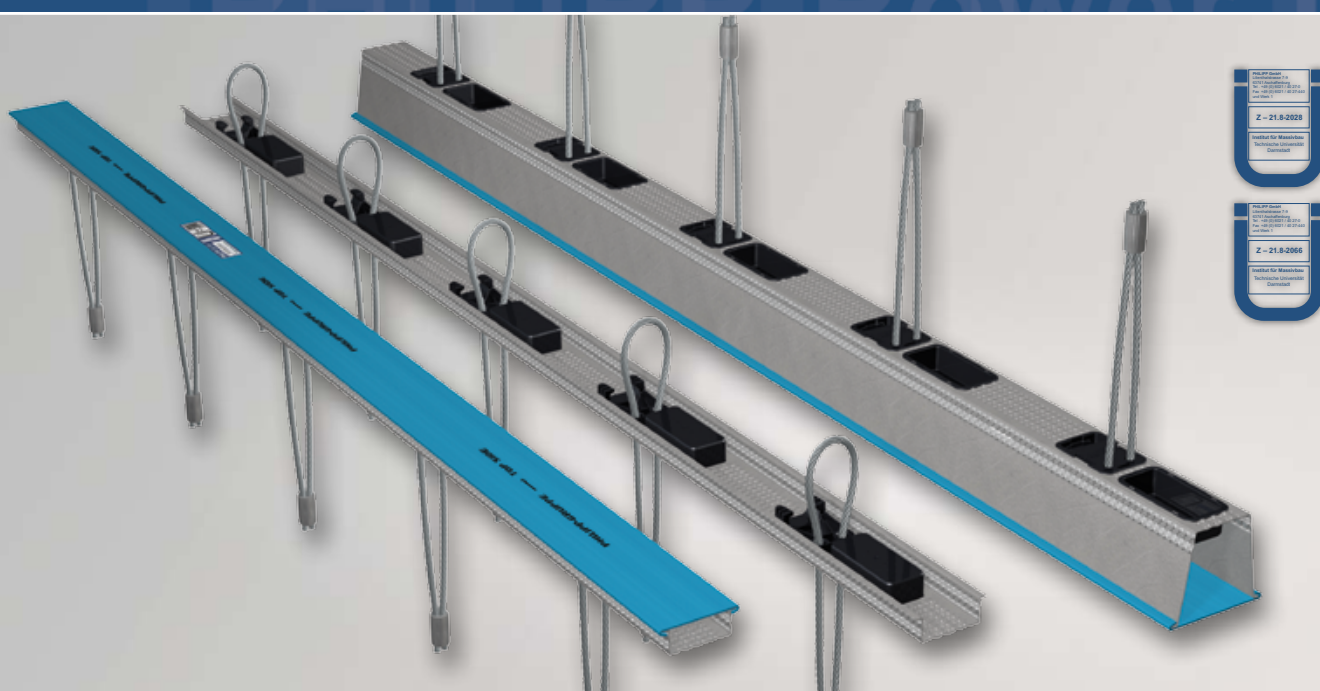


PHILIPP GROUP

PHILIPP Power Duo System



VB3-V-001-en - 09/17

Installation Instruction

Transport and mounting systems for prefabricated building

■ Technical department

Our staff will be pleased to support your planning phase with suggestions for the installation and use of our transport and mounting systems for precast concrete construction.

■ Special designs

Customized to your particular needs.

■ Practical tests on site

We ensure that our concepts are tailored precisely to your requirements.

■ Inspection reports

For documentation purposes and your safety.

■ On-site service

Our engineers will be pleased to instruct your technicians and production personnel at your plant, to advise on the installation of precast concrete parts and to assist you in the optimisation of your production processes.

■ High safety level when using our products

Close cooperation with federal materials testing institutes (MTIs), and official approvals for the use of our products and solutions whenever necessary.

■ Software solutions

The latest design software, animated videos and CAD libraries can always be found under www.philipp-gruppe.de.

■ Engineering contact

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Fax: +49 (0) 6021 / 40 27-340
E-mail: technik@philipp-gruppe.de

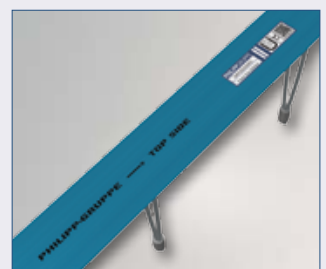
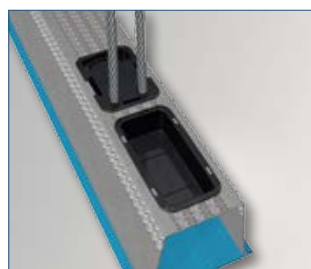
■ Sales contact

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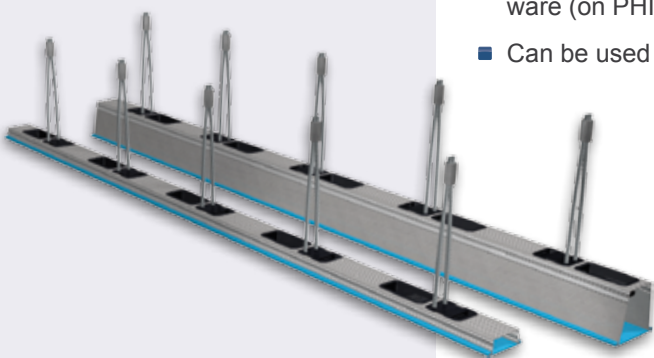


Content

■ System components	Page	5
■ Application	Page	6
■ Dimensions of concrete unit / length of joints	Page	6
■ Range of applications	Page	6
■ Installation of the rails	Page	7
■ Fire Protection	Page	7
■ Application for fire walls	Page	8
■ Fire wall	Page	8
■ Forces on non-loadbearing fire walls	Page	8
■ Lying, non-loadbearing walls	Page	8
■ Standing, non-loadbearing walls	Page	9
■ Horizontal joints	Page	11
■ Design and construction	Page	12
■ Design examples	Page	14
■ Reinforcement	Page	18
■ Installation	Page	19
■ Installation of the Power Duo rails	Page	19
■ Preparation for mounting	Page	20
■ Mounting	Page	21
■ Mounting of the precast elements	Page	21
■ Thixo mortar	Page	22
■ Joint grouting with PHILIPP - BETEC® Thixo-mortar	Page	22
■ Joint grouting with EuroGrout® Universalfüller	Page	23
■ Grouting mortar	Page	24
■ Joint grouting with PHILIPP - BETEC® Grouting mortar	Page	24
■ Joint grouting with EuroGrout® Varix	Page	25
■ Software / CAD	Page	26
■ General notes	Page	27
■ Construction site check list	Page	27
■ Mortar consumption (BETEC® / EuroGrout®)	Page	27



