

HALFEN SANDWICH PANEL ANCHORS

TECHNICAL PRODUCT INFORMATION



HALFEN SANDWICH PANEL ANCHORS

SP 08-E

FAÇADE



HALFEN
YOUR BEST CONNECTIONS

HALFEN SANDWICH PANEL ANCHORS

General

The aim

Would you like to implement your planning ideas safely and economically? HALFEN supports you, competently and reliably.

Today, innovative production techniques and the use of high grades of concrete permit the highest quality concrete precast elements to be manufactured. It is possible to economically plan and realize architecturally imposing facades with precast elements, in particular due to new surface treatments, but also with surface structures and colouring.

Sandwich constructions

Building with large sandwich elements has proved its value on the market over decades. Varied functional and design requirements imposed on external wall constructions can be satisfied very effectively with sandwich panel constructions, without losing their significance in the future. Certainly the demands on solid and safe anchoring technology are becoming ever more important. Increasing physical construction requirements are responsible for this (in particular increased insulation thicknesses) which must be satisfied with a simultaneous enhancement of profitability.

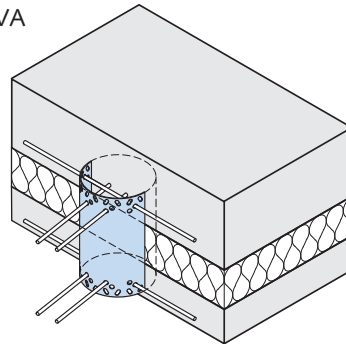
Special lifting anchors for sandwich panels are also included in the comprehensive range of HALFEN products, together with various supporting anchor and restraint tie systems. This enables us to supply you with a suitable and cost-effective overall solution for every application. HALFEN, with their wide-ranging experience, are pleased to be your partners from the commencement of planning, through the calculation of the anchorage right to the assembly of your sandwich panels, assisting you in the achievement of your objectives.

HALFEN sandwich panel anchors SP

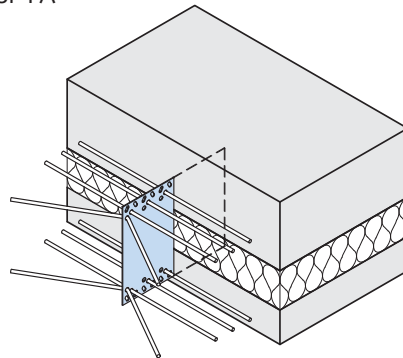
HALFEN supply three different types of anchor for the connection of load-bearing and facing layers of sandwich panels::

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

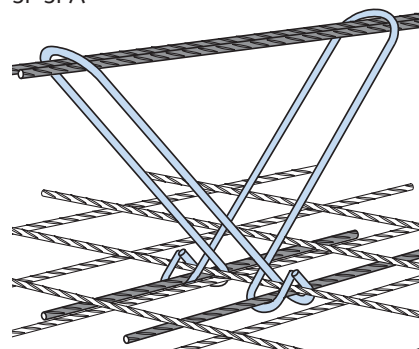
SP-MVA



SP-FA



SP-SPA

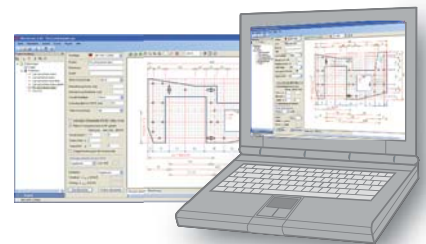


The benefits

- quick and simple assembly
- type-tested systems
- insignificant heat bridges
- corrosion-resistant stainless steel
- different systems provide solutions for all geometrical challenges (slim building components, openings etc.)

Software

HALFEN provides calculation software to facilitate the selection and calculation of the required sandwich panel anchor. This is available for download under www.halfen.de/Download or on our current HALFEN-CD which can be ordered free of charge.



Anchor types and their installation locations can be calculated with this software, after entering the sandwich panel dimensions. Element plans and parts lists can be printed out in DIN A4 format.

Technical support

The engineers in our International Competence Center Technology (ICT) answer your technical queries concerning planning and application competently and reliably. See the rear cover of the catalogue for contact details.



HALFEN SANDWICH PANEL ANCHORS

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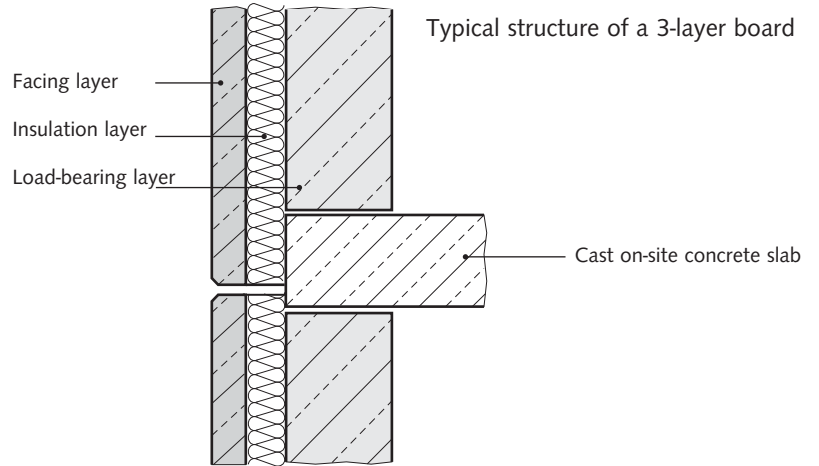
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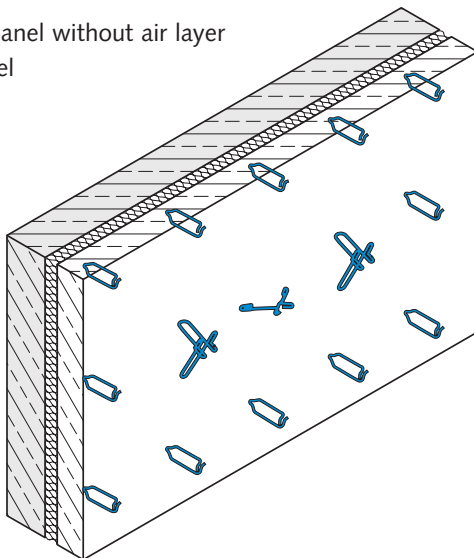
Basics

Structure of a sandwich panel

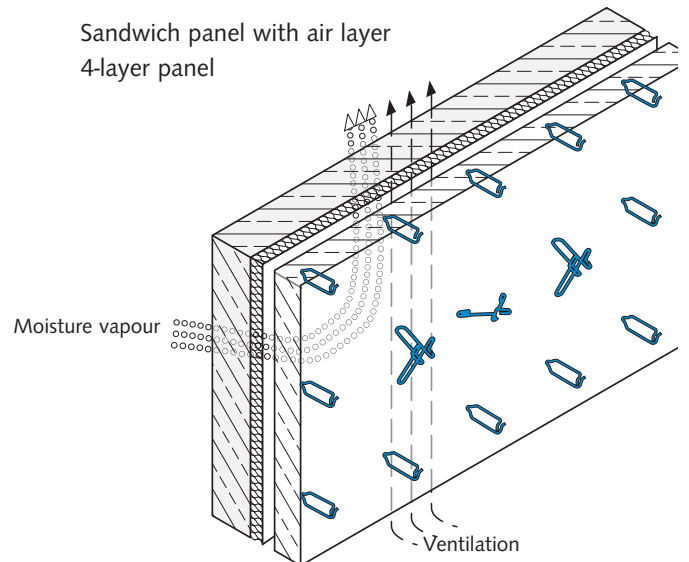
Sandwich panels are multilayer, large reinforced concrete cladding elements. They consist of a facing layer, a heat insulation layer and a load-bearing layer (3-layer board). An air layer can be interposed between the heat insulation layer and the facing layer due to physical construction reasons (4-layer board).



Sandwich panel without air layer
3-layer panel



Sandwich panel with air layer
4-layer panel



Requirements on the anchorage system

The function of the HALFEN sandwich panel anchor system is to connect the load-bearing and facing layers of sandwich panels. Firstly the stresses acting on the facing layer must be transferred to the load-bearing layer and secondly constraints in the facing layer must be avoided. The connecting parts are subject to corrosion and must be made from stainless steel (stainless steel A4).

The following influences must be taken into account with the calculation of anchorages:

- dead load of the facing layer
- eccentricity of the permanent load
- wind load
- temperature fluctuations within the facing layer (warping)
- changes to the average temperature of the facing layer (expansion)
- adhesion to mould
- transport and assembly conditions
- admissible distances e , resp. e_H of the load-bearing, resp. restraint ties to the fulcrum F

HALFEN sandwich panel anchor systems are type-tested. The type test report can be downloaded free of charge from www.halfen.de.



HALFEN SANDWICH PANEL ANCHORS

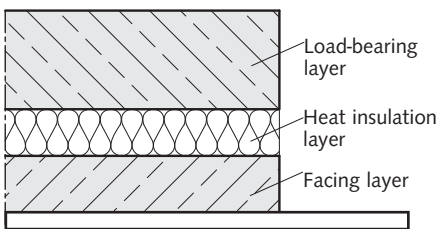
Production processes

For the production of sandwich panels a distinction is made between two production processes:

- Negative production
- Positive production

Negative production

(facing layer down method of production)



Production of the facing layer

- Placement of the reinforcement in the mould and installation of the supporting anchors also the stirrup ties SP-SPA-B, resp. the clip-on pins SP-SPA-A.
- The concrete is to be uniformly placed in the mould.
- Compaction of the concrete (with external vibrators).

Placing of the heat insulation layer

Press the insulation material into the vicinity of the anchors. When high quality pressure resistant insulation material is used the anchor areas have to be cut out carefully. The formation of cavities must be prevented under all circumstances so that concrete can not enter and thus the creation of cold thermal bridges or constraint points is avoided.

Recommendation:

Install the heat insulation in 2 layers. The butt joints have to be staggered. In the case of single layer heat insulation the joints are to be formed as step joints or sealed with adhesive tape. This will prevent concrete running into the joints. When using high quality insulation materials (low thermal conductivity capacity and low water absorption) the

thickness of the heat insulation layer can be reduced. The resulting increase in anchor load-bearing force permits the use of supporting anchors with a lower load rating. Insulation materials with low water absorption capacity favourably influence concrete shrinkage.

Placing the separating foil

The separating foil prevents concrete slurry from entering the butt joints of the heat insulation. The adhesion between heat insulation layer and load-bearing layer concrete (important when using rough, expanded polystyrene insulation material) is avoided. A foil layer should be placed between the facing layer and the insulation layer to ensure optimal flexibility of the facing layer. When using a high grade insulation material with a smooth surface no foil is necessary.

Production of the load-bearing layer

- Installing the load-bearing layer reinforcement
- A traversable insulation layer material will assist installation.
- The concrete has to be distributed over the mould uniformly and compacted.

Note when using connector pins SP-SPA-N

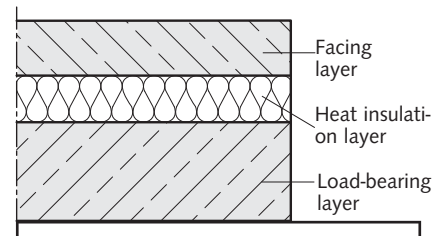
The connecting pins are installed above a reinforcement bar cross point of the load-bearing layer reinforcement, through the heat insulation layer into the still soft concrete of the facing layer to the bottom of the mould. To avoid that the tips of the pins are visible on the facade the pins should be drawn back slightly after reaching the mould base (important with washed concrete, sprayed or painted facades). It is recommended to subsequently compact the concrete of the facing layer.

Important:

When using a vibrator poker, avoid contact between the vibrator and the anchors. If this contact cannot be avoided then a separation of the facing concrete causing colour contrasts can result and thus make the contours of the anchors visible.

Positive production

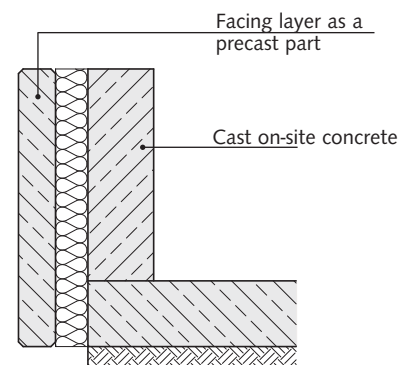
(facing layer up method of production)



The production of a sandwich panel using the positive production method takes place in reverse order to the previously described method for negative production. Firstly the load-bearing layer is concreted. Clip-on pins, resp. stirrup ties are to be used. When using anchors SP-SPA, the instructions for sandwich panels in positive production should be noted (see page 37).

Sandwich panel as a semi-precast part

In this case a factory made "facing layer" is provided with anchors and insulation as a lost mould. The "load-bearing layer" is created in on-site cast concrete.



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Deformation of sandwich panels

Warping caused by shrinking

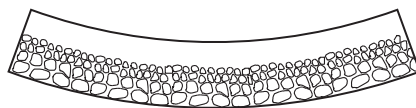
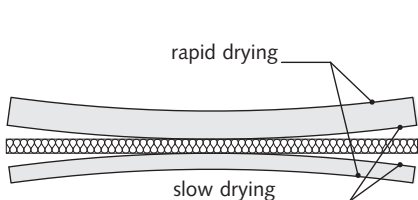
Sandwich panel elements often show warping deformation. Particularly large panels with a length of more than 6 m are affected by such deformation. Shrinkage is mainly dependant on the drying-out of the concrete. This drying proceeds from the exterior inwards. The inner and outer layers of the sandwich element warp in different directions.

The deformation is stronger when drying proceeds more rapidly at the exterior and more slowly in the interior. Deformations can be expected in sandwich panels exposed to direct sunlight and wind in the first few days after production.

Insulation with a low water absorption capacity should be used. Insulation materials with a high water absorption capacity transfer moisture to the concrete during the curing process. This leads to higher differences in the curing speed of the external and internal layers of the sandwich element.

Furthermore, measures applied in concrete technology can be employed in order to reduce shrinkage and the resulting detrimental consequences to a minimum. A low water/cement ratio should be used. The top size of the aggregate is to be chosen according to the workability reinforcement and dimensions of the sandwich panel. The smaller aggregate content is to be chosen so that the voids are infilled. The cement binder and fine aggregate content is to be kept low. The use of concrete additives, especially wetting agents, air-entraining agents, damp-proofings and permeability reducing agents and retarders can have a very detrimental effect on the shrinkage behaviour of the concrete.

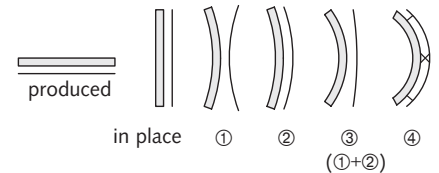
It is impossible to avoid separation when compacting the concrete. Large and heavy components of the concrete mix sink to the bottom during vibration. The smaller, lighter and wetter components remain at the top. This results in a larger shrinkage value at the top compared to the bottom. ('top' and 'bottom' refer to the position of the panel during concreting). The warping tendencies of lightweight concrete are completely reversed, as the aggregate material here is lighter than the other concrete mix and rises to the top during vibration.



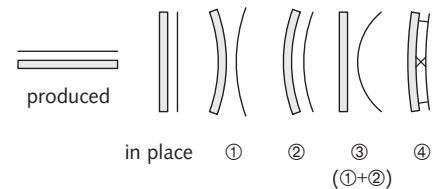
segregated concrete

The vibration procedures are to be limited in both intensity and duration in order to keep separation to a minimum.

The type and intensity of the warping of a sandwich panel is dependent on how it is produced. In the case of sandwich elements produced in the **facing layer down method**, the warping tendency in the load-bearing layer is caused by time-dependent shrinkage (① drying out) and is added to the structurally dependent differential shrinkage (② mix separation). In the facing layer, the warping tendencies from ① and ② counteract each other ③, and it remains virtually plane. The stiffer load-bearing layer imposes its warping to the facing layer via the connecting anchors ④.



For sandwich panels produced in the **facing layer up method**, the warping tendencies ① and ② are counteractive, the load-bearing layer remains virtually plane ③. The warping tendencies from the facing layer ① and ② are added together. The warping of the facing layer is prevented by restraint from the sandwich panel anchorages if adequate connections (e.g. retaining anchors) properly link both layers together ④.



The prevention of warping of the sandwich panel by using sandwich panel anchorages produces forces which can lead to cracks in the facing layer. Care should be taken to prevent warping. Apart from the previously described production engineering measures, suitable construction measures can be chosen in the design of the prefabricated elements.

