Power OS rail

Installation Instruction

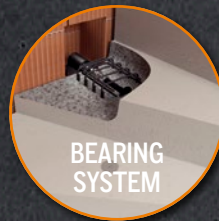## Our products from the division
BUILDING SOLUTIONS

SERVICES
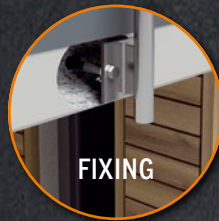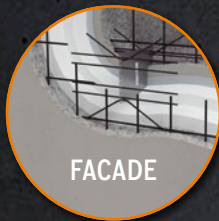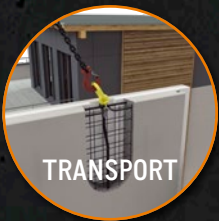
» On-site tests -> we ensure that your requirements are properly covered by our planning.

» Test reports -> for your safety and documentation.

» Trainings -> the knowledge of your employees from planning and production is enhanced by our experts on site, online or via webinar.

» Planning support -> latest design software, planning documents, CAD data and much more can be downloaded any time from www.philipp-group.de.

HIGH DEMANDS ON PRODUCT SAFETY AND PRACTICALITY

» Close cooperation with notified bodies and - if necessary - approval of our solutions.

TECHNICAL DEPARTMENT

» Our expert-team will support you at any time during your planning phase with detailed advice.
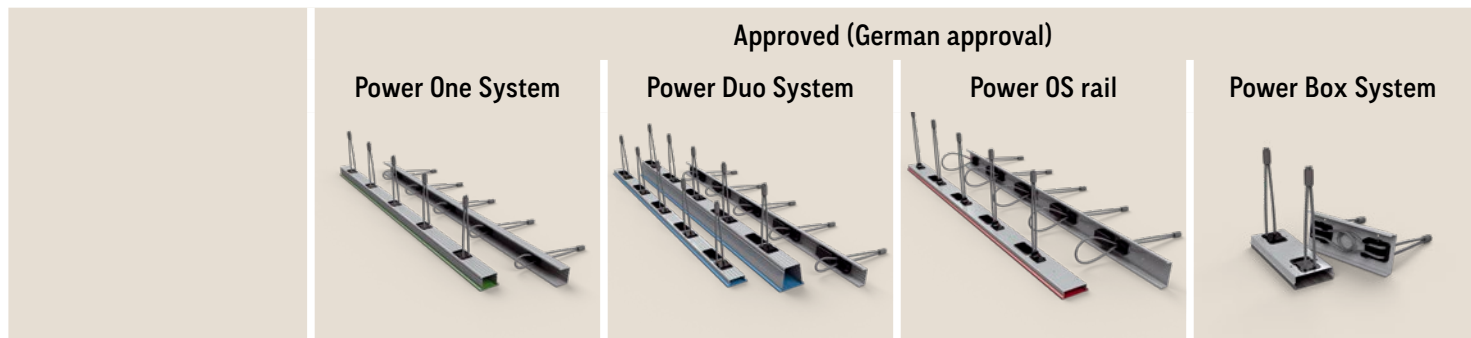
TRANSPORT   CONNECTION   FACADE   FIXING   BEARING SYSTEM   EARTHING

CONTENT

PRODUCT CHARACTERISTICS - OVERVIEW

	Power One System	Approved (German approval)		
		Power Duo System	Power OS rail	Power Box System
LOAD DIRECTIONS / MAX. DESIGN RESISTANCES				
$v_{Rd.II}$ (kN/m)	60.0	90.0	80.0	105.0
$v_{Rd.\perp}$ (kN/m)	37.5	37.5	35.7	28.6
Z_{Rd} (kN/loop)	10.0	10.0	10.0	–
AREA OF APPLICATION (RECOMMENDED)				
Precast building	✓	✓	✓	✓
In-situ concrete constructions	–	–	✓	–
Wall / wall	✓	✓	✓	✓
Wall / wall (T-connection)	–	✓	✓	✓
Wall / column	–	✓	✓	–
Minimum wall thickness (cm)	10	12 / 14 ①	14	14
Concrete strength precast unit	C30/37	C25/30 ② / C30/37	C25/30	C30/37
TECHNICAL INFORMATION				
Technical basis	National technical approval (abZ)	National technical approval (abZ)	National technical approval (abZ)	National technical approval (abZ)
Max. fire resistance	F 180	Firewall (REI 90-M) and also F 180	F 180	F 180
Mortar grouting	Grouting mortar	Thixo- or grouting mortar	Normal weight concrete	Grouting mortar
Manufacturer of mortar	BETEC	BETEC / P&T	–	P&T

① with P&T / ② with BETEC

Constructive	
Connecting rails	**Connecting loop**

-	-
-	-
-	-

✓	✓
✓	✓
✓	✓
✓	✓
✓	✓
-	-
-	-
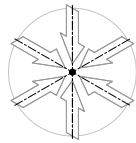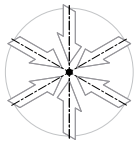
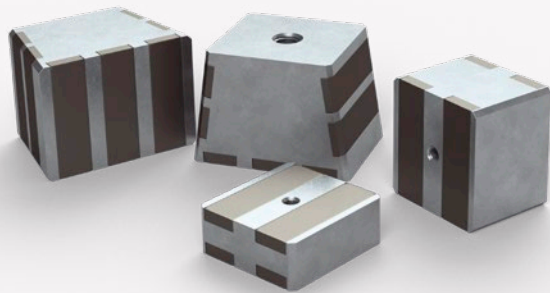|	
-	-
F 180	F 180
Mortar or normal weight concrete	Mortar or normal weight concrete
-	-

Accessories

for connecting rails and loop systems

Magnetic fastener

Mortar

⇥ BETEC Grouting

⇥ BETEC Thixo

⇥ EuroGrout Varix

⇥ EuroGrout Universalfüller


⇥ P&T Grouting mortar (PHILIPP VG)

THE APPROVED POWER OS CONNECTING RAIL

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

» Suitable for vertical and horizontal connections

» German approved connecting rail

Our design software you will find at
*www.philipp-software.de*
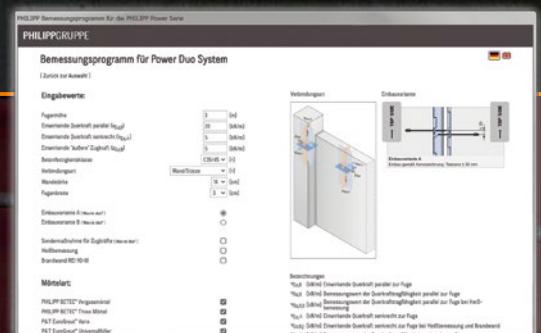
COMPONENT

The galvanised Power 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.
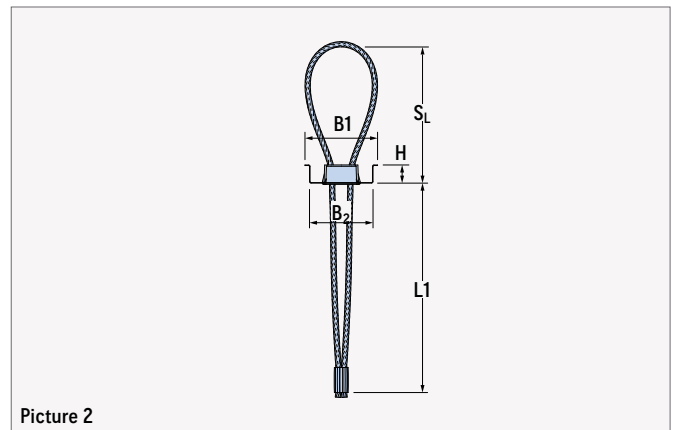
⚠ OBSERVE APPROVAL!

