columns, and other concrete structural elements
- accurate installation using HSC-B Positioning plate

Optimised construction

- easy to handle low weight components
- simple bolted assembly
- immediately loadable connection
- no complicated and time consuming formwork
- Simplifies the shape of precast elements – damage free transport and efficient use of storage space.

Environmentally focused

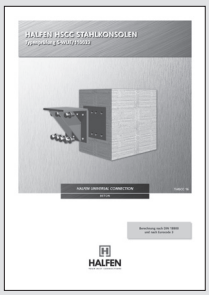
- durable hot-dip galvanized components
- screw connection allows easy recycling of building material

HALFEN HSCC Steel Corbels

Product overview

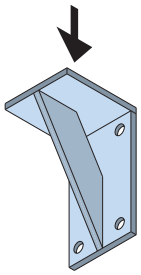
HALFEN HSCC Steel corbels are available in 34 type-tested variants with small or large cantilever.
The joints are made with HSC-B Steel connection elements attached to reinforced concrete with socket bars with 16, 20 or 25 mm diameter.

The socket bars are aligned in 2 rows, each with 2 up to 11 bolts depending on the corbel type and static requirements.
All dimensions and the data relevant for application of HALFEN HSCC Steel corbels can be found in the type test report S-WUE/11032.

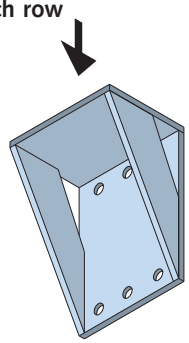


Free download at
www.halfen.com

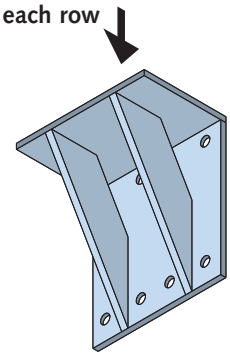
HSCC
2 bolts in each row



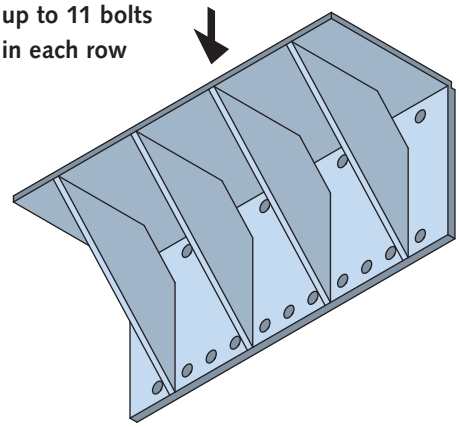
HSCC
3 bolts in each row



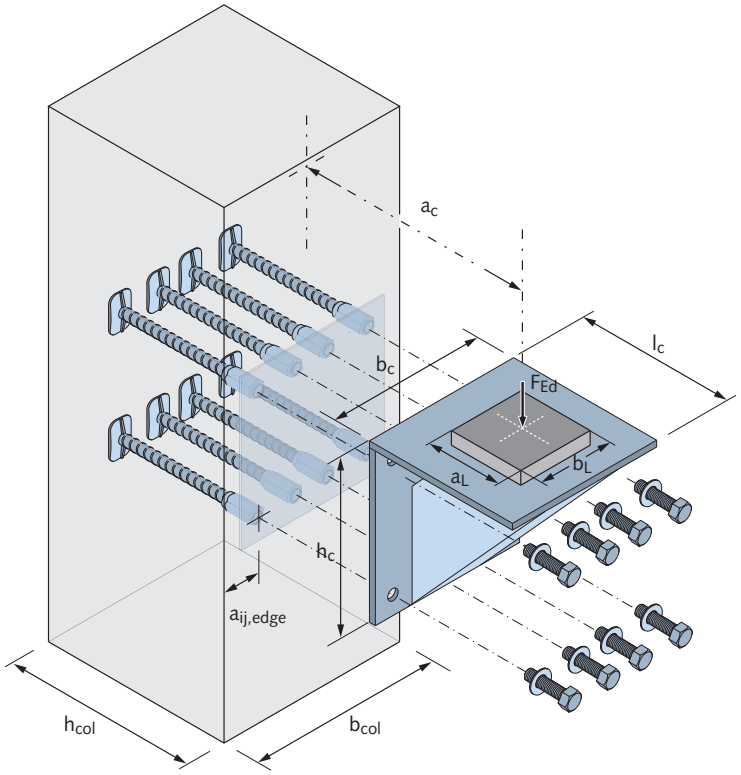
HSCC
4 bolts in each row



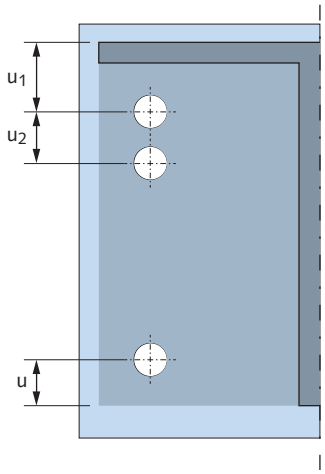
HSCC
up to 11 bolts in each row



Geometry HSCC Corbel with steel connection



Hole spacing



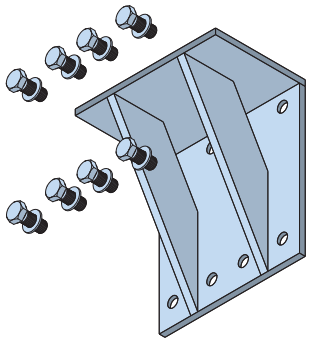
Product overview

Delivery is in two sets; the HSCC Corbel together with the matching HSC-B Steel connection.

Set 1
HSCC Corbel and HSK Hexagonal bolts with washers

Content:
HALFEN HSCC Steel corbel, hot-dip galvanized [FV]