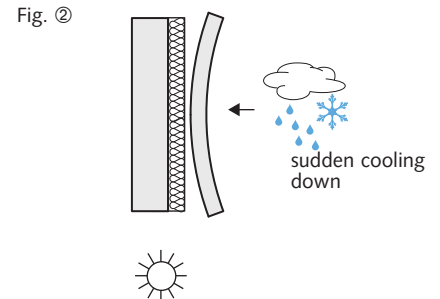
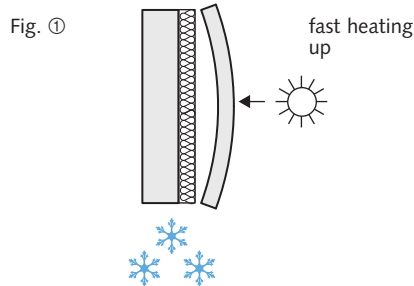
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Deformation of sandwich panels

Warping caused by temperature difference

With a rapid rise in temperature (e.g. through direct sunlight in the winter, Fig. ①) or sudden cooling (e.g. with thunderstorms in summer, Fig. ②), the weathered outer surface of the facing layer is subjected to greater changes in length than the inner surface against the insulation layer. The resulting warping of the facing layer is largely restrained through the anchor by the more rigid load-bearing layer. The magnitude of the resulting restraining forces is dependent upon the following factors:

- temperature fluctuation within the facing layer
- thickness of the facing layer
- concrete quality, resp. E-module of the facing layer
- geometry of the facing layer
- type and arrangement (grid) of the anchors



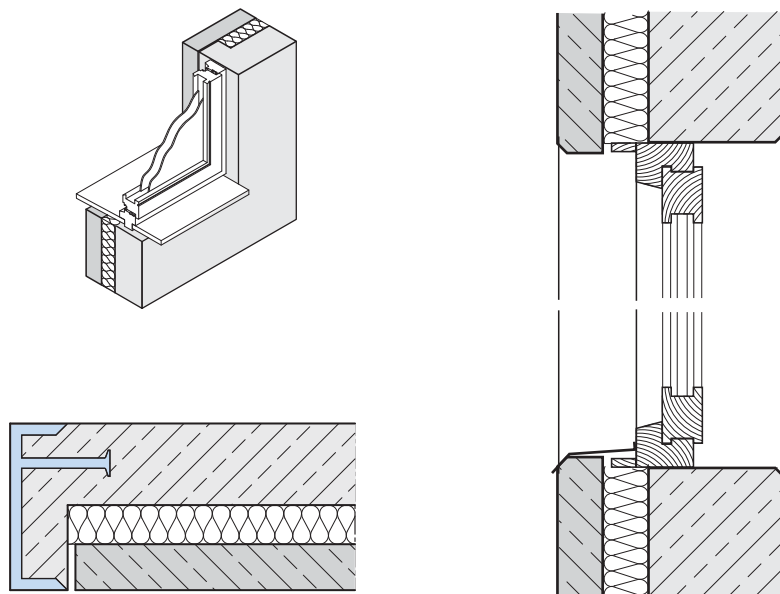
Favourable influences are:

- bright facing layers
- small facing layer thicknesses (f = 70 – 80mm)
- a regular grid of the anchors (ratio ~ 1:1)

Window and door fixing

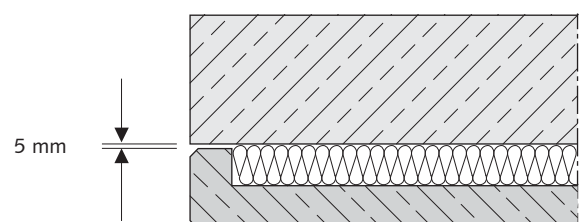
The facing layer must be fixed to the load-bearing layer in a flexible way. Additional fixed points such as e.g. window or door fixings at the facing layer can lead to constraints resulting in cracks.

Built-in components such as windows and doors may only be fixed to one layer (normally to the load-bearing layer).



Soffits

Concrete connections between load-bearing and facing layers have to be principally avoided. To effectively prevent constraints, reveals at panel edges, window and door frames are to be separated from the load-bearing layer by at least 5 mm joints.



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Geometric boundary conditions

Forming the facing layer

The minimum thickness of the facing layer is 7 cm according to DIN 1045-1 (par. 13.7.3).

A minimum crosswise reinforcement of ca. 1.31 cm²/m (Q 131) is to be

provided.

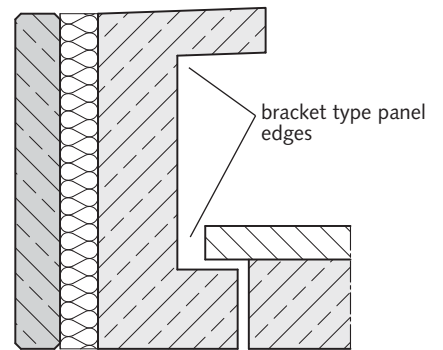
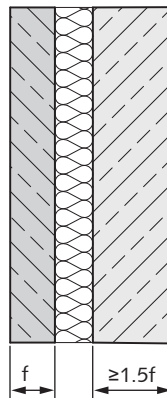
The necessary additional reinforcement of the facing layer in the anchor area is to be taken from the type-testing (see also → page 25-29).

Thick facing layers with $f > 10\text{cm}$ should have 2-layer reinforcement.

Forming the load-bearing layer

In order for the load-bearing layer to counter the deformations of the facing layer it is to be formed with at least 1.5 times the thickness of the facing layer.

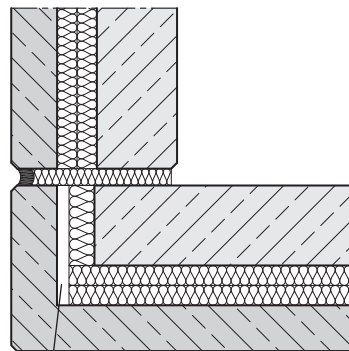
The rigidity can be additionally increased with special requirements by means of a bracket type formation of the load-bearing panel edges (window ledge, bracket support).



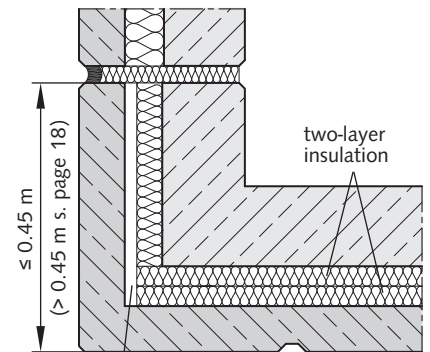
Corner construction

If the facing layer is continued round a corner at building edge zones, resp. at window or door openings, the following points are to be noted:

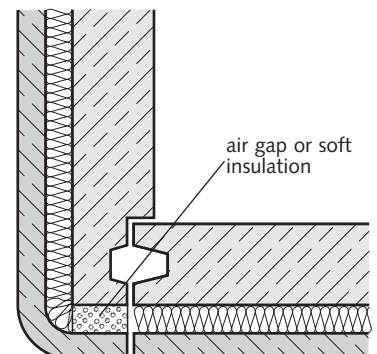
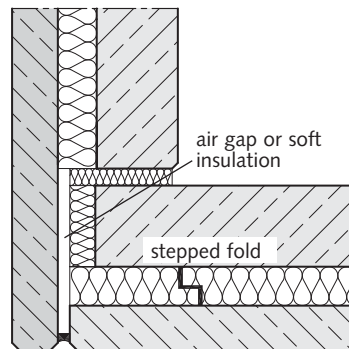
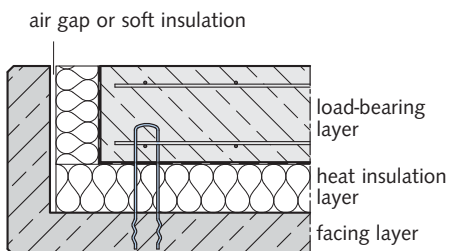
- an air gap is to be provided between the facing layer and the heat insulation layer in the region of the corner leg. Alternatively this area of heat insulation can consist of soft fibre (e.g. mineral wool).
- there are to be no connector pins in the vicinity of the corner leg.



air gap or soft insulation



air gap or soft insulation possible dummy joint



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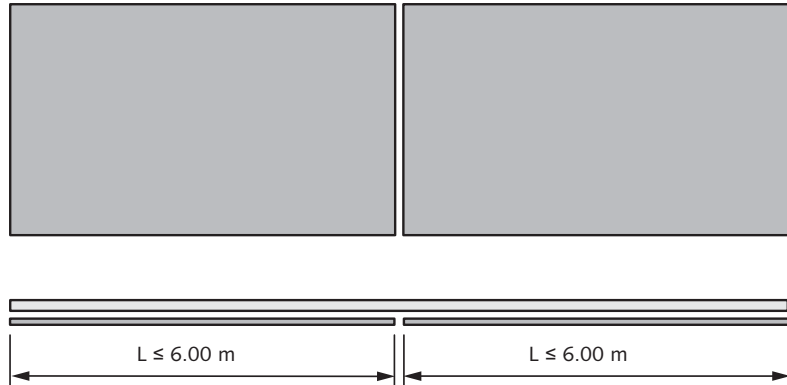
Geometric boundary conditions

Panel length

The following maximum dimensions for weather shells of sandwich elements are recommended in the technical literature to keep crack widths small (e.g. BK 88 T2 page 413ff): For structured weather shells L_{max} should be < 8.0 resp. $A < 15 \text{ m}^2$). With smooth surfaces the surface size of 15 m^2 can be retained but the length should be reduced to 5 - 6 m.

If longer elements cannot be avoided for constructive reasons it is recommended to separate the facing layer. However the facing layer can be produced in a single piece.

If longer panels cannot be avoided for architectural reasons this recommendation can be ignored under special circumstances. These circumstances should restrict shrinkage and length changes through temperature differences and keep the resulting constraining forces low.

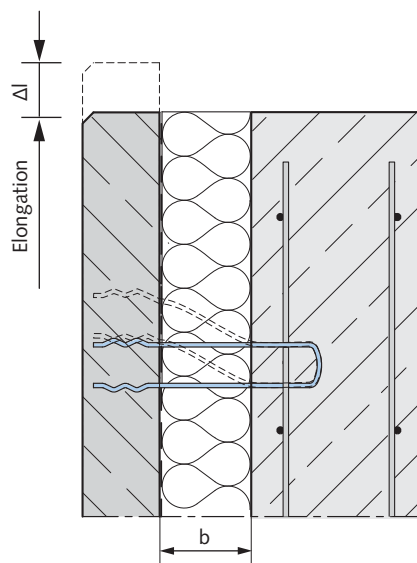


Favourable influences are as follows:

- lower w/z value of the concrete
- proper storage and after-treatment of the precast parts
- use of bright facing layers
- installation of the heat insulation layer in two layers with staggered joints
- provision of a separation layer (foil) between facing layer and heat insulation layer
- adequate thickness of the insulation layer
- reinforcement of the load-bearing layer
- formation of sufficiently wide expansion joints

With normal heat insulation layer thicknesses ($b > 80\text{mm}$) the possible dimensions of the facing layer are not limited by the admissible distances e , resp. e_H of the anchor in most cases (→ page 10).

In that case the decisive factors for the subdivision are normally the above recommendations for the dimensions of weather shells and the required joint formation (joint width and filling material).



Large heat insulation layer thickness b

- less elongation of the anchor with length changes of the facing layer
- larger admissible distance e , resp. e_H of the anchor to the fulcrum F

DIN 18540 is to be observed for panels with permanently flexible joints. Joints are to be formed to permit a constraint-free elongation of the facing layer.

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Supporting systems

Fulcrum of the sandwich panels

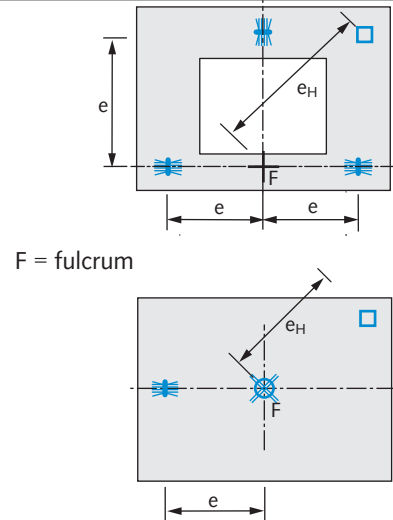
HALFEN supply 3 different types of anchor for connecting the load-bearing and facing layers:

Sleeve anchor SP-MVA, flat anchor SP-FA and sandwich panel anchor SP-SPA.

4 different types of supporting system can be created from these (MVA, MVA-FA, FA-FA, SPA-SPA).

To fix the facing layer to the load-bearing layer as constraint-free as possible, certain rules of application have to be complied with.

In principle, the fixing system has to be selected to obtain a single point at the facing layer as a so-called fulcrum. In this way practically no constraint forces occur which could lead to cracks in the facing layer. The admissible distance from the fulcrum to the supporting, torsion, resp. horizontal anchors (e) and the restraint ties (e_H) is to be taken into account with the anchor positioning.



F = fulcrum

See page 12 for the symbol explanation

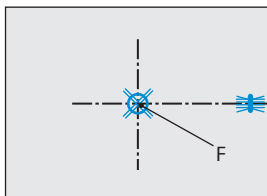
Fulcrum in systems with SP-MVA

The fulcrum for systems with sleeve anchors (MVA, MVA-FA) is always the position of the MVA.

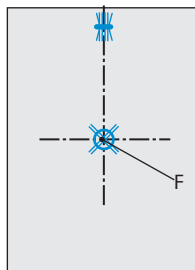
This means that sandwich panels with sleeve anchors always contain just one MVA where the lifting position is

identical to the assembly position and panels which are rotated during lifting.

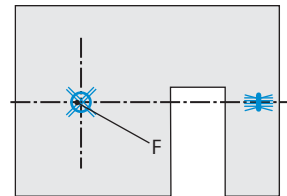
MVA



panel rotated



MVA-FA

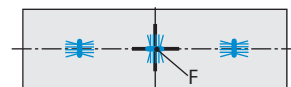


Fulcrum in systems with SP-FA and SP-SPA

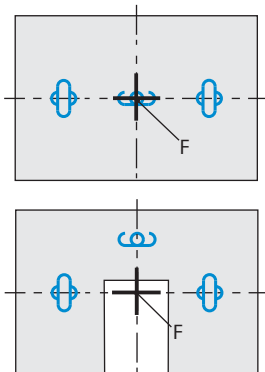
Panels with systems FA-FA and SPA-SPA always contain at least 2 supporting anchors and 1 horizontal anchor, which are arranged on 2 axes vertical to one another.

The fulcrum is always at the intersection point of the two anchor transverse axes.

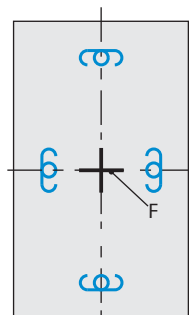
FA-FA



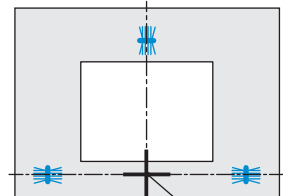
SPA-SPA



SPA-SPA



(panel rotated)



(panel rotated)

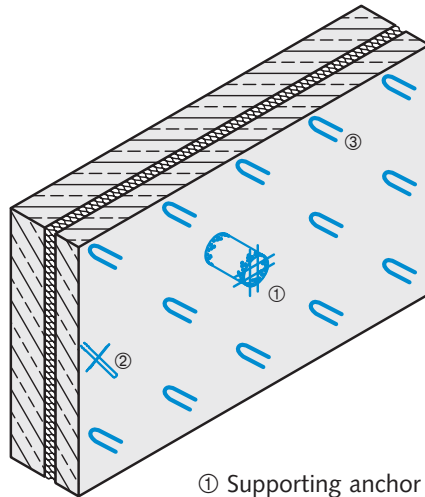
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Supporting systems

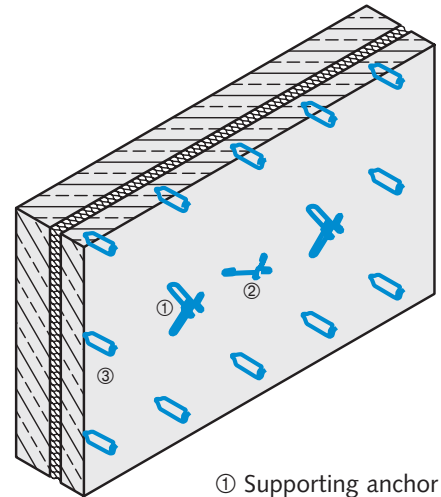
Function of the anchor

Sandwich panels with the MVA supporting system have one sleeve anchor as a supporting anchor at the centre of gravity of the facing layer and one torsion anchor. In the case of panels with supporting system MVA-FA there are 2 supporting anchors (MVA and FA), the sleeve anchor serving simultaneously as horizontal anchor.

Panels with supporting system SPA-SPA and FA-FA basically have 2 supporting anchors, resp. supporting anchor groups and 1 horizontal anchor (in the case of panels rotated for lifting, usually 2 horizontal anchors, resp. horizontal anchor groups are to be arranged).



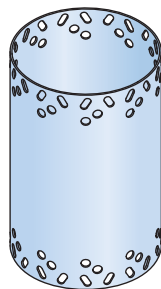
- ① Supporting anchor
- ② Torsion anchor
- ③ Restraint tie



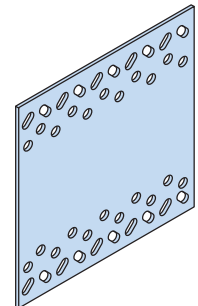
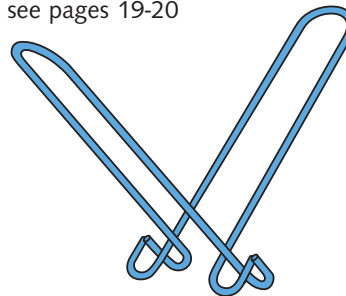
- ① Supporting anchor
- ② Horizontal anchor
- ③ Restraint tie

Supporting anchors

Supporting anchors are primarily responsible for carrying the vertical loads from the dead load of the facing layer. Also loads from centring (planned or unplanned) should also be taken into account, as horizontal loads (e.g. from the wind, warping).



see pages 19-20

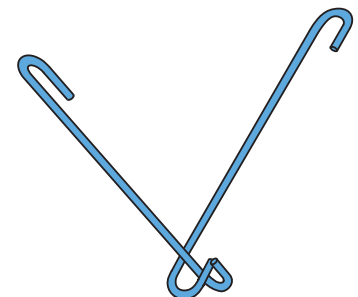
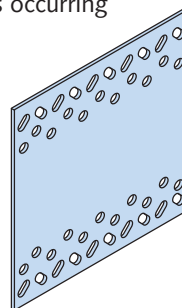
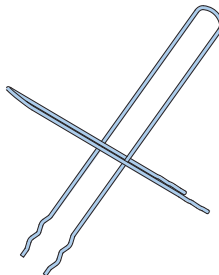


Torsion anchors / horizontal anchors

In the MVA system the torsion anchor has to carry the forces resulting from the centre (planned or unplanned). In the systems SP-FA and SP-SPA the function of the horizontal anchors is to carry horizontally acting forces (e.g. from panels hanging askew on the crane, impact forces during lifting or wind forces on soffits).