This Installation Instruction provides necessary technical information. In any case the requirements of the national German approval must be considered!
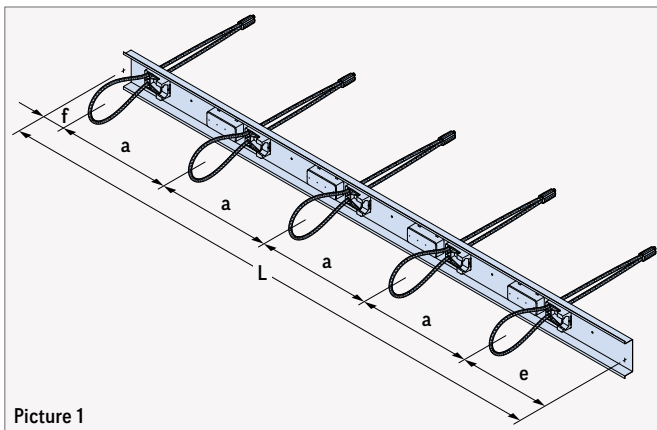
Picture 1

Picture 2

TABLE 1: DIMENSIONS OF THE POWER OS RAIL

Ref. no.	Dimensions									Weight per rail
	B_1 (mm)	B_2 (mm)	H (mm)	L (mm)	L_1 (mm)	S_L (mm)	a (mm)	e (mm)	f (mm)	(kg)
84POS201555	80	70	20	1250	250	155	250	200	50	1.55

APPLICATION

RANGE OF APPLICATIONS

The Power OS rail 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.

Precast element / semi-finished precast element / cast in-situ concrete (first element)
Cast in-situ concrete (second element)

Precast element
Semi-finished precast element
Cast in-situ concrete
(min. C25/30)

Cast in-situ concrete
(min. C25/30)

B500A/B Ø12

B500A/B stirrup Ø8/250
Anchorage length according to EN 1992-1-1

B500A/B stirrup Ø8/150
Anchorage length according to EN 1992-1-1

≥ 140

B500A/B Ø10   10 – 30

Mesh reinforcement Q188

160 – 220

Picture 3

Precast element / semi-finished precast element / cast in-situ concrete (first element)
Semi-finished precast element (second element)
Cast in-situ concrete (second element)

Precast element
Semi-finished precast element
Cast in-situ concrete
(min. C25/30)

Semi-finished precast element
(incl. cast in-situ addition)
(min. C25/30)

10 – 40

B500A/B stirrup Ø8/150
Anchorage length according to EN 1992-1-1
or lattice girders (equivalent cross-section)

B500A/B stirrup Ø8/250
Anchorage length according to EN 1992-1-1

B500A/B Ø12

≥100 ≥80

B500A/B Ø10   10 – 30

Mesh reinforcement Q188

160 – 220

Picture 4

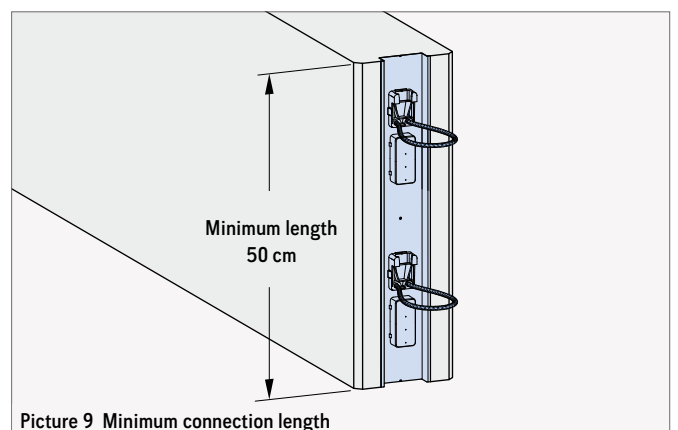## APPLICATION

DIMENSIONS OF CONCRETE UNIT

A minimum wall thickness of 140 mm is required when installing the Power OS rail in wall combinations of reinforced precast and cast in-situ concrete elements (pictures 5 and 6).

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

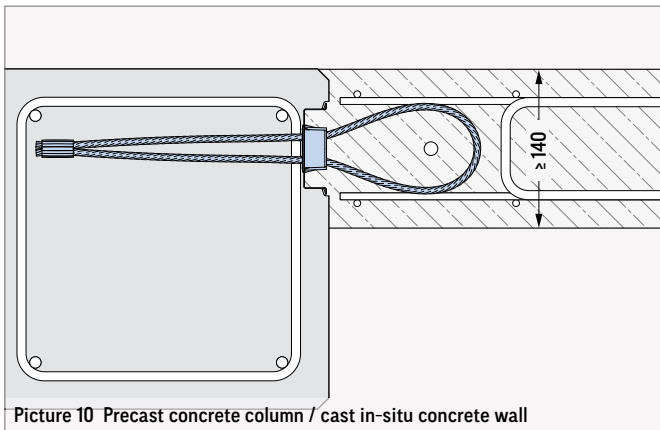Picture 5

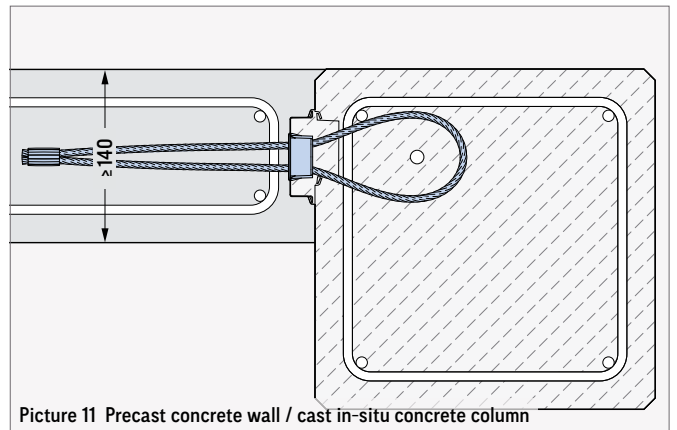Picture 6
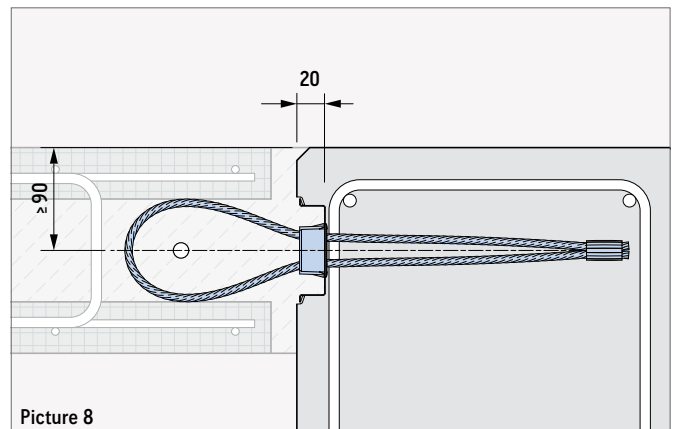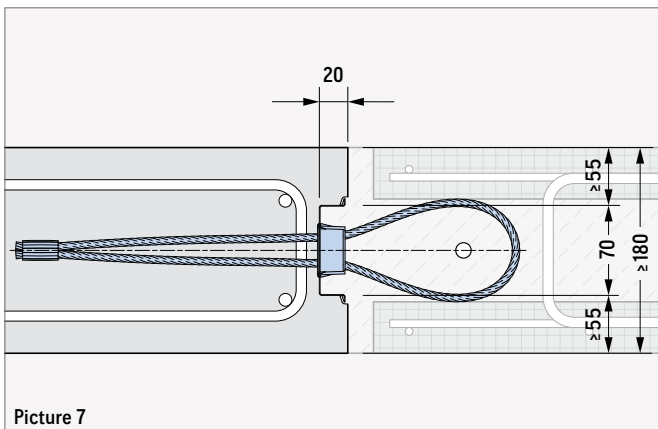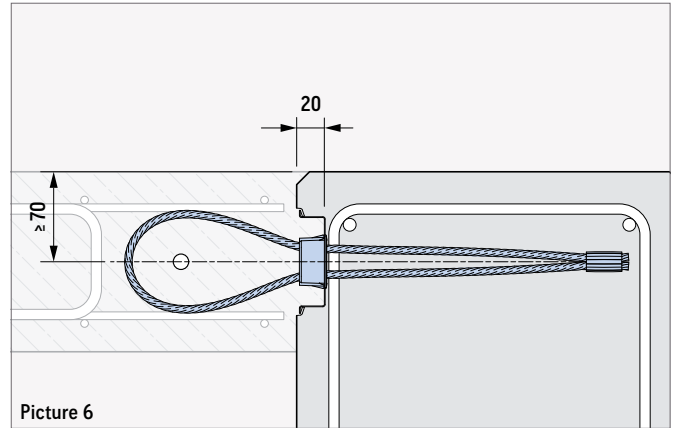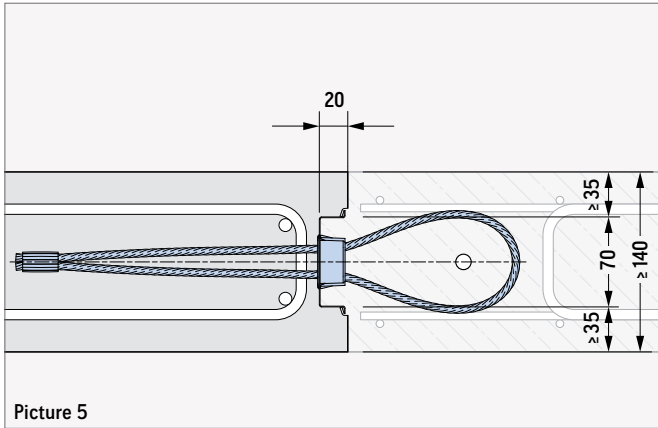
Picture 7