HALFEN HSK Hexagonal bolts ISO 4017, hot-dip galvanized, strength class 10.9 with washers (The number of bolts with washers required depends on the type of corbel)

Information required when ordering:
Corbel type, see order example



Order example: **HSCC - 20 - 4 - 1**

Nominal diameter socket bar
Number of bolts in tension
Corbel variant: short ... -1, long ... -2

Also available on request:
- Additional HALFEN HSK Hexagonal bolts ISO 4017

HSK Hexagonal bolts ISO 4017	
Article description thread × length [mm]	Order no.
HSK M 16 × 40	0385.070-00067
HSK M 20 × 50	0385.080-00036
HSK M 27 × 60	0385.100-00005
Strength class 10.9, hot-dip galvanized	

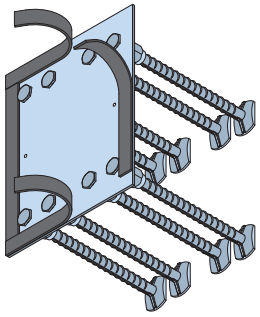
Further accessories can be found on page 8; HSC-B product range.

Set 2
HSC-B Positioning plate, HSC-B SH Single headed female bars, HSC-B SE Sealing tape

Content:
- HALFEN HSC-B SH Single headed female bar with hot-dip galvanized sockets [FV]; alternative bar types SD, S or SB on request
- HALFEN HSC-B Positioning plate, hot-dip galvanized [FV], see page 6
- HALFEN HSC-B SE Sealing tape, see page 8

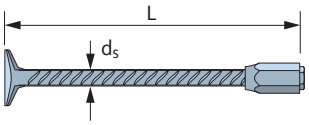
Information required when ordering:
- HSC-B female bar type (SH, SD, S, SB), see order example
- Required length of the bars [mm] ....

Optional available on request:
- alternative HSC-B bar types SD, S, SB see pages 7-8
- alternative corrosion protection of the sockets: GV/A4
- alternative corrosion protection and material of the positioning plate GV/A4



Order example: **HSC-B SH - 20 - 4 - 1 / L=460**

Socket bar type (SH, SD, S, SB)
Nominal diameter socket bar
Number of bolts in tension
Corbel variant: short ... -1, long ... -2
Required length of the bar [mm]



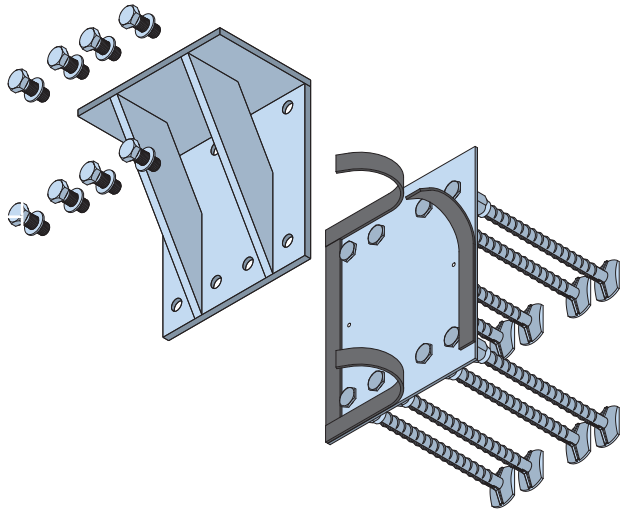
Rod length L must also be specified in [mm]

Also available on request
HALFEN HSC-B FI Pan head screw for asssembly of the anchors without formwork penetration, see page 8.