In the case of panels rotated for lifting, the horizontal anchors are to be dimensioned for the forces occurring with this load case.

see page 21



Restraint ties

Restraint ties carry the forces acting vertically to the panel surface resulting from temperature deformation and wind or cladding adhesion.

see page 22



connector pin



clip-on stirrup



clip-on pin

HALFEN SANDWICH PANEL ANCHORS

Supporting systems

Rules for the arranging of anchors

1. Supporting and torsion, resp. horizontal anchors

Please note the following marginal conditions for the arrangement of the supporting and torsion, resp. horizontal anchors:

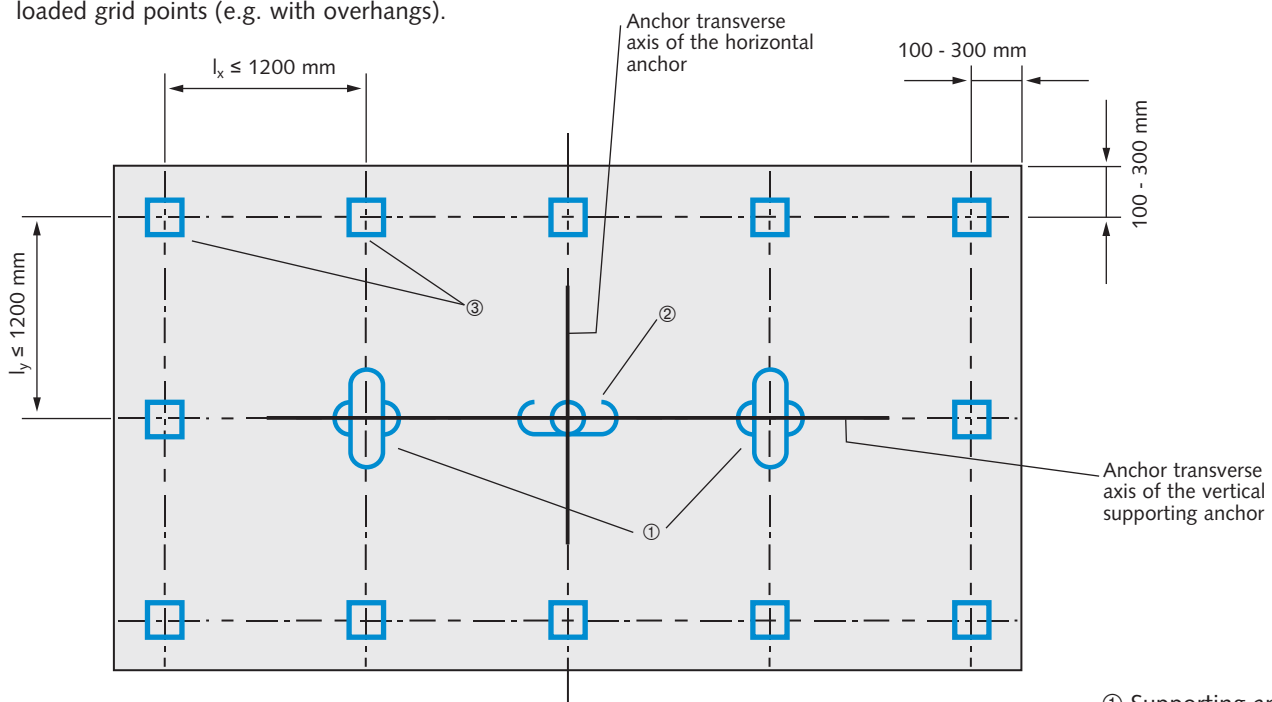
- The anchors for each supporting direction must be situated on one axis (anchor transverse axis)
- The minimum number of anchors and the arrangement of the anchors with respect to the centre of gravity depends on the selected supporting system (see page 13 ff)
- Where possible place supporting anchors at grid points.
- Comply with the admissible distance of the anchor with reference to the fulcrum.
- Comply with the admissible edge and axis distances.

2. Restraint ties

Take note of the following marginal conditions for the arrangement of restraint ties:

- Where possible place restraint ties at grid points.
- Comply with the admissible distance e_H of the restraint tie with reference to the fulcrum.
- Comply with the admissible edge and axis distances.
- Place 2 restraint ties at a distance of ca. 15 cm at heavily loaded grid points (e.g. with overhangs).

Sandwich anchor types icons		
	MVA	
	FA	
	SPA-2	
	SPA-1	
	SPA-B	



Where possible the side ratio l_x/l_y should be between 0.75 and 1.33!

- ① Supporting anchor
- ② Horizontal anchor
- ③ Restraint tie

HALFEN SANDWICH PANEL ANCHORS

Supporting systems

Representation of the supporting systems

Please find explanations of the different supporting systems with examples including their special features below.

Supporting system MVA

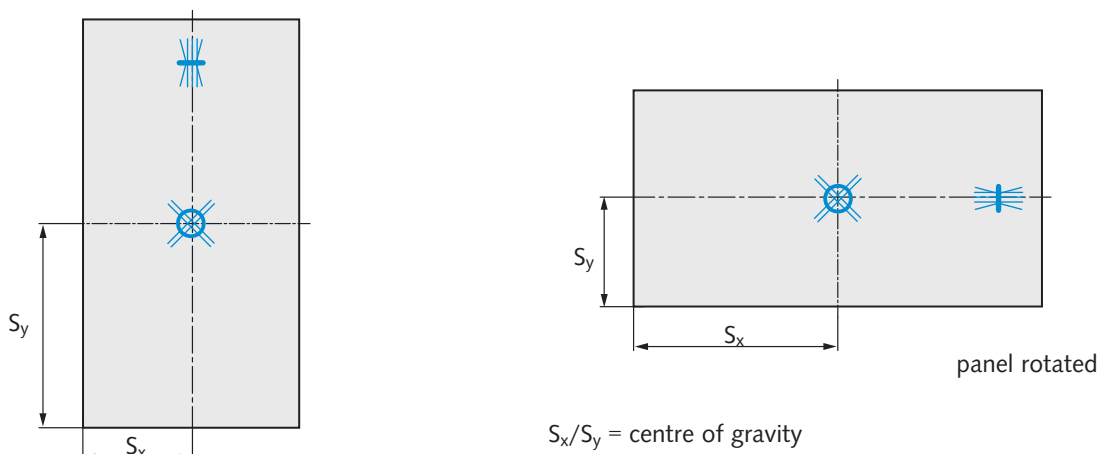
1 SP-MVA as a supporting anchor (positioned at the centre of gravity of the facing layer)

1 SP-FA as torsion anchor

(As an alternative you can also use 1 SP-SPA or a crossed connector pin as a torsion anchor).

Note: No additional measures are required for rotated panels.

Rectangular panel



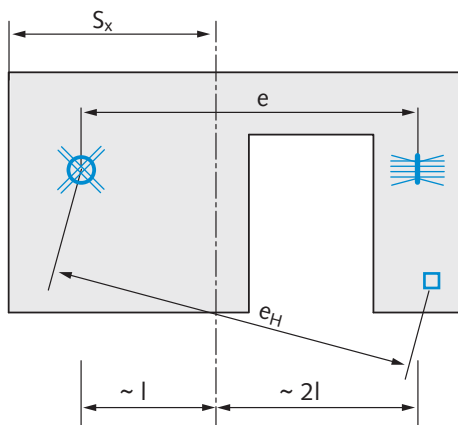
Supporting system MVA-FA

1 SP-MVA and 1 SP-FA as a supporting anchor (normally arranged asymmetrically to the centred axis in the ratio 1:2)

No additional horizontal anchor is required.

Note: The supporting system is changed for rotated panels (supporting anchors are arranged on the horizontally centred axis S_y).

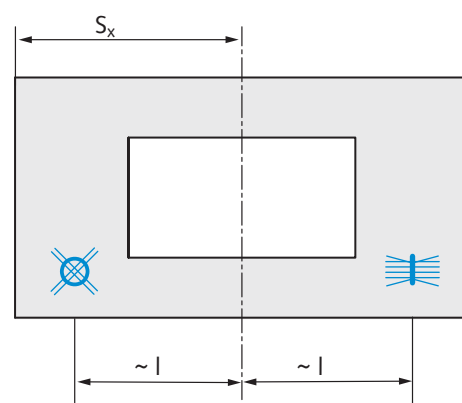
Rectangular panel with door opening



Attention:

Large distances e , resp. e_H because the panel fulcrum is off centre.

Rectangular panel with large window opening



Special case:

Symmetrical arrangement of the supporting anchors

HALFEN SANDWICH PANEL ANCHORS

Supporting systems

Supporting systems FA-FA

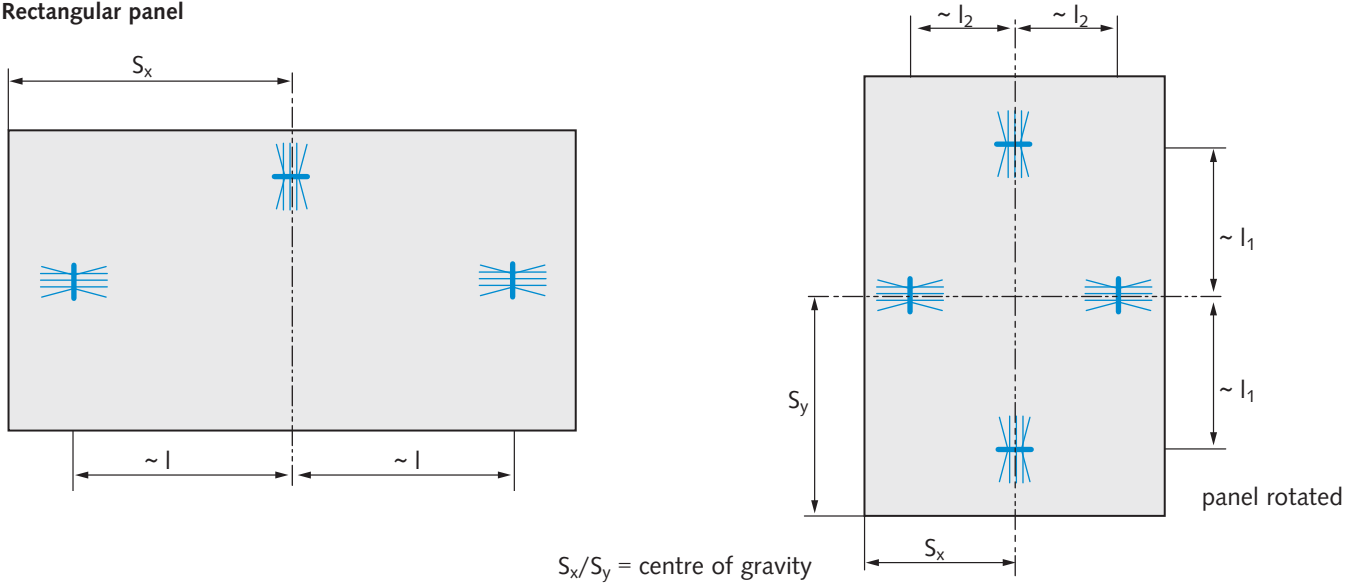
2 SP-FA as supporting anchors (normally arranged symmetrical to the centred axis)

1 SP-FA as horizontal anchor

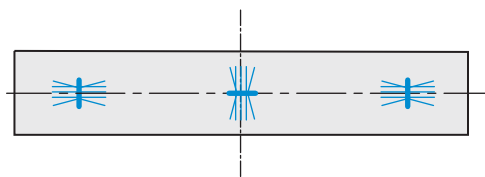
(As an alternative you can also use 1 SP-SPA or a crossed connector pin as a horizontal anchor).

Note: For rotated panels the horizontal anchors have to be dimensioned as for the supporting anchors.

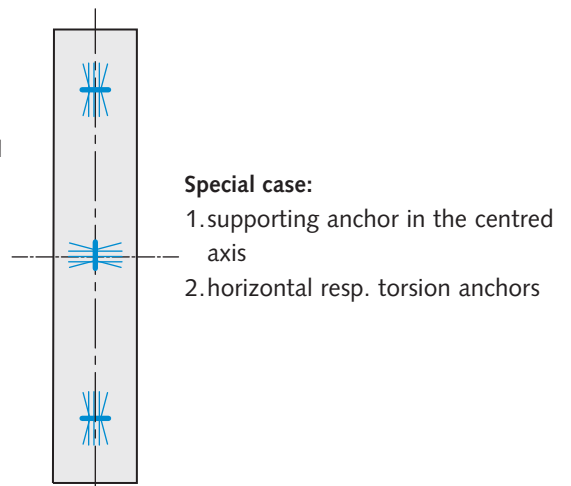
Rectangular panel



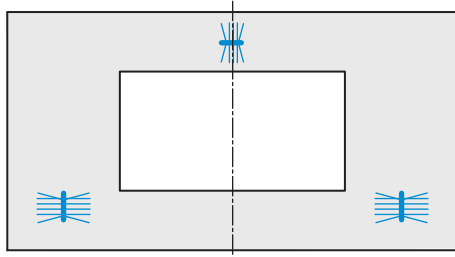
Base panel



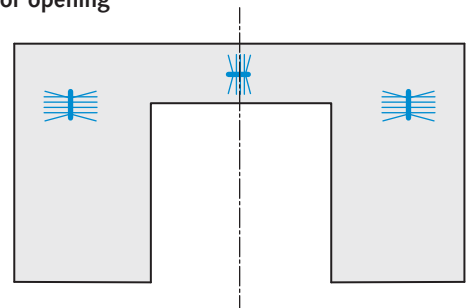
Narrow, high panel



Panel with window opening



Panel with door opening



HALFEN SANDWICH PANEL ANCHORS

Supporting systems

Supporting systems SPA-SPA

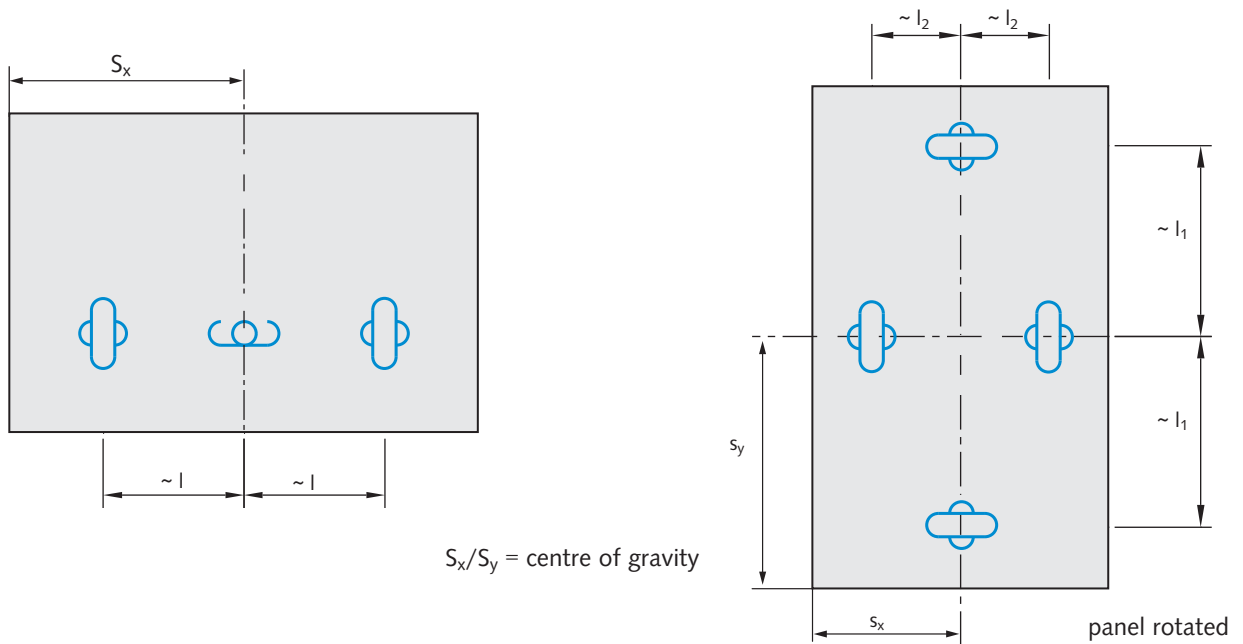
2 SP-SPA as supporting anchors, resp. 2 supporting anchor groups (normally arranged symmetrically to the centred axis)

1 SP-SPA as horizontal anchor

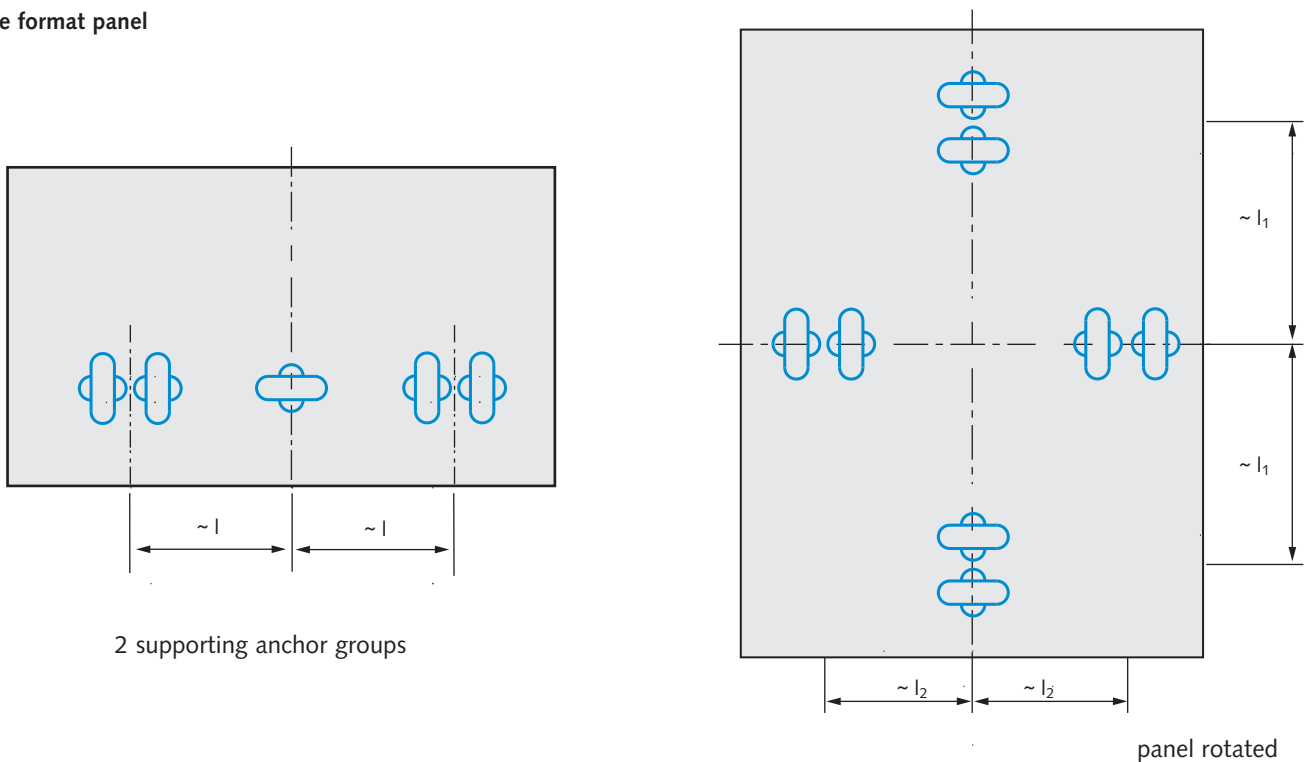
(As an alternative you can also use 1 SP-FA or a crossed connector pin as a horizontal anchor).