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
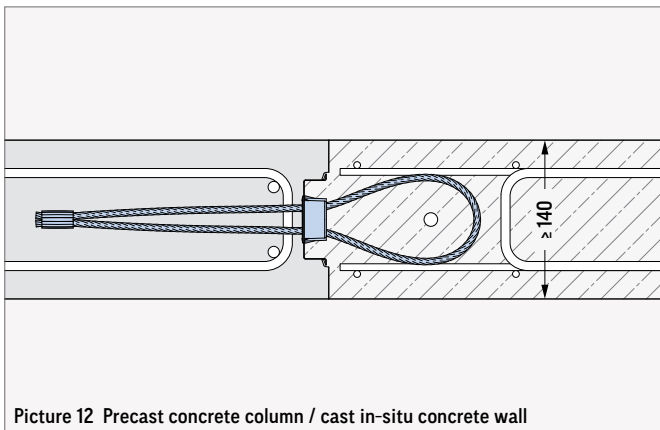

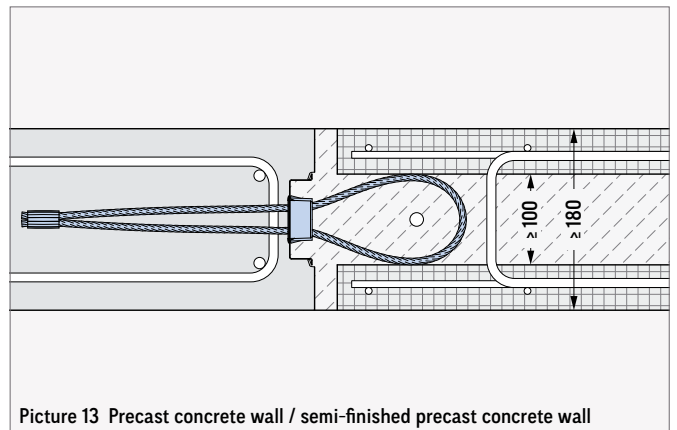## APPLICATION EXAMPLES (VERTICAL JOINT)

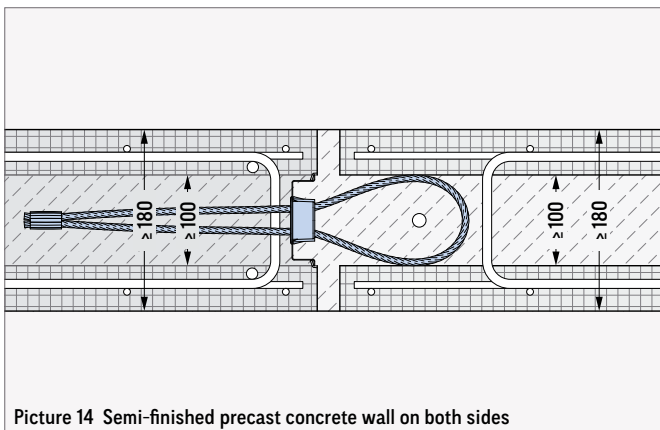Picture 10 Precast concrete column / cast in-situ concrete wall

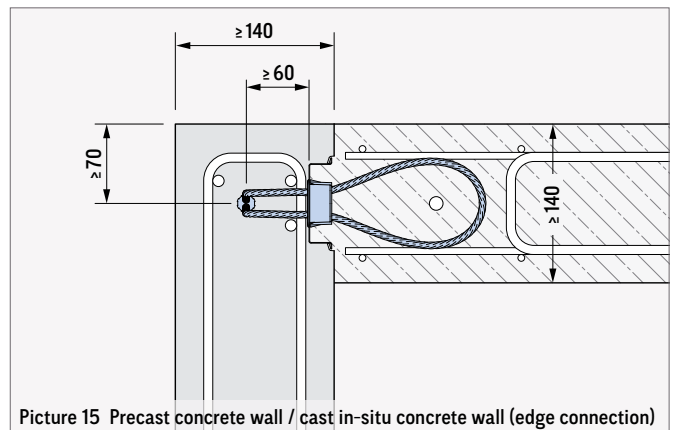Picture 11 Precast concrete wall / cast in-situ concrete column

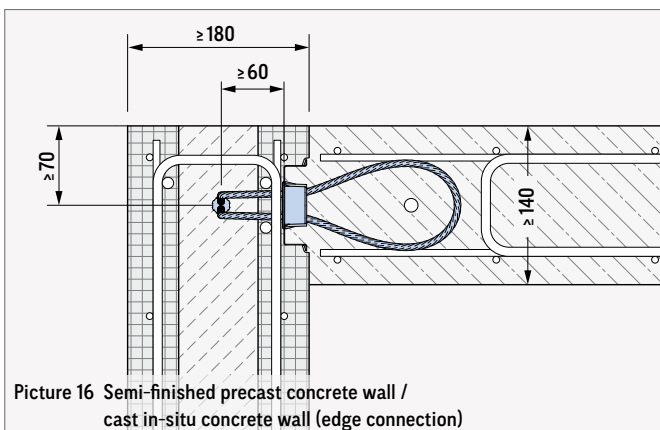Picture 12 Precast concrete column / cast in-situ concrete wall

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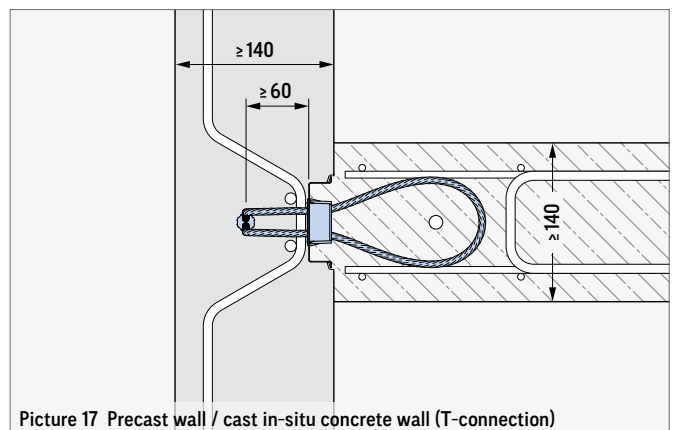