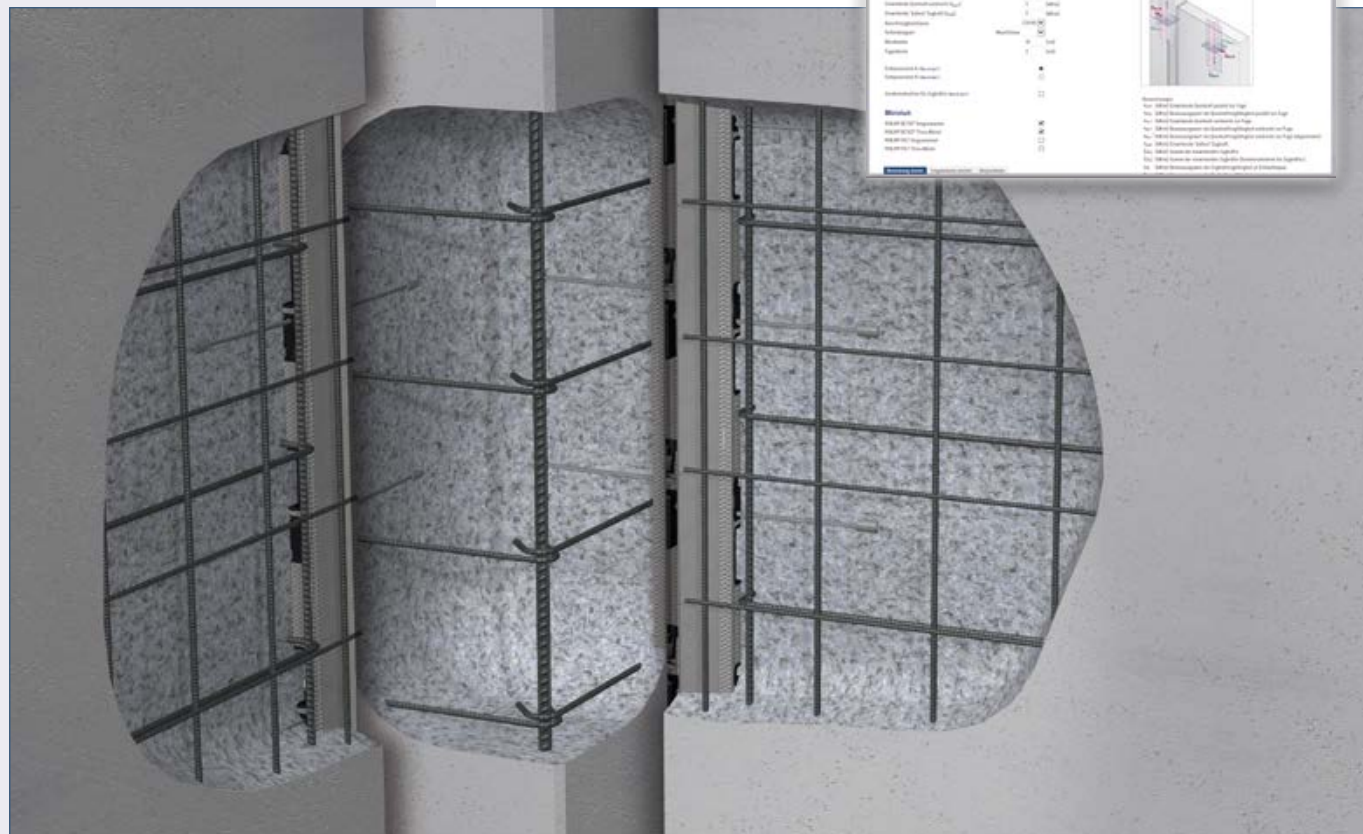
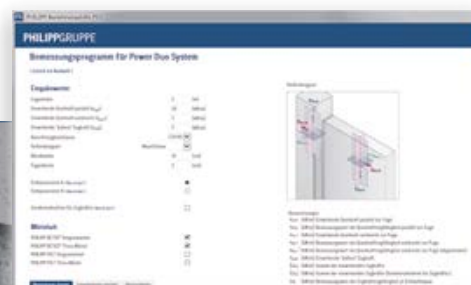
PHILIPP Power Duo System



Advantages at a glance:

- Power Duo rails are combinable with products of two mortar suppliers.
- More tolerant in case of faulty installation, e.g. false position of the loops.
- Forces in all directions transmittable
 - tension forces, lateral forces parallel and right-angled to the joint.
- Approved application
 - with thixotropic mortar as well as grouting mortar.
- Most economical application using Thixo mortar
 - saves sealing of the joint and grouting in sections.
 - saves time and reduces costs.
- Reduced efforts for design and planning using our free online design software (on PHILIPP website).
- Can be used in fire walls.

Our design software you will find at
PH www.philipp-group.de



System components

System components and dimensions

The Power Duo System is used to connect precast concrete units where high static forces have to be transferred and proofed. It is able to transfer shear and tension 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.

All components of the Power Duo System are optimally coordinated, it consists of two differently deep, profiled and galvanised channels.

Both channels are equipped with plastic recess formers and galvanised steel wire loops each with a distance of 250 mm. During concreting the plastic recess formers are filled and in combination with the profiled channel and the wire loops the system enables an excellent load bearing capacity.

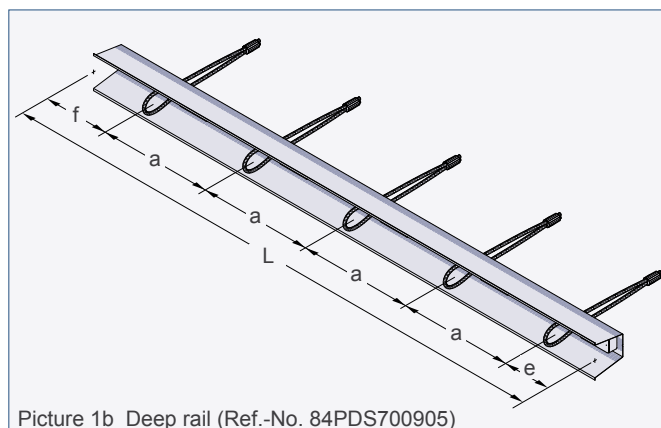
The two rails are installed flush with the surface on the opposite side of each particular concrete unit.

After demoulding, the plastic cover is removed and the loops are folded down easily to the position needed. So, the concrete units are ready for transport and mounting at the job-site.