Note: For rotated panels the horizontal anchors are to be dimensioned as for the supporting anchors.

Rectangular panel



Large format panel

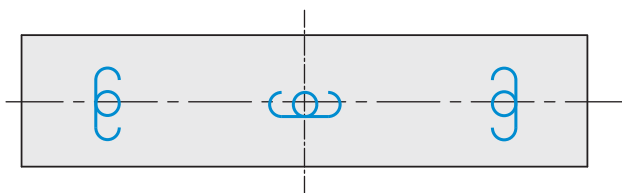


HALFEN SANDWICH PANEL ANCHORS

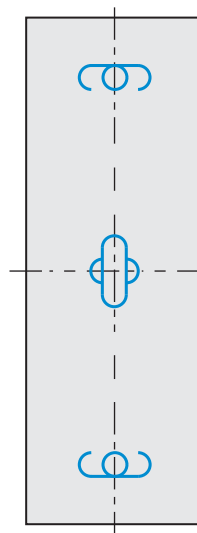
Supporting systems

Supporting systems SPA-SPA (continuation)

Base panel

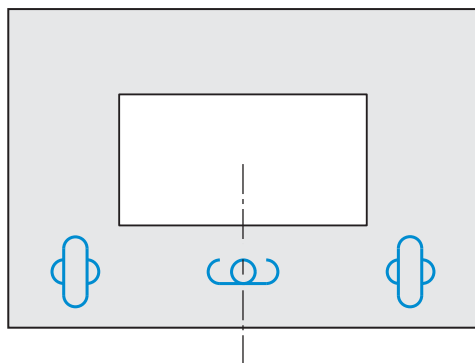


Narrow, high panel

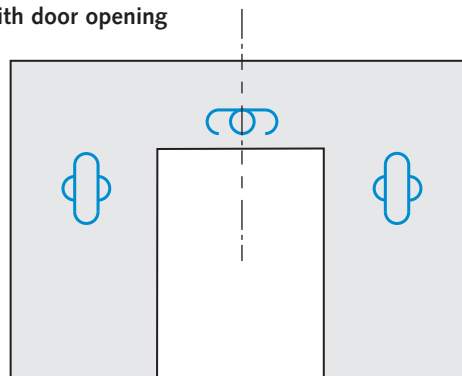


- Special case:**
1. supporting anchor in the centred axis
 2. horizontal resp. torsion anchors

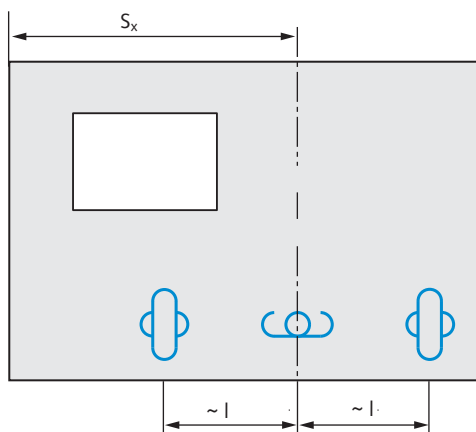
Panel with window opening



Panel with door opening



Asymmetric panel



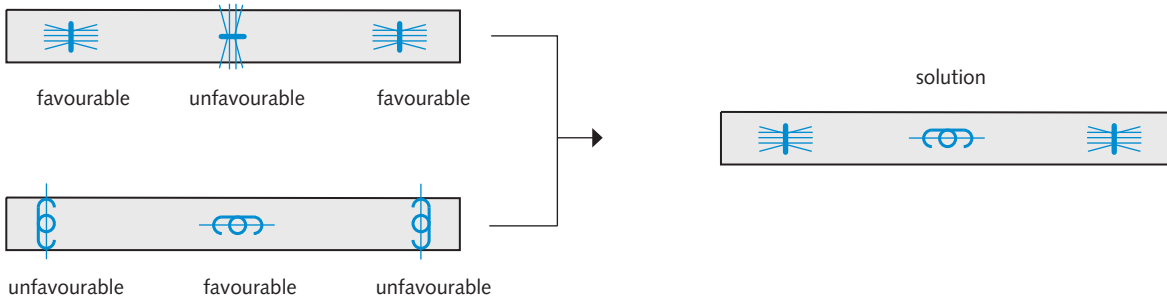
HALFEN SANDWICH PANEL ANCHORS

Supporting systems

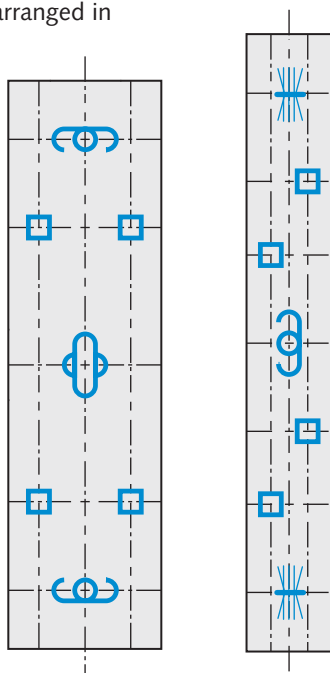
Mixed systems and special solutions

Very low, resp. narrow panels

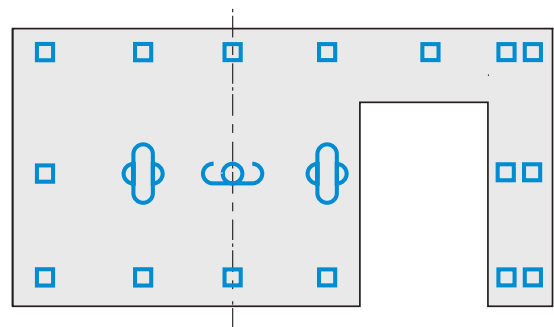
Due to the anchor height, resp. the direction of the fixing reinforcement, with very low panels it is preferable to install SP-FA as a supporting anchor and SP-SPA as a horizontal anchor (the same procedure can be applied with narrow, high panel). In case of very low panels it is preferable to install SP-FA as supporting anchor and SP-SPA as a horizontal anchor due to the anchor height and the direction of the fixing reinforcement.



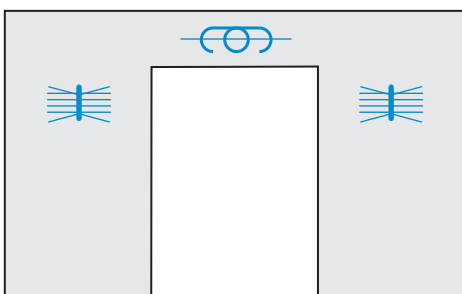
With very low, resp. narrow panels the restraint ties should also be arranged in pairs or staggered even if the minimum axis or edge distances are not adhered to.



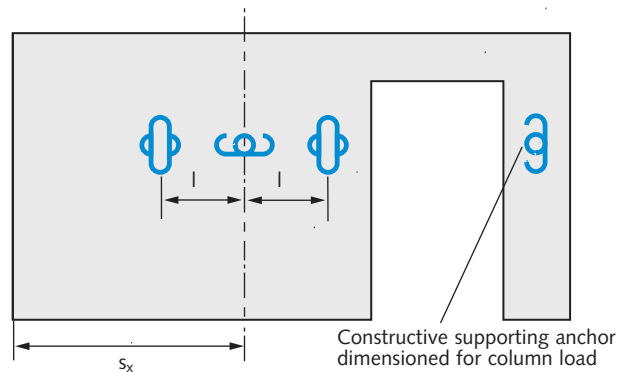
Proceed in the same way with narrow panel areas (e.g. adjacent to door openings).



Panels with low lintel areas



Panels with posts adjacent to openings with a low lintel



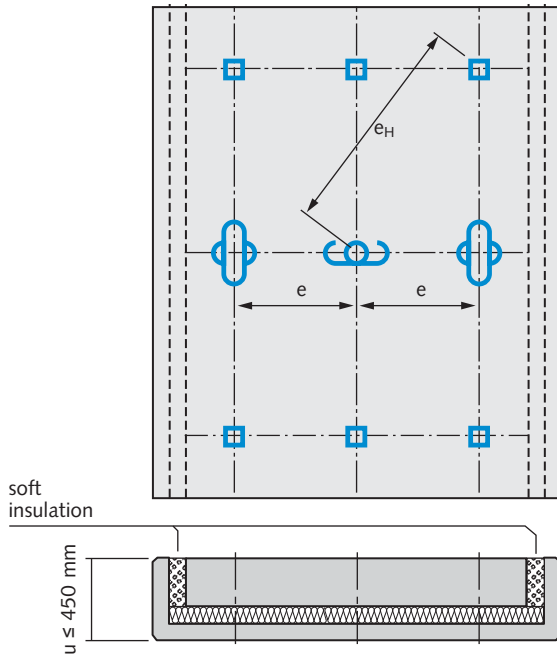
HALFEN SANDWICH PANEL ANCHORS

Supporting systems

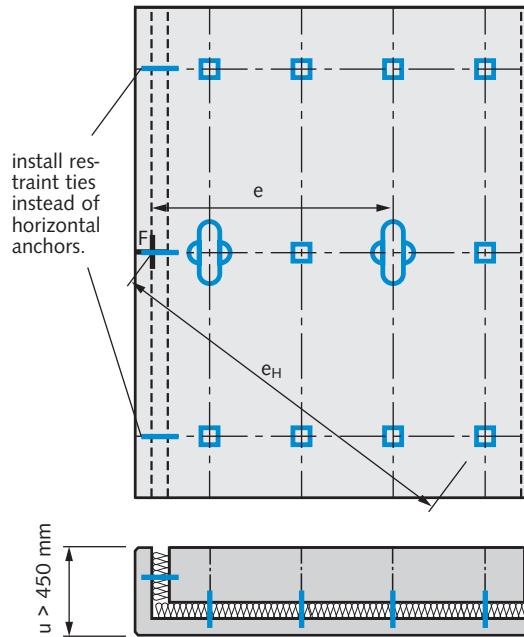
Mixed systems and special solutions (continuation)

Panels with lateral soffits

In the case of lateral soffits with $u \leq 450$ mm, care is to be taken that no connecting elements (neither supporting anchors nor restraint ties) are arranged in the soffit.



Restraint ties are to be arranged in the soffit with $u > 450$ mm. In this case the horizontal anchor is dispensed with and the distance e , resp. e_H is to be measured from the soffit.



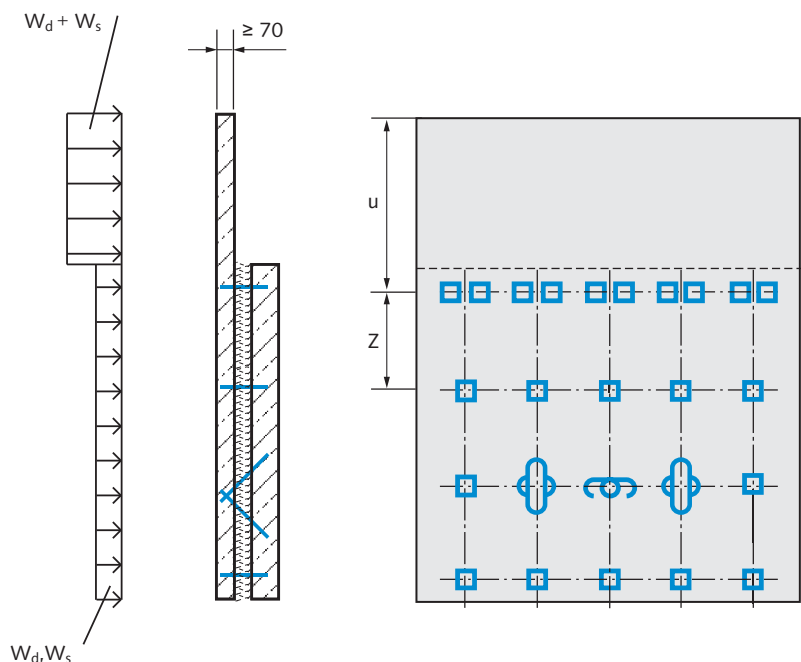
Note: Also possible with supporting system FA-FA. In the case of systems with SP-MVA the arrangement of restraint ties in the soffit is not possible (constraints).

Facing layer with a large overhang

A facing layer with large overhangs u (ca. 300 to 900 mm) causes high forces as a result of wind loads in the outermost row of restraint ties. Two restraint ties per grid point should be placed at a distance of ca. 15 cm from each other to carry these forces (1 reinforcement crossing mat).

Wind loads lead to a twisting of the facing layer in the area of its end supports with large overhangs (last row of restraint ties) and hence to comparatively large shifts at the edge of the facing layer. As a countermeasure we recommend to select the dimension "Z" in the first field adjacent to the overhang, smaller than the maximum admissible dimension.

With other preconditions the values for \ddot{u} must be calculated separately.



HALFEN SANDWICH PANEL ANCHORS

Anchor types

Supporting anchors

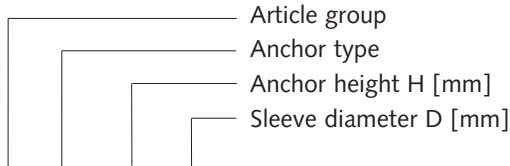
Sleeve anchors (MVA)

Article designation: SP-MVA - height [mm] - \varnothing D [mm]

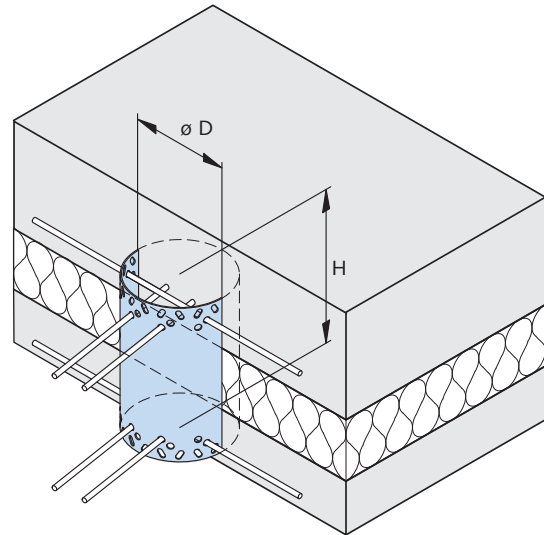
The cylindrical sleeve anchor has a sheet metal thickness of 1.5 mm. The ends are provided with round and oval holes. The round holes are for reinforcement bars and the oval holes are for embedding with the concrete. Sleeve anchors are used with the systems MVA and MVA-FA as supporting anchors. The anchors are marked for instance by embossing the anchor height and diameter on the surface.

Material stainless steel A4

Order example:



SP - MVA - 225 - 076



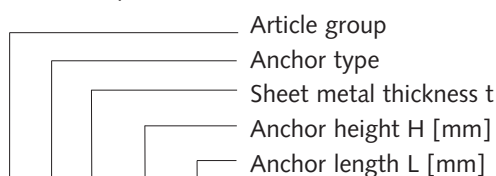
Flat anchors (FA)

Article designation: SP-FA-1 - height [mm] - length [mm]
SP-FA-2 - height [mm] - length [mm]
SP-FA-3 - height [mm] - length [mm]

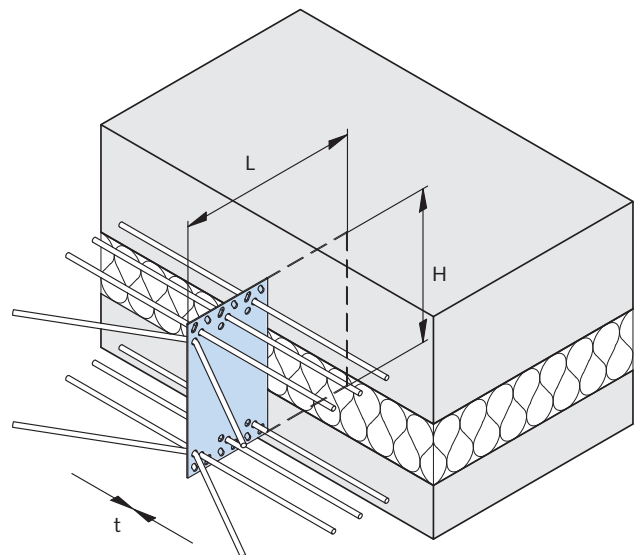
Flat anchors are supplied in the following sheet metal thicknesses: 1.5 mm; 2.0 mm or 3.0 mm. Two opposite sides are provided with round and oval holes. The round holes are for the reinforcement bars and the oval holes are for embedding with the concrete. Flat anchors are used with systems MVA-FA and FA-FA as supporting anchors. They are marked by embossing with anchor height, length and sheet metal thickness.