Tender specification; example text

HALFEN HSCC Standard corbel with steel connection; used with socket bars to anchor static forces to reinforced concrete.

The corbel is type-tested (S-WUE/110032) according to Eurocode 3. The steel connection is Building Authority approved; Approval Z-21.8-1974. Socket bars are made in B500B.



Type: HSCC Steel corbel, hot-dip galvanized
with socket bars ...,
number of bars ...,
bar type ... (-SH / -S / -SD / -SB),
bar diameter [mm] ... (16 / 20 / 25),
bar length [mm] ... (according to drawing),
sockets hot-dip galvanized,
hexangonal bolts with washers; hot-dip galvanized,
strength class 10.9,
positioning plate according to drawing (hot-dip galvanized),
foam sealing tape,

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

Type test according to Eurocode 3

The type-test includes all verifications for the steel connecting elements as well as the verifications for the transfer of forces into the reinforced concrete. Decisive for load capacity is the smallest resistance value from all verifications. The stated load capacities are for effects of predominantly static loads and apply for single and double corbels. A horizontal load of $H_{Ed} = 0.2\ F_{Ed}$ has been considered. The dimensioning and load transfer of loads into steel reinforced concrete depends on each individual situation. These are not included in the type-test. The verifications for steel element are according to Eurocode 3 (DIN EN 1993). In addition, for each corbel type, the load capacities for bolts strength classes 8.8 and 10.9 were calculated, in some cases adapting the number of bolts.

Please refer to the type-test for the position of the sockets for each individual bolt. Place a bearing plate (for example an elastomer plate) on the corbel flange to ensure an even load distribution. See tables on page 20 ff. or the type-test for dimensions.

Load transfer into the reinforced concrete element was verified according to the guidelines set in National Technical Approval Z-21.8-1974. Please observe the notes on pages 9-15. The specified, required, bursting reinforcement for loads (maximum yield) for large column widths include a safety margin. Please observe the minimum diameter for reinforcement bars, see page 14. Further information for calculating the actual required bursting reinforcement for individual applications can be found on page 14. Separate verification is required for possible required stirrup reinforcement in the column. Anchoring the socket bars with HSC Anchor-heads is according to approval Z-21.8-1973. See notes on page 15. Alternatively, other anchorage variants can be used; additional verification is required here.

The following tables are for bolts, strength grade 10.9.
Calculations for bolts strength grade 8.8 and further calculation examples as well as all relevant details can be found in the type test.

Type tests are available for all types of corbels; download at www.halfen.com

HALFEN HSCC Steel Corbels

Short corbels, bolt strength class 10.9 (calculated according to approval Z-21.8-1974, Eurocode 3)

