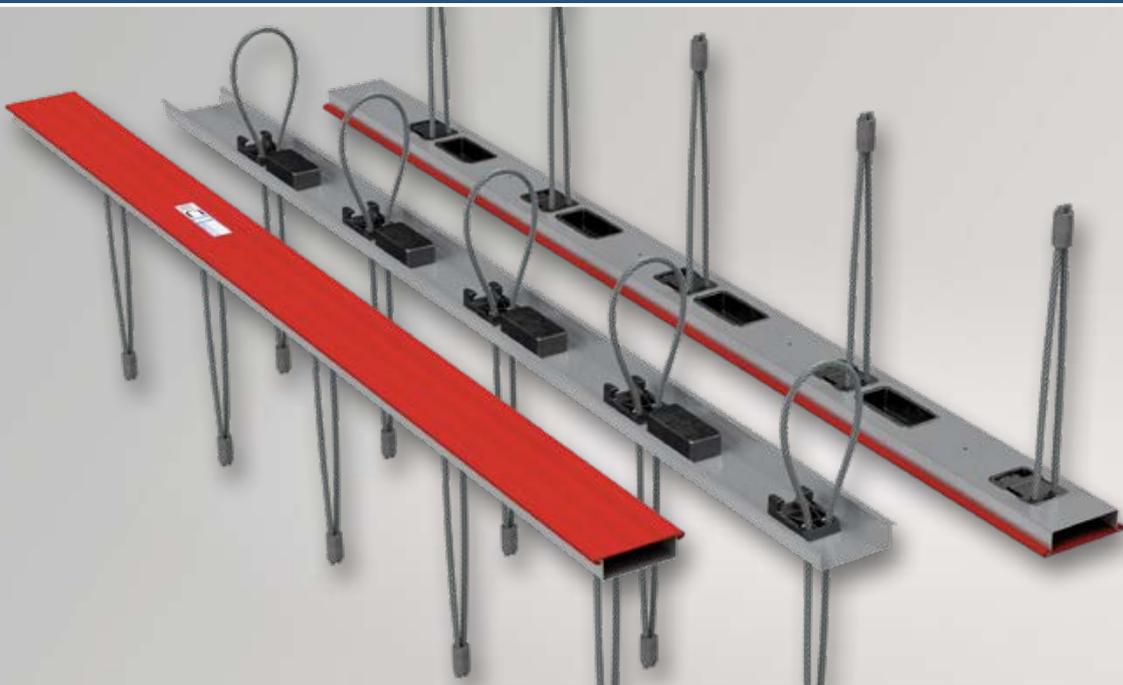


# PHILIPPGROUP

## PHILIPP Power OS rail



VB3-V-017-en - 09/19 - PDF

## Installation Instruction

## Transport and mounting systems for prefabricated building

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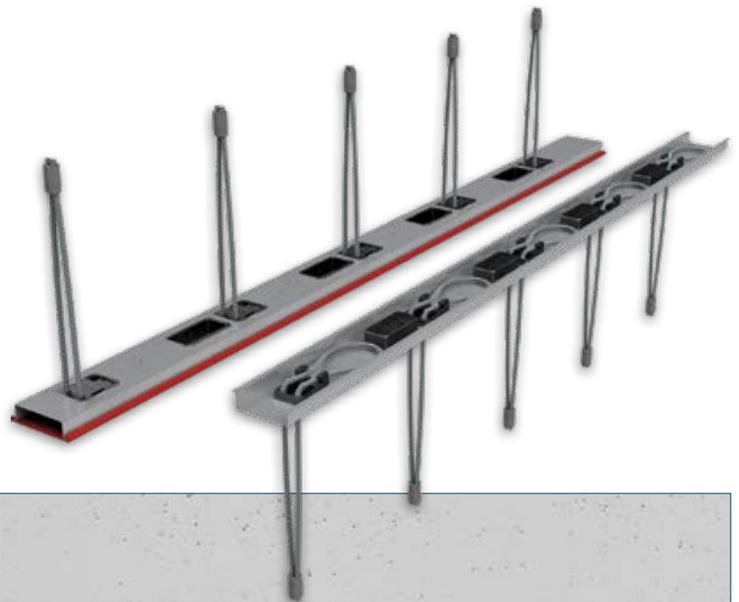


## The PHILIPP Power OS rail

The Power OS rail combines the know-how of the well-known connection systems of the Power series with the requirements of cast in-situ concrete constructions. The German approved system for the connection of (semi-finished) precast elements/cast in-situ concrete constructions with in-situ or semi-finished elements consists of only one rail. High design values for all three force directions are also available as standard here, thus enabling a wide range of applications.

### Your benefits at a glance:

- ⊙ Application as connection of (semi-finished) precast concrete elements / cast in-situ constructions with in-situ or semi-finished elements
- ⊙ Forces in all directions transferable
  - tensile forces, shear forces parallel and right-angled to the joint
- ⊙ No regard of the installation direction necessary
- ⊙ No danger of mix-up, as only one rail type is used
- ⊙ German approved connecting rail system



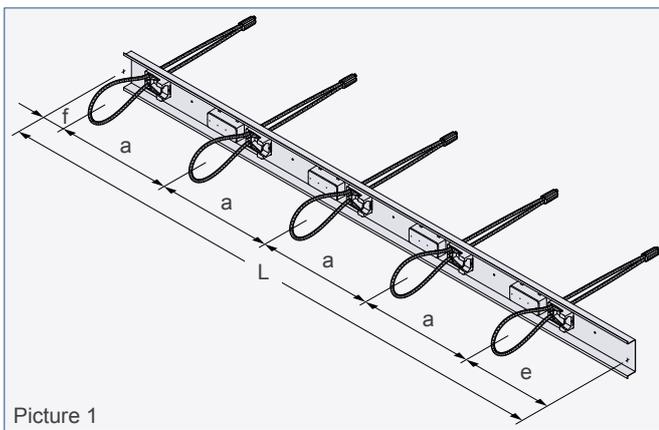
## Component

The galvanised OS rail is used to connect (semi-finished) precast concrete elements / cast-in situ concrete constructions with in situ or semi-finished elements in areas an approval is required. It is able to transfer shear and tensile forces in the wall plane (stiffening, support reactions) as well as shear forces right-angled to the wall (wind pressure, earth pressure). A simple installation and the joint geometry pre-defined by the rail guarantee an easy application.

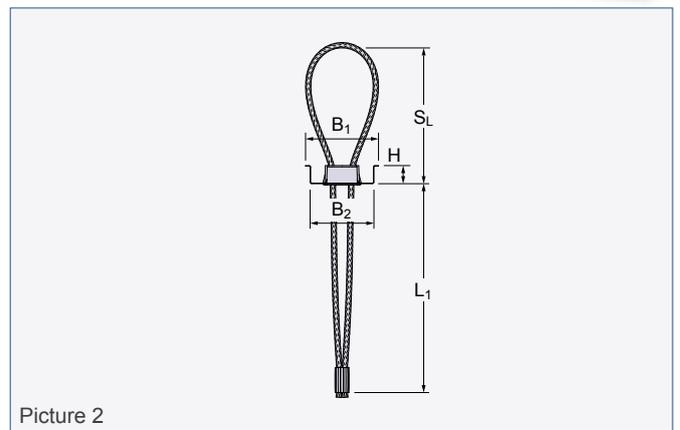
The rail is equipped with galvanised wire rope loops at 250 mm intervals and is set into concrete in the (semi-finished) precast element. There is no need to check the direction of the rail as it is symmetric. After demoulding, the plastic cover is removed and the loops are folded right-angled to the rail.



This Installation Instruction provides necessary technical information. In any case the requirements of the national German approval must be considered!