Material stainless steel A4

Order example:



SP - FA - 2 - 225 - 240



HALFEN SANDWICH PANEL ANCHORS

Anchor types

Sandwich panel anchors (SPA)

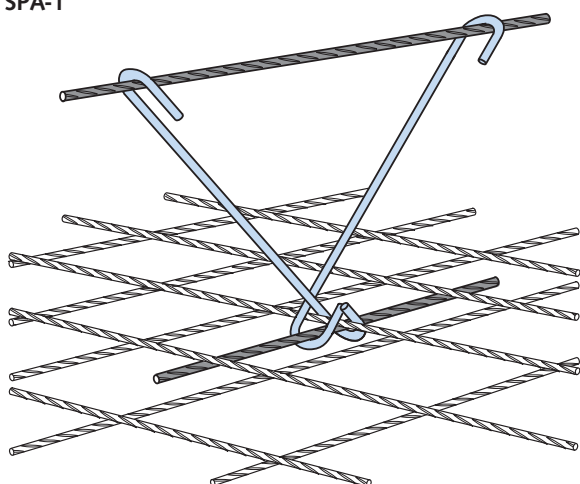
Article designation: SP-SPA-1 - Ø [mm] - height [mm]
 SP-SPA-2 - Ø [mm] - height [mm]

Sandwich panel anchors SP-SPA-1 and SP-SPA-2 are V-shaped anchors of round steel bar diameter 5.0 mm; 6.5 mm; 8.0 mm und 10.0 mm. The bent ends serve to anchor in the concrete and fix the reinforcement bars. Sandwich panel anchors are used with system SPA-SPA as supporting anchors. They are marked with coloured adhesive labels showing type, diameter and height.

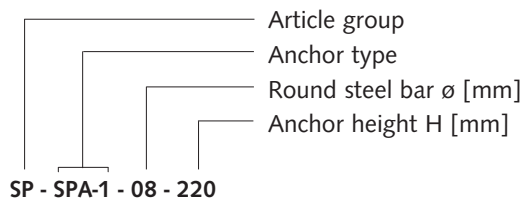
Material: stainless steel A4

Colour marking				
Colour	Anchor type		Designation rebar - Ø	Material
red	SPA-1	SPA-2	5	A4
blue	SPA-1	SPA-2	6	A4
green	SPA-1	SPA-2	8	A4
white	SPA-1	SPA-2	8	A2
yellow	SPA-1	SPA-2	10	A4
grey	SPA-1	SPA-2	10	A2

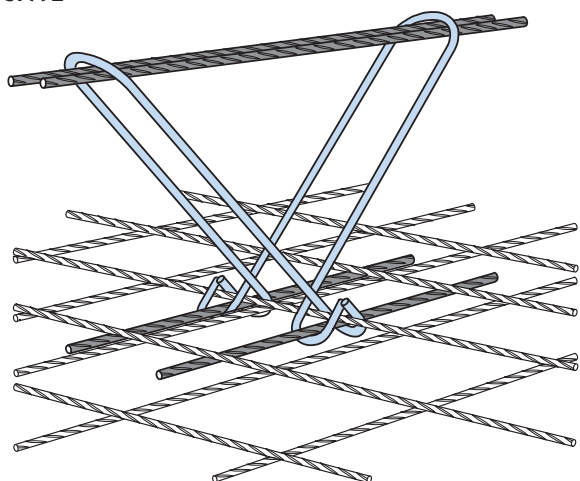
SPA-1



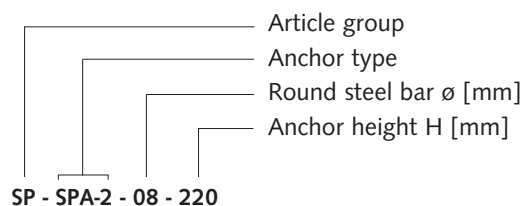
Order example:



SPA-2



Order example:



HALFEN SANDWICH PANEL ANCHORS

Anchor types

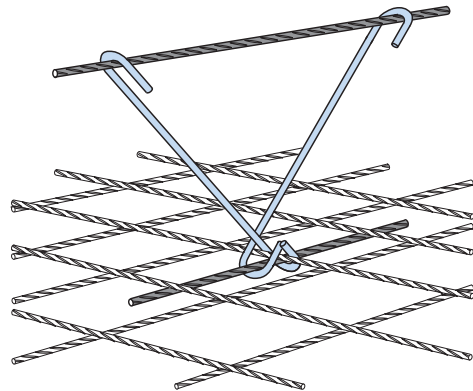
Torsion anchors / Horizontal anchors

The following types of anchor can be used with sandwich panels as torsion, resp. horizontal anchors (for article designations and order examples, see pages 19 and 20).

Sandwich panel anchors (SPA)

Sandwich panel anchor SP-SPA-1 is used with the SPA-SPA system as a horizontal anchor (where necessary SP-SPA-2 can also be installed as a horizontal anchor).

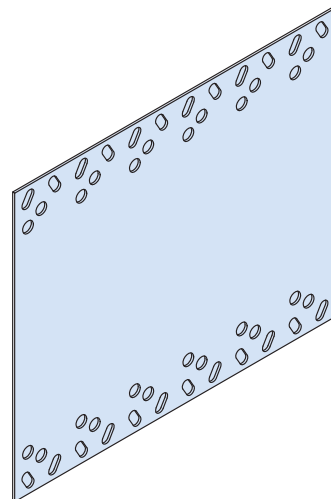
Material: stainless steel A4



Flat anchor (FA)

The flat anchor is used with the MVA system as a torsion anchor and with system FA-FA as a horizontal anchor.

Material: stainless steel A4



Crossed connector pins (VNK)

Article designation: 2 x SP-SPA-N – Ø [mm] – height [mm]

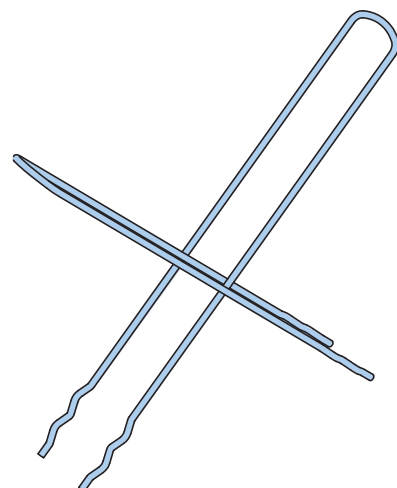
The crossed connector pin comprises two connector pins clipped together at an angle of 45°.

Wire diameter: 4.0 mm; 5.0 mm and 6.5 mm.

The crossed connector pins can be used with systems SPA-SPA and FA-FA as a horizontal anchor, resp. with system MVA as a torsion anchor. Their use is recommended only for small loads.

Note: Higher anchor heights must be selected on account of the 45° inclination.

Material: stainless steel A4



HALFEN SANDWICH PANEL ANCHORS

Anchor types

Restraint ties

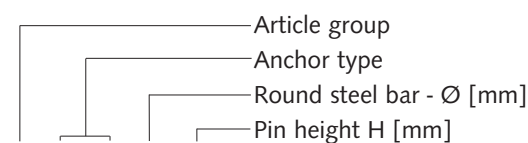
Connector pins (SPA-N)

Article designation: SP-SPA-N - Ø [mm] - height [mm]

Connector pins are U-shaped bent wires with wire diameters 3.0 mm; 4.0 mm; 5.0 mm and 6.5 mm.

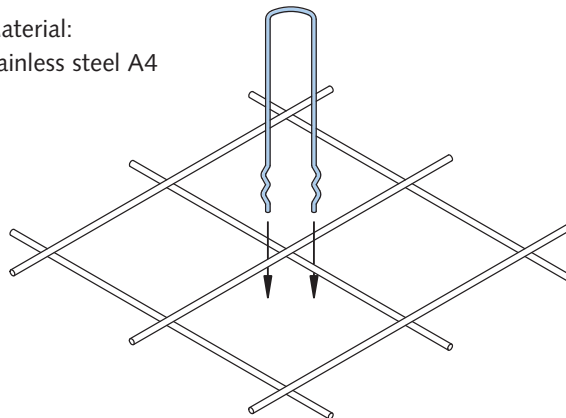
They are fixed in the concrete by the corrugated ends, resp. by the closed bent form.

Order example:



SP - SPA-N - 04 - 220

Material:
stainless steel A4

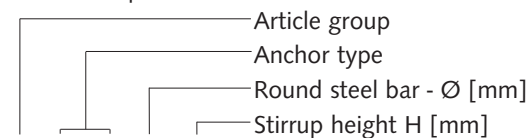


Stirrup tie (SP-SPA-B)

Article designation: SP-SPA-B - Ø [mm] - height [mm]

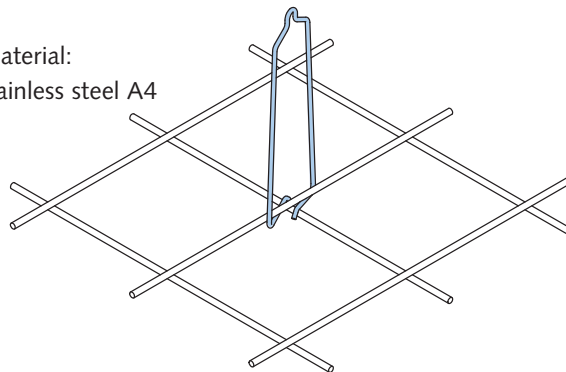
Stirrup ties are bent wires with wire diameters 3.0 mm; 4.0 mm; 5.0 mm. They are fixed in the concrete by encircling the reinforcement mat bars, resp. by the closed bent form.

Order example:



SP - SPA-B - 04 - 220

Material:
stainless steel A4



Note:
The specially formed tip guarantees the acceptance of tensile and pressure forces, also with thin load carrying layers.

Clip-on pins (SPA-A)

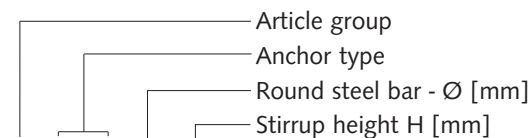
Article designation: SP-SPA-A - Ø [mm] - height [mm]

Clip-on pins are connector pins with which the closed end is bent at 90°.

Wire diameters: 3.0 mm; 4.0 mm and 5.0 mm.

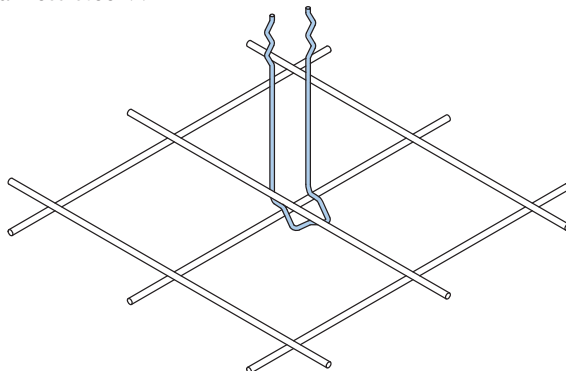
They are fixed in the concrete by the corrugated ends, resp. the encircling of the reinforcement mat.

Order example:



SP - SPA-A - 04 - 220

Material:
stainless steel A4



HALFEN SANDWICH PANEL ANCHORS

Anchor calculation

Basics

The vertical load-bearing strengths $F_{VR,d}$ are strength values taking into consideration the material side part safety coefficients. The values $F_{VR,d}$ are to be opposed to the loads from the self-weight of the facing layer increased by the load part safety coefficients and any additional applied loads.

The vertical load-bearing strengths $F_{VR,d}$ are additionally dependent on the horizontal load-bearing strengths $F_{HR,d}$ necessary for carrying the existing horizontal loads. The actually existing horizontal loads are composed of warping forces and wind loads and are decisively influenced by the panel geometry, the grid ratio and the position of the anchors.

Design loads

1. Vertical Loads

The self-weight of the facing layer plus any existing additional loads are to be taken into account as influencing vertical loads.

2. Warping loads

The influencing factors to be taken into account for determining the warping forces are detailed below:

- Anchor arrangement on grid with a side ratio of $0,75 \leq l_x / l_y \leq 1,33$
- Facing layer thickness $f = 70 - 120$ mm (a special verification is necessary for larger facing layer thicknesses)
- Temperature stresses according to DIBT Information 5/1995: Temperature change for three-layer panel without air gap (dark surface) $\Delta T = \pm 5^\circ\text{K}$

3. Wind loads according to DIN 1055-4

A sandwich panel with an anchor grid of max. $l_x \times l_y = 1.20$ m \times 1.20 m is assumed.

The wind design loads take into account a dynamic pressure of $q(z) = 1.20$ kN/m².

With a building location at < 800 m above sea level the type calculation comprises e.g. the following combinations of wind zones, terrain categories and building construction heights (the ratio of building height to building width was taken into account with $0.25 \leq h/d \leq 5.0$).

Considered combinations		
Wind zone	Region	Building height
1 and 2	Inland (mixed profile of terrain categories II and III)	≤ 50 m
3	Inland (mixed profile of terrain categories II and III)	≤ 30 m
3	coastal regions, plus islands in the Baltic (mixed profile of terrain categories II and III)	≤ 18 m
4	Inland (mixed profile of terrain categories II and III)	≤ 18 m

4. Distance from the anchors to the fulcrum (e, resp. e_H)

The following influencing factors are taken into account for determining the admissible distances e, resp. e_H:

- Heat insulation layer thickness b
- Temperature stress according to DIBT Information 5/1995: Load-bearing layer temperature (internal, whole year)
 - $\vartheta_i = + 20^\circ\text{C}$
 - Facing layer temperature in summer $\vartheta_a = + 65^\circ\text{C}$
 - Facing layer temperature in winter $\vartheta_a = - 20^\circ\text{C}$
 - Temperature difference compared to state on installation $\Delta T = \pm 45^\circ\text{K}$

HALFEN SANDWICH PANEL ANCHORS

Anchor calculation

HALFEN calculation software

HALFEN supply calculation software for both supporting anchor types MVA/FA and supporting anchor types SPA for calculating sandwich panels.

After entering the panel geometry the required anchors can be determined with the aid of the calculation programs.

Calculation reports are created for the calculated sandwich panels; these display the installation position of the anchors and the panel geometry.

It is also possible to create and print-out part lists for the required anchors.

HALFEN calculation software can be downloaded free of charge from www.halfen.de.

Anchor calculation and anchor selection

In the case of sleeve anchors MVA and flat anchors FA, the calculation values of load-bearing strengths $F_{VR,d}$ can be obtained from the available tables which are based on the previously stated design loads and take the unfavourable anchor position for these loads into account.

For sandwich panel anchors SPA-1 and SPA-2, the vertical load-bearing strengths are to be determined by an interaction of the steel and concrete load-bearing capacity. Tables are provided for this purpose in the type-testing

for the steel load-bearing capacity and limit lines for the concrete load-bearing capacity.

For restraint ties SPA-N/SPA-B/SPA-A the admissible horizontal load-bearing strengths $F_{HR,d}$ are read from a table contained in the type-testing.

Examples for determining load-bearing strengths for each type of anchor are detailed below.

Sleeve anchors (MVA)

The required input values for determining the admissible load-bearing strengths from the tables are the layer structure (with or without air gap), the facing layer thickness f and the

wall distance b . Represented below by way of example are the load-bearing strengths of a three-layer panel with a facing layer thickness of $f = 80$ mm.

Example: SP-MVA, $f = 80$ mm, without air gap

Vertical load-bearing strengths $F_{VR,d}$ [kN] for HALFEN SP-MVA with facing layer thicknesses of $f = 80$ mm

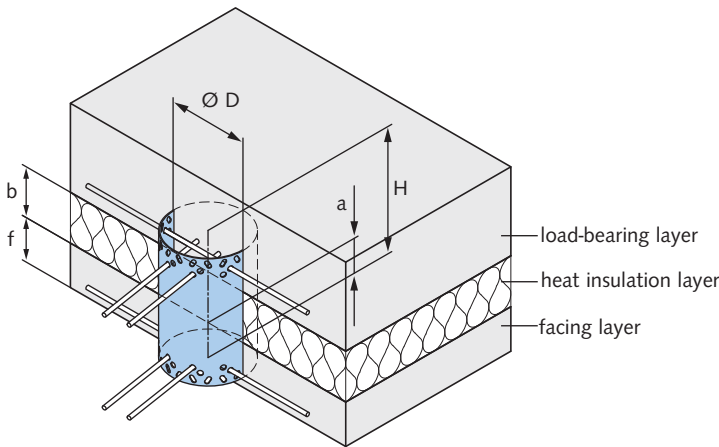
Designation SP-MVA- H - Ø D	Heat insulation thickness b [mm]												
	30	40	50	60	70	80	90	100	110	120	130	140	150
SP-MVA-(height)-051	14.7	13.7	12.5	11.6	10.8	10.1	9.5	8.4	8.0	7.6	7.2	5.5	5.3
SP-MVA-(height)-076	23.0	21.3	19.6	18.1	16.8	15.7	14.8	13.3	12.5	11.9	11.3	8.8	8.4
SP-MVA-(height)-102	31.2	28.5	26.3	24.3	22.7	21.2	19.9	17.0	16.1	15.2	14.5	12.1	11.6
SP-MVA-(height)-127	39.5	37.2	34.2	31.7	29.5	27.7	26.0	24.8	23.4	22.2	21.2	17.9	17.1
SP-MVA-(height)-153	47.5	45.5	43.3	40.5	37.8	35.4	33.4	31.3	29.7	28.2	26.9	24.4	23.4
SP-MVA-(height)-178	55.0	52.0	49.5	47.3	45.4	42.6	40.1	39.4	37.4	35.6	33.9	30.9	29.6
SP-MVA-(height)-204	62.3	59.0	55.6	53.0	51.0	48.1	45.2	43.7	41.5	39.5	37.7	36.0	34.5
SP-MVA-(height)-229	69.5	65.5	61.5	58.5	55.7	52.2	49.2	49.0	46.5	44.3	42.2	40.4	38.6
SP-MVA-(height)-255	76.5	71.5	67.5	64.3	61.3	57.5	54.1	52.7	50.0	47.6	45.4	43.4	41.5
SP-MVA-(height)-280	83.0	77.5	73.0	69.0	64.9	60.8	57.2	57.6	54.7	52.0	49.6	47.4	45.4

Minimum concrete quality C 30/37 according to DIN 1045-1 and core insulation without back-ventilation

All further tables are to be found in the Type Testing for MVA – Annex 6 to 10

HALFEN SANDWICH PANEL ANCHORS

Anchor calculation



Sandwich panel material:
Stainless steel A4

Concrete quality:
Facing layer > C 30/37
Load-bearing layer > C 30/37

Reinforcement:
Reinforcing mats BSt 500 M
Ribbed reinforcing bars BSt 500 S

Minimum reinforcement of the facing layer:
Reinforcing mats corresponding to Q 131

Minimum embedding depth of sleeve anchors MVA

The minimum embedding depth (a) of the sleeve anchor is dependant on the thickness of the facing layer (f) and the thickness of the heat insulation layer (b).