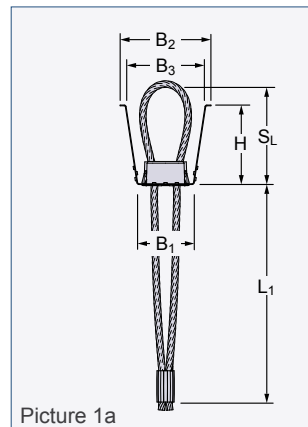
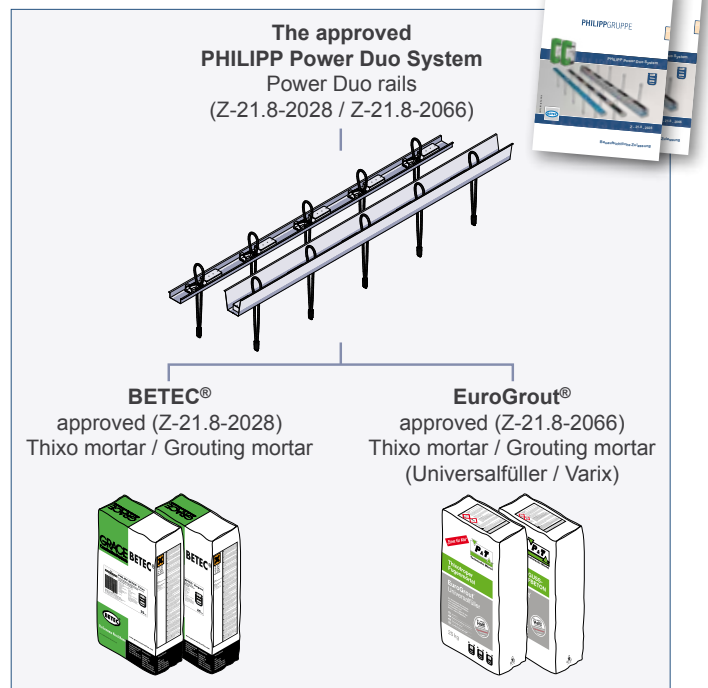
Due to the possibility to install wall elements directly between columns already positioned (e.g. with skeleton construction) the outcome of this is a significant reduction of time. Finally, the joints are filled with a belonging Thixo mortar (page 22) or Grouting mortar (page 24) to generate a force transmitting and form-fit connection.



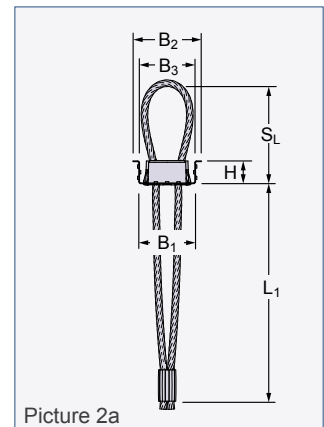
This Installation Instruction provides necessary technical information. In all cases, the requirements of the national German approval must be considered!



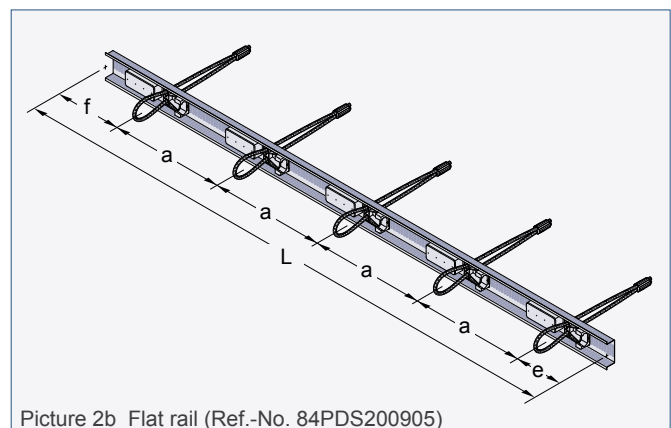
Picture 1b Deep rail (Ref.-No. 84PDS700905)



Picture 1a



Picture 2a



Picture 2b Flat rail (Ref.-No. 84PDS200905)

Table 1: Dimensions of the Power Duo rails

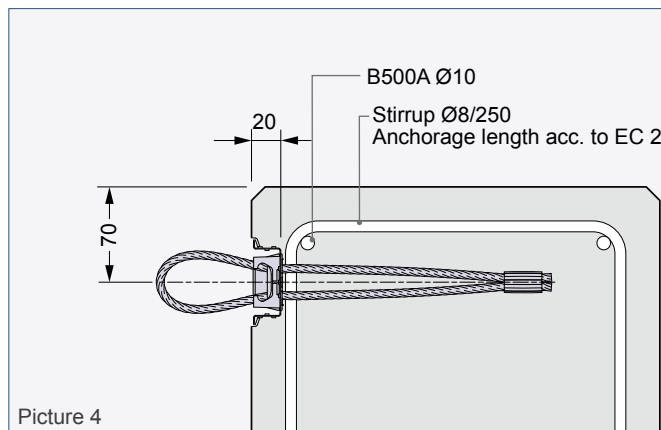
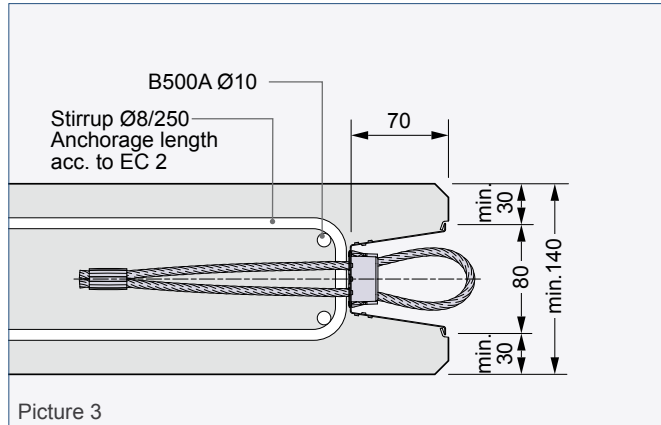
Ref.-No.	Dimensions [mm]										Weight per rail [kg]
	B ₁	B ₂	B ₃	H	L	L ₁	S _L	e	f	a	
84PDS700905	50	80	70	70	1250	190	90	107	143	250	1.99
84PDS200905	50	60	50	20							1.34

Application

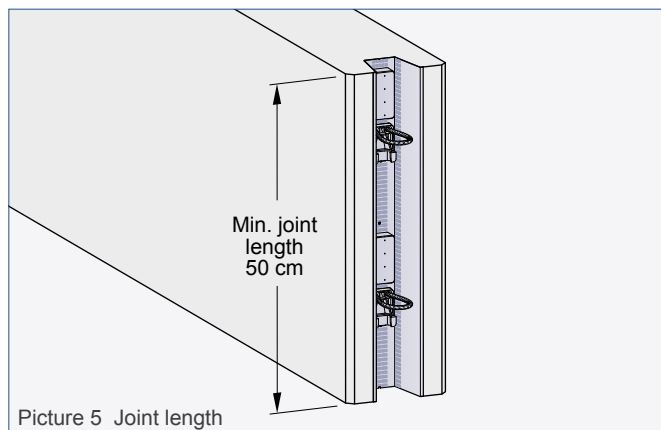
Dimensions of concrete units / length of joints

Due to the required concrete cover of 30 mm for the Power Duo rails the min. resulting wall thickness is 140 mm (picture 3).

In the following pictures only the required reinforcement for the Power Duo system is shown!