Picture 14 Semi-finished precast concrete wall on both sides

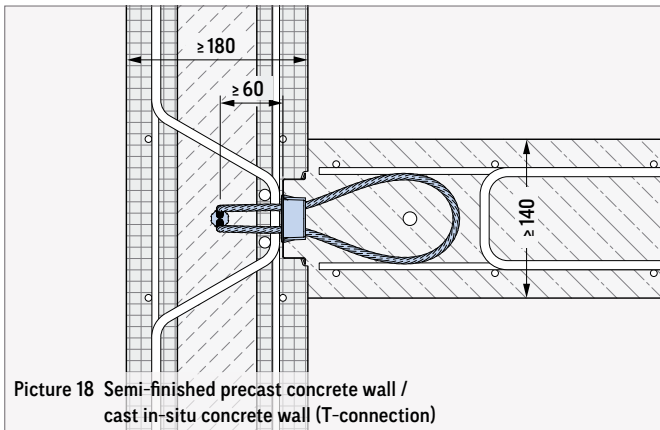Picture 15 Precast concrete wall / cast in-situ concrete wall (edge connection)

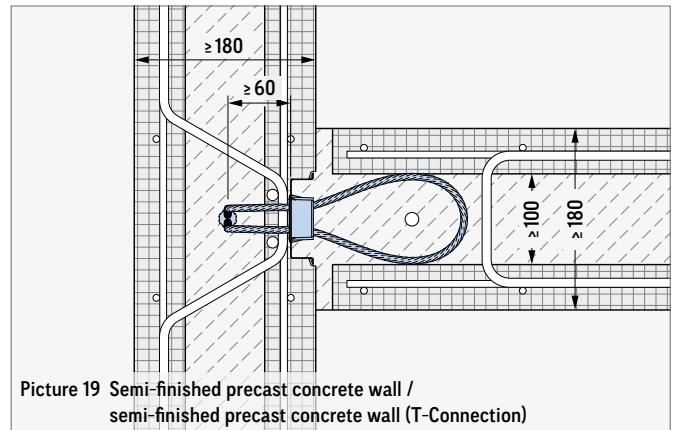Picture 16 Semi-finished precast concrete wall / cast in-situ concrete wall (edge connection)

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

## APPLICATION EXAMPLES (VERTICAL / HORIZONTAL JOINT) / FIRE PROTECTION

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

Picture 19 Semi-finished precast concrete wall / semi-finished precast concrete wall (T-Connection)

HORIZONTAL JOINT

The Power OS rail can be used also in horizontal joints (picture 20) e. g. as an alternative to starter bars for an in-situ concrete slab.
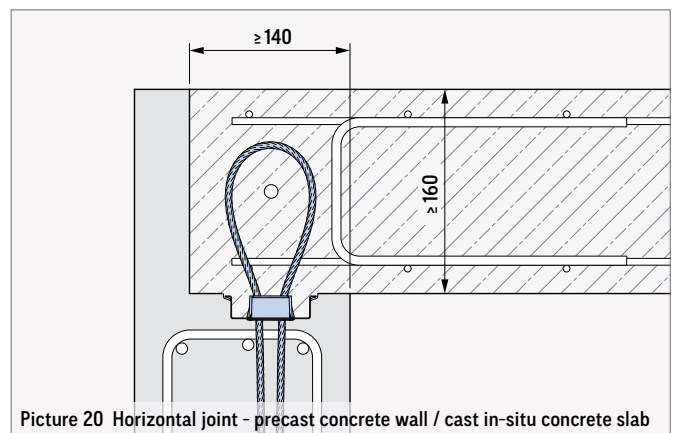
Picture 20 Horizontal joint - precast concrete wall / cast in-situ concrete slab

FIRE PROTECTION

The connection construction has been tested apart from the approval by an expert opinion based on the German standard DIN 4102-4.

For the fire resistance class F180 a wall thickness of ≥ 15 cm is required, for thinner walls the fire resistance class is F120.

Picture 21

DESIGN AND CONSTRUCTION

The reinforced 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 ($v_{Rd,II}$) and in table 4 shear loads right-angled to the rail ($v_{Rd,\perp}$) are listed according to the approval. 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 23.

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 (page 13)
No constructive solution, which takes the acting tensile force (table 5).

$$z_{Ed.ges} = z_{Ed,N} + 0.5 \times v_{Ed,II} + 0.25 \times v_{Ed,\perp}$$
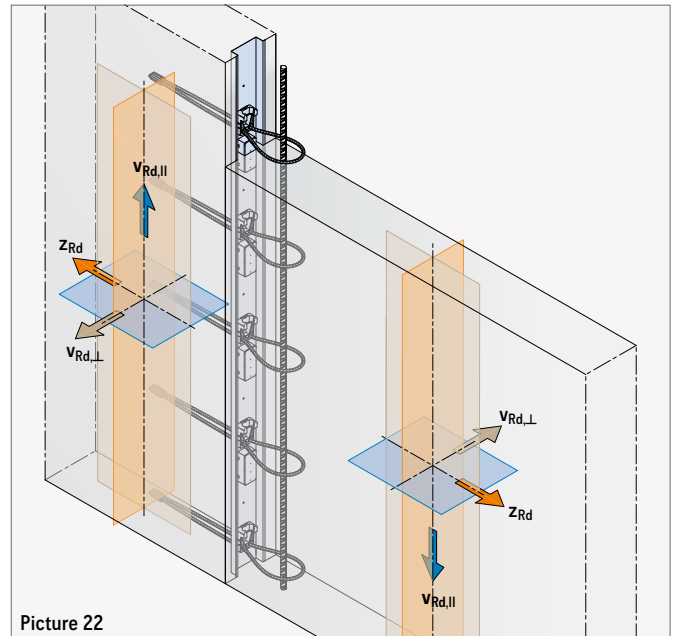
Picture 22

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 $v_{Rd,\parallel}$ (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

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

Picture 23 Interaction diagram of the shear forces parallel and right-angled to the rail
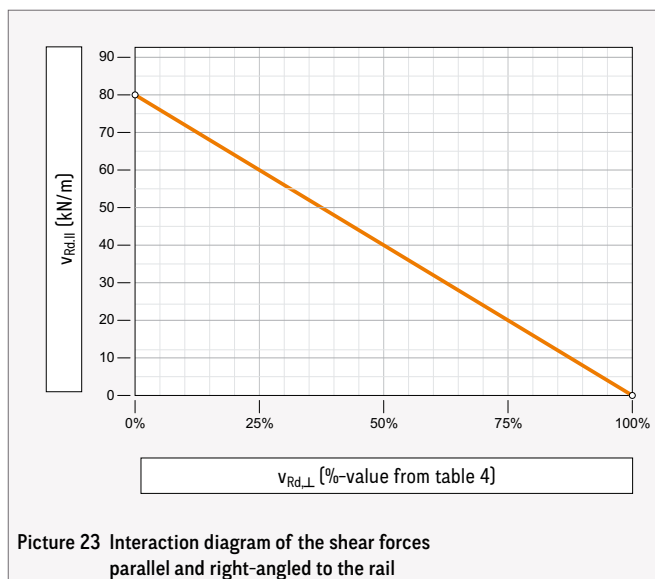
TABLE 4: DESIGN VALUES OF THE SHEAR FORCE BEARING CAPACITY RIGHT-ANGLED TO THE RAIL

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 AND CONSTRUCTION

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.

