PHILIPP GROUP

PHILIPP Power Duo System

Installation Instruction

Transport and Mounting Systems for Precast Units

◢ **Technical department –** our staff will be pleased to support you during your design process with suggestions for installation and use of our transport and mounting systems for precast units.

◢ **Special constructions –** individual for your special application.

◢ **Practical tests in plant –** we ensure that our concepts are customized.

◢ **Test reports –** for documentation and your safety.

◢ **Service –** our engineers will be pleased to train your technicians and staff at plant, consult during installation of precast units and help to optimize the production process.

◢ **High application safety of our products –** close cooperation with federal institute for material testing and – where required – German approvals of our products.

◢ **Software solutions –** design software for our sandwich anchor system and our power system (connecting technique).

◢ **Technical Department:**
   Phone: +49 (0) 6021 / 40 27-318
   Fax: +49 (0) 6021 / 40 27-329
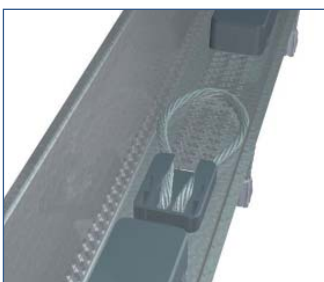   Email: technik@philipp-gruppe.de

◢ **Sales Department:**
   Phone: +49 (0) 6021 / 40 27-300
   Fax: +49 (0) 6021 / 40 27-440
   Email: export@philipp-gruppe.de

Contents

Advantages, System Components and Dimensions

The **PHILIPP Power Duo System** is used for the connection of precast concrete units where an approval is required. The system can transfer shear forces parallel to the joint (stiffening forces, bearing forces) and at right angles to the wall (wind or earth pressure) safely. The simple installation and the geometry which forms a recess former guarantee a practical application.

The **PHILIPP Power Duo** System is optimally harmonized and consists of two galvanized rails with different heights. These rails are equipped with recess formers and steel wire loops in a distance of 250mm. During concreting this recess formers are filled with concrete which ensures an excellent load bearing capacity.

The rails are installed flush with surface at the opposite sides of the particular concrete units. After concreting the units the perforated cover is opened and the loops are folded out. The transport of the concrete units is now possible. Due to the option that the elements can be installed between columns (e.g. at framework constructions) short construction times can be achieved which is a considerable advantage.
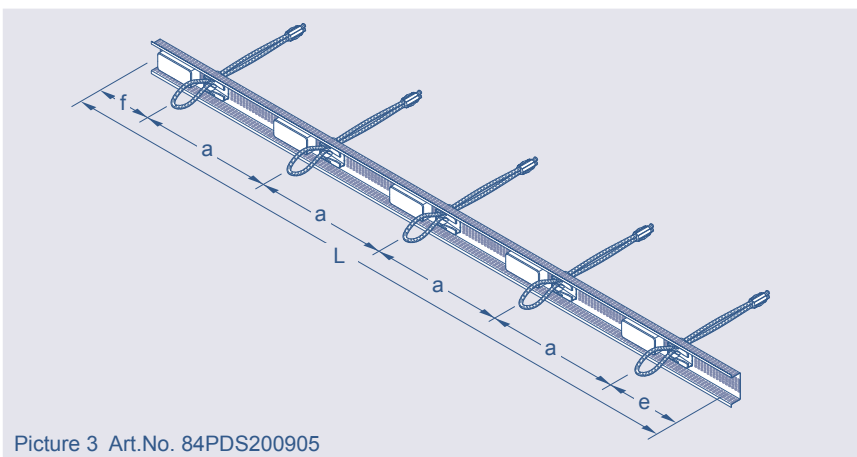
The minimised joint is then filled with the belonging grouting joint to generate a force and form fit connection.
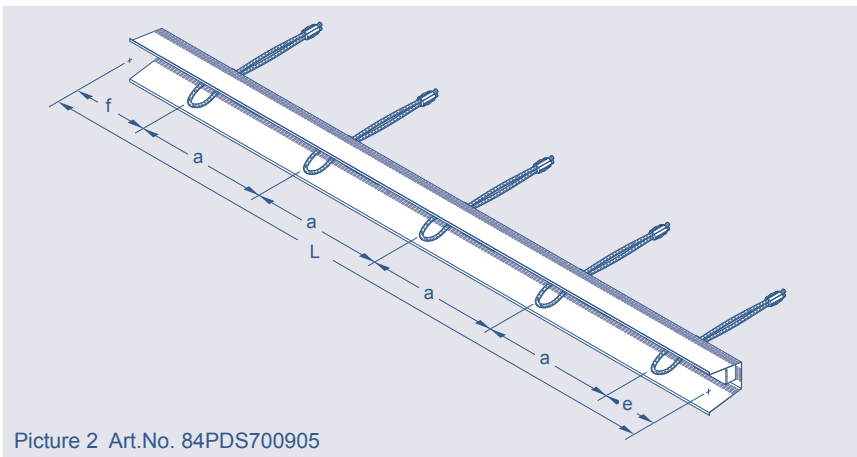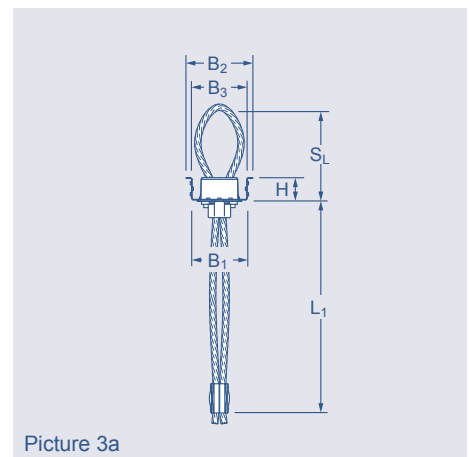
Picture 2 Art.No. 84PDS700905
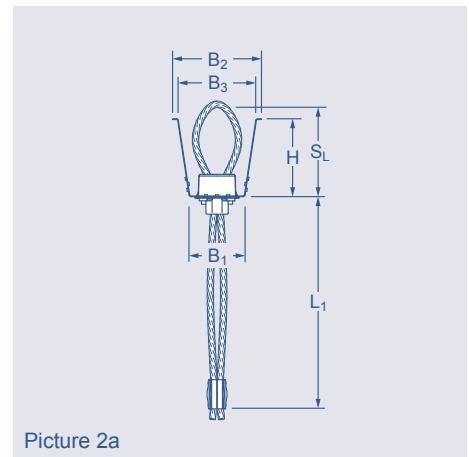
Picture 2a