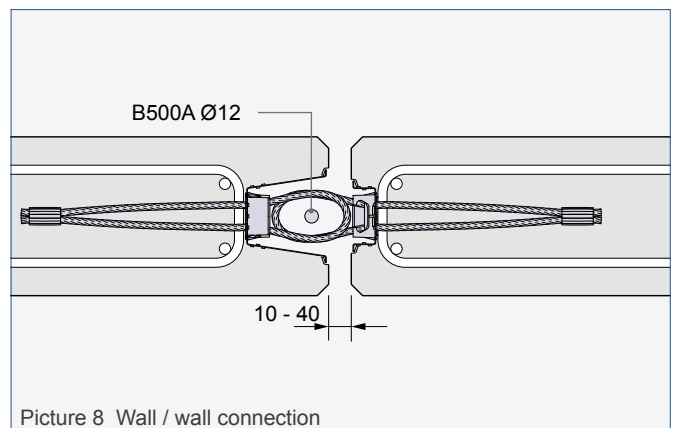
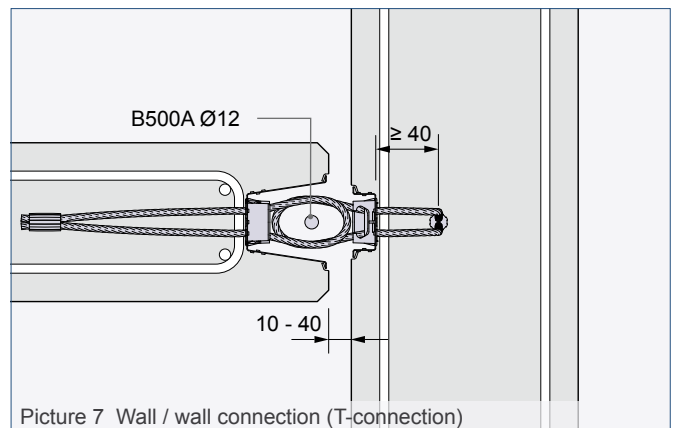
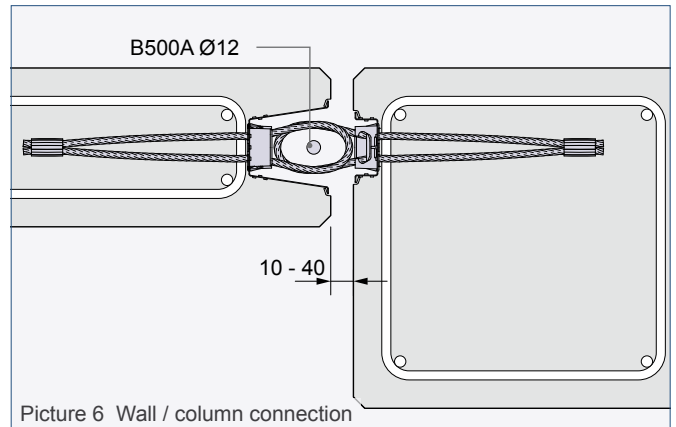


The minimum length of a joint must be 50 cm for the Power Duo system (minimum 2 loops are required so that a strut-and-tie-model can work). So, it is possible to install the Power Duo rails in shorter parts (page 20).



Range of applications

The Power Duo system can be used for various connections of reinforced concrete elements. It transfers primarily static shear forces parallel and right-angled to the wall as well as tension forces from predominantly static loads. Only in case of direct weathering on the connection between reinforced concrete elements it must be ensured for the application that the crack width in the joint is limited to $w \leq 0,3 \text{ mm}$.

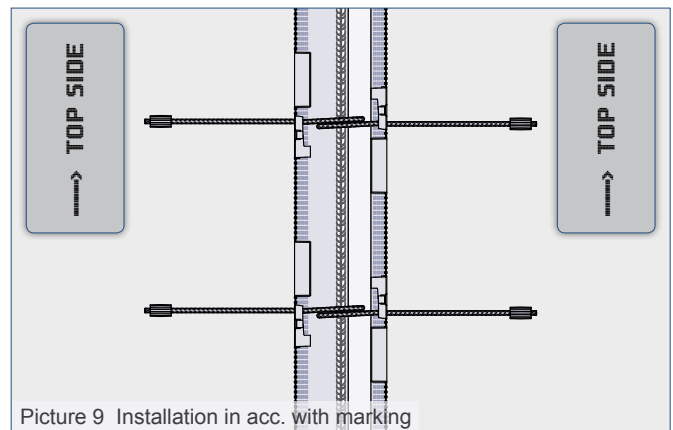


Application

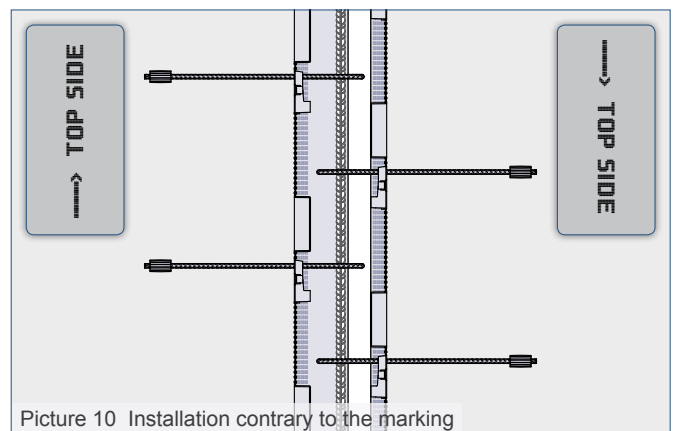
Installation of the rails

In general, the Power Duo rails shall be installed with care for the direction (see marking on the rails). If the installation is not done correctly there are still design values for bearing capacities available so that a verification is possible anyway (see also Picture 27 and 28).

Picture 9 shows the correct installation of the Power Duo rails. The opposite rails are arranged according to its marking. As a result, the wire rope loops do not have a false position in vertical direction.



In contrast, picture 10 shows an incorrect installation of the Power Duo rails. Here, one of the opposite rails is arranged against the direction given by the marking. False positions in vertical direction up to the maximum of half a wire rope loop distance (= 125 mm) are covered by a design value.



Fire protection

For the installation of the Power Duo system in walls with increased fire protection requirements up to fire resistance class F180 an expert report of the Materials Testing Institute (MPA) in Braunschweig, Germany, is available. Accordingly, a wall thickness of min. 15 cm is necessary for the fire resistance class F180. For wall thicknesses below 15 cm the fire resistance class is F120.



Application for fire walls

Fire wall

The Power Duo system can be installed in most fire wall constructions as a connection solution. Based on the approvals the Power Duo system provides connections equivalent to the construction details mentioned in DIN 4102-4:1994-03 chap. 4.8.5 - 4.8.8.

These details primarily refer to connection possibilities of non-loadbearing, lying or standing walls. The term "non-loadbearing wall" is defined (in DIN 4102-4:1994-03, chap. 4.1.1.2) approx. as follows:

Non-loadbearing walls are pane-shaped elements which, even in the event of fire, are loaded only by their self-weight and also do not serve as a stiffening against buckling of loadbearing walls; but they must transfer wind loads acting on their surface to loadbearing components, e.g. shear walls.

Lying, non-loadbearing walls

Following applications and construction details show connections of lying, non-loadbearing wall elements according to DIN 4102-04:1994-03 chap. 4.8.5 and 4.8.6.