Picture 1



Picture 2

**Table 1: Dimensions of the Power OS rail**

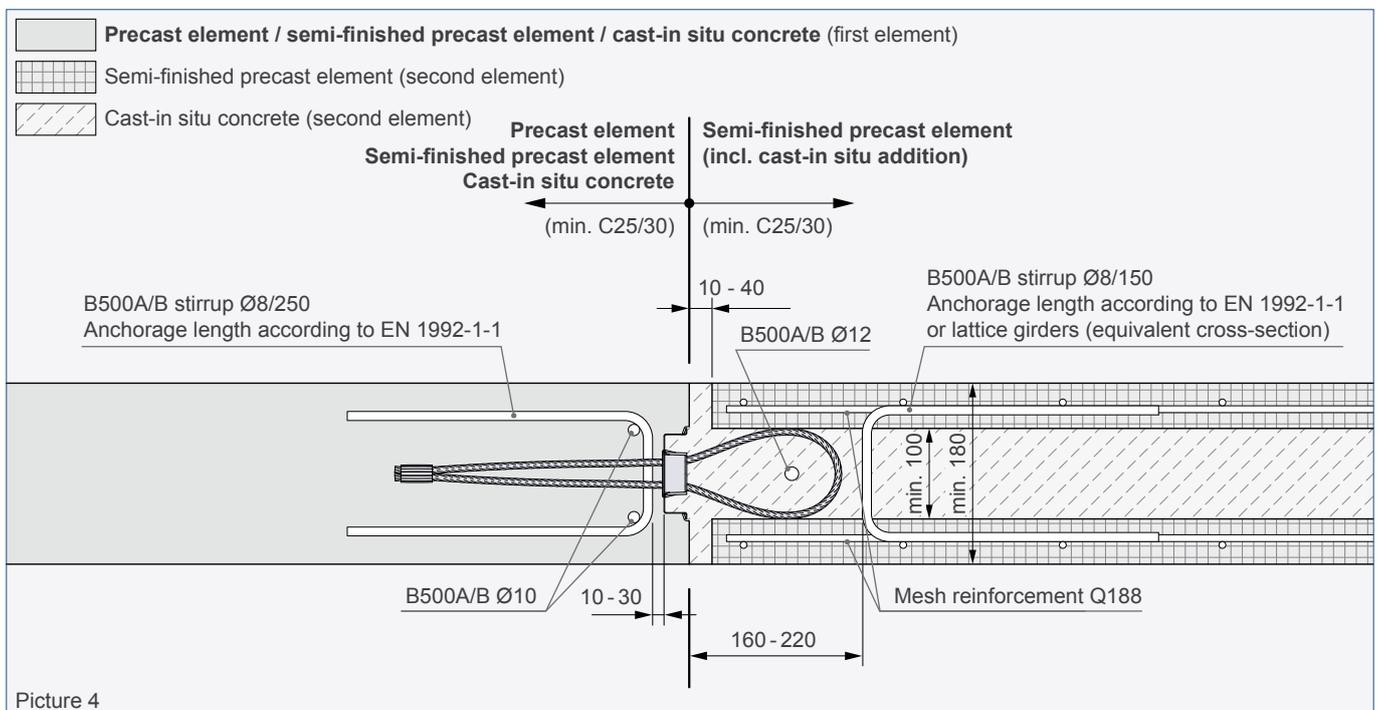
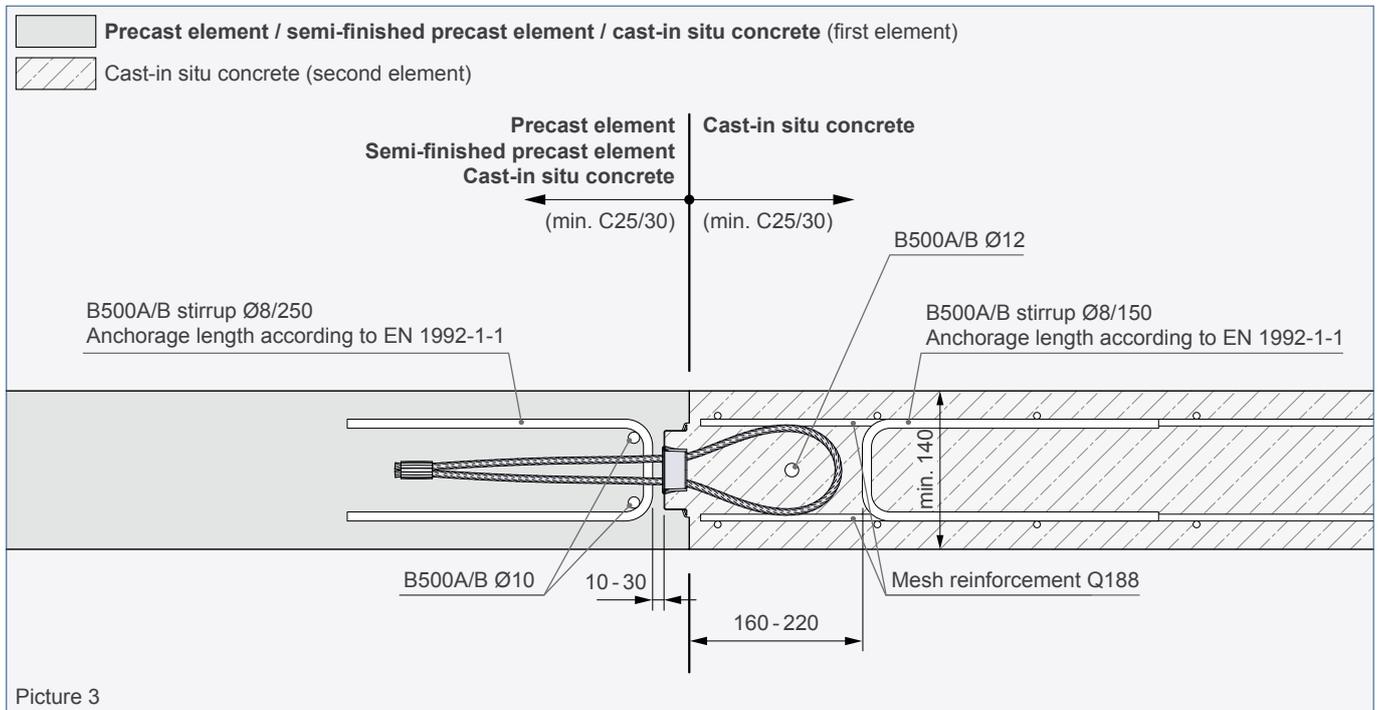
Ref.-no.	Dimensions									Weight per rail [kg]
	B <sub>1</sub> [mm]	B <sub>2</sub> [mm]	H [mm]	L [mm]	L <sub>1</sub> [mm]	S <sub>L</sub> [mm]	a [mm]	e [mm]	f [mm]	
84POS201555	80	70	20	1250	250	155	250	200	50	1.55

## Application

### Range of applications

The Power OS can be used for different connections between (semi-finished) precast concrete elements / cast-in situ constructions with in situ or semi-finished precast elements.

It transfers primarily static shear forces parallel and right-angled to the wall as well as tensile forces from predominantly static loads.

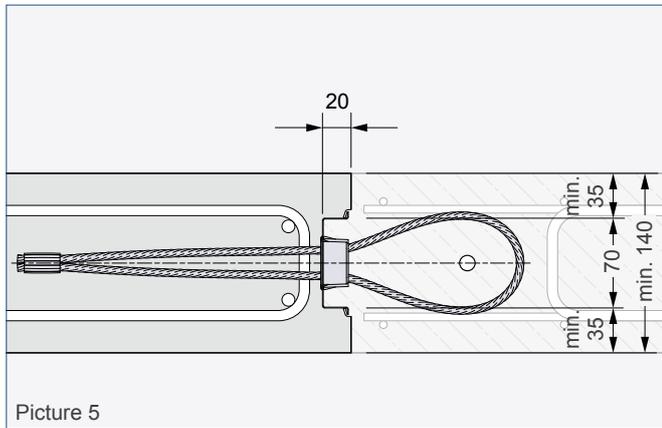


**Application**

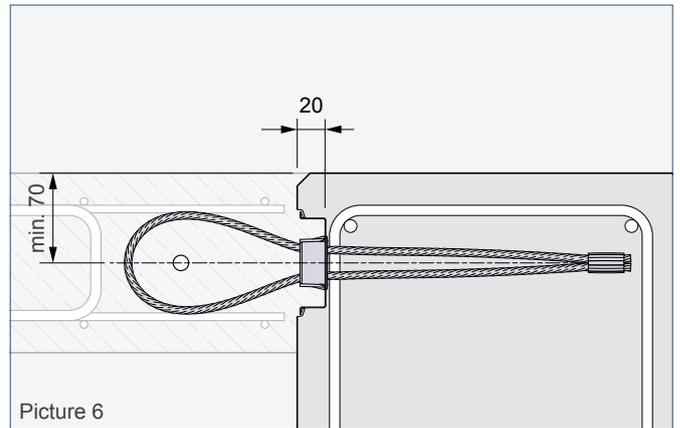
**Dimensions of concrete unit**

A minimum wall thickness of 140 mm is required when installing the Power OS rail in wall combinations of precast reinforced and cast-in situ concrete elements (picture 5 and

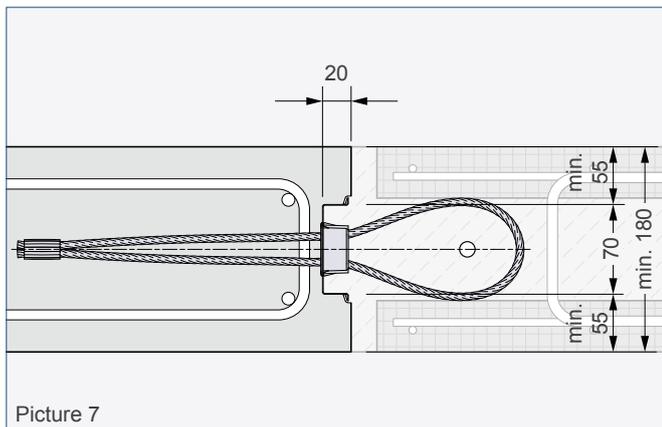
picture 6). For wall combinations with semi-finished elements, a component thickness of 180 mm is required (picture 7 and picture 8).