Picture 3 Art.No. 84PDS200905

Picture 3a

Table 1: Dimensions of the PHILIPP Power Duo Rails

Art.-No.	Dimensions [mm]										Weight per rail
	B_1	B_2	B_3	H	L	L_1	S_L	e	f	a	[kg]
84PDS700905	50	80	70	70	1250	160	90	107	143	250	1.34
84PDS200905	50	60	50	20				143	107		1.99

PHILIPP POWER DUO SYSTEM APPLICATION

Fields of application

The **PHILIPP Power Duo System** can be used for connections of precast concrete units. It can transfer shear forces parallel and at right angles to the wall of primarily static forces. Planned tensile forces in the joint (along the wall) shall be excluded or avoided through appropriate design.

Direct weathering and high changes in temperature shall be excluded. This requirement can be neglected, if a cracks width of 0.3mm or smaller is ensured.

Geometry of precast units

Due to the requirements that 30mm concrete cover must be given when using **PHILIPP Power Duo Rails** the minimum unit thickness is 140mm (see Picture 4). In general, three connecting rails may be aligned above one another. This results in a maximum joint height of h_{max} = 3.75m

The following pictures only show the reinforcement which is required for the **PHILIPP Power Duo System**!

Picture 4

Picture 5

Picture 6

Picture 7

Picture 8
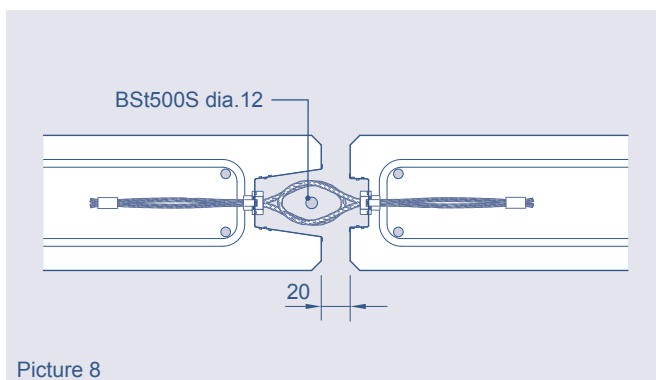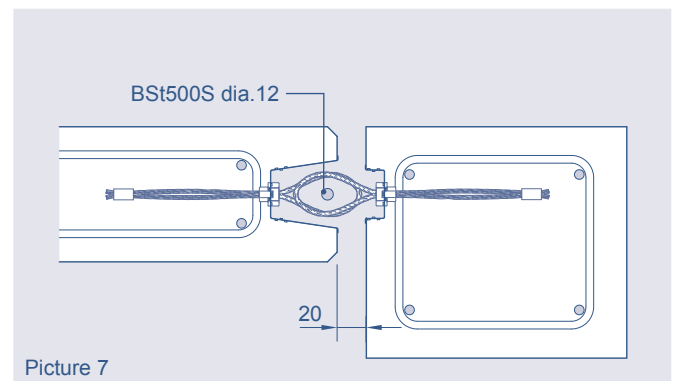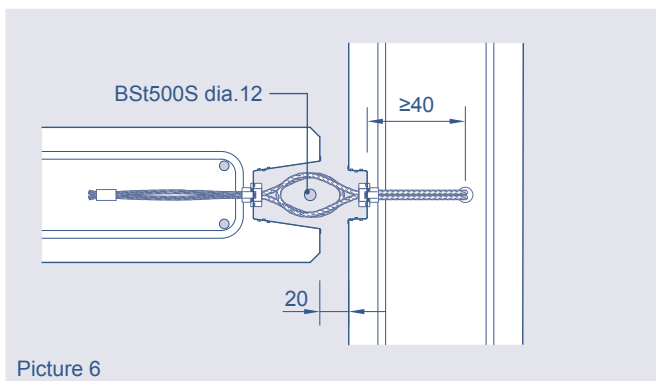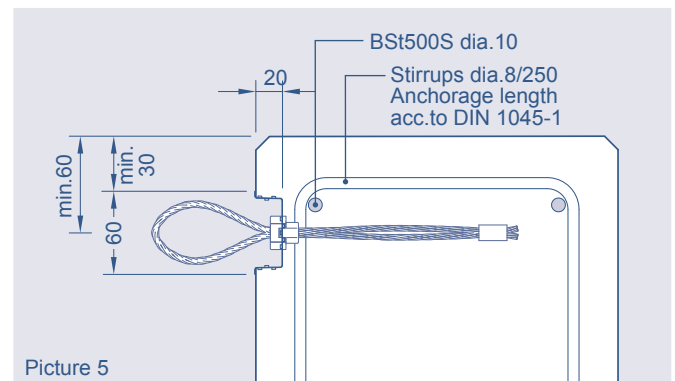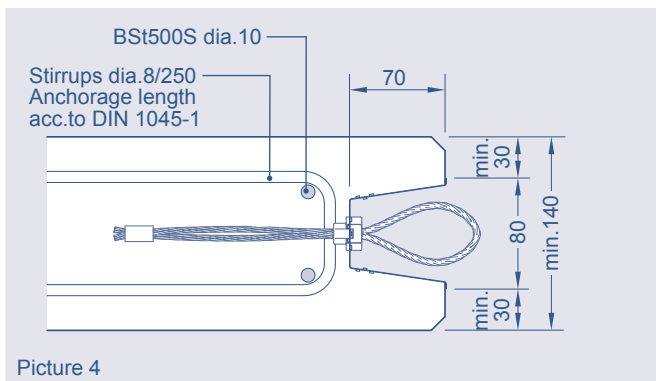
Higher joints are possible if the subsequent grouting of the joint is undertaken in a batch-bulk processing in combination with a grouting hose.
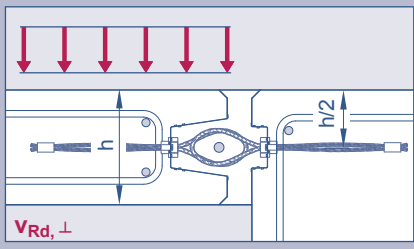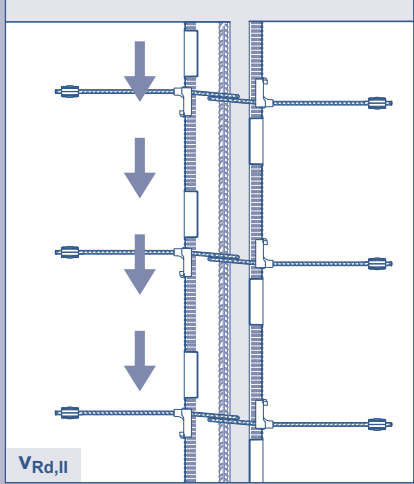
Dimensioning and Design