Lying elements of a fire wall can be connected to columns directly by the installation of the Power Duo system **1** (Picture 12 and 13). For the connection of two lying walls to each other **2**, an additional connection is required e.g. a fixation with cast-in anchor channels to the columns (Picture 14). Horizontal joints **3** have to be executed according DIN 4102-4 (Picture 21 and 22).

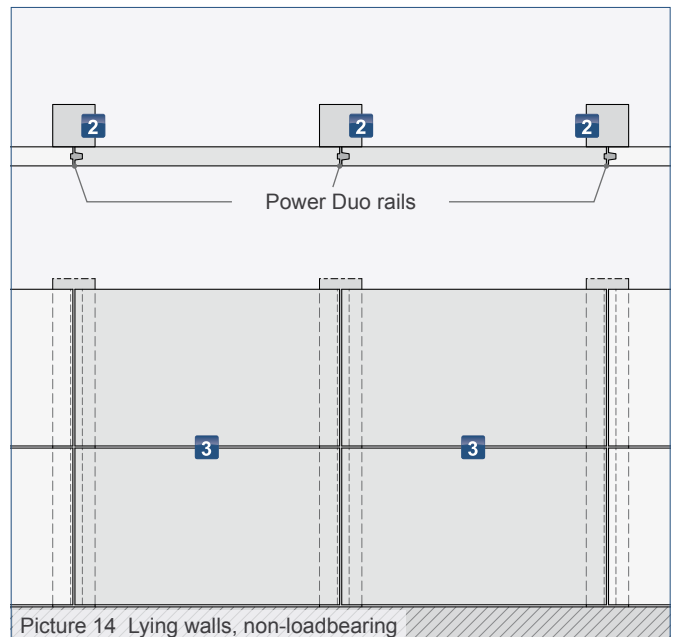
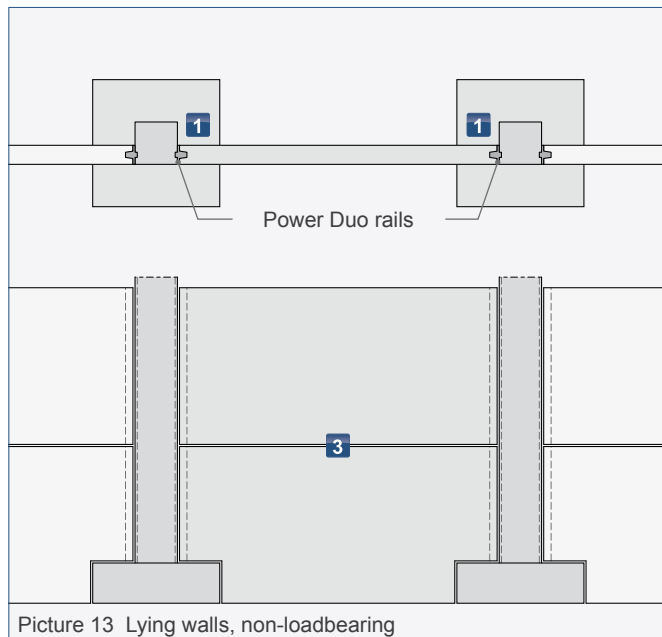
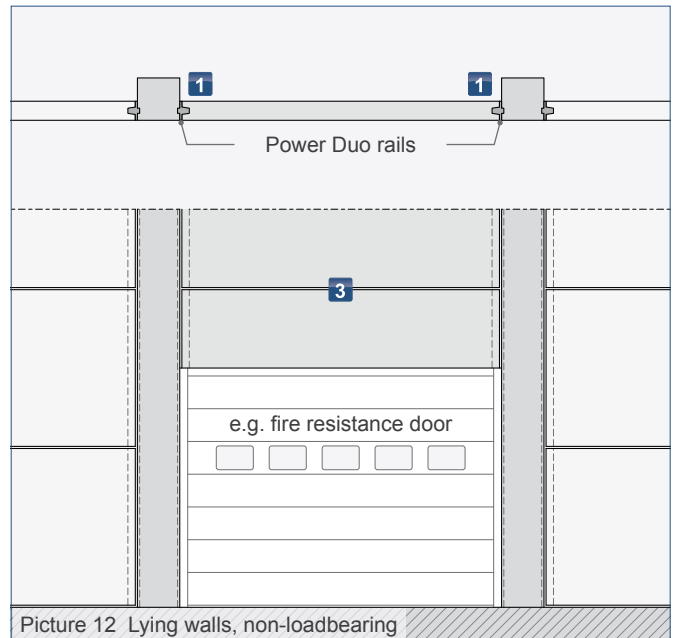
Details of the given connection possibilities in Picture 12 to 16 are shown on page 10 and 11.

Forces on non-loadbearing fire walls

permissible: Self-weight, wind pressure vertical to the wall plane

inadmissible: Additional loads, use as stiffening element

i For the planning of fire walls DIN EN 1992-1-2:2010-12 in combination with DIN EN 1992-1-2/NA:2010-12 and DIN 4102-4:1994-03 must be considered.



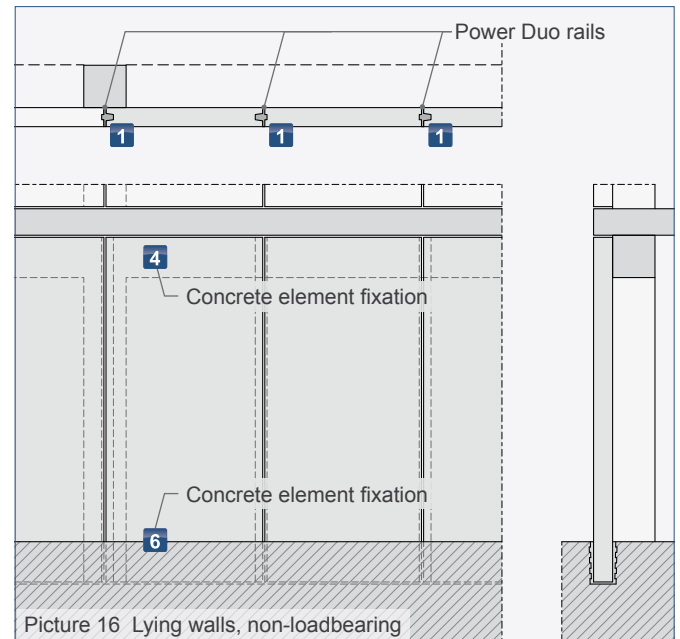
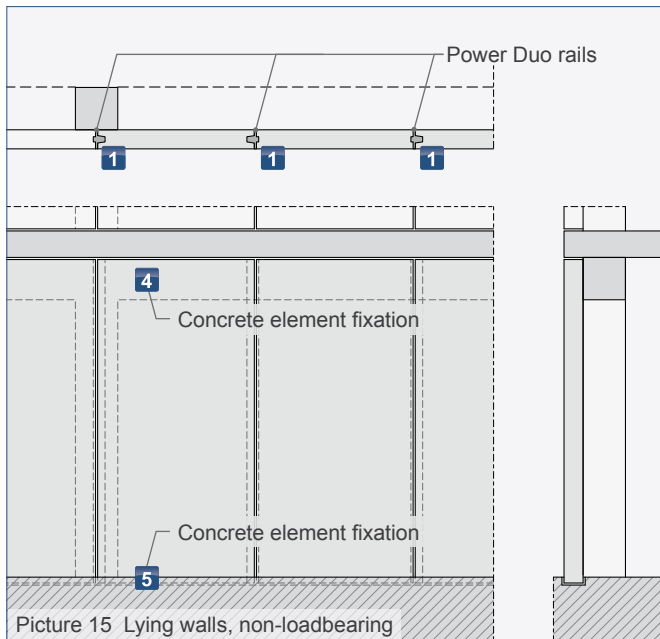
Application for fire walls