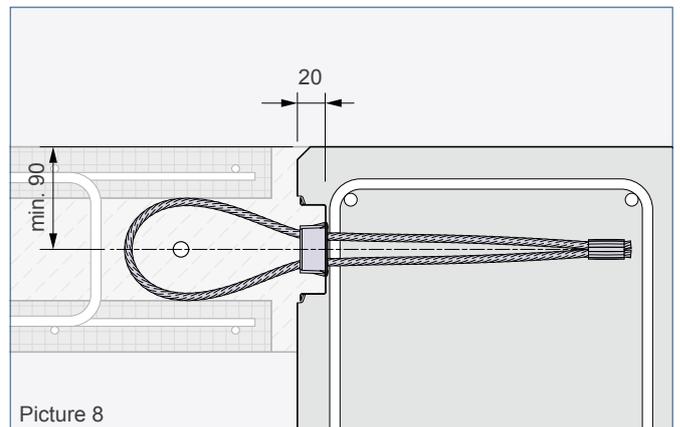
Picture 5



Picture 6



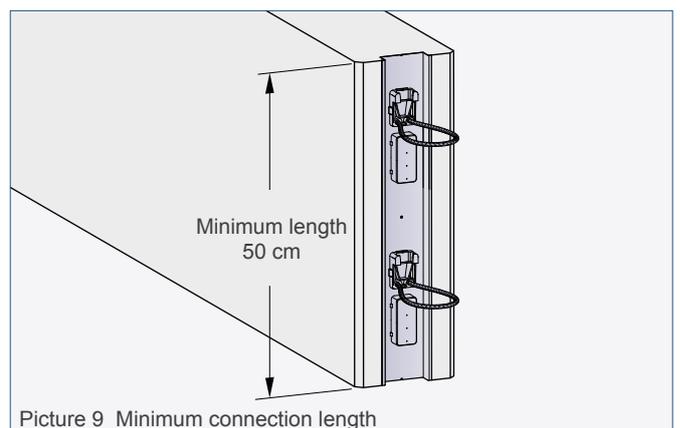
Picture 7



Picture 8

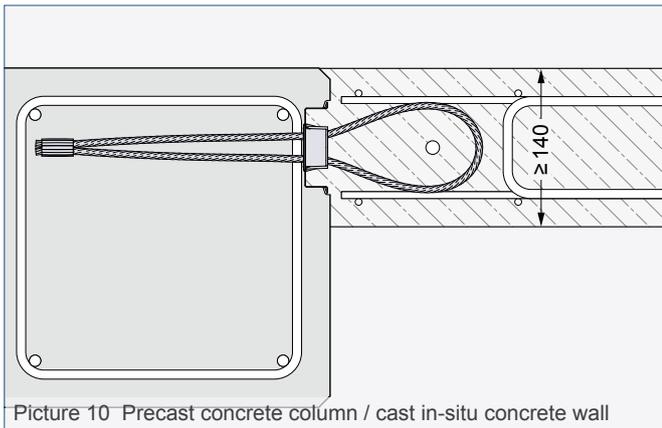
**Minimum connection length**

The minimum length of a joint must be 50 cm for the Power OS rail (at least 2 loops are required so that a strut-and-tie-model can work).

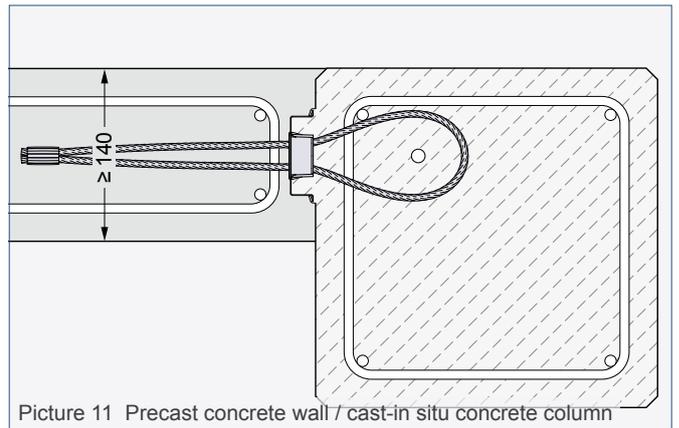


Picture 9 Minimum connection length

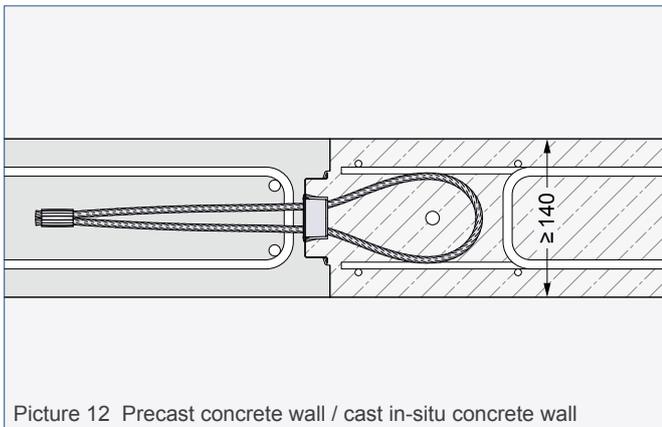
## Application examples



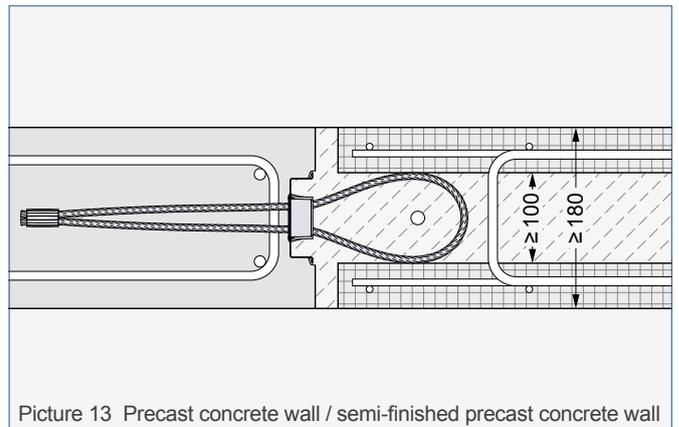
Picture 10 Precast concrete column / cast in-situ concrete wall



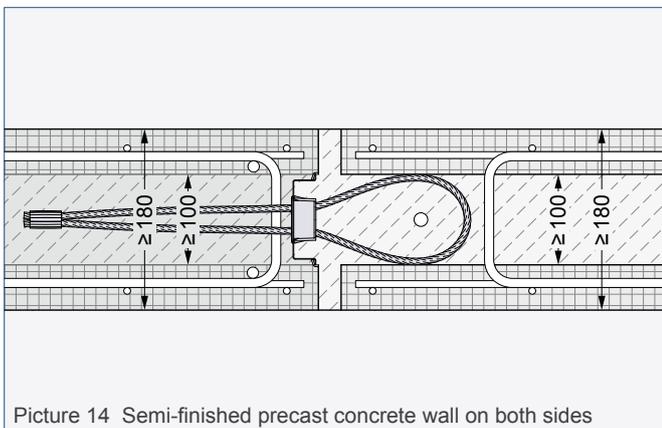
Picture 11 Precast concrete wall / cast-in situ concrete column