Minimum embedding depth a [mm]		
f [mm]	b [mm]	
	30 - 90	100 - 140
70	55	60
80	60	65
90 - 120	60	70

Selection of anchor height for MVA

The height (H) of the sleeve anchor is dependant on the thickness of the heat insulation layer (b) and the thickness of the facing layer (f).

Anchor height H [mm]												
f [mm]	b [mm]											
	30	40	50	60	70	80	90	100	110	120	130	140
70	150	150	175	175	200	200	200	225	260	260	260	260
80	150	175	175	200	200	200	225	260	260	260	260	-
90 - 120	150	175	175	200	200	200	225	260	260	260	-	-

$$H \geq 2 \times a + b$$

Note:

Please consider the overview of available anchors on page 32.

Additional reinforcement for MVA

The anchoring bars are to be arranged in the facing and load-bearing layers. The number and length of the reinforcing bars is dependant on the Ø D of the sleeve anchor.

Additional reinforcement			
Sleeve anchor	Ø D [mm]	Symbol	Anchoring bars BSt 500 S
	51 76 102		2 × 2 Ø 6 mm l = 500 mm
	127 153 178		2 × 4 Ø 6 mm l = 700 mm
	204 229 255 280		Additions: 2 × 4 Ø 8 mm l = 700 mm crosswise in the cut-out area of the reinforcement mat

HALFEN SANDWICH PANEL ANCHORS

Anchor calculation

Flat anchor (FA)

The required input values for determining the admissible load-bearing strengths from the table are layer structure (with or without air gap), sheet metal thickness t of the flat anchor, the facing layer thickness f and the wall distance b .

Please find following examples for flat anchors with sheet metal thickness $t = 2$ mm, the load-bearing strengths of a three-layer panel with a facing layer thickness $f = 80$ mm plus the maximum admissible distances e from the fulcrum F .

Example: SP-FA-2, ($t = 2$ mm), $f = 80$ mm, without air gap

Vertical load-bearing strengths $F_{VR,d}$ [kN] for HALFEN SP-FA-2 with facing layer thickness of $f = 80$ mm

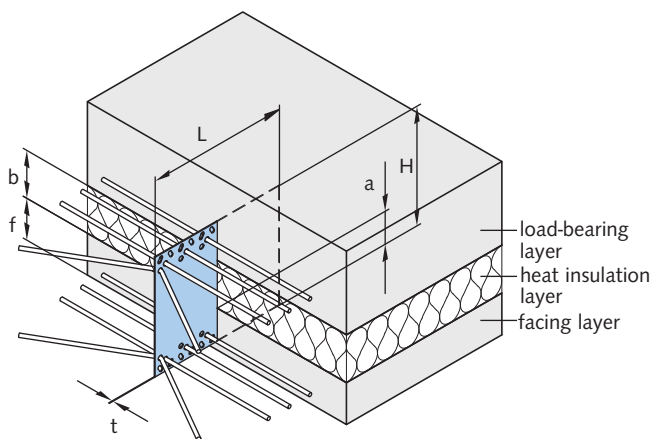
Designation SP-FA-2 - H - L	Heat insulation layer thickness b [mm]														
	30	40	50	60	70	80	90	100	120	140	160	180	200	230	250
SP-FA-2-(height)-080	5.0	4.5	4.1	3.8	3.5	3.2	3.0	2.8	2.5	2.1	1.6	1.2	0.0	0.0	0.0
SP-FA-2-(height)-120	14.0	12.5	11.6	10.6	9.8	9.0	8.5	8.0	7.0	5.3	4.1	3.2	2.5	0.0	0.0
SP-FA-2-(height)-160	21.0	21.0	20.5	19.0	18.0	17.0	16.0	15.0	12.0	9.2	7.2	5.6	4.6	3.5	2.9
SP-FA-2-(height)-200	28.5	27.5	26.0	24.5	23.5	22.5	21.5	20.5	17.5	13.6	10.8	8.5	7.0	5.5	4.6
SP-FA-2-(height)-240	32.0	31.0	30.0	29.0	28.0	27.0	26.0	25.0	22.0	18.5	14.8	12.0	9.7	7.6	6.5
SP-FA-2-(height)-280	35.5	34.5	33.5	32.5	31.5	30.5	29.5	28.5	25.5	24.0	19.0	15.5	12.8	10.0	8.6
SP-FA-2-(height)-320	40.5	40.0	39.0	38.5	37.5	37.0	36.0	35.5	32.0	29.0	23.5	19.0	16.0	12.6	11.0
SP-FA-2-(height)-360	43.0	42.0	41.5	41.0	40.0	39.0	38.5	38.0	35.0	33.5	28.0	23.0	19.5	15.5	13.0
SP-FA-2-(height)-400	44.5	44.0	43.5	43.0	42.5	41.5	41.0	40.5	38.0	36.5	33.0	27.5	23.0	18.0	15.3

Minimum concrete quality C 30/37 according to DIN 1045-1 and core insulation without ventilation of cavity

Maximum anchor distance e_{max} [cm] from mobility rest point F

Designation	Heat insulation layer thickness b [mm]														
	30	40	50	60	70	80	90	100	120	140	160	180	200	230	250
SP-FA-2	95	165	250	360	450	470	500	530	600	700	780	880	990	1000	1000

All further tables are to be found in Type Testing for FA – Annex 6 to 15



Sandwich panel material:

Stainless steel A4

Concrete quality:

Facing layer > C 30/37

Load-bearing layer > C 30/37

Reinforcement:

Reinforcing mats BSt 500 M

Ribbed reinforcing bars BSt 500 S

Minimum reinforcement of the facing layer:

Reinforcing mats corresponding to Q 131

HALFEN SANDWICH PANEL ANCHORS

Anchor calculation

Minimum embedding depth for flat anchor FA

The minimum embedding depth (a) of the flat anchor in the load-bearing and facing layer is 55 mm.

Minimum embedding depth a [mm]	
f [mm]	b [mm]
30 - 250	55
70 - 120	55

Selecting the anchor height for FA

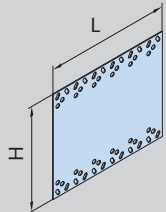




The height of the flat anchor (H) is dependant on the thickness of the heat insulation layer (b) and the embedding depth (a).

$$H \geq 2 \times a + b$$

Anchor height H [mm]														
b [mm]														
30	40	50	60	70	80	90	100	120	140	160	180	200	230	250
150	150	175	175	200	200	200	225	260	260	280	300*	325*	350*	375*
* on request														

Additional reinforcement for FA

The anchoring bars have to be arranged in the facing and load-bearing layers. The number of reinforcement bars is dependent upon the length of the flat anchor.

Anchoring in the concrete			
Flat anchor	Length L [mm]	Symbol	Anchoring bars BSt 500 S
	80		2 × 4 Ø 6 mm l = 400 mm
	120		2 × 5 Ø 6 mm l = 400 mm
	160,200,240,280		2 × 6 Ø 6 mm l = 400 mm
	320,360,400		2 × 7 Ø 6 mm l = 400 mm

Note:

Please refer to the overview of available anchors on page 32.

HALFEN SANDWICH PANEL ANCHORS

Anchor calculation

Sandwich panel anchor (SPA)

The required input variables for determining the admissible load-bearing strengths with interaction are anchor type, heat insulation layer thickness b and the existing horizontal loads. The admissible distances e are dependant on the heat insulation layer thickness b . The tables for the steel load-bearing

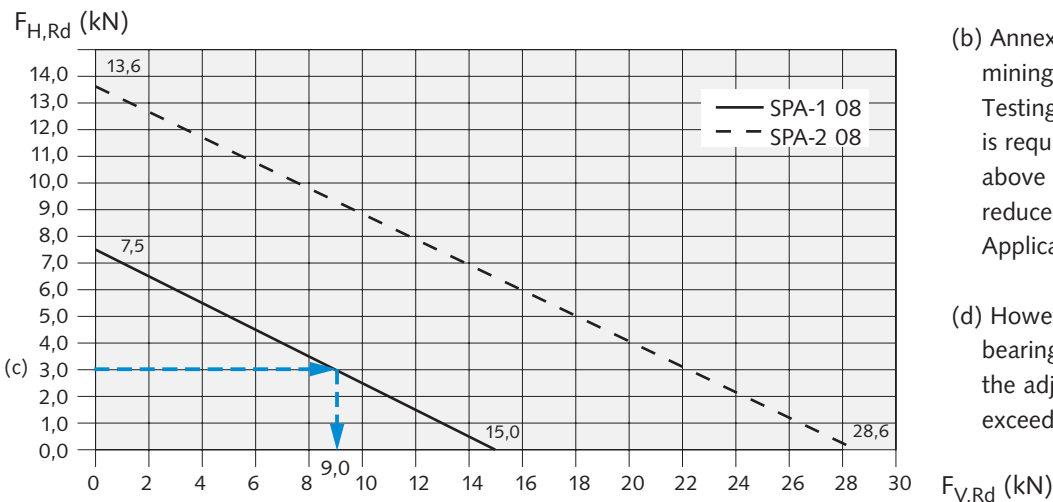
capacity and the limit line for concrete load-bearing capacity are represented below by way of example for sandwich panel anchors SPA-1-08, resp. SPA-2-08. The procedure for determining the vertical load-bearing strengths is shown for a heat insulation layer thickness $b = 12$ cm and an acting horizontal force $F_{H,d} = 3.0$ kN exemplarily.

Example: Load-bearing capacity for SP-SPA with $\varnothing 8$ mm

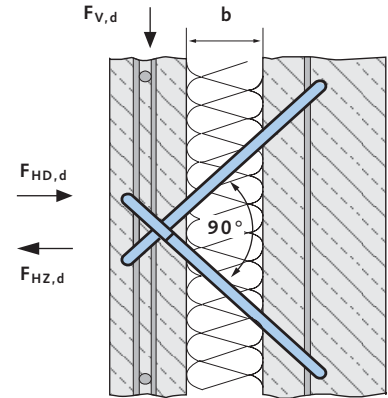
Load-bearing strengths $F_{V,Rd}$ [kN] for HALFEN SP-SPA with $\varnothing 8$ mm							
b [cm]	e_{max} [cm]	SP-SPA-1-08			SP-SPA-2-08		
		$F_{V,Rd}$	$F_{HD,Rd}$	$F_{HZ,Rd}$	$F_{V,Rd}$	$F_{HD,Rd}$	$F_{HZ,Rd}$
6	125	15.00	0.00	0.00	28.60	0.00	0.00
7	162	15.00	0.00	0.00	28.60	0.00	0.00
8	204	15.00	0.00	0.00	28.60	0.00	0.00
9	252	15.00	0.00	0.00	28.60	0.00	0.00
10	304	14.40	0.30	0.30	28.60	0.00	0.00
11	361	13.70	0.65	0.65	27.40	0.57	0.57
(a) 12	400	13.00	1.00	1.00	26.00	1.24	1.24
13	400	12.30	1.35	1.35	24.60	1.90	1.90
14	400	11.70	1.65	1.65	23.40	2.47	2.47
15	400	11.00	1.80	2.00	22.00	3.14	3.14
16	400	10.50	1.70	2.25	21.00	3.40	3.61
17	400	9.80	1.60	2.60	19.60	3.20	4.28
18	400	9.50	1.50	2.75	19.00	3.00	4.57
19	400	9.00	1.45	3.00	18.00	2.90	5.04
20	400	8.50	1.35	3.25	17.00	2.70	5.52
21	400	8.00	1.30	3.50	16.00	2.60	5.99
22	400	7.60	1.25	3.70	15.20	2.50	6.37
23	400	7.10	1.20	3.95	14.20	2.40	6.85
24	400	6.75	1.10	4.13	13.50	2.20	7.18
25	400	6.40	1.05	4.30	12.80	2.10	7.51

(a)

Concrete load-bearing capacity line SP-SPA mit $\varnothing 8$ mm



All further tables and diagrams are to be found in the Type Testing for SPA – Annex 2 to 5



Example:

Heat insulation layer thickness $b = 12$ cm
Horizontal force $F_{H,d} = 3.0$ kN
Supporting anchor SPA-1-08

1. Steel load-bearing capacity

→ admiss. $F_{V,Rd} = 13,0$ kN with

$F_{H,d} = 1,0$ kN (a)

→ $F_{H,d} = 3,0$ kN is

admiss. $F_{V,Rd} = 13,0 - (3,0 - 1,0)$

$= 11,0$ kN (b)

2. Concrete load-bearing capacity

→ admiss. $F_{V,Rd} = 9,0$ kN with $F_{H,d}$

$= 3,0$ kN (c)

→ **The concrete load-bearing capacity is determining!**

admiss. $F_{V,Rd} = 9,0$ kN (d)

(b) Annex 1 is applicable for determining $F_{H,d}$ and $F_{V,d}$ of the Type Testing.

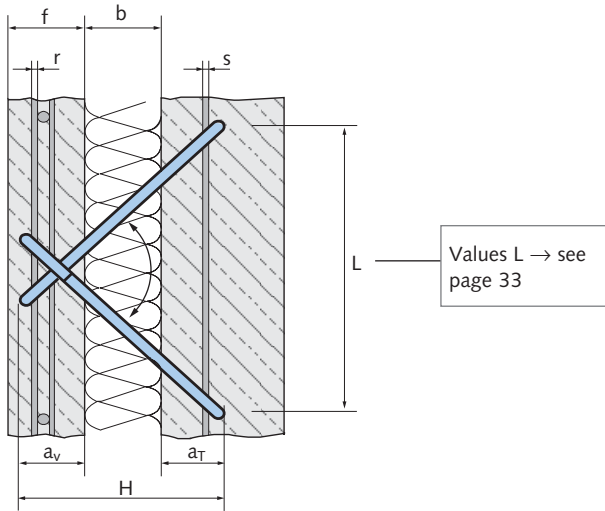
If a larger $F_{H,Rd}$ resp. $F_{V,Rd}$ is required than indicated in the above table $F_{V,Rd}$ resp. $F_{H,Rd}$ can be reduced.

Applicable is: $\Delta F_{H,Rd} = \Delta F_{V,Rd}$.

(d) However, the concrete load-bearing capacity line according to the adjacent graph may not be exceeded.

HALFEN SANDWICH PANEL ANCHORS

Anchor calculation



Material for sandwich panel anchors:
Stainless steel A4

Concrete quality:
Facing layer \geq C 30/37
Load-bearing layer \geq C 20/25

Reinforcement:
Reinforcing mats BSt 500 M
Ribbed reinforcing bars BSt 500 S

Minimum reinforcement for the facing layer:
Concrete steel mats corresponding to Q 131

Minimum embedding depth for the sandwich panel anchors SPA

The minimum embedding depths a_v , resp. a_T in the facing, resp. load-bearing layer are dependent on the wire diameter of the supporting anchor.

Minimum embedding depth a and selection of the anchor height H:				
Type	Designation			
	SP-SPA-1-05 SP-SPA-2-05	SP-SPA-1-06 SP-SPA-2-06	SP-SPA-1-08 SP-SPA-2-08	SP-SPA-1-10 SP-SPA-2-10
\emptyset	5.0	6.5	8.0	10.0
b	30-70	40-150	60-210	200-250
a_v	≥ 49	≥ 50	≥ 52	≥ 54
a_T	≥ 55	≥ 55	≥ 55	≥ 55
H	a_v+b+a_T	a_v+b+a_T	a_v+b+a_T	a_v+b+a_T
f	≥ 70	≥ 70	≥ 70	≥ 70

All dimension in [mm]

Additional reinforcement for SPA

The anchoring bars are to be arranged in the facing and load-bearing layers. The length and diameter of the reinforcing bars is dependant on the anchor size.

Additional reinforcement				
Type	SPA-1-05	SPA-1-06	SPA-1-08	SPA-1-10
r	1 \emptyset 8 l = 450	1 \emptyset 8 l = 450	1 \emptyset 8 l = 700	1 \emptyset 8 l = 700
s	1 \emptyset 8 l = 700	1 \emptyset 8 l = 700	1 \emptyset 10 l = 700 ①	1 \emptyset 10 l = 700 ①
Type	SPA-2-05	SPA-2-06	SPA-2-08	SPA-2-10
r	2 \emptyset 8 l = 450	2 \emptyset 8 l = 450	2 \emptyset 8 l = 700	2 \emptyset 8 l = 700
s	2 \emptyset 8 l = 700	2 \emptyset 8 l = 700	2 \emptyset 10 l = 700 ①	2 \emptyset 10 l = 700 ①

All dimension in [mm]
① for L > 500 mm l is to be selected to 900 mm (values L \rightarrow see page 33)

Note:
Please refer to the overview of the available anchors on page 33

HALFEN SANDWICH PANEL ANCHORS

Anchor calculation

Restraint ties (connector and clip-on pins, resp. stirrup ties)

The input variable for determining the admissible horizontal load-bearing strengths $F_{HR,d}$ and the maximum admissible distances e_H (→ table page 31) is the heat insulation layer thickness b .