Standing, non-loadbearing walls

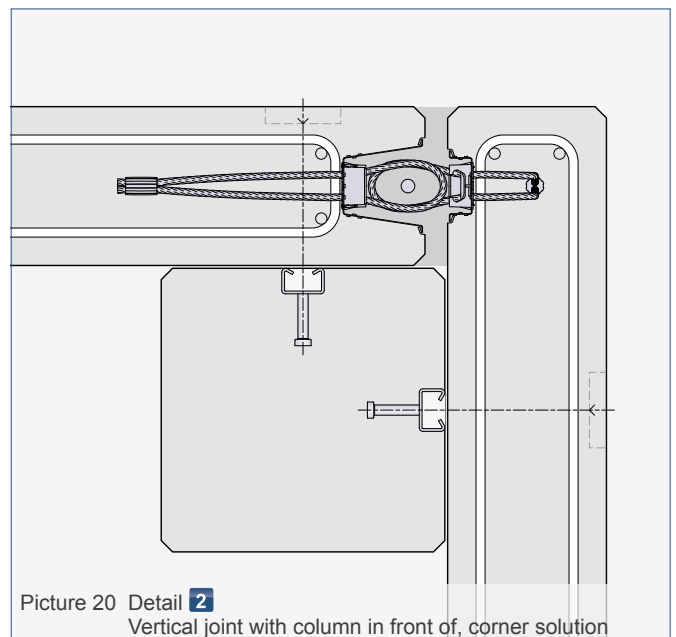
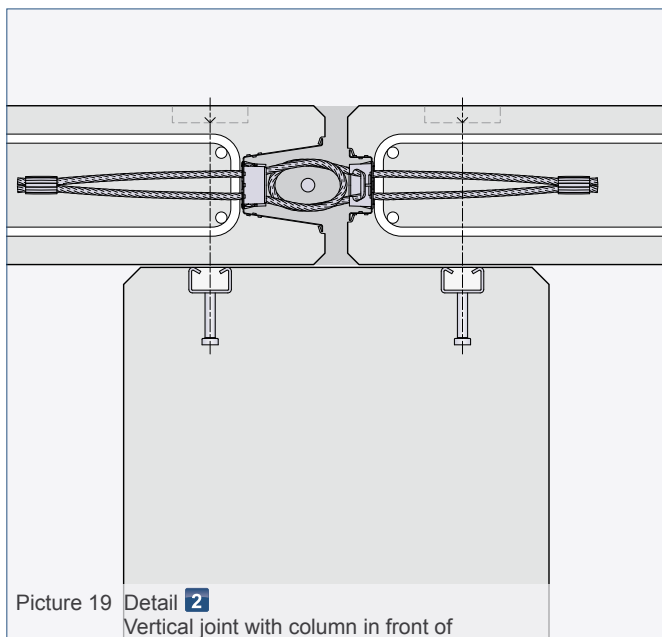
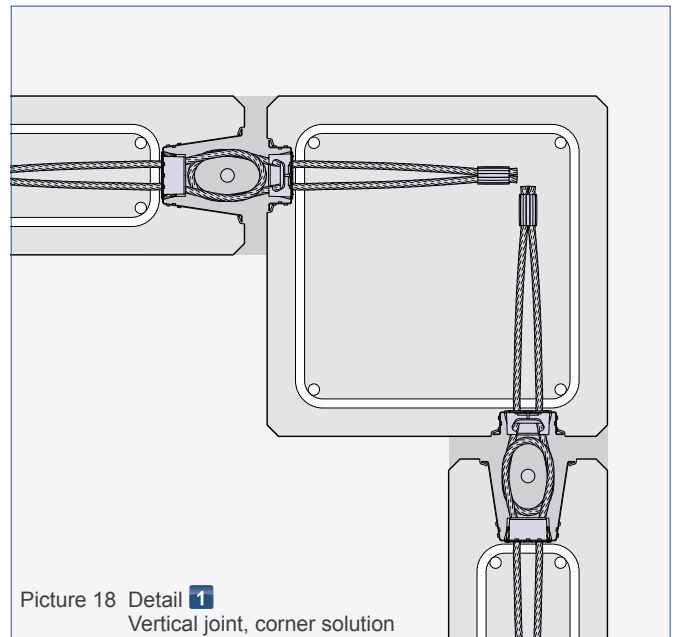
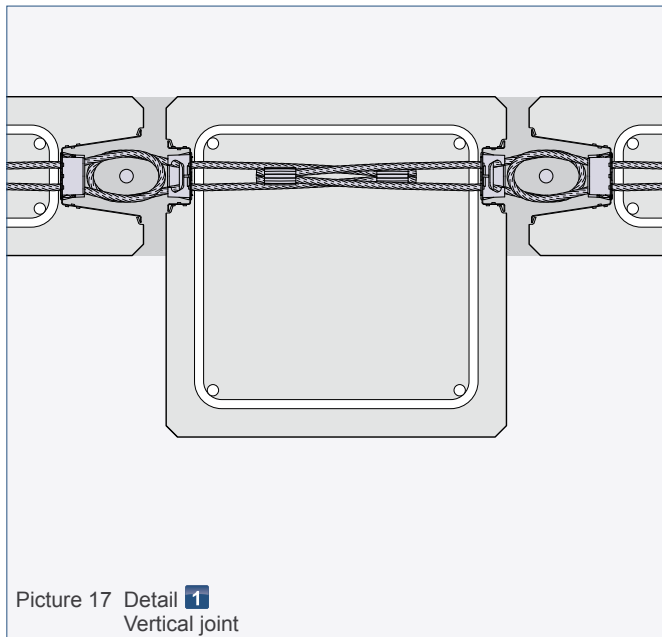
Following applications and construction details show connections of standing, non-loadbearing wall elements according to DIN 4102-04:1994-03 chap. 4.8.7.

Standing elements of a fire wall can be connected to columns directly by the installation of the Power Duo system **1** (Picture 15 and 16).

Here, it is required to fix the walls at the top and the bottom according to DIN 4102-04:1994-03 to a bearing construction. At the top, a connection e.g. with a cast-in anchor channel to a beam **4** is possible. At the bottom of the wall e.g. a recess **5** or a sleeve foundation **6** can be used for this.