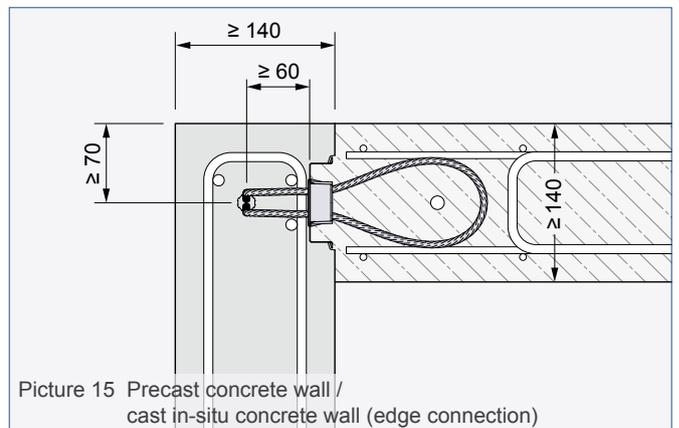
Picture 12 Precast concrete wall / cast in-situ concrete wall



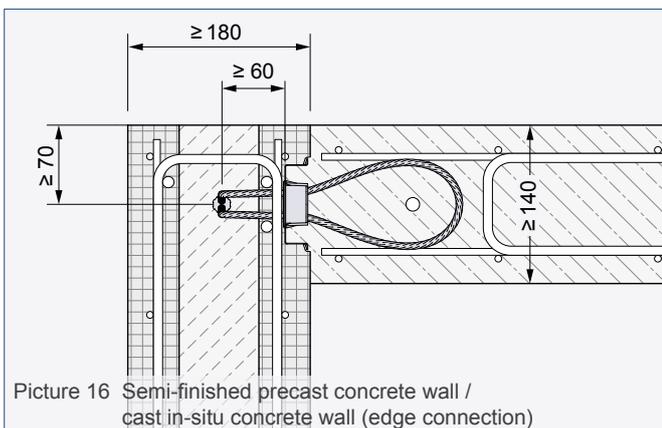
Picture 13 Precast concrete wall / semi-finished precast concrete wall



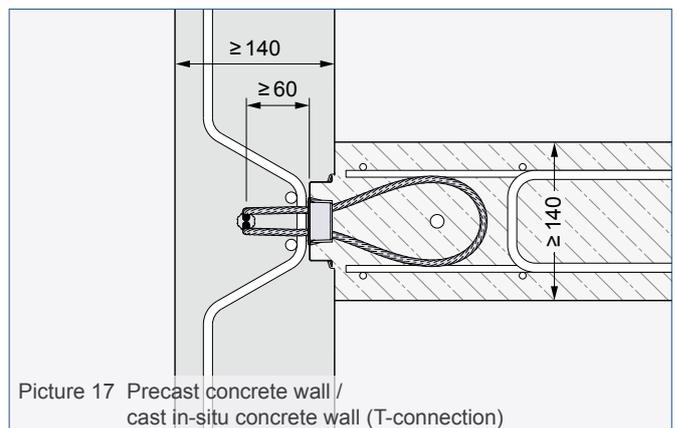
Picture 14 Semi-finished precast concrete wall on both sides



Picture 15 Precast concrete wall / cast in-situ concrete wall (edge connection)

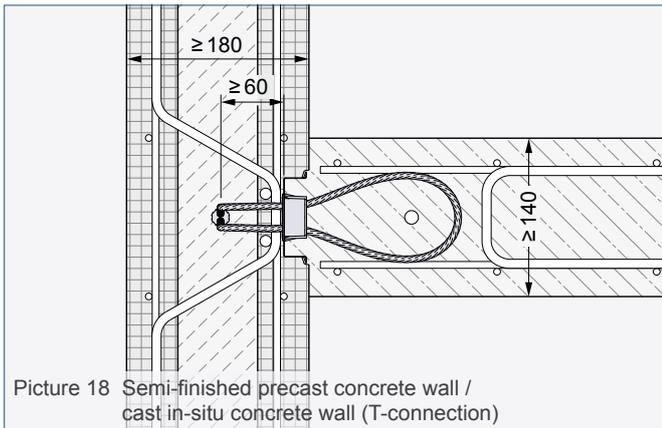


Picture 16 Semi-finished precast concrete wall / cast in-situ concrete wall (edge connection)

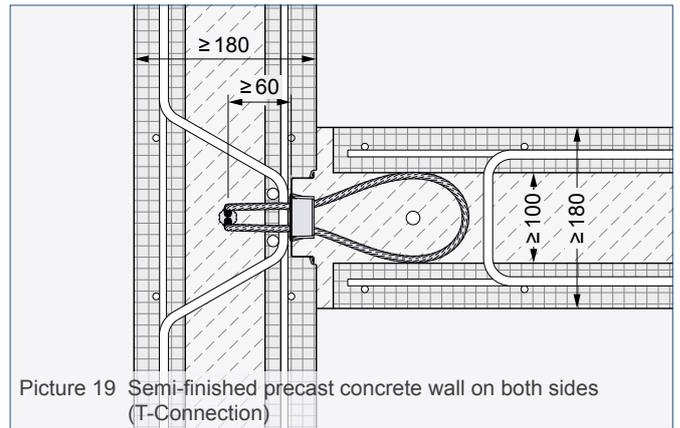


Picture 17 Precast concrete wall / cast in-situ concrete wall (T-connection)

Application examples / fire protection



Picture 18 Semi-finished precast concrete wall / cast in-situ concrete wall (T-connection)



Picture 19 Semi-finished precast concrete wall on both sides (T-Connection)

Fire protection

The connection construction has been tested apart from the approval by an expert opinion of the independent institute of the Technical University Kaiserslautern, Germany, based on DIN 4102-4.

For the fire resistance class of F180 a wall thickness  $\geq 15$  cm is required for the Power OS rail. Fire resistance class F120 applies to wall thicknesses  $< 15$  cm.



Picture 20

## Design and construction

The precast concrete units to be connected must be designed according to EC 2. They have to be made of normal weight concrete with a concrete strength class of at least C25/30 and a maximum aggregate size of 16 mm acc. to EN 206. The consistency of the concrete to be cast should not be less than F4 according to EN 206.

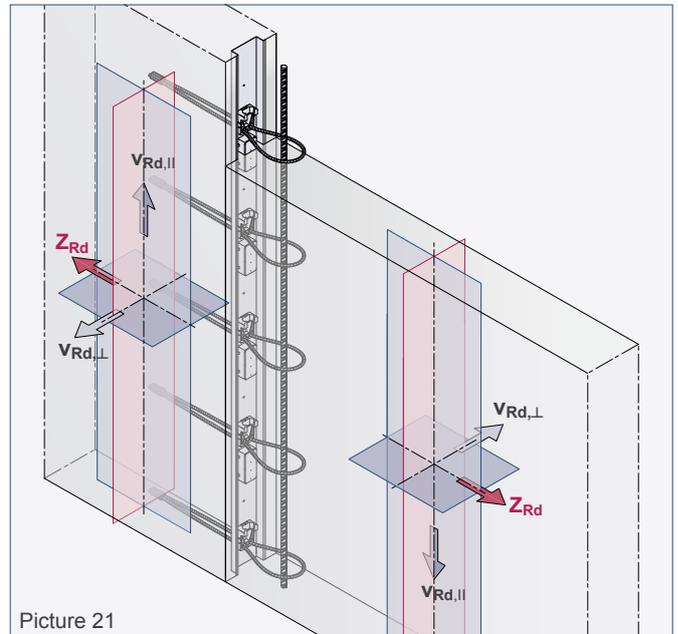
It is part of the structural engineer to design the units and to prove the connection according to the national German approval. In table 2 shear loads parallel to the rail ( $v_{Rd,||}$ ) and in table 4 shear loads right-angled to the rail ( $v_{Rd,\perp}$ ) are listed according to the approvals. If shear loads parallel and right-angled to the rail appear at the same time, the load bearing capacities have to be reduced acc. to the diagram in picture 22.

Table 3 shows the bearing capacities for tensile forces ( $Z_{Rd}$ ). Because of the different load directions single components of tensile forces result, which act in the direction of the wire rope (see table 5). The sum of these single components has to be smaller than the tensile load capacity ( $Z_{Rd}$ ). Finally the verification of the total tensile force must be done.