The precast units which are connected must correspond to DIN 1045-1:2001-07. The precast units are made of normal concrete with a concrete strength class of at least C30/37 based on German Standard (DIN 1045-1:2001-07). The structural engineer is responsible to design the units and prove the joint connections acc. to German approval.

The design value which has to be used as resistance value of the shear force parallel to the joint ($V_{Rd,\parallel}$) and at right angles to the joint ($V_{Rd,\perp}$) is given in table 2:
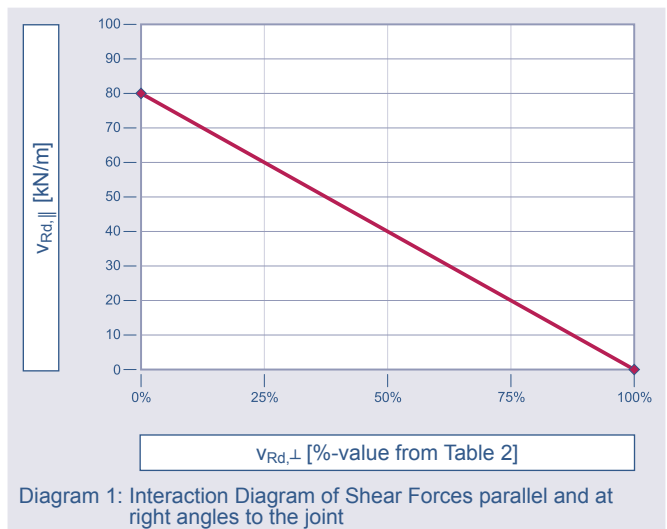
Table 2: Design value of the Shear Force Bearing Capacity parallel and at right angles to the wall.

Wall thickness h [cm]	Design value of the Shear Force Bearing Capacity [kN/m]							
	C30/37		C35/45		C40/50		C45/55	
	$V_{Rd,\parallel}$	$V_{Rd,\perp}$	$V_{Rd,\parallel}$	$V_{Rd,\perp}$	$V_{Rd,\parallel}$	$V_{Rd,\perp}$	$V_{Rd,\parallel}$	$V_{Rd,\perp}$
14		9.7		11.1		11.9		12.6
15		11.2		12.7		13.7		14.5
16		12.7		14.4		15.5		16.5
17		14.2		16.2		17.4		18.6
18		15.9		18.1		19.4		20.7
19		17.5		20.0		21.4		22.8
20		19.3		21.9		23.5		25.1
21		21.0		24.0		25.7		27.4
22	80.0	22.8	80.0	26.0	80.0	27.9	80.0	29.7
23		24.7		28.1		30.2		32.2
24		26.6		30.3		32.5		34.6
25		28.5		32.5		34.9		37.2
26		30.5		34.8		37.3		37.5
27		32.5		37.1		37.5		37.5
28		34.6		37.5		37.5		37.5
29		36.7		37.5		37.5		37.5
30		37.5		37.5		37.5		37.5

$V_{Rd,\perp}$

$V_{Rd,\parallel}$

If shear forces at right angles to the wall are planned, tensile forces (1.5 times the shear force) have to be considered. These tensile forces can be transferred through appropriate reinforcement (e.g. ring beam) or through other measures (columns, friction).