Picture 24a
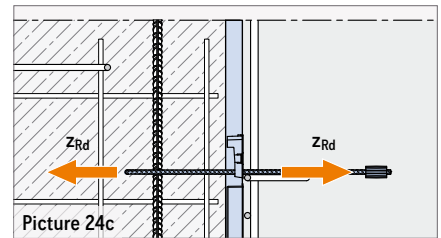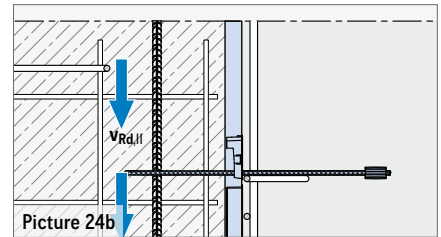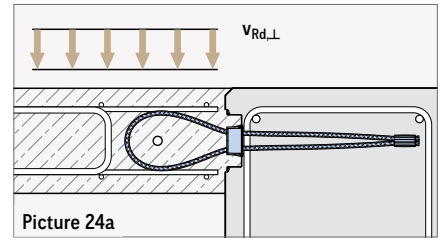
VERIFICATION OF THE TOTAL TENSION FORCE: $z_{Rd} \geq z_{Ed,VII} + z_{Ed,V\perp} + z_{Ed,N}$

z_{Rd} (kN/m) : Design value of tensile force bearing capacity per metre 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

Picture 24b

Picture 24c

TABLE 5: COMPONENTS OF TENSILE FORCE

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

DESIGN EXAMPLE

BOUNDARY CONDITIONS:

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

ACTIONS:

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

VERIFICATION:

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

Shear force parallel: $v_{Rd,II}$ = 80 kN/m (value from table 2) ≥ 40 kN/m → **OK**

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

INTERACTION:

If both forces occur at the same time, the interaction (picture 23) must be considered:

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

The linear interaction results in a permissible shear force right-angled to the joint: 100 % – 50 % = 50 %

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

red. $v_{Rd,\perp}$ = 0.5 × 14.3 kN/m = 7.15 ≥ 5 kN/m → **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:

$z_{Rd} \geq z_{Ed,VII} + z_{Ed,V\perp} + z_{Ed,N}$
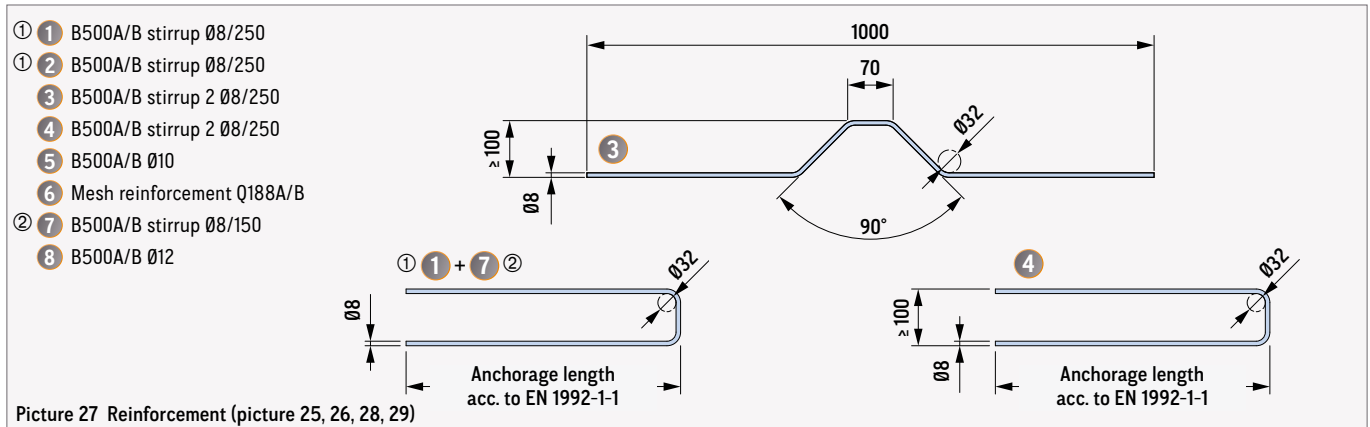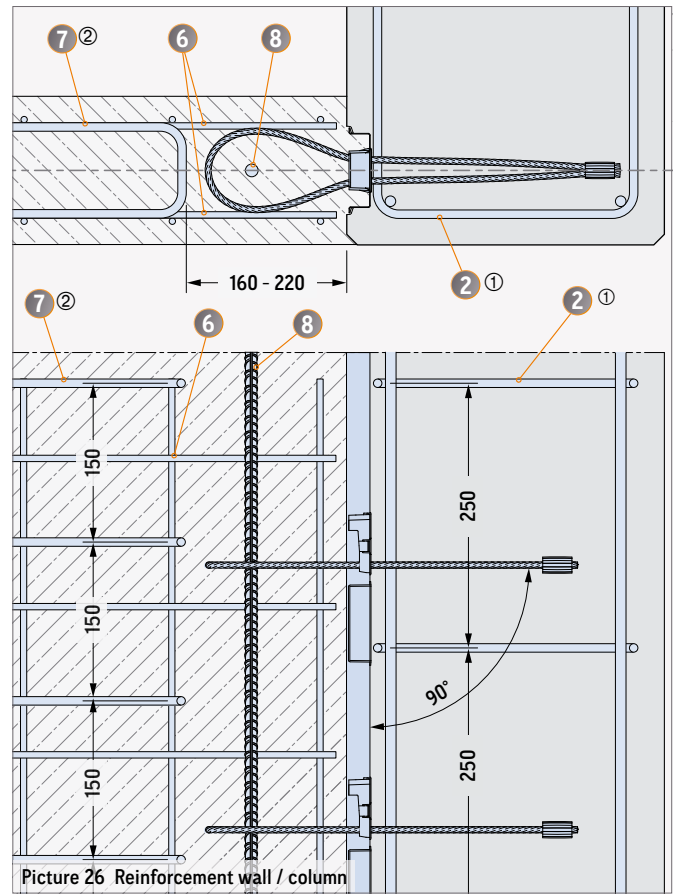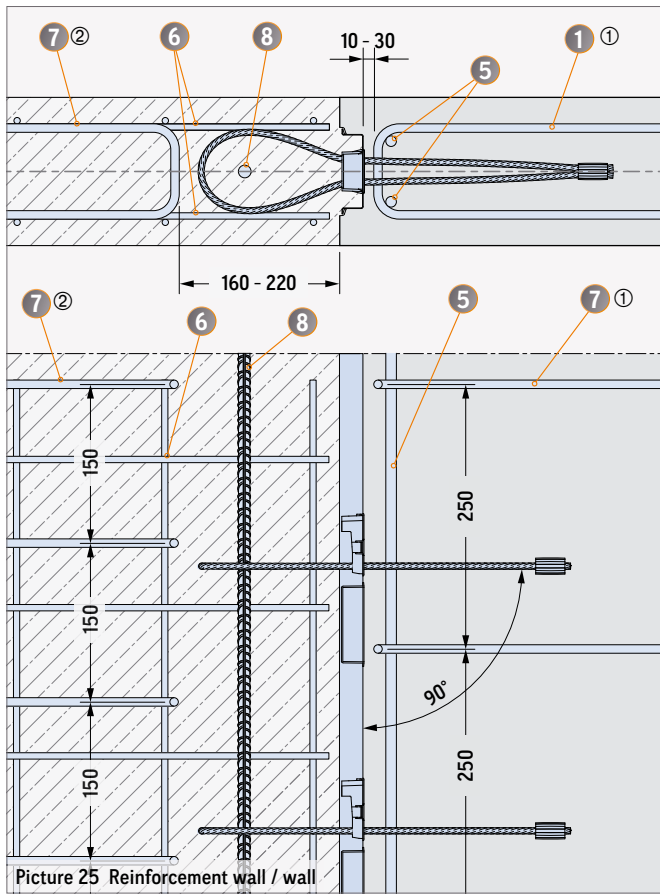
$z_{Ed,VII}$ = 0.5 × 40.0 kN/m = 20.0 kN/m

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

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

z_{Rd} = 40.0 kN/m (table 3)

40 kN/m ≥ 20.0 kN/m + 1.25 kN/m + 2.0 kN/m = 23.25 kN/m → **OK**

REINFORCEMENT

Picture 25 Reinforcement wall / wall

Picture 26 Reinforcement wall / column

① ❶ B500A/B stirrup Ø8/250
① ❷ B500A/B stirrup Ø8/250
❸ B500A/B stirrup 2 Ø8/250
❹ B500A/B stirrup 2 Ø8/250
❺ B500A/B Ø10
❻ Mesh reinforcement Q188A/B
② ❼ B500A/B stirrup Ø8/150
❽ B500A/B Ø12

Anchorage length acc. to EN 1992-1-1

Picture 27 Reinforcement (picture 25, 26, 28, 29)

① All stirrups ❶ + ❷ can be replaced by an equal mesh reinforcement. This requirement is fulfilled e.g. by a mesh reinforcement type Q257 A (equal 2.57 cm²/m). Existing reinforcement can be taken into account.