Material: Stainless steel A4

Reinforcement:

Concrete steel mats BSt 500 M,
concrete ribbed steel BSt 500 S

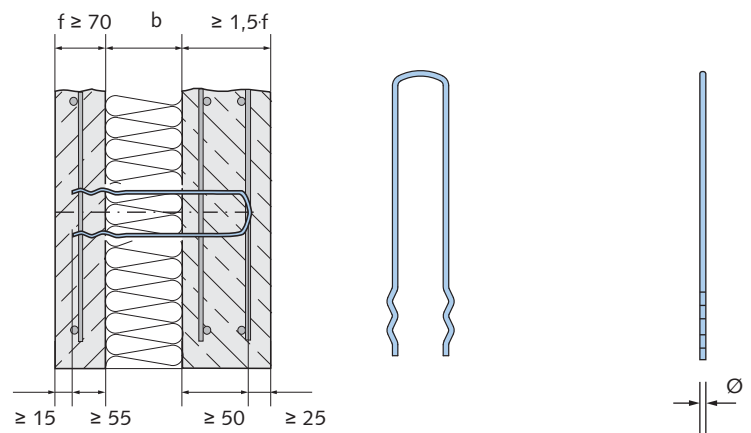
Concrete quality: Facing and load-bearing layer \geq C 30/37
Exception stirrup ties:
> C 25/30 for facing layer
> C 20/25 for load-bearing layer

Minimum reinforcement for the facing layer:

Reinforcing mats corresponding to Q 131

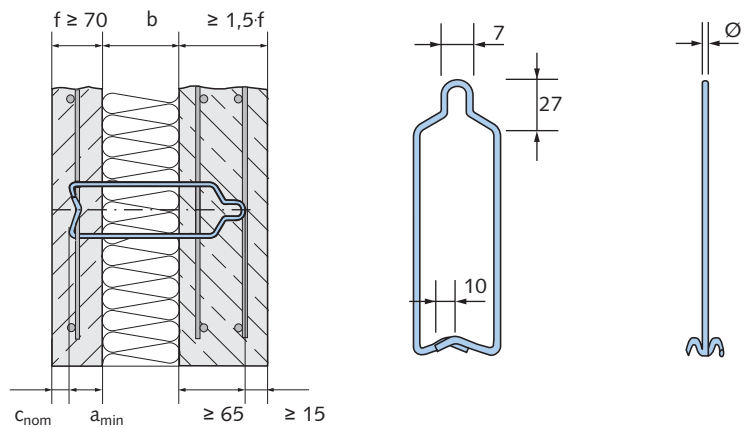
Connector pins SPA-N

- Ø 3.0 designation SP-SPA-N-03
- Ø 4.0 designation SP-SPA-N-04
- Ø 5.0 designation SP-SPA-N-05
- Ø 6.5 designation SP-SPA-N-06



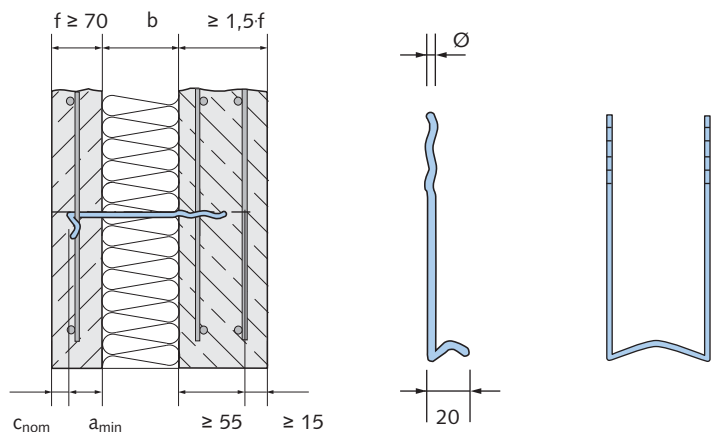
Stirrup ties SPA-B

- Ø 3.0 designation SP-SPA-B-03
- Ø 4.0 designation SP-SPA-B-04
- Ø 5.0 designation SP-SPA-B-05



Clip-on pins SPA-A

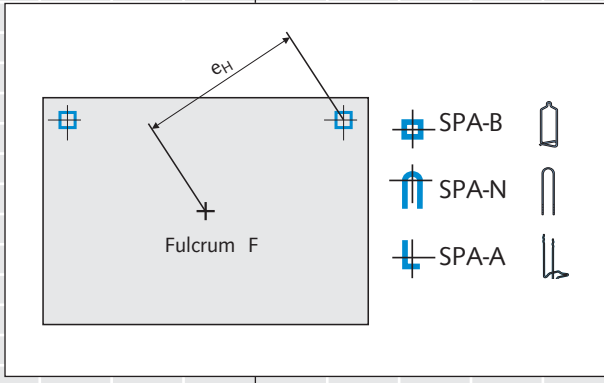
- Ø 3.0 designation SP-SPA-A-03
- Ø 4.0 designation SP-SPA-A-04
- Ø 5.0 designation SP-SPA-A-05



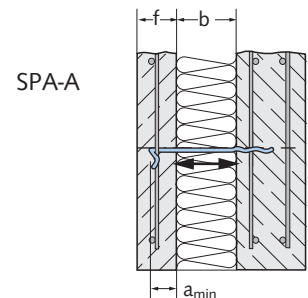
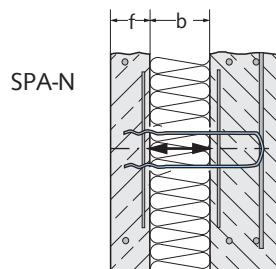
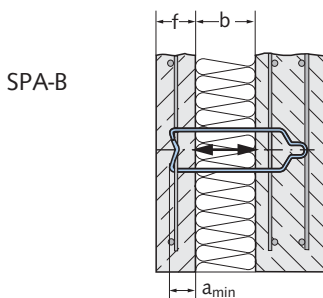
HALFEN SANDWICH PANEL ANCHORS

Anchor calculation

Load-bearing strengths $F_{HR,d}$ [kN] and admissible distances e_H [cm]																																
b [cm]	SP-SPA-N-03 SP-SPA-B-03 SP-SPA-A-03				Ø 3 mm				SP-SPA-N-04 SP-SPA-B-04 SP-SPA-A-04				Ø 4 mm				SP-SPA-N-05 SP-SPA-B-05 SP-SPA-A-05				Ø 5 mm				SP-SPA-N-06				Ø 6.5 mm			
	$F_{HR,d}$ [kN] with facing layer thickness $f_{min} \geq 70$ [mm], $a_{min} \geq f_{min}/2 + \varnothing$ [mm]																$F_{HR,d}$ [kN] with facing layer thickness $f_{min} \geq 70$ [mm]															
	1.5	2.4	3.0	3.8	3.0	3.6	4.3	5.1	6.6	3.9	4.5	5.1	5.8	6.7	4.3	5.1	5.8	6.6														
3	191	182	166	152	170	167	159	156	149	163	161	160	160	159																		
4	311	298	270	249	271	266	254	249	237	254	252	250	250	248																		
5	461	441	400	369	396	388	371	363	347	367	363	360	360	357																		
6	500	500	500	500	500	500	500	499	476	500	494	490	490	486																		
7	500	500	500	500	500	500	500	500	500	500	500	500	500	500																		
8	500	500	500	500	500	500	500	500	500	500	500	500	500	500																		
9	500	500	500	500	500	500	500	500	500	500	500	500	500	500																		
10	500	500	500	500	500	500	500	500	500	500	500	500	500	500																		
11	500	500	500	500	500	500	500	500	500	500	500	500	500	500																		
12	500	500	500	500	500	500	500	500	500	500	500	500	500	500																		
13	500	500	500	500	500	500	500	500	500	500	500	500	500	500																		
14	500	500	500	500	500	500	500	500	500	500	500	500	500	500																		
15	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500														
16					500	500	500	500	500	500	500	500	500	500	500	500	500	500														
17					500	500	500	500	500	500	500	500	500	500	500	500	500	500														
18					500	500	500	500	500	500	500	500	500	500	500	500	500	500														
19										500	500	500	500	500	500	500	500	500														
20										500	500	500	500	500	500	500	500	500														
21										500	500	500	500	500	500	500	500	500														
22										500	500	500	500	500	500	500	500	500														
23										500	500	500	500	500	500	500	500	500														
24										500	500	500	500	500	500	500	500	500														
25										500	500	500	500	500	500	500	500	500														
26										500	500	500	500	500	500	500	500	500														
27										500	500	500	500	500	500	500	500	500														
28															500	500	500	500														
29															500	500	500	500														
30															500	500	500	500														
31															500	500	500	500														
32															500	500	500	500														
33															500	500	500	500														
34															500	500	500	500														
35															500	500	500	500														
36															500	500	500	500														
37															500	500	500	500														
38															500	500	500	500														
39															500	500	500	500														
40															500	500	500	500														



The values below the step line are only admissible with tensile stress!



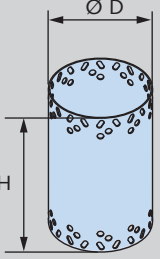
Note: Please note the overview of available anchors on page 33.

HALFEN SANDWICH PANEL ANCHORS

Overview of available anchors

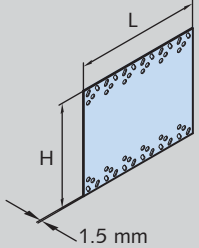
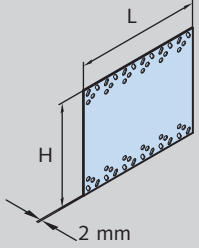
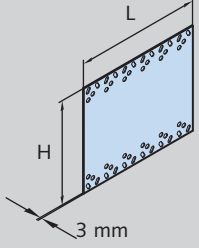
The available heights and diameters, resp. lengths of the anchors can be found in the following tables.

Sleeve anchors (MVA)

Available anchor diameter D [mm]					
Anchor type	Anchor height H [mm]				
	150	175	200	225	260
	51	51	51	51	51
	76	76	76	76	76
	102	102	102	102	102
	127	127	127	127	127
	153	153	153	153	153
	178	178	178	178	178
		204	204	204	204
		229	229	229	229
		255	255	255	255
		280	280	280	280

Subject to design changes

Flat anchors (FA)

Available anchor lengths L [mm]						
Anchor type	Anchor height H [mm]					
	150	175	200	225	260	280
	80	80	80	80		
	120	120	120	120		
	160	160	160	160		
	200	200	200	200		
	240	240	240	240		
	280	280	280	280		
	320	320	320	320		
	360	360	360	360		
	400	400	400	400		
		80	80	80	80	
		120	120	120	120	
		160	160	160	160	
		200	200	200	200	
		240	240	240	240	
		280	280	280	280	
		320	320	320	320	
		360	360	360	360	
		400	400	400	400	
					80	80
					120	120
					160	160
					200	200
					240	240
					280	
					320	
					360	
					400	

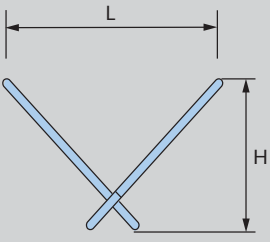
Subject to design changes

Note: Please enquire for larger anchor heights.


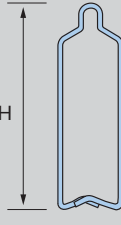

HALFEN SANDWICH PANEL ANCHORS

Overview of available anchors

Sandwich panel anchors (SPA)

Available anchor heights H and anchor lengths L [mm]											
Anchor type	round steel – Ø [mm]										
	05		06		08		10				
	H	L	H	L	H	L	H	L			
	160	265	160	265							
	180	305	180	305							
			200	345							
			220	385	220	378					
			240	425	240	418					
			260	465	260	458					
					280	498					
					300	538					
					320	578					
										340	609
									360	649	

Connector pins (SPA-N), stirrup ties (SPA-B), clip-on pins (SPA-A)

Available anchor heights H [mm]				
Anchor type	round steel – Ø [mm]			
	03	04	05	06
	120			
	140			
	160	160		
	180	180		
	200	200		
		220		
		240		
			240	
			260	
			280	
		300		
		320		
			340	
			360	
			380	
			400	
			420	
	160	160		
	180	180		
		200		
		220		
		240		
			240	
			260	
			280	
			300	
			320	
	120			
	140			
	160	160		
	180			
		200	200	
		250	250	
			280	
			320	

Subject to design changes

HALFEN SANDWICH PANEL ANCHORS

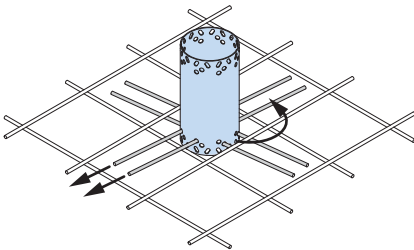
Assembly and installation

Placing anchors using the negative process = facing layer down (normal case)

The anchors are installed when laying the facing layer reinforcement.

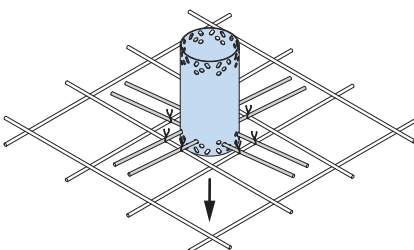
Sleeve anchors MVA

- Insert the anchoring bars in the bottom row of round holes of the MVA so that they lay parallel to the bottom reinforcement layer of the reinforcing mat.
- Insert the anchoring bars in the top row of round holes vertical to the bottom layer, resp. parallel to the top layer of the reinforcing mat.
- Rotate the MVA through 45° so that the bottom anchoring bars slide under the bottom row of bars and the top ones slide over the top row of bars.
- Wiring is not necessary with reinforcing mats.
- Place the prefabricated reinforcement for the facing layer into the mould.



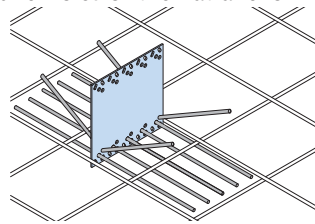
Alternative MVA installing (recommended in principle for thin facing layers):

- Retrospective placing from above into the already placed reinforcement.
- No retrospective shifting of the anchoring bars under the reinforcing mat.
- Safeguard the positioning by wiring to the reinforcing mat.

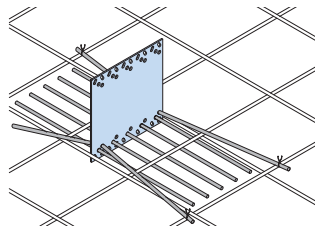


Flat anchors FA

- Insert two anchoring bars bent in the middle to 30° (L = 400 mm) in the outside holes of the top-most row of round holes in the flat anchor.
- Place the flat anchors on the reinforcing mat at the location of the bent anchoring bars.
- Push the anchoring bars under the bottom layer of bars of the reinforcing mat, through the bottom row of round holes of the flat anchor.



- Turn the bent up ends of the anchoring bars down to the horizontal and wire the ends to the reinforcing mat.



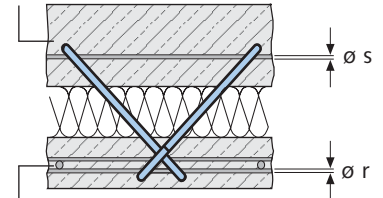
Alternative FA installing

- (by wiring to the reinforcing mat):
- Place the flat anchors from above on to the previously placed reinforcing mat and secure by wiring.

Attention: Comply with the admissible distances e of the FA from the fulcrum (see table on page 26).

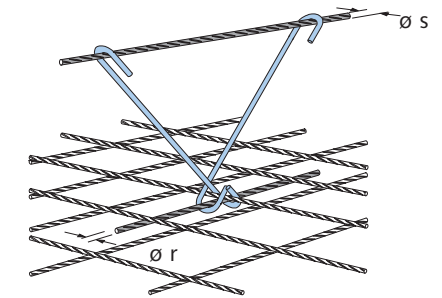
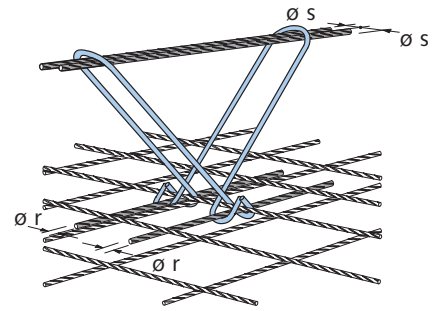
Supporting anchors SPA-1 and SPA-2

Load-bearing layer



Facing layer

- Place the supporting anchors on the reinforcing mat and lock them under the mat with one or two reinforcing bars ($\varnothing r$ corresponding to anchor type, page 29).



- Place the concrete of the bottom facing layer, install the heat insulation and lay the bottom reinforcement layer for the load-bearing layer.
- On-site, draw 1, resp. 2 reinforcing bars ($\varnothing s$ corresponding to anchor type, see table on page 29) through the top loops of the supporting anchor
- Fix centrally.

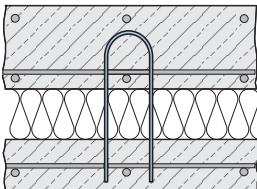
When lifting precast sandwich panel components from the moulds or formwork the adhesion should be kept as low as possible. In particular, do not lift parallel to the tilting table!

HALFEN SANDWICH PANEL ANCHORS

Assembly and installation

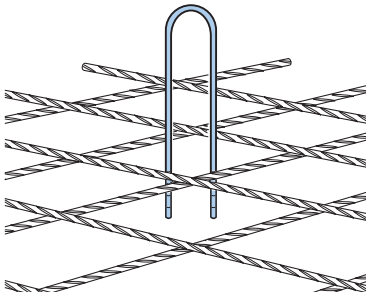
Connector pins SPA-N

Load-bearing layer



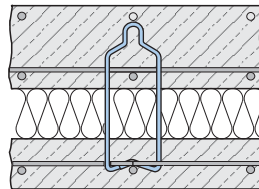
Facing layer

- Press the connector pin through the heat insulation into the still soft concrete of the facing layer to a depth of at least 55 mm.