If shear forces occur at the same time, the load bearing capacity must be reduced as shown in Diagram 1.

$V_{Rd,\parallel}$ [kN/m]

$V_{Rd,\perp}$ [%-value from Table 2]

Diagram 1: Interaction Diagram of Shear Forces parallel and at right angles to the joint

Calculation Example - Wall Bearing

In this example the bearing loads are transferred through the **PHILIPP Power Duo System**.

Not only the dead weight of the wall, but also the dead weight of beams and roof as well as variable loads are considered.

Picture 9
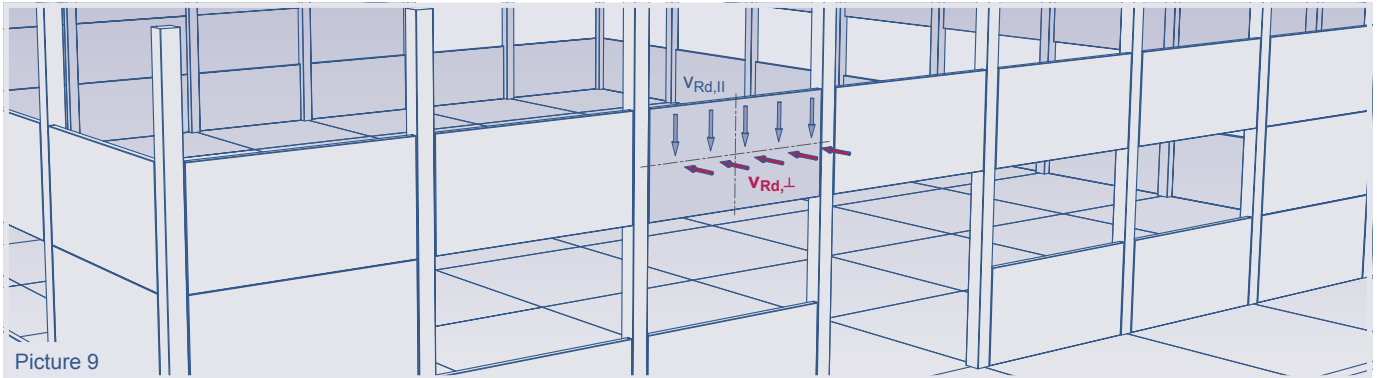
Acting loads at the joint:

• Dead weight from wall: $2,5m \times 4m \times 0,14m \times 25kN/m^3 = 35kN$

• Dead weight from roof and beams: 120kN

• Relevant variable loads: 30kN

The design load is calculated as follows (shear force parallel to the joint):

$v_{ed,\parallel} = (1,35 \times (35kN + 120kN) + 1,5 \times 30kN) / 2 = 127,2kN$ per joint
$v_{ed,\parallel} = 127,2kN / 2,5m = 50,9kN/m$

The shear force at right angles to the wall by wind is (acc.to DIN 1055-4):

$v_{ed,\perp} = 1,5 \times (0,8kN/m^2 \times 0,5 \times 2,5m \times 4,0m) / 2 = 3kN/m$ per joint

Chosen concrete class: C30/37

At the web site www.philipp-gruppe.de a calculation program is provided which can be used without registration for the calculation of Power Duo System.

The resistance forces result into the following values (shear forces parallel and at right angles to the wall):

Shear force parallel: $v_{Rd,\parallel} = 80kN/m$
Shear force at right angles to the wall: $v_{Rd,\perp} = 9,7kN/m$ (value from Table 2)

If both shear forces occur at the same time, an interaction (Diagram 1) must be considered:

Percentage of shear force parallel: $v_{ed,\parallel} / v_{Rd,\parallel} = 50,9kN / 80kN = 63,6\%$

Due to the linear interaction the permissible percentage of shear force at right angles to the wall is: 100% - 63,6% = 36,4%

The reduced shear force at right angles to the joint is therewith:

$red.v_{Rd,\perp} = 0,36 \times 9,7kN/m = 3,5kN/m$

The example shows that not only the self weight can be considered for application of the **Power Duo System** but also loads from beams and roof are not a problem.

Fire Resistance

This connecting construction is additional to the approval approved by MPA Braunschweig regarding the fire resistance (F90). It lets no smoke or fire pass prior the 90th minute. Even inadmissible increase of temperature does not occur with this construction so that the stability is not endangered by fire.