② All stirrups ❼ can be replaced by an equal mesh reinforcement. This requirement is fulfilled e.g. by a mesh reinforcement type Q335 A (equal 3.35 cm²/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
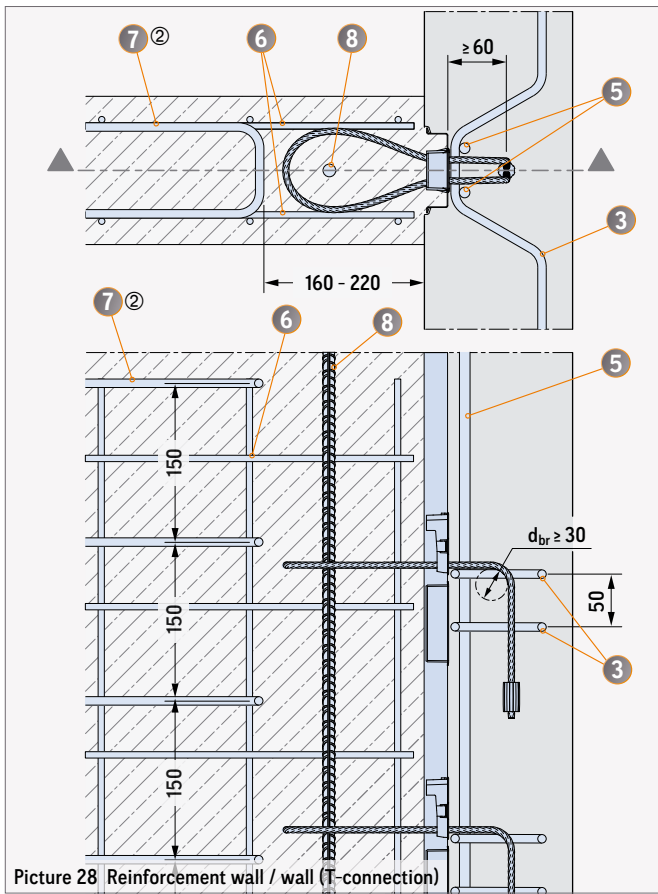
Picture 28 Reinforcement wall / wall (T-connection)
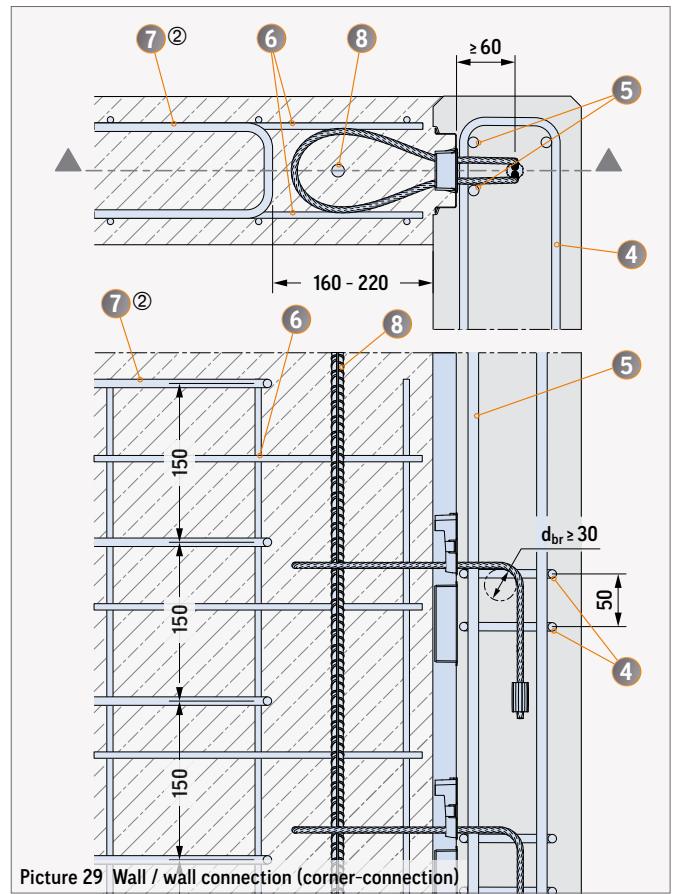
Picture 29 Wall / wall connection (corner-connection)

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. (see picture 25 or 26). With a vertical installation in the formwork 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 ≥ 60 mm (picture 28 or 29). Depending on the installation situation, additional reinforcement ❸ or ❹ as shown in picture 28 or 29 must be provided.
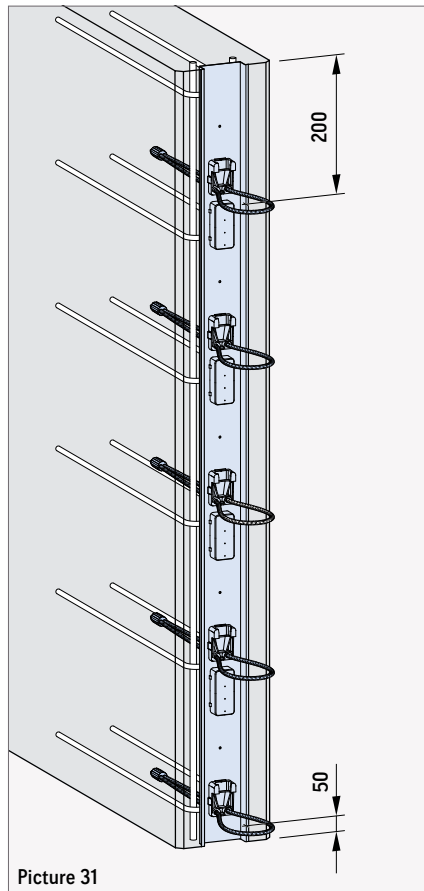
END ANCHORAGE OF THE ROPE

A bending of the end anchorage by the reinforcement is not permissible.
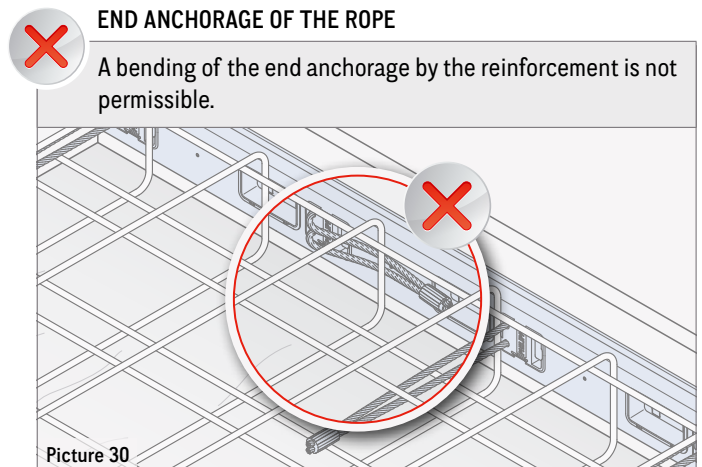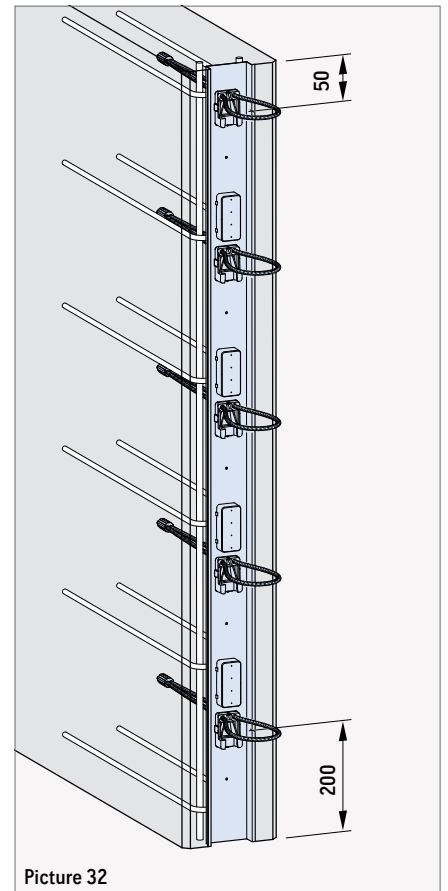

Picture 30

INSTALLATION

EDGE DISTANCES OF THE WIRE ROPE LOOPS

The minimum edge distances of the wire rope loops according to picture 31 or 32 must be met.