### Design example (from page 12)

No constructive solution, which takes the acting tensile force (table 5).

$$Z_{Ed,ges} = Z_{Ed,N} + 0.5 \times v_{Ed,||} + 0.25 \times v_{Ed,\perp}$$



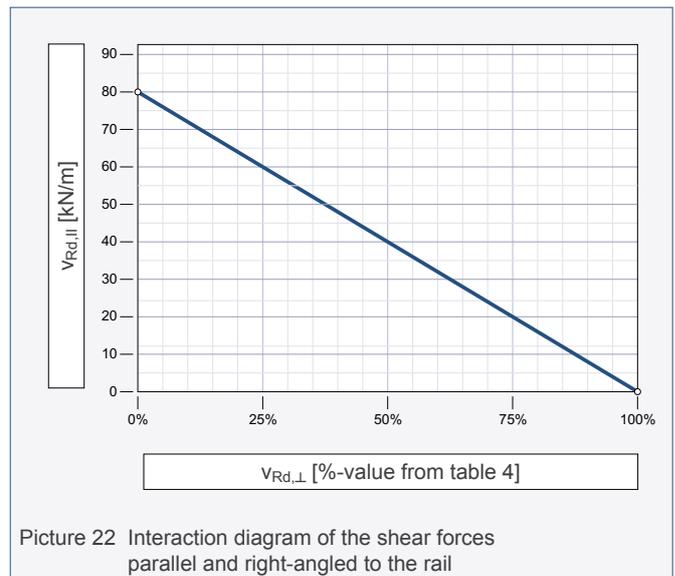
Design and construction

**Table 2: Design value of the shear force bearing capacity parallel to the rail**

Wall thickness h [cm]	Design value of the shear force bearing capacity $V_{Rd,  }$ [kN/m] Minimum concrete grade (precast and cast in-situ concrete)				
	C25/30	C30/37	C35/45	C40/50	C45/55
≥ 14	80.0				

**Table 3: Design value of the tensile force bearing capacity per metre rail**

Wall thickness h [cm]	Design value of the tensile force bearing capacity $Z_{Rd}$ [kN/m] Minimum concrete grade (precast and cast in-situ concrete)				
	C25/30	C30/37	C35/45	C40/50	C45/55
≥ 14	40.0				



Picture 22 Interaction diagram of the shear forces parallel and right-angled to the rail

**Table 4: Design values of the shear force bearing capacity right-angled to the rail**

Wall thickness h [cm]	Design value of the shear force bearing capacity $V_{Rd,\perp}$ [kN/m]				
	C25/30	C30/37	C35/45	C40/50	C45/55
14	6.4	7.3	8.4	9.0	9.6
15	7.6	8.7	9.9	10.7	11.4
16	8.8	10.1	11.6	12.4	13.2
17	10.1	11.6	13.3	14.2	15.2
18	11.5	13.2	15.0	16.1	17.2
19	12.9	14.8	16.8	18.1	19.3
20	14.3	16.4	18.7	20.1	21.4
21	15.8	18.1	20.7	22.2	23.6
22	17.3	19.9	22.6	24.3	25.9
23	18.8	21.7	24.7	26.5	28.2
24	20.4	23.5	26.8	28.7	30.6
25	22.1	25.4	28.9	31.0	33.1
26	23.7	27.3	31.1	33.4	35.6
27	25.4	29.3	33.3	35.7	35.7
28	27.2	31.3	35.6	35.7	35.7
29	29.0	33.3	35.7	35.7	35.7
≥ 30	30.8	35.4	35.7	35.7	35.7

## Design example

### Verification of tensile forces

#### (No load transfer of tensile forces by constructive solutions)

Because of the different load directions (shear force parallel and right-angled to the rail) single components of tensile forces result, which act in the direction of the wire rope. The sum of these single components (total tensile force) is verified on a basis of the tensile force resistance  $Z_{Rd}$  of the loops according to table 3.

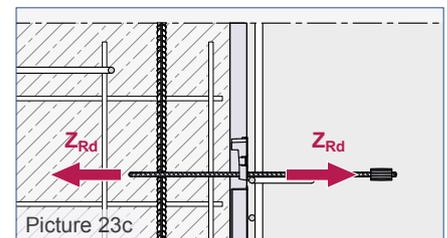
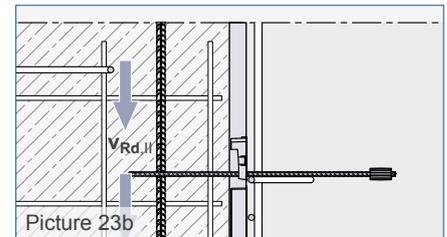
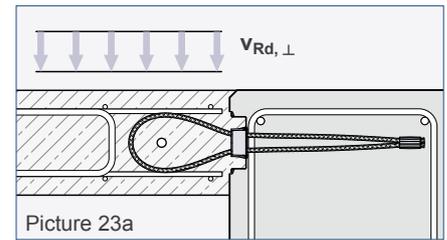
Verification of the total tensile force:  $Z_{Rd} \geq Z_{Ed,VII} + Z_{Ed,V\perp} + Z_{Ed,N}$

$Z_{Rd}$  [kN/m]: Design value of tensile force bearing capacity per wire rope loop acc. to table 3

$Z_{Ed,N}$  [kN/m]: Acting „external” tensile force per metre of rail

$Z_{Ed,VII}$  [kN/m]: Expansion force resulting from shear force parallel per metre of rail

$Z_{Ed,V\perp}$  [kN/m]: Expansion force resulting from shear force right-angled per metre of rail



**Table 5: Components of tensile force**

Load from	Shear force parallel $V_{Ed,  }$	Shear force right-angled $V_{Ed,\perp}$	"External" tensile force
Component of tensile force	$Z_{Ed,VII} = 0.5 \times V_{Ed,  }$	$Z_{Ed,V\perp} = 0.25 \times V_{Ed,\perp}$	$Z_{Ed,N}$

## Design example

### Boundary conditions:

- Wall thickness: 20 cm
- Concrete strength: C25/30

### Actions:

- Shear force parallel:  $v_{Ed,II} = 40 \text{ kN/m}$
- Shear force right-angled:  $v_{Ed,\perp} = 5 \text{ kN/m}$
- Tensile force:  $z_{Ed,N} = 2 \text{ kN/m}$

### Verification:

#### Resistance values and verifications determined from wall thickness and concrete strength class:

Shear force parallel:  $v_{Rd,II} = 80 \text{ kN/m}$  (value from table 2)  $\geq 40 \text{ kN/m} \rightarrow \text{OK}$

Shear force right-angled:  $v_{Rd,\perp} = 14.3 \text{ kN/m}$  (value from table 4)  $\geq 5 \text{ kN/m} \rightarrow \text{OK}$

#### Interaction:

**If both forces occur at the same time, the interaction (picture 22) must be considered:**

Percentage of shear force parallel:  $v_{Ed,II} / v_{Rd,II} = 40 \text{ kN/m} / 80 \text{ kN/m} = 50 \%$

The linear interaction results in a permissible shear force right-angled to the rail:  $100 \% - 50 \% = 50 \%$

**The reduced shear force right-angled to the rail can be set to 50 %:**

red.  $v_{Rd,\perp} = 0.5 \times 14.3 \text{ kN/m} = 7.15 \geq 5 \text{ kN/m} \rightarrow \text{OK}$

It is shown that the interaction of both shear forces can be absorbed. Furthermore, it must be checked, if all occurring tensile forces can be absorbed (according to the approval).