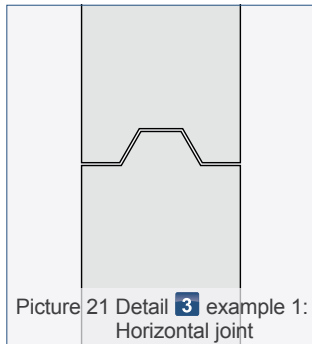
Application for fire walls



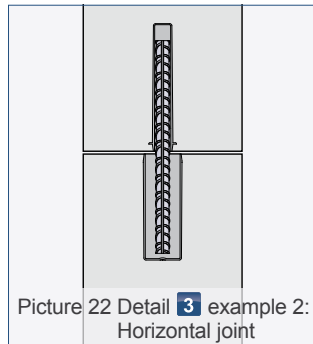
Application for fire walls

Horizontal joints

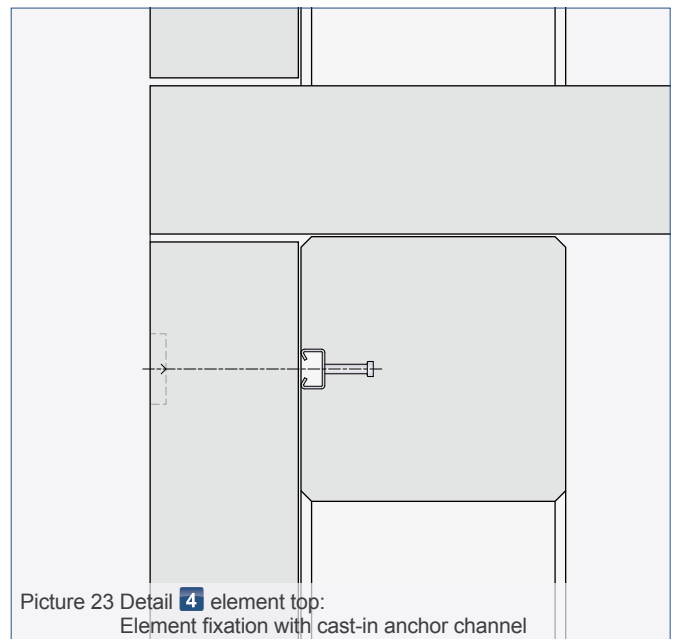
Construction details of horizontal joints between lying walls are given in chap. 4.8.8 of DIN 4102-04:1994-03. Both tongue-and-groove joints as well as smooth joints with dowel connections (e.g. PHILIPP Dowelling system) are possible and must be done with a joint sealer based on cement mortar or synthetic resin-based mortar.



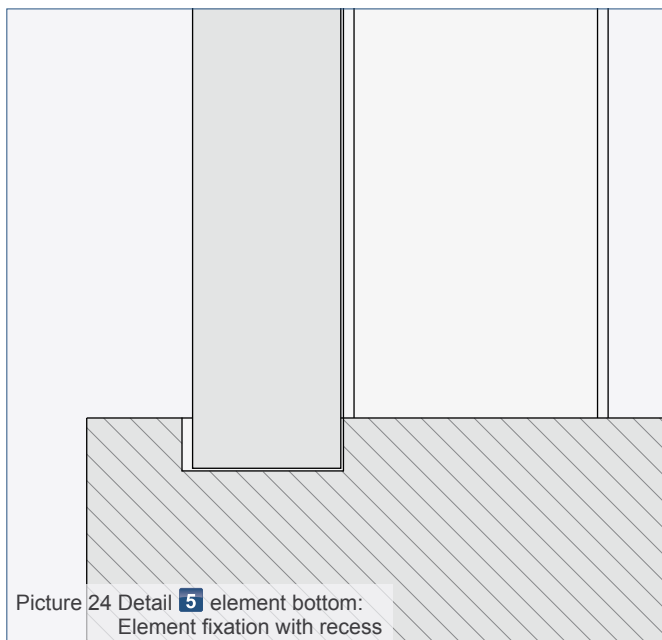
Picture 21 Detail 3 example 1:
Horizontal joint



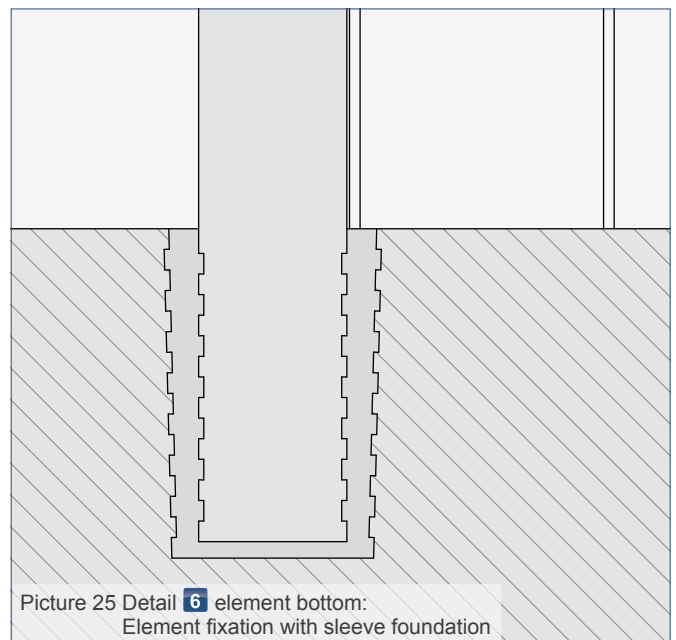
Picture 22 Detail 3 example 2:
Horizontal joint



Picture 23 Detail 4 element top:
Element fixation with cast-in anchor channel



Picture 24 Detail 5 element bottom:
Element fixation with recess



Picture 25 Detail 6 element bottom:
Element fixation with sleeve foundation

Design and construction

The precast concrete units to be connected must be designed according to EC 2. They have to be made of normal concrete with a concrete strength class of at least C30/37 according to DIN EN 206-1.

It is part of the structural engineer to design the units and prove the joint connections according to the national German approval. When designing the bearing capacities of the concrete element connection with the Power Duo system the type of the mortar used must be considered in advance. In the approvals Z-21.8-2028 (PHILIPP - BETEC®) and Z-21.8-2066 (P&T EuroGrout®) the thixotropic mortar as well as the grouting mortar are specified. In table 2 shear loads parallel to the joint ($v_{Rd,II}$) and in table 3 shear loads right-angled to the joint ($v_{Rd,L}$) are listed according to the approvals.