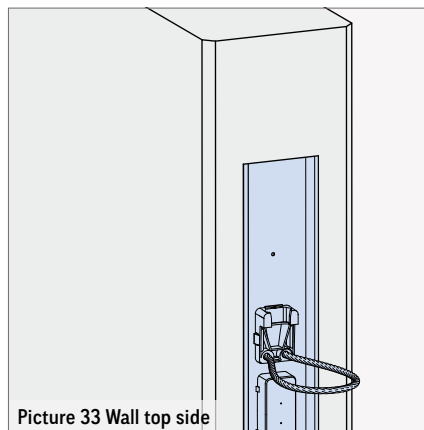If multiple rails are installed on top of each other, the loop spacing must be 250 mm.
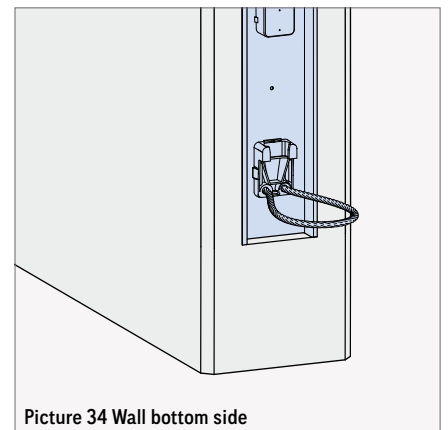
Picture 31

Picture 32

EDGE DISTANCE OF THE RAIL PROFILE

A flush installation of the Power OS rail to the wall top or bottom is not required.
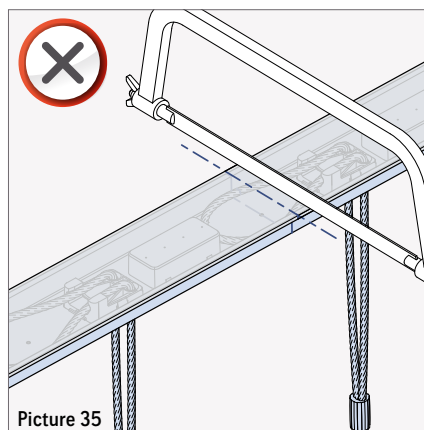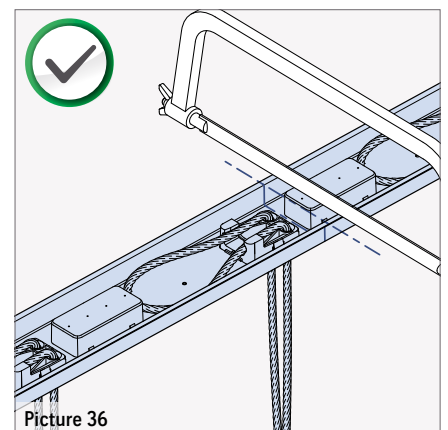
Picture 33 Wall top side

Picture 34 Wall bottom side

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.
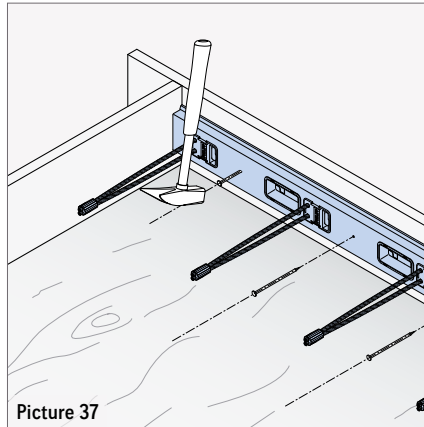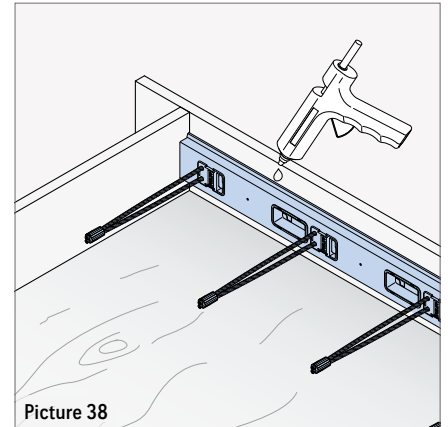
Picture 35

Picture 36

INSTALLATION

INSTALLATION OF THE POWER OS RAILS

A fixation of the Power OS rail is possible by nailing as well as hot bonding to the formwork (picture 37 and 38).
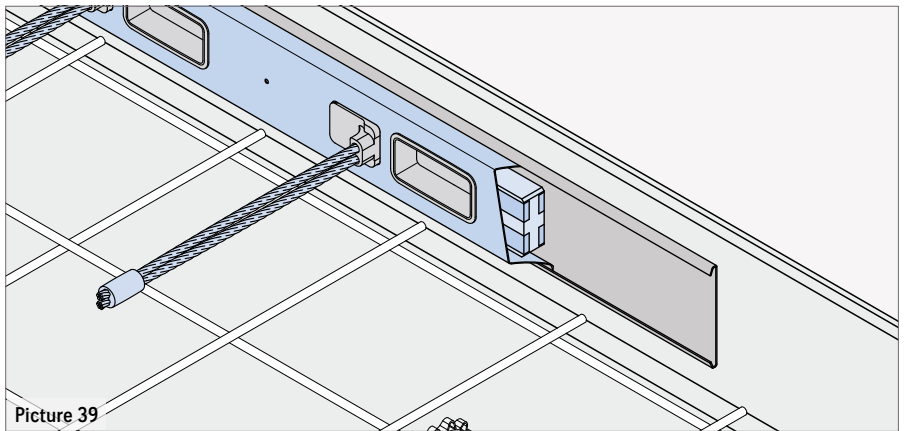

Picture 37

Picture 38

By using the Magnetic fastener the PHILIPP OS rails can be fixed to steel formworks fast and easily.
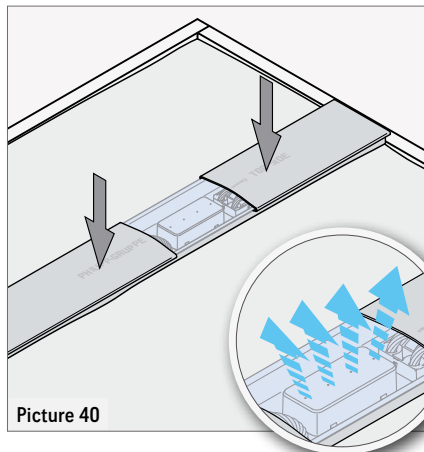
ℹ MAGNETIC FASTENER