#### Verification of tensile forces:

$$Z_{Rd} \geq z_{Ed,VII} + z_{Ed,V\perp} + z_{Ed,N}$$

$$z_{Ed,VII} = 0.5 \times 40.0 \text{ kN/m} = 20.0 \text{ kN/m}$$

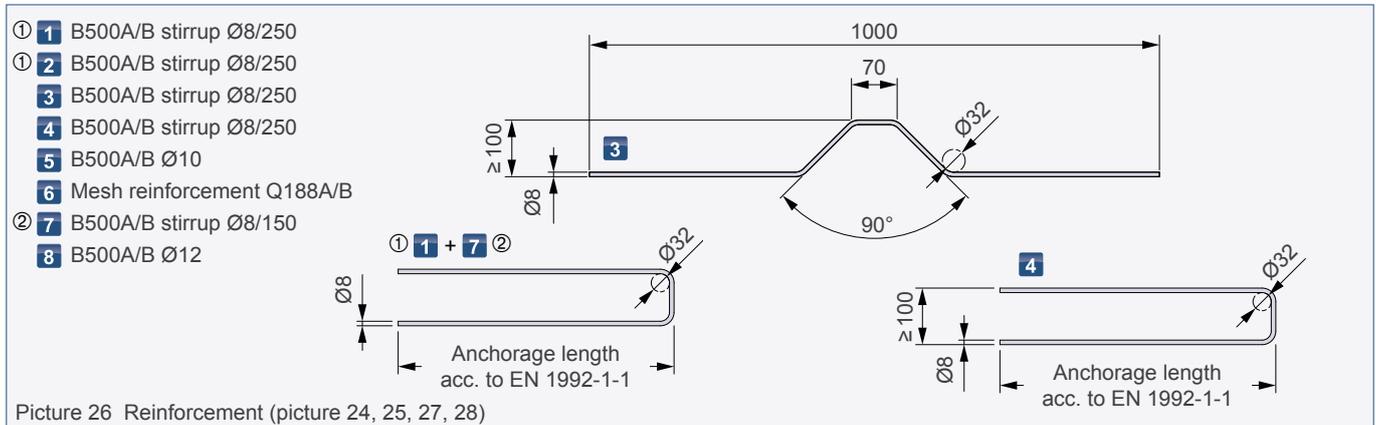
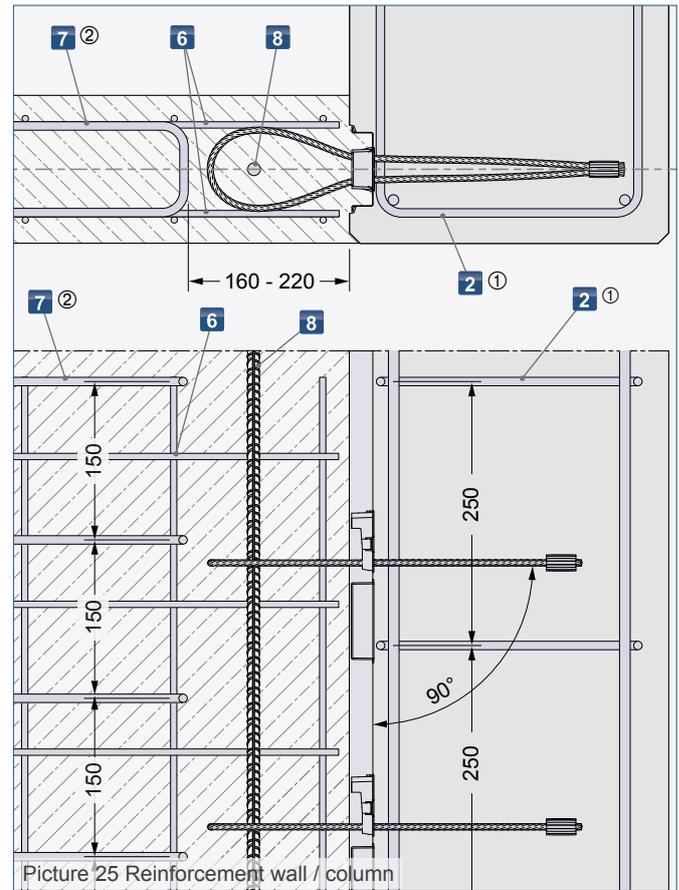
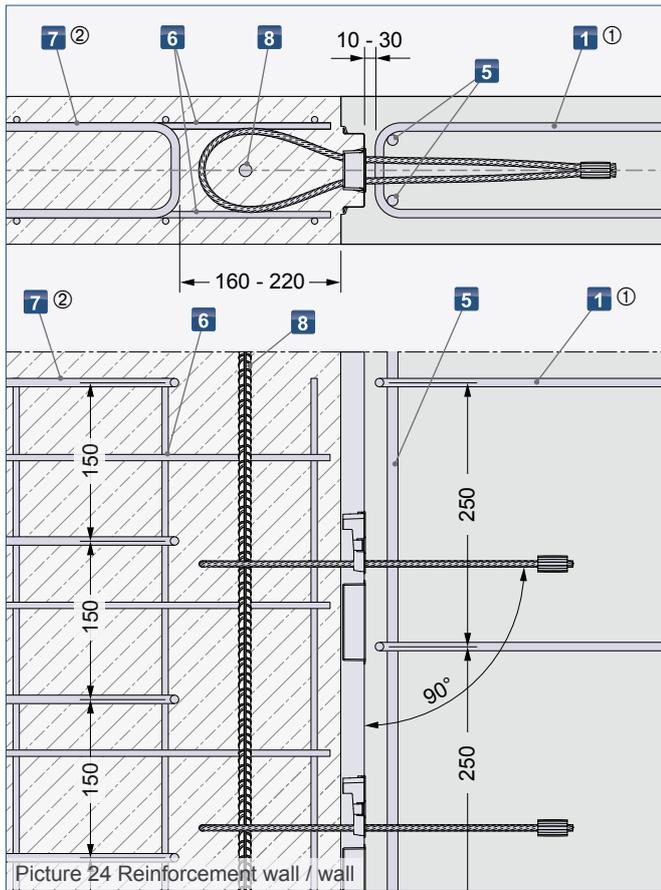
$$z_{Ed,V\perp} = 0.25 \times 5.0 \text{ kN/m} = 1.25 \text{ kN/m}$$

$$z_{Ed,N} = 2.0 \text{ kN/m}$$

$$Z_{Rd} = 40.0 \text{ kN/m (table 3)}$$

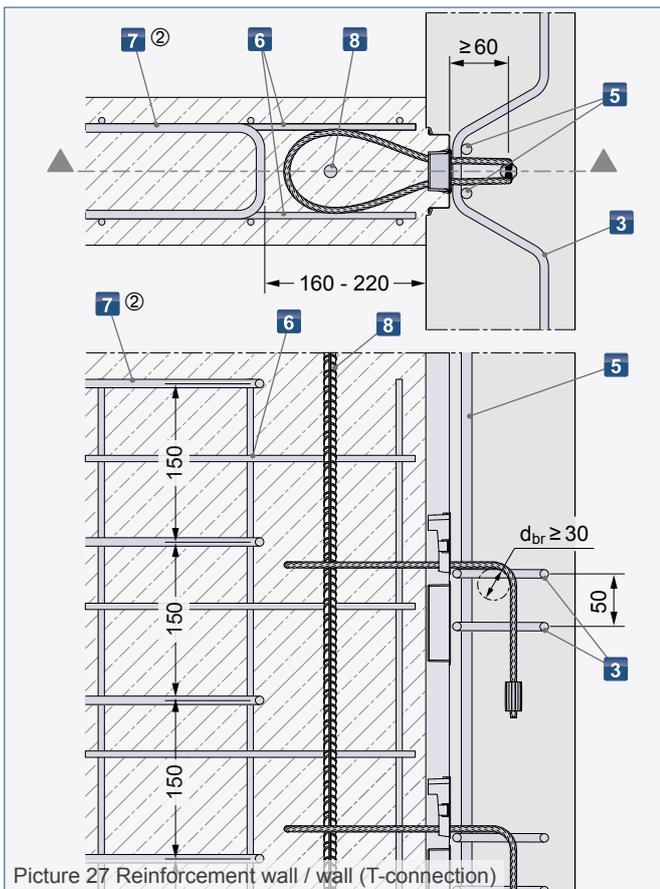
$$40 \text{ kN/m} \geq 20.0 \text{ kN/m} + 1.25 \text{ kN/m} + 2.0 \text{ kN/m} = 23,25 \text{ kN/m} \rightarrow \text{OK}$$

## Reinforcement

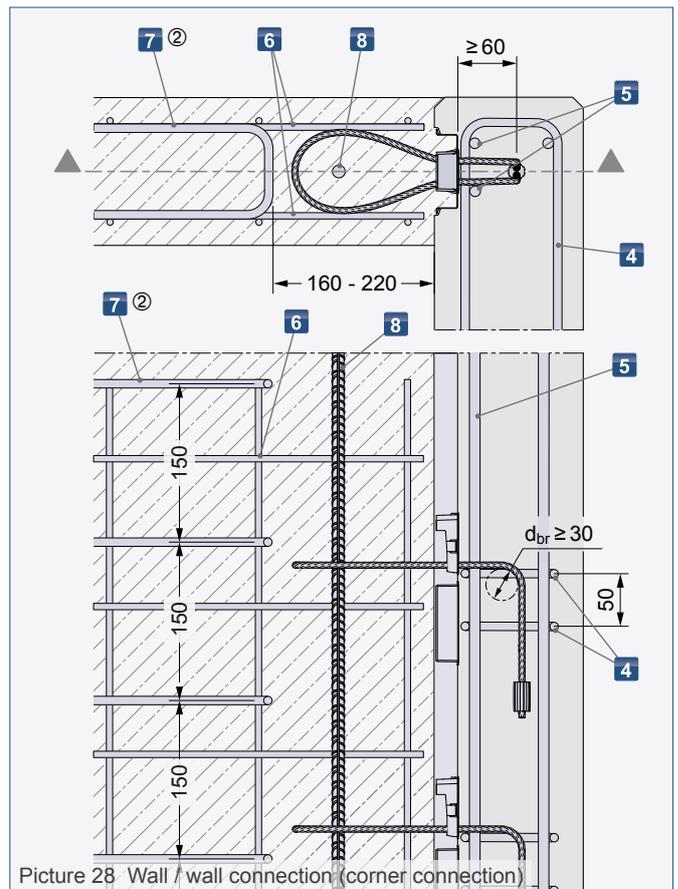


- ① All stirrups **1** + **2** can be replaced by an equivalent mesh reinforcement. This requirement is fulfilled e.g. by a mesh reinforcement type Q257 A (equal 2.57 cm<sup>2</sup>/m). Existing reinforcement can be taken into account.
- ① All stirrups **7** + can be replaced by an equivalent mesh reinforcement. This requirement is fulfilled e.g. by a mesh reinforcement type Q335 A (equal 3.35 cm<sup>2</sup>/m). Existing reinforcement can be taken into account.  
In case of a semi-finished precast concrete element, the stirrup can be replaced by an equivalent lattice girder.