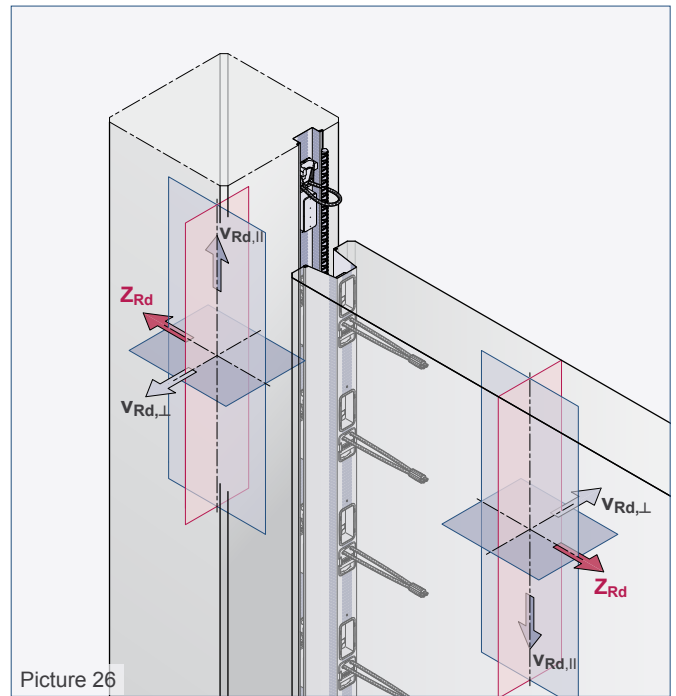
If shear loads parallel and right-angled to the joint appear at the same time, the load bearing capacities have to be reduced according to the diagrams in Picture 29 and Picture 30. Table 4 shows the bearing capacities for tensile forces (Z_{Rd}) of the Power Duo system in combination with thixotropic and grouting mortar. The acting tensile force has to be added as described below.

Here, two cases have to be differentiated:

Case 1: (Design example from page 14)

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

$$Z_{Ed,ges} = Z_{Ed,N} + 0.5 \times v_{Ed,II} + 0.25 \times v_{Ed,L}$$



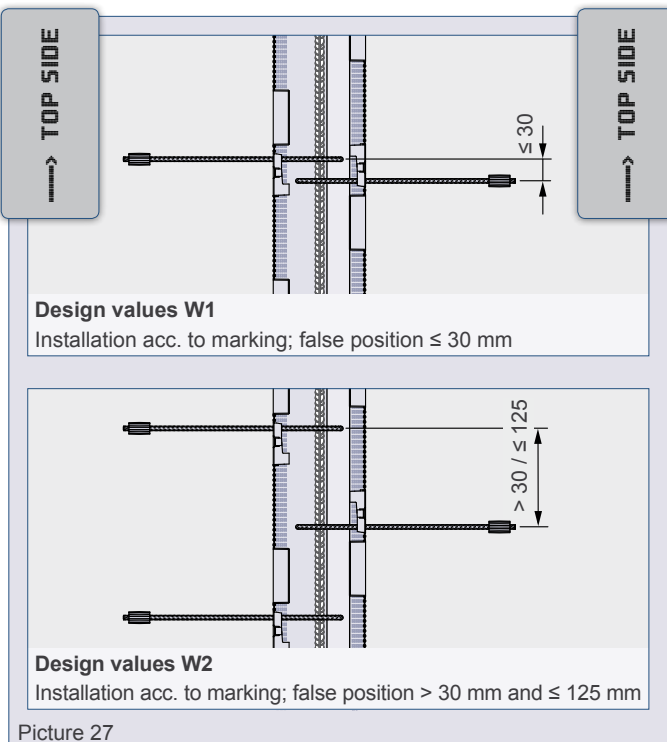
Picture 26

Case 2: (Design example from page 16)

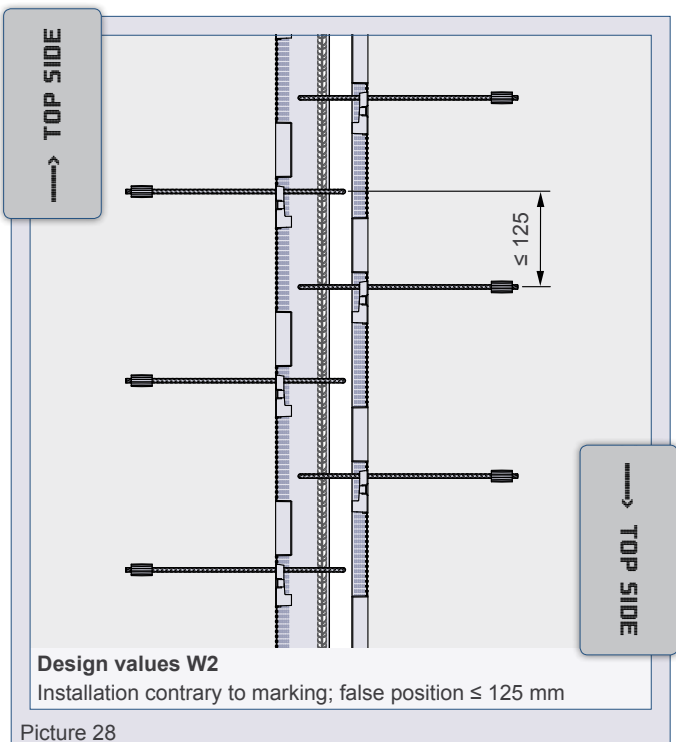
Constructive solution, which takes the acting tensile force (table 6).

$$Z_{Ed,ges} = Z_{Ed,N} + 0.25 \times v_{Ed,L}$$

Design values for the shear force bearing capacity $v_{Rd,II}$ and tensile force bearing capacity Z_{Rd}



Picture 27



Picture 28

Design and construction

Table 2: Design values of the shear force bearing capacity parallel to the joint

Wall thickness h [cm]	Design value of the shear force bearing capacity $v_{Rd, }$ [kN/m]			
	Design values W1		Design values W2	
	Grouting mortar BETEC® / EuroGrout®	Thixo mortar BETEC® / EuroGrout®	Grouting mortar BETEC® / EuroGrout®	Thixo mortar BETEC® / EuroGrout®
≥ 14	90.0	70.0	65.0	50.0

Table 3: Design values of the shear force bearing capacity right-angled to the joint

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

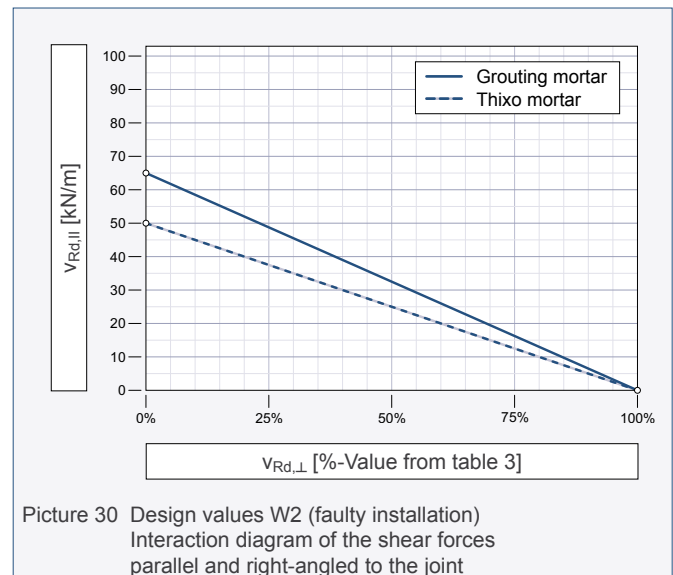