For more information about the Magnetic fastener please refer to the separate Application Instruction.
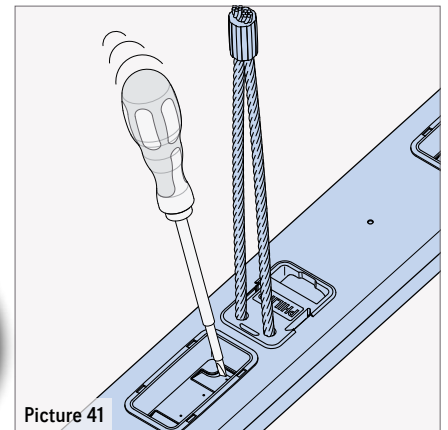

Picture 39

INSTALLATION TO 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 40), it has four little holes on the top air can pass off.
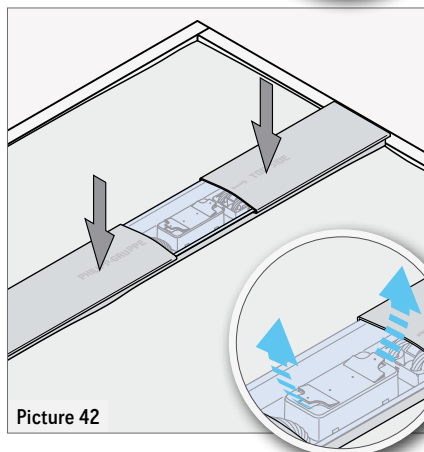

Picture 40

Picture 41

If necessary, the plastic recesses can be opened at the predetermined breaking point by using a spiky tool (e. g. screw driver – picture 41).
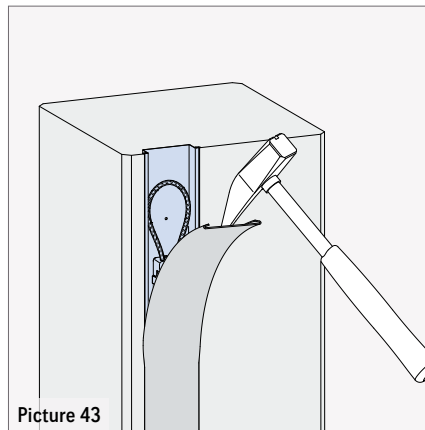Hence, a complete filling of the concrete into the recesses is guaranteed.
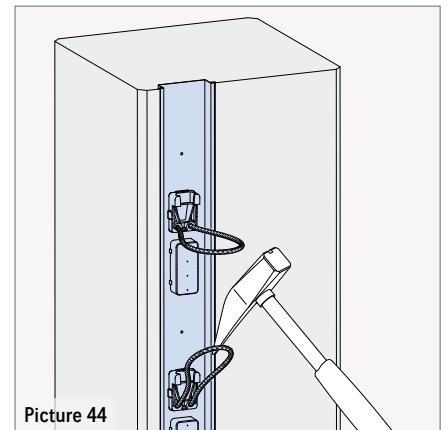

Picture 42

MOUNTING

PREPARATION FOR MOUNTING

The plastic cover of the installed rail must be released at one end. Then, it can be removed easily from the rail (picture 43). Now, the wire rope loops have to be folded out right-angled to the rail (picture 44).

Picture 43

Picture 44

MOUNTING OF THE PRECAST ELEMENTS
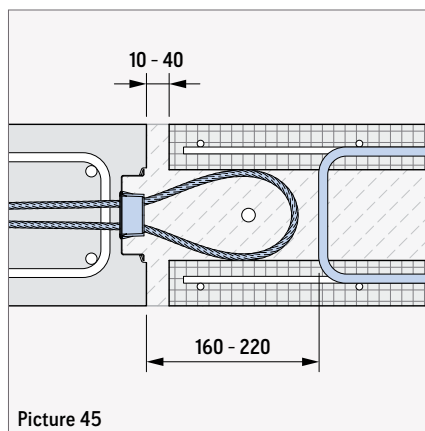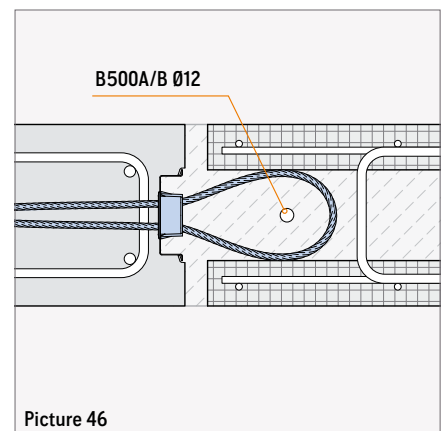
If semi-finished precast concrete elements are installed, the distances according to picture 45 are to be observed.

Prior the filling of the connection a reinforcing bar (Ø12 mm) shall be positioned along the entire rail length through the overlapping loops (picture 46). The correct installation is to be checked visually.
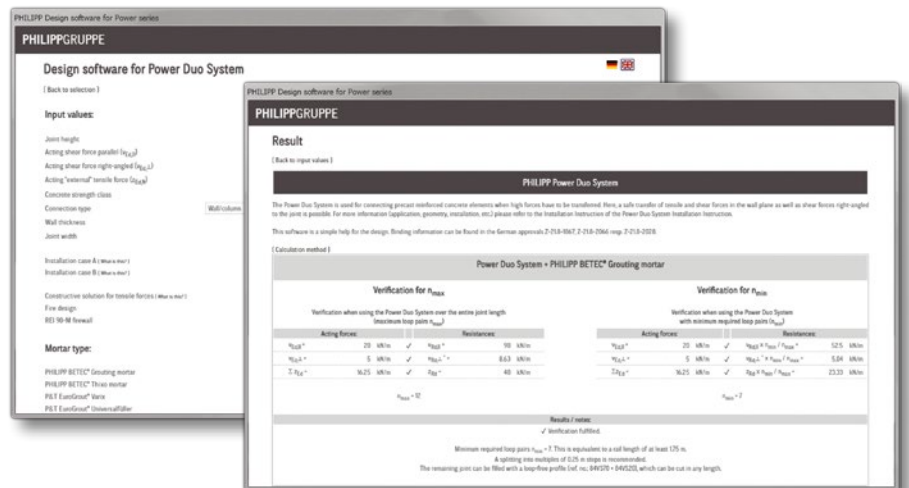

10 - 40
160 - 220
Picture 45

B500A/B Ø12
Picture 46

SOFTWARE / CAD

DESIGN

In order to design connections with the PHILIPP Power OS rail you can find a webbased tool on the website www.philipp-software.de, easy-to-use and understandable.

3-D 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 efficiently on these matters.

» More than 1,200 PHILIPP products are available as 3-D model
» Universal CAD library with many export formats compatible for all CAD systems (e. g. IFC, DWG)
» Free offer for all people involved in precast building
» Time-saving in the design process because of ready-made models and views
» Simply structured catalogue
» More product details are provided
» Standard PartCommunity:
   philipp.partcommunity.com
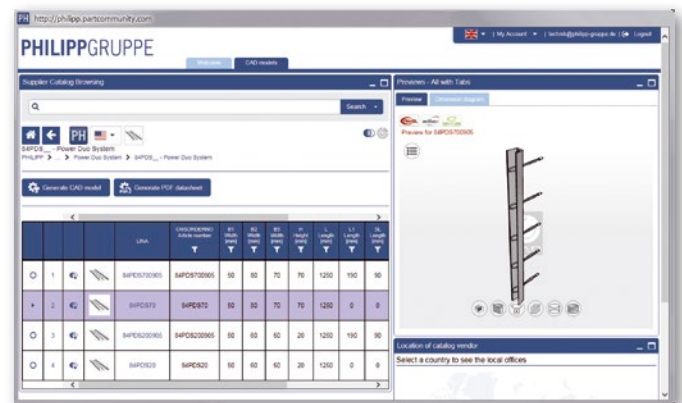» BIM specific PartCommunity:
   3dfindit.com/en

TABLE 6: SITE CHECK LIST

Step	What	Comment	
1	Open the rail	Remove cover	✓
2	Control of concrete 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	Note tolerances of the approval (semi-finished precast concrete element)	✓
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 of timber boards resp. joint tapes (semi-finished precast concrete element)	✓

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