Installation of Power Duo mounting parts

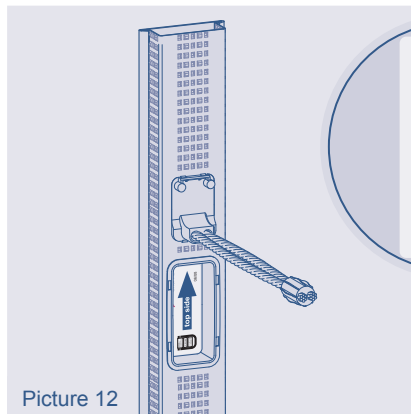The **PHILIPP Power Duo** can be fixed at the mould by nailing and by hot-gluing (see Picture 10 and 11).
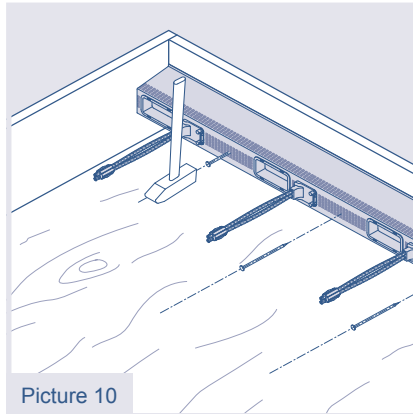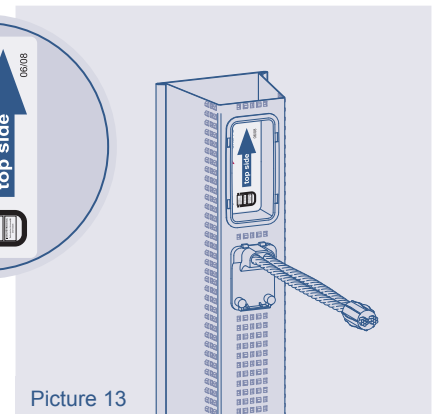
Picture 10
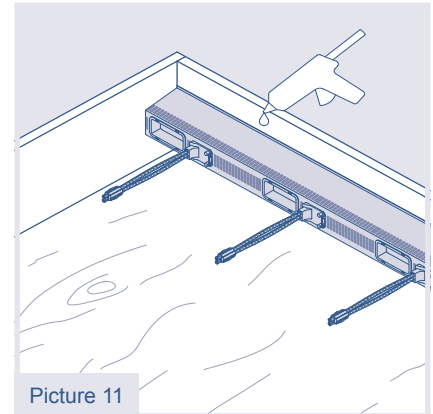
Picture 11

The **PHILIPP Power Duo System** consists of a flat and a deep rail. Both rails are marked with a label which shows manufacturer, product name and installation direction.
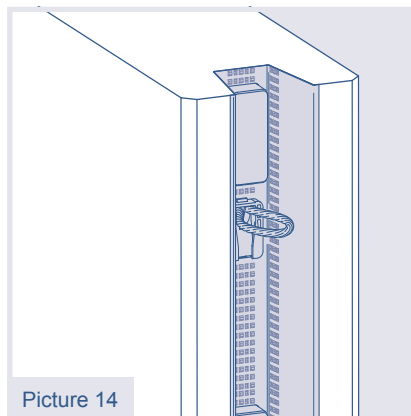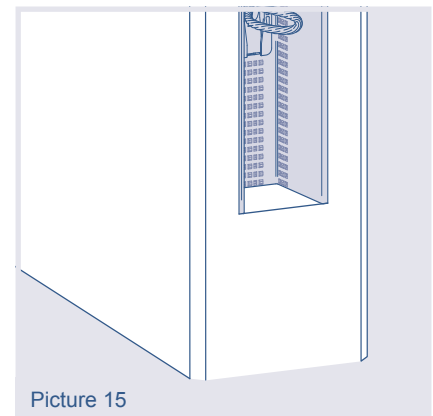
Picture 12

Picture 13

For units with the same height it is recommended to begin at the top side of the unit (Picture 14). Thereby it is allowed to concrete the rail free area (Picture 15).
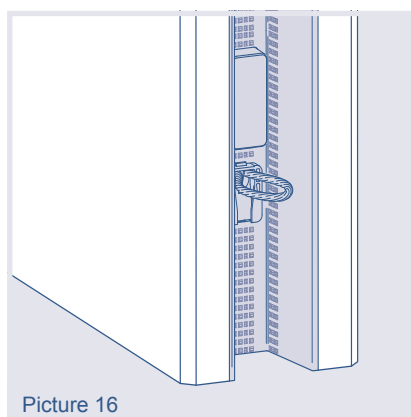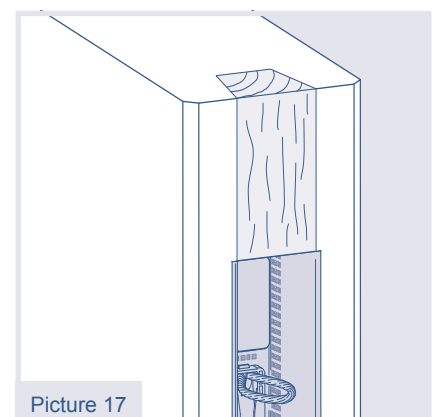
Picture 14