Corbels short type ... -1 (Bolt pattern symbols are according to Eurocode 3)		Order no.		Corbel dimensions					Minimal column dimensions ①	
		Corbel set HSCC	Connection set HSC-B	b_c [mm]	h_c [mm]	l_c [mm]	u_1 [mm]	u [mm]	$b_{col,min}$ [mm]	$h_{col,min}$ [mm]
HSCC-16-2-1		1060.500-00001	1060.609-00001	120	118	160	29	21	180 (240)	(240)
HSCC-16-3-1		1060.500-00003	1060.609-00003	160	185	160	33	21	200 (240)	(240)
HSCC-16-4-1		1060.500-00005	1060.609-00005	220	185	160	31	21	260	(240)
HSCC-16-5-1		1060.500-00007	1060.609-00007	260	185	160	33	21	310	(240)
HSCC-20-2-1		1060.510-00001	1060.619-00001	160	230	190	37	27	200 (240, 300)	(240, 300)
HSCC-20-3-1		1060.510-00003	1060.619-00003	210	230	190	42	27	240 (240, 300)	(240, 300)
HSCC-20-4-1		1060.510-00005	1060.619-00005	270	230	190	39	27	310	(240, 300)
HSCC-20-5-1		1060.510-00007	1060.619-00007	330	230	190	42	27	370	(240, 300)
HSCC-25-1-1		1060.520-00001	1060.629-00001	160	250	200	46	36	200 (300)	(300, 350, 400)
HSCC-25-2-1		1060.520-00004	1060.629-00004	220	250	200	51	36	270 (300)	(300, 350, 400)
HSCC-25-3-1		1060.520-00007	1060.629-00007	280	300	250	56	36	320	(300, 350, 400)
HSCC-25-4-1		1060.520-00009	1060.629-00009	370	300	250	51	36	410	(300, 350, 400)
HSCC-25-5-1		1060.520-00011	1060.629-00011	460	300	250	56	36	500	(300, 350, 400)
HSCC-25-6-1		1060.520-00013	1060.629-00013	540	300	250	51	36	570	(300, 350, 400)
HSCC-25-8-1		1060.520-00015	1060.629-00015	680	300	250	56	36	725	(300, 350, 400)
HSCC-25-11-1		1060.520-00017	1060.629-00017	900	300	250	56	36	955	(300, 350, 400)

① Values in brackets need to be considered for the anchor reinforcement with HSC anchor heads, see page 15.

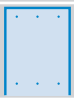
Please include the details from the order example on page 18 in the final order number.

HALFEN HSCC Steel Corbels

Max F_{Ed} [kN] (including H_{Ed} = 0.2 F_{Ed})							No. of sockets, bolts		Bolt spacing		Outer cantilever	Inner cantilever	Bursting reinforcement for C50/60, full load-capacity (calculated maximum value)			Load plate (example Elastomer layer)	
C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	≥ C50/60	Tension zone	Pressure zone	$a_{ij,max}$	Σa_{ij}	a_c	z	Primary (each socket row) $A_{sw,1}$	Secondary (tension zone) $A_{sw,2,tie}$	Secondary (pressure zone) $A_{sw,2,strut}$	a_L	b_L
							[-]	[-]	[mm]	[mm]	[mm]	[mm]	[cm²]	[cm²]	[cm²]	[mm]	[mm]
115							2	2	62	62	100	80.1	0.10	0.33	0.41	80	80
222							3	3	38	76	100	136.8	0.17	0.64	0.73	80	120
297							4	4	55	148	100	138.6	0.12	0.85	0.98	80	180
370							5	5	59	194	100	136.8	0.13	1.06	1.22	80	220
240							2	2	68	68	112.5	173.7	0.19	0.69	0.78	105	110
360							3	3	50	100	110	169.2	0.14	1.04	1.17	100	170
480							4	4	67	182	110	171.9	0.19	1.38	1.56	100	230
600							5	5	72	240	110	169.2	0.20	1.73	1.95	100	290
225							1	1	-	-	115	183.6	-	0.65	0.73	110	120
460							2	2	98	98	115	179.1	0.38	1.32	1.49	110	180
680							3	3	67	134	140	219.6	0.54	1.96	2.20	160	240
900							4	4	86	239	140	224.1	0.34	2.59	2.91	160	300
1101	1130						5	5	94	320	140	219.6	0.60	3.25	3.66	160	400
1295	1360						6	6	88	396	140	224.1	0.57	3.91	4.40	160	470
1627	1720	1810					8	8	96	552	140	219.6	0.51	5.20	5.87	160	620
2153	2276	2382	2500				11	11	96	780	140	219.6	0.63	7.19	8.10	160	840

HALFEN HSCC Steel Corbels

Long corbels, bolt strength class 10.9 (calculated according to approval Z-21.8-1974, Eurocode 3)