Reinforcement



Picture 27 Reinforcement wall / wall (T-connection)



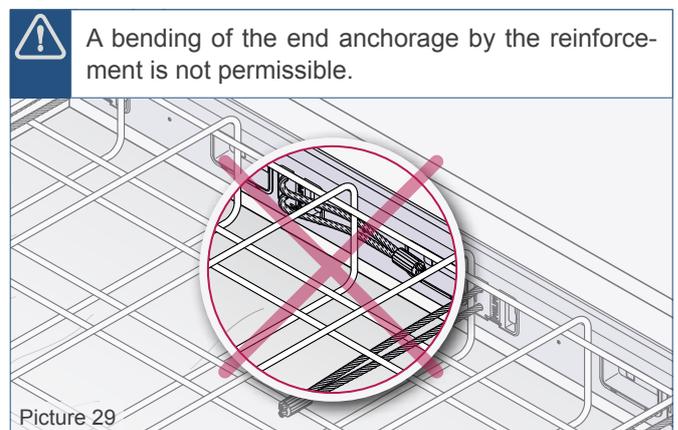
Picture 28 Wall / wall connection (corner connection)

End anchorage of the wire rope loops

The anchorages of the connecting loops in the precast element must be aligned at an angle of 90° to the Power OS rail. With a vertical installation in the mould the stability of the rope ends in the precast unit shall be ensured by tying them to the reinforcement with wire.

Bending of the end anchorage

If the anchorage of the wire rope loop is bent, attention must be paid that the horizontal anchorage part is  $\geq 60$  mm (picture 28). Depending on the installation situation, additional reinforcement **3** or **4** as shown in picture 27 or 28 must be provided.



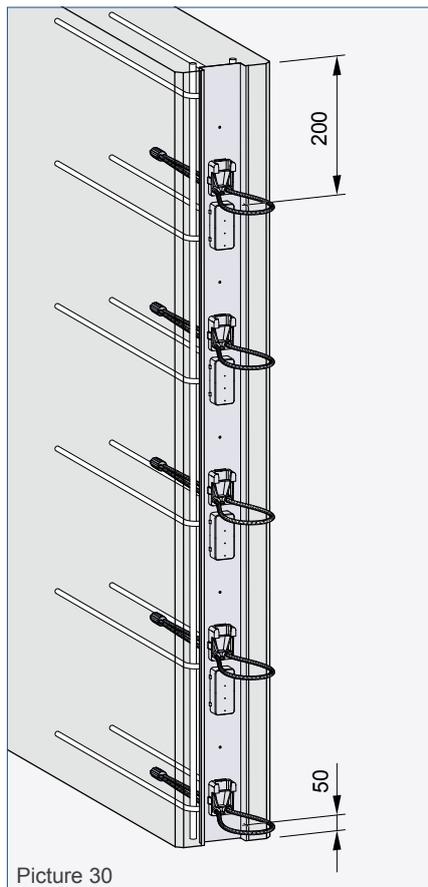
Picture 29

## Installation

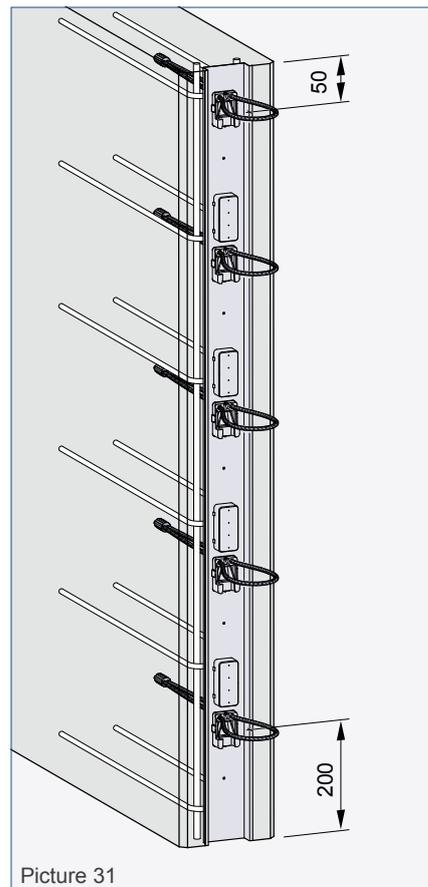
### Edge distances of the wire rope loops

The minimum edge distances of the wire rope loops according to picture 30 or 31 must be met.

If multiple rails are installed on top of each other, the loop spacing must be 250 mm.



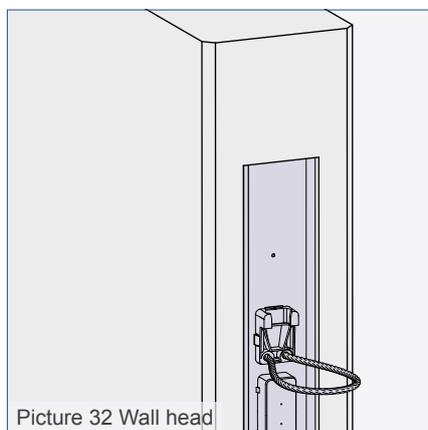
Picture 30



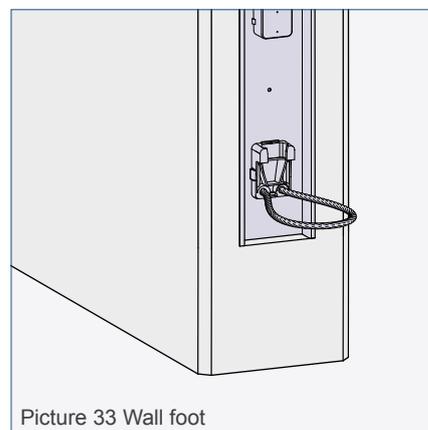
Picture 31

### Edge distance of the rail profile

A flush installation of the Power OS rail to the wall head or foot is not required.



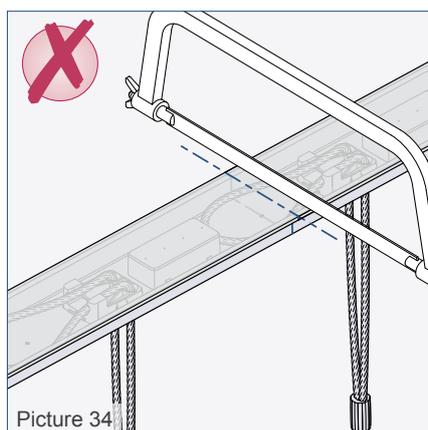
Picture 32 Wall head



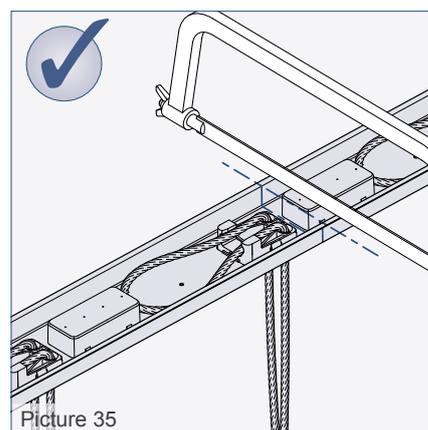
Picture 33 Wall foot

### Cutting of the rail

If it is necessary to shorten a Power OS rail, it must be opened before cutting in order to avoid damages to the angled wire rope loops.