Picture 15

If the installation is started at the bottom side of the unit (Picture 16) the rail free area must be recessed with a timber board (Picture 17) to enable to fill the joint.
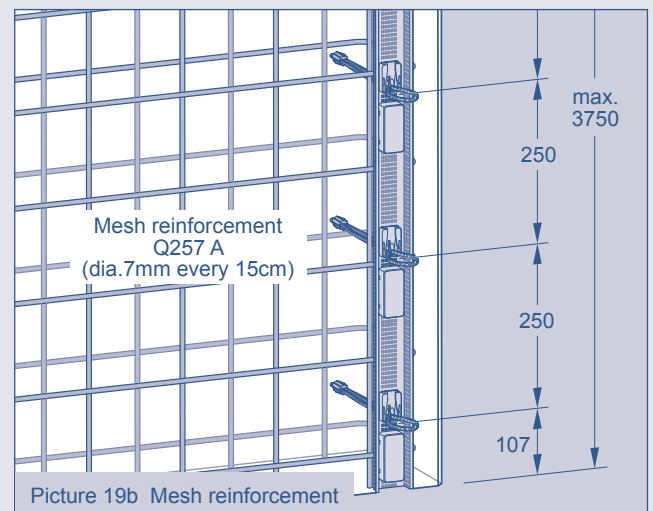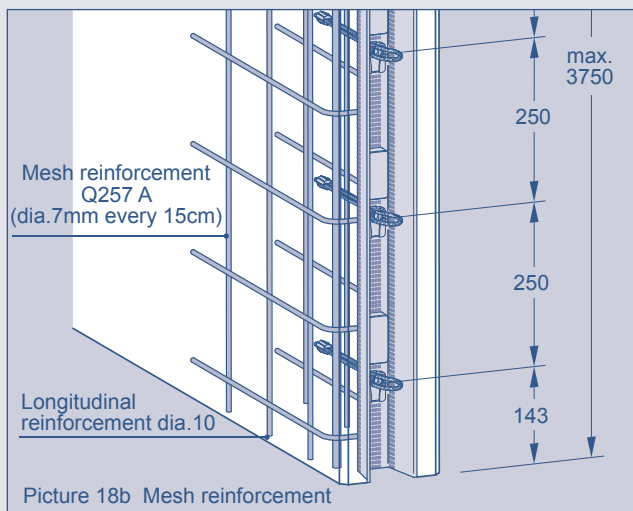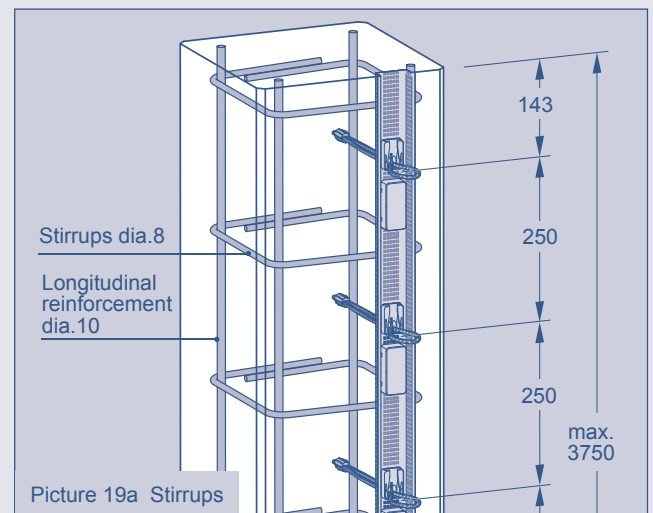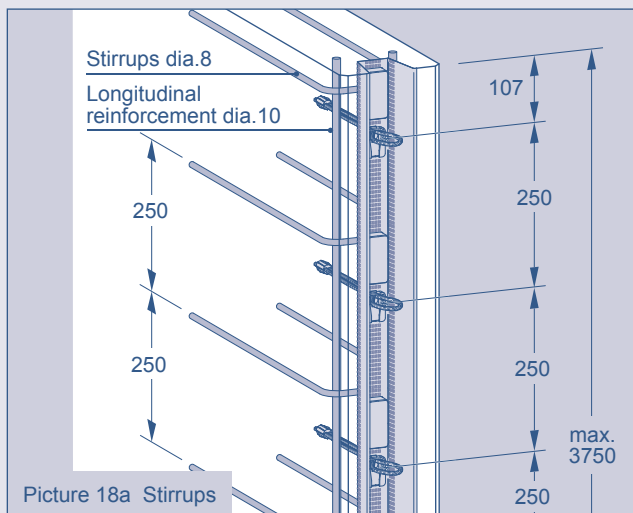
Picture 16

Picture 17

PHILIPP POWER DUO SYSTEM REINFORCEMENT

Reinforcement

If a flush installation of **PHILIPP Power Duo System** is made, all requirements for edge distances (Picture 18a, 18b, 19a and 19b) are fulfilled. Additionally please see section "Manufacture of Precast Concrete Units".

To ensure that the introduced forces of the connecting loop are transferred into the wall, a minimum reinforcement of the precast elements with stirrups dia.8mm every 25cm and 2 bars dia.10mm (alignment in Picture 18a, 19a) is required.

Picture 18a Stirrups

Picture 19a Stirrups

Picture 18b Mesh reinforcement

Picture 19b Mesh reinforcement

⚠ The stirrups may alternatively be replaced through comparable mesh reinforcement (see Picture 18b and 19b).

This requirement is e.g. fulfilled by mesh reinforcement Type Q257A (dia. 7mm every 15cm).

The end anchorage of the connecting loops must be aligned rectangular to the **PHILIPP Power Duo** in the precast unit. If an installation in the vertical formwork is preferred, the alignment of the wire loops ends in the precast unit should be guaranteed by tying wire to the reinforcement.

⚠ A bending as shown in Picture 20 is not permitted.