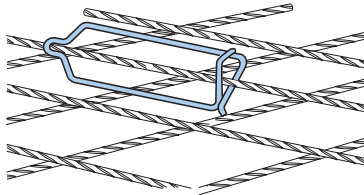
Stirrup tie SPA-B

Load-bearing layer

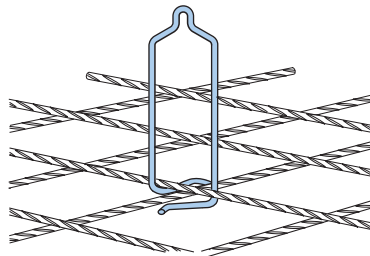


Facing layer

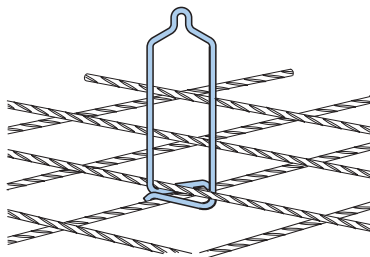
- Hook under the top reinforcing bar as described.



- Turn to an upright position.

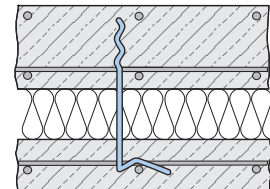


- Turn clockwise whilst pressing the legs together and clip onto the bottom reinforcing bar.



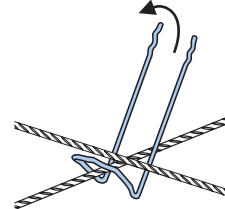
Clip-on pin SPA-A

Load-bearing layer

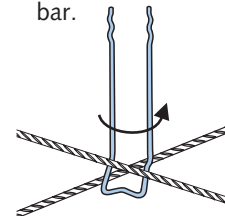


Facing layer

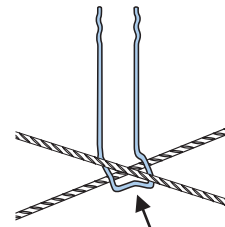
- Pass the clip-on pin under the top reinforcing bar and swing to an upright position.



- Twist the clip-on pin counter clockwise over the bottom reinforcing bar.

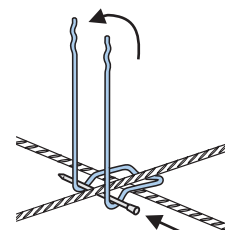


- Clip the clip-on pin firmly to the crossing mat.



Alternative:

- Pass the clip-on pin in the crossing mat under the top and over the bottom reinforcing bar. Press the legs gently to the left and insert a nail under the top reinforcing bar.



HALFEN SANDWICH PANEL ANCHORS

Assembly and installing

Placing the heat insulation layer

Sleeve anchor MVA

The insulation can simply be pressed over the sleeve anchor (punched out).

Important:
The round punched out part of the heat insulation must be placed on the inside of the sleeve anchor. Otherwise

the resulting thermal bridges will be visible as damp round marks on the facing layer.

Flat anchors FA

Flat anchors can be simply pressed into the insulation.

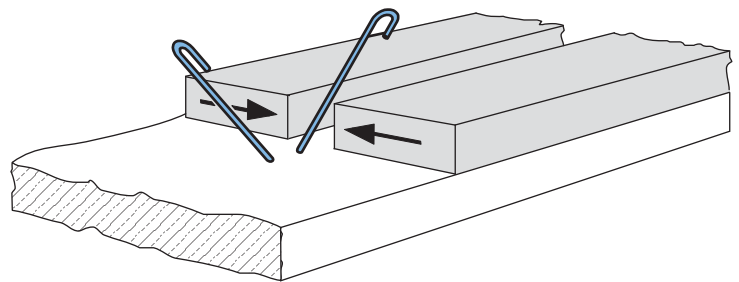
Alternatively the insulation joint can be aligned exactly with the position of the

flat anchor.

Sandwich panel anchors SPA

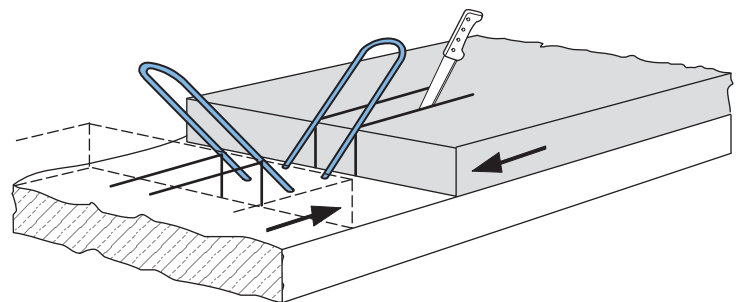
Supporting anchor SPA-1

The supporting anchor SPA-1 permits very simple placing of the heat insulation layer by dividing the insulation material at the longitudinal axis of the anchor.



Supporting anchor SPA-2 using slotted panels

The heat insulation panel is divided over the centre of the sandwich supporting anchor. Two cuts are made in the insulation panel at the same distance of the bars from the anchor. Both halves are now pushed over the bars of the anchor from the side.



Connector pins SPA-N

Connector pins are pushed through the previously placed insulation layer.

Stirrup ties SPA-B

Styropor® panels can be simply pressed over the stirrups. When using extruded hard foam, the heat insulation layer should be cut out at the anchor position to avoid bending the stirrups.

Clip-on pins SPA-A

The insulation is easily pressed over the corrugated ends.

HALFEN SANDWICH PANEL ANCHORS

Assembly and installing

Placing anchors using the positive process = facing layer up

The placing of sleeve anchors MVA and flat anchors FA is the same as with the negative process.

Supporting anchors SPA-1 and SPA-2

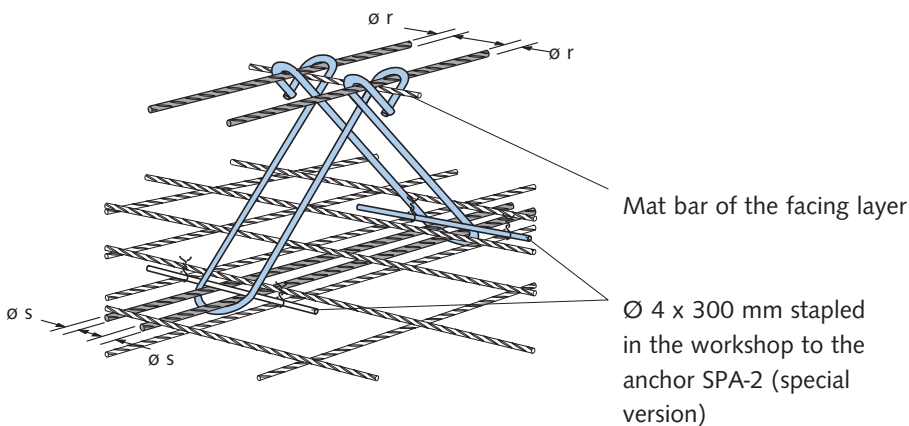
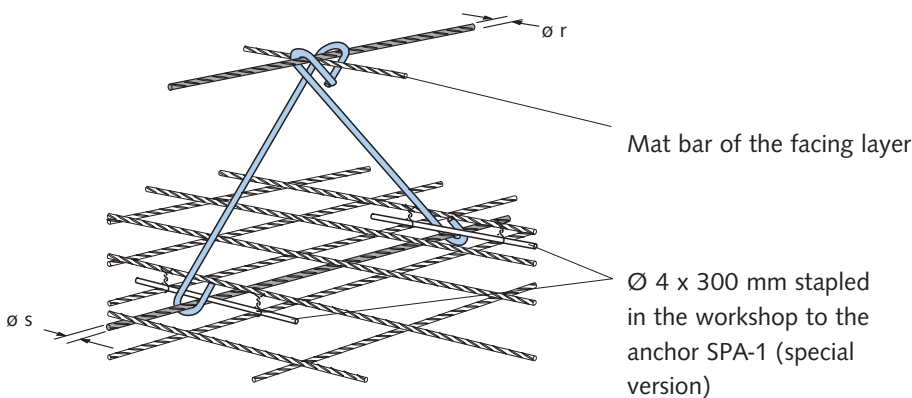
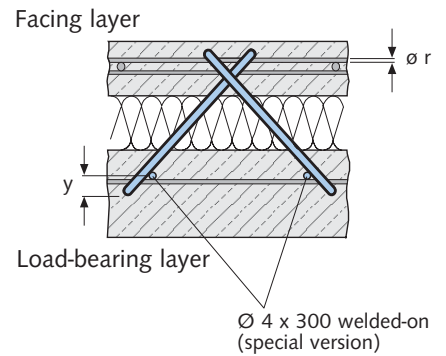
Supporting anchors are provided in the factory with welded-on round bars $\varnothing 4 \times 300$ mm for producing sandwich panels using the positive process (please enquire for special production).

For the installation, the supporting anchors are placed on the top reinforcing mat of the load-bearing layer. The welded-on bars are wired to the mat and locked with the secondary bars ($\varnothing s$ see table on page 29). After placing the concrete and the insulation, the facing layer mat is placed in the angle of the anchor and locked with the secondary bars.

Connector pins type SPA-N are used for the horizontal anchoring.

Important:

When ordering, state dimension y (position of the welded-on bars $\varnothing 4 \times 300$ mm).



Note:
When lifting sandwich panel components from the mould the adhesion should be kept as low as possible. In particular, do not lift parallel to the tilting table!

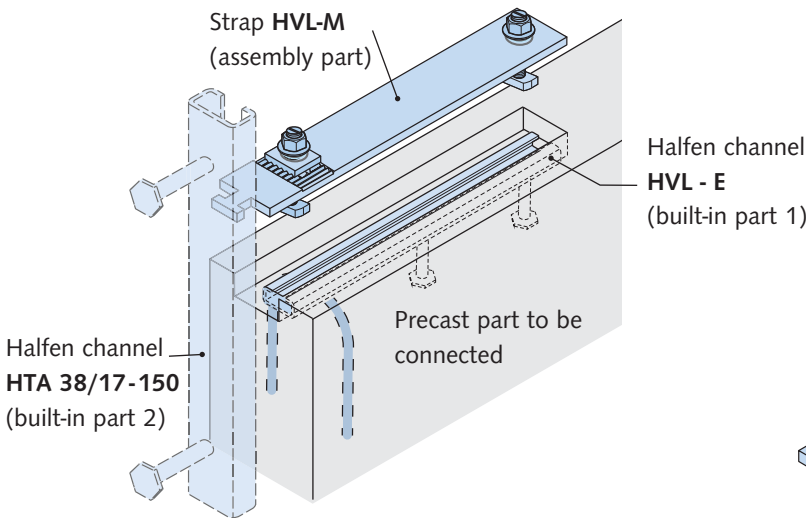
HALFEN SANDWICH PANEL ANCHORS

Further products for sandwich panels

HALFEN supplies further products for the fixing and lifting of sandwich panels in addition to the previously described sandwich panel anchors.

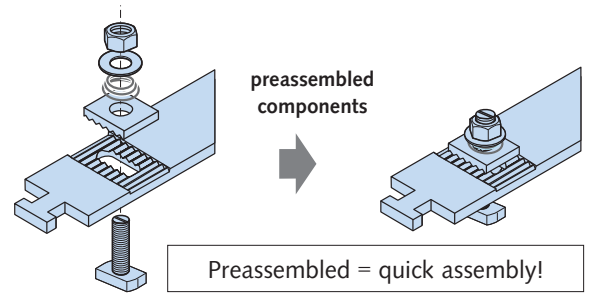
Precast panel connector HVL

Wall elements (e.g. the load-bearing layers of sandwich panels) can be fixed between available supports by means of the HALFEN precast panel connector HVL.



Assembly:

The connection strap is delivered ready to install: The screw fixing sets and the counter plate are preassembled!



Assembly part: HVL-M

preassembled, comprising:

- Hammer-head strap with serrations
- 1 toothed counter plate
- 2 fixing screw sets (screw HS 38/17 - M 12 × 50 + U-washer + conical compression spring)

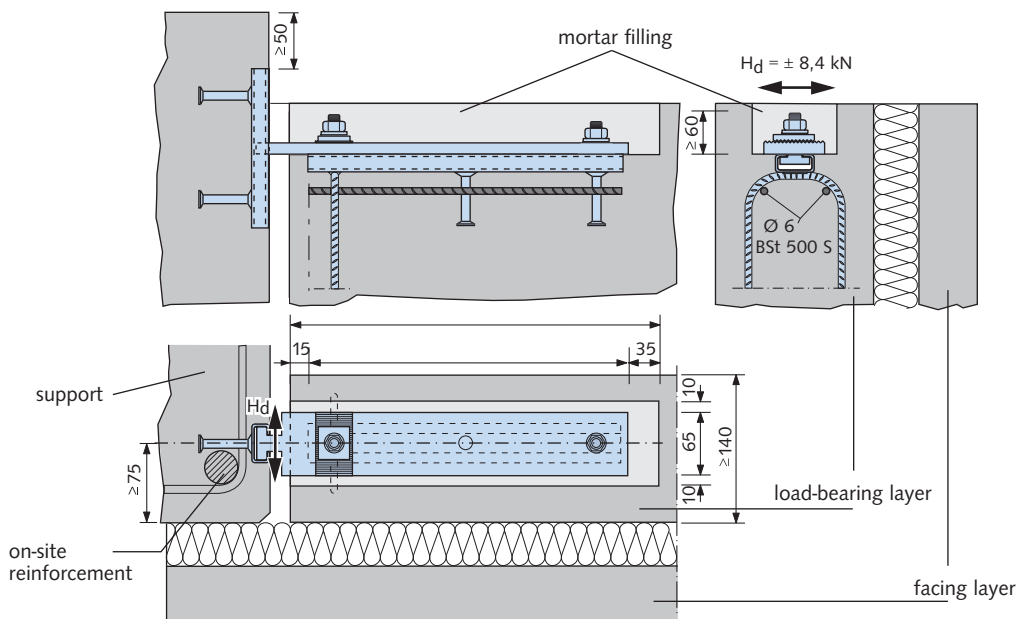
Built-in part 1: HVL-E

comprising Halfen channel HTA 38/17-300 with 2 anchor bolts and a loop end anchor.

Built-in part 2: HTA 38/17-150

Corrosion protection

Hammer-head strap, Halfen channel: hot dip galvanised, Halfen screws, nuts, U-washers, Springs: zinc electroplated. These parts are covered by mortar in the fully assembled status.



HALFEN SANDWICH PANEL ANCHORS

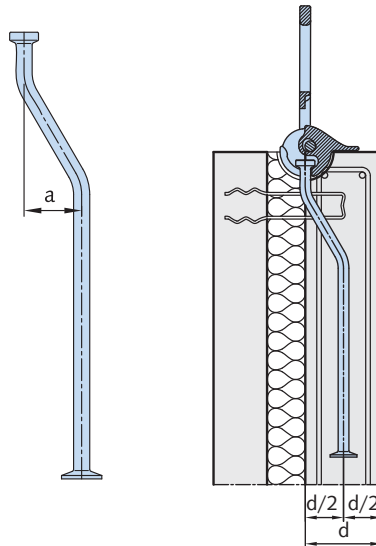
Further products for sandwich panels

HALFEN supply two special lifting anchor systems for the lifting of sandwich panels.

Spherical-head lifting anchor, bent to right angles

The spherical-head lifting anchor, bent to right angles, differs from the normal spherical-head lifting anchor only by its cranked shape. This special shape permits the special use of this anchor for sandwich panels. After installation inside the load-bearing layer, the head is approximately positioned at the centred axis of the sandwich panel and the foot to ensure an effective load transmission of the forces.

In this way the sandwich panels can be lifted and mounted almost vertically (the use of a spreader beam is recommended).

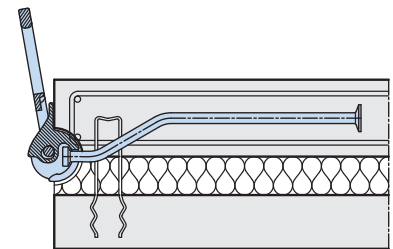


Chipping of the concrete is avoided when aligning according to the illustration.

The placing of a few connector pins in the anchor zone has shown very beneficial results.

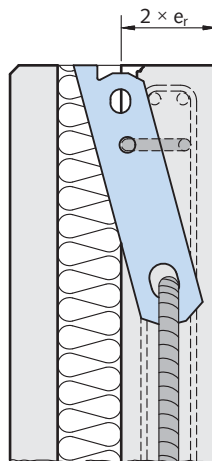
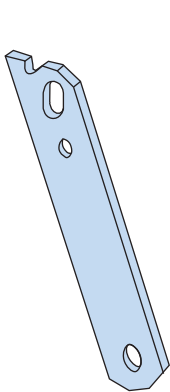
In the case of positive production (facing layer at top), lift only with a tilting table.

The anchor head shape has been adjusted to the KKT accessory programme.

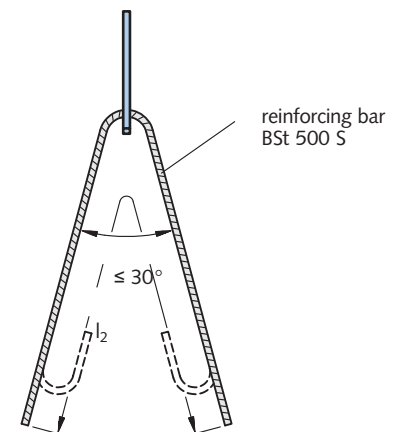
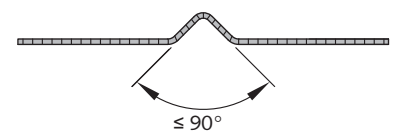


Further information on spherical-head lifting anchors, bent at right angles, can be obtained from the **Technical Product Information KKT**.

Transport anchor TPA-FX



additional reinforcement



By means of the obliquely punched head shape the sandwich panel lifting anchor type TPA-FX can be placed almost at the centred axis of large sandwich panels. This ensures that the panel hangs almost straight during

lifting and assembling (the use of a spreader beam is recommended). The TPA-FX can be used for aligning sandwich panels (with negative and positive production).

Further information on sandwich panel lifting anchors type TPA-FX can be obtained from the **Technical Product Information TPA**.

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