Picture 34

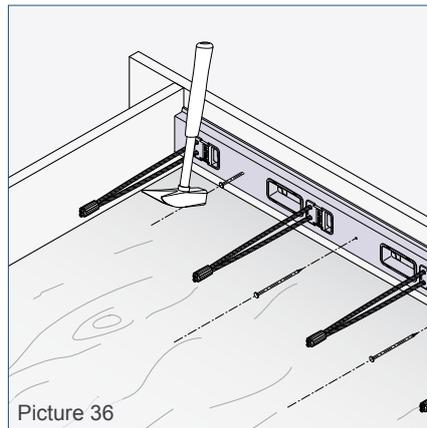


Picture 35

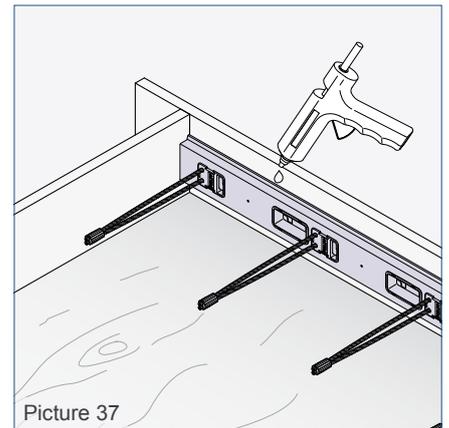
## Installation

### Fixation to the formwork

A fixation of the Power OS rail is possible by nailing as well as hot bonding to the mould (picture 36 and picture 37).



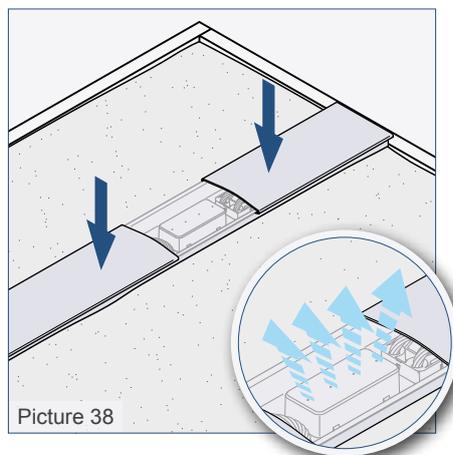
Picture 36



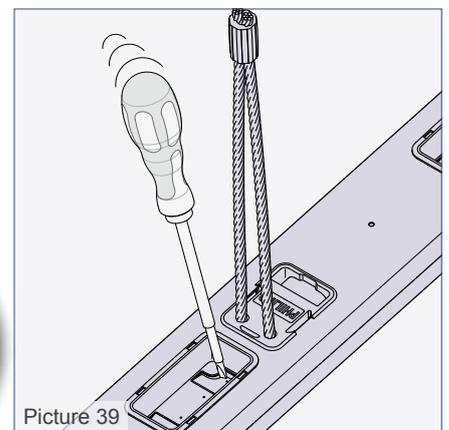
Picture 37

### Installation on the surface

In order to ventilate a plastic recess box, e.g. when the Power OS rails are installed on the concrete surface (plastic cover at the top, picture 38), it has four little holes on the top air can pass off.

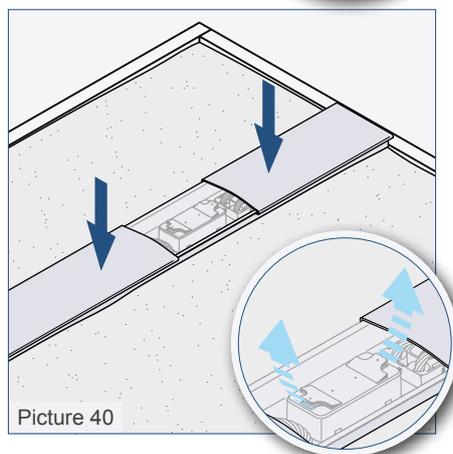


Picture 38



Picture 39

If necessary, the plastic recesses can be opened at the predetermined breaking point by using a spiky tool (e.g. screw driver - picture 39). Hence, a complete filling of the concrete into the recesses is guaranteed.

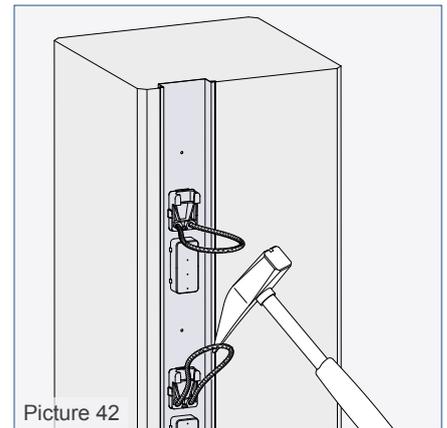
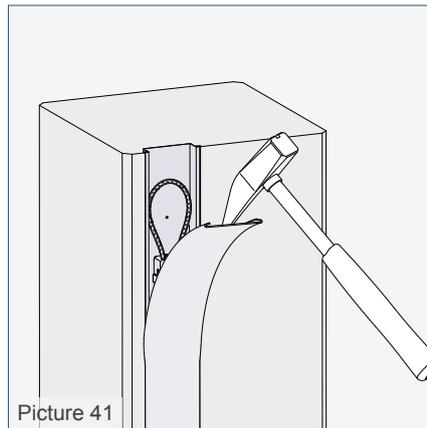


Picture 40

## Mounting

### Preparation for mounting

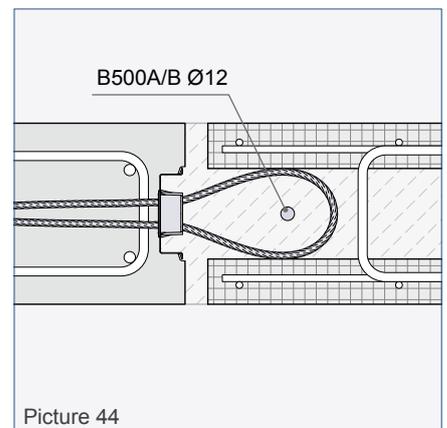
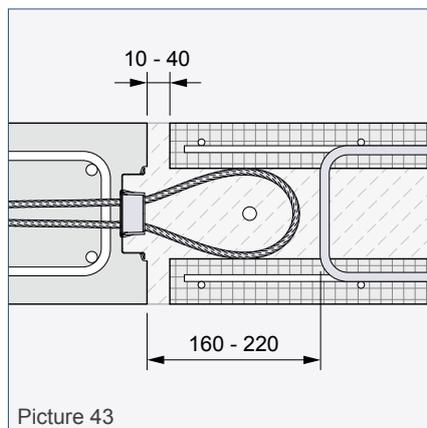
The plastic cover of the installed rail must be released at one rail end. Then, it can be removed easily from the complete rail (picture 41). Now, the wire rope loops have to be folded right-angled to the rail (picture 42).



### Mounting of the precast elements

If semi-finished precast concrete elements are installed, the distances according to picture 43 are to be observed.

Prior the filling of the connection a reinforcing bar ( $\text{Ø}12$  mm) shall be positioned along the entire rail length through the overlapping loops. The correct installation is to be checked visually.

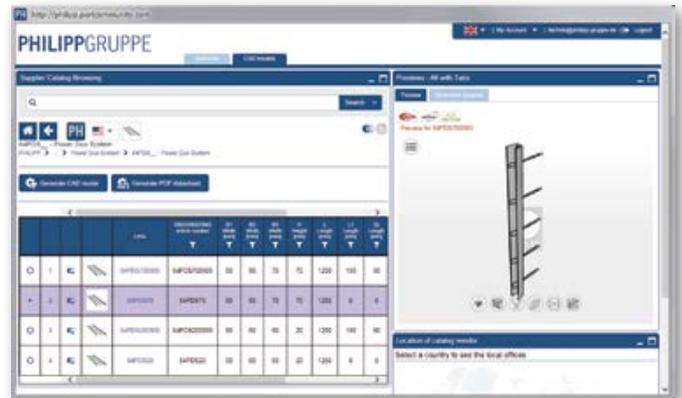


## CAD / check-list

### 3D mounting parts

Time-saving during the planning process and support for the Building Information Modelling (BIM) method are becoming more and more important. This is the reason why the universal PHILIPP CAD library helps to work efficient on these matters.

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- BIM specific PartCommunity:  
[bimcatalogs.partcommunity.com](http://bimcatalogs.partcommunity.com)



**Table 6: Site check list**

Step	What	Comment
1	Open the rail	Remove cover
2	Control of concreting surface	Pay attention to a clean surface, when necessary clean again
3	Fold-out the connecting loops	Pay attention to the 90° position
4	Align concrete units	Pay attention to admissible tolerances
5	Insert the loop reinforcement	Over the entire rail length
6	Pre-wetting of the concrete surface	Improvement of adhesion
7	Sealing on both sides	Use formwork, timber boards or joint tapes (semi-finished precast concrete element)

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