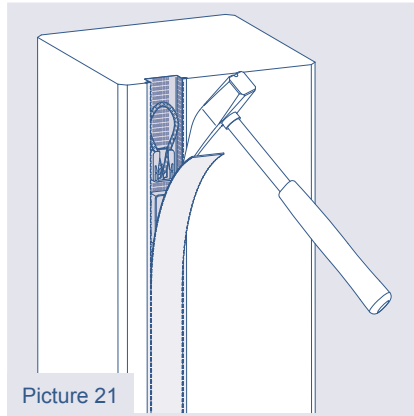Picture 20
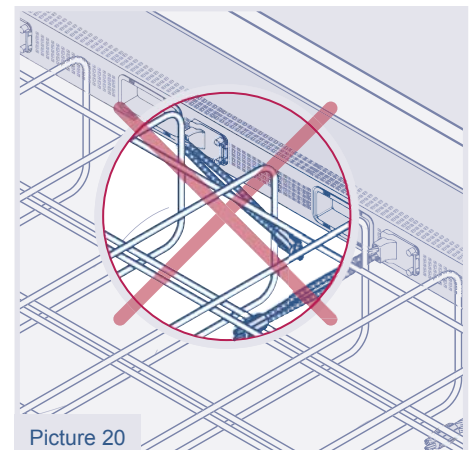
Manufacture of Precast Concrete Units

Due to the perforation the removal of the cover is easy. The rail cover of the concreted mounting part is removed at the side. Then the inner part of the cover can be taken off easily.

After removing the rail cover the loops can be folded out until they have a position of 90° to the rail.
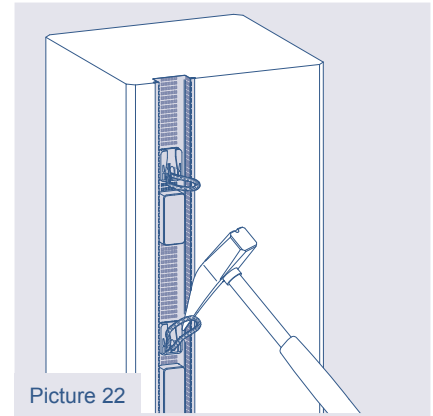

Picture 21

Picture 22

When the loops are aligned rightly the loops overlap each other by the given nominal measure of 70mm (Picture 23) and lay in vertical direction upon each other (Picture 24). If the anchorage loop is bent it must be paid attention that the horizontal part is ≥ 40mm (see Picture 25).

BSt500S dia.12
70
20

Picture 23

BSt500S dia.12

Picture 24

The approval of the **PHILIPP Power Duo System** takes the horizontal and vertical mounting tolerances into account already. The maximum allowable deviations are shown in Picture 26 to 28.
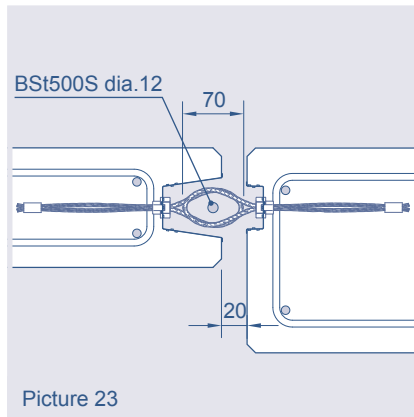
Prior to the setting of step ends of the grouting joints, a concrete reinforcing bar (dia.12 mm) should be positioned along the entire length of the joint (when using a joint tape be careful that it does not impede the grouting profile or reduces the required concrete cover for the **PHILIPP Power Duo**). Proper installation should be observed visually. Step ends should thereafter be set on the sides of the joints and filled using **PHILIPP Grouting Mortar**. The use of a grouting hose with a hopper eases the process considerably. To reduce the pouring pressure, it is recommended that **PHILIPP Grouting Mortar** is filled in layers.
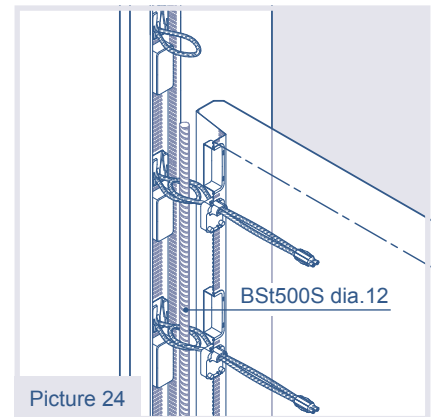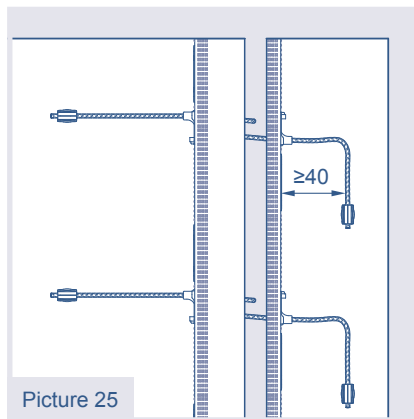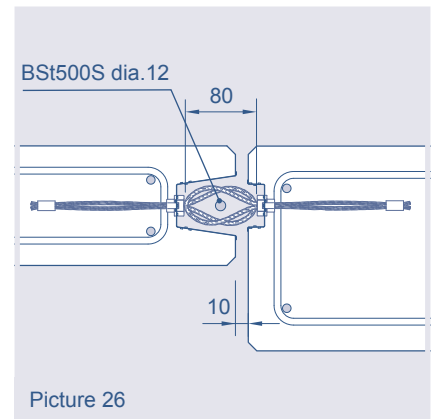