Corbels long type...-2.. -3 (Bolt pattern symbols are according to Eurocode 3)		Order no.		Corbel dimensions					Minimal column dimensions ①	
		Corbel set	Connection set	b_c [mm]	h_c [mm]	l_c [mm]	u_1 u_2 [mm]	u [mm]	$b_{col,min}$ [mm]	$h_{col,min}$ [mm]
HSCC-16-2-2		1060.500-00002	1060.609-00002	125	135	210	29	21	180 (240)	(240)
HSCC-16-3-2		1060.500-00004	1060.609-00004	160	210	230	31	21	200 (240)	(240)
HSCC-16-4-2		1060.500-00006	1060.609-00006	220	210	230	31	21	260	(240)
HSCC-16-5-2		1060.500-00008	1060.609-00008	260	210	230	31	21	310	(240)
HSCC-20-2-2		1060.510-00002	1060.619-00002	160	270	265	37	27	200 (240, 300)	(240, 300)
HSCC-20-3-2		1060.510-00004	1060.619-00004	210	270	265	42	27	240 (240, 300)	(240, 300)
HSCC-20-4-2		1060.510-00006	1060.619-00006	270	270	265	37	27	310	(240, 300)
HSCC-20-5-2		1060.510-00008	1060.619-00008	330	270	265	39	27	370	(240, 300)
HSCC-25-1-2		1060.520-00002	1060.629-00002	160	300	250	48 63	36	200 (300)	(300, 350, 400)
HSCC-25-1-3		1060.520-00003	1060.629-00003	170	380	350	48 63	36	200 (300)	(300, 350, 400)
HSCC-25-2-2		1060.520-00005	1060.629-00005	220	300	250	51	36	260 (300)	(300, 350, 400)
HSCC-25-2-3		1060.520-00006	1060.629-00006	240	380	350	51 63	36	270 (300)	(300, 350, 400)
HSCC-25-3-2		1060.520-00008	1060.629-00008	280	380	350	56	36	320	(300, 350, 400)
HSCC-25-4-2		1060.520-00010	1060.629-00010	370	380	350	51	36	410	(300, 350, 400)
HSCC-25-5-2		1060.520-00012	1060.629-00012	460	380	350	51	36	480	(300, 350, 400)
HSCC-25-6-2		1060.520-00014	1060.629-00014	540	380	350	51	36	570	(300, 350, 400)
HSCC-25-8-2		1060.520-00016	1060.629-00016	680	380	350	51	36	710	(300, 350, 400)
HSCC-25-11-2		1060.520-00018	1060.629-00018	900	380	350	51	36	930	(300, 350, 400)

① values in brackets need to be considered for the anchor reinforcement with anchor heads, see page 15.

Please include the details from the order example on page 18 in the final order number.

HALFEN HSCC Steel Corbels

Max F_{Ed} [kN] (including H_{Ed} = 0.2 F_{Ed})							No. of sockets, bolts		Bolt spacing		Outer cantilever	Inner cantilever	Bursting reinforcement for C50/60, full load-capacity (calculated maximum value)			Load plate (example Elastomer layer)	
C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	≥C50/60	Tension zone	Pressure zone	$a_{ij,max}$	Σa_{ij}	a_c	z	Primary (each socket row) $A_{sw,1}$	Secondary (tension zone) $A_{sw,2,tie}$	Secondary (pressure zone) $A_{sw,2,strut}$	a_L	b_L
							[-]	[-]	[mm]	[mm]	[mm]	[mm]	[cm²]	[cm²]	[cm²]	[mm]	[mm]
115							2	2	62	62	120	95.4	0.10	0.33	0.41	120	85
222							3	3	38	76	130	161.1	0.17	0.64	0.74	140	120
297							4	4	55	148	130	161.1	0.12	0.85	0.99	140	180
370							5	5	59	194	130	161.1	0.13	1.06	1.24	140	210
240							2	2	68	68	147.5	209.7	0.19	0.69	0.79	175	110
360							3	3	50	100	147.5	205.2	0.14	1.04	1.18	175	160
480							4	4	67	182	147.5	209.7	0.19	1.38	1.57	175	220
600							5	5	72	240	147.5	207.9	0.20	1.73	1.97	175	270
370							1+1	1	-	-	140	198.5	-	1.06	1.21	160	120
370							1+1	1	-	-	190	270.5	-	1.06	1.21	260	120
460							2	2	88	88	140	224.1	0.35	1.32	1.49	160	150
567	600	628	652	674	700		2+2	2	98	98	190	267.8	0.39	2.01	2.30	260	180
680							3	3	67	134	190	291.6	0.54	1.96	2.21	260	240
900							4	4	86	239	190	296.1	0.34	2.59	2.92	260	330
1100	1130						5	5	88	308	190	296.1	0.60	3.25	3.67	260	400
1291	1360						6	6	88	396	190	296.1	0.57	3.91	4.41	260	480
1625	1719	1810					8	8	90	534	190	296.1	0.51	5.20	5.87	260	620
2151	2275	2381	2500				11	11	90	756	190	296.1	0.62	7.19	8.11	260	840

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