≥40

Picture 25

BSt500S dia.12
80
10

Picture 26

BSt500S dia.12
50
40

Picture 27

max.30
BSt500S dia.12

Picture 28

PHILIPP POWER DUO SYSTEM GROUTING MORTAR
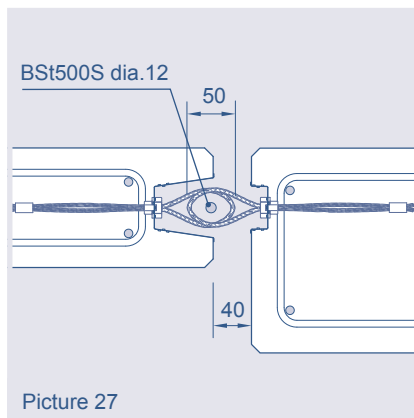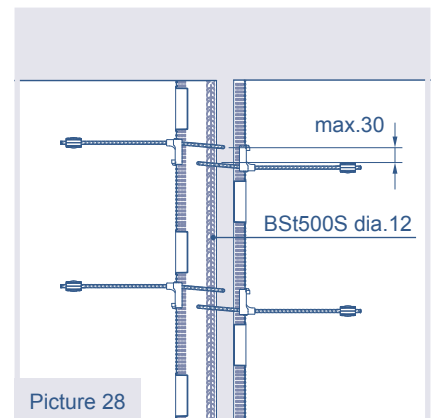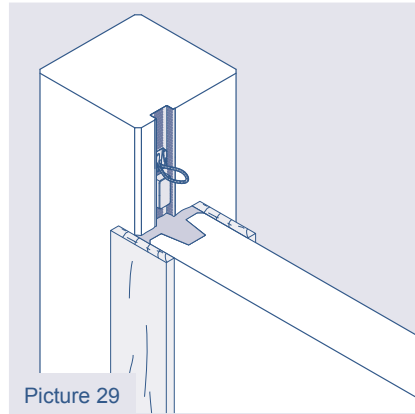
Processing Instructions and Properties of PHILIPP Grouting Mortar

PHILIPP Grouting Mortar is a ready-to-use dry mixture on a cement basis for grouting of precast concrete units. It is free of shrinkage and has a high strength and good flow ability.

Picture 29

Picture 30

Properties

PHILIPP Grouting Mortar is free of chlorides. It has a good bond with steel and concrete and allows no separation of the components. Furthermore it has a good pump ability and a good frost and de-icing salt resistance. **PHILIPP Grouting Mortar** is produced in reliably consistent quality and is easy to process. Due to its flowing consistency, the mortar is self-levelling and fills out all accessible, venting hollow spaces.

Preparation

The subsurface must be free of dirt such as oils, greases, etc. Cement slurry leavings on the surface shall be removed. A seal formwork should be used. To improve grip, the joint surface should be pre-wetted thoroughly.

Mixing

Approximately 2/3 of the mixing water is put into the mixer; the **PHILIPP Grouting Mortar** is then completely stirred in. Afterwards the remaining water can be used to adjust the consistency. Mixing takes 4 – 6 minutes depending on the type of mixing.

Note

During grouting, air must be able to escape. Careful compactions can prevent trapped air. The processing time is about 60 minutes at 20° C.

Processing Temperature

DIN 1045-2 and DIN EN 206-1 must be taken into account when working with **PHILIPP Grouting Mortar**. These standards give a processing temperature of at least +5° C.

Post-treatment

It should be prevented that **PHILIPP Grouting Mortar** dries up too fast for at least three days after application. Appropriate procedure includes covering with plastic sheets, wet tissues or irrigation.

Table 3: Mechanical Strength Properties of Grouting Mortar

Characteristic	1 day	3 days	7 days	28 days
	[N/mm²]			
Compressive Strength	44	55	70	80
Bending Tensile Strength	5.8	8	10	10

Increase of Volume

Bulking amounts to at least 0.1% after 24 hour

Consumption

25 kg dry mortar results in 13 - 14 litres **PHILIPP Grouting Mortar.**

Table 4: Grout Consumption

Unit Thickness [mm]	Joint Width [mm]	Grout Consumption per 1 m Joint	
		[l/m]	[kg/m]
140	20	8.0	15.4
160	20	8.4	16.1
180	20	8.8	16.9
200	20	9.2	17.7

Delivery form

25 kg paper/PE bags

PHILIPP Grouting Mortar can be purchased from:

PHILIPP GmbH   **Tel.: +49 (0) 6021 / 40 27-300**

PHILIPP GROUP

Ropes

- wire rope slings
- crane and forest ropes
- wire, hemp and polyamide ropes
- hoisting and special ropes
- polypropylene ropes
- rope connections

Lifting, attachment and lashing equipment

- load restraint systems
- RUD sling chains
- load suspension devices
- round slings, sling bands and lifting equipment
- rope and chain acccessories
- lifting beams

Transport and mounting systems for prefabricated units

- transport anchors
- spherical-head anchor system
- fixing sockets
- connecting technique

Hydraulic, pneumatics and conveyor technique

- hydraulic units and components
- pneumatic, connector systems and acccessories
- Hoses, fittings and acccessories
- machines, tools, machinery systems and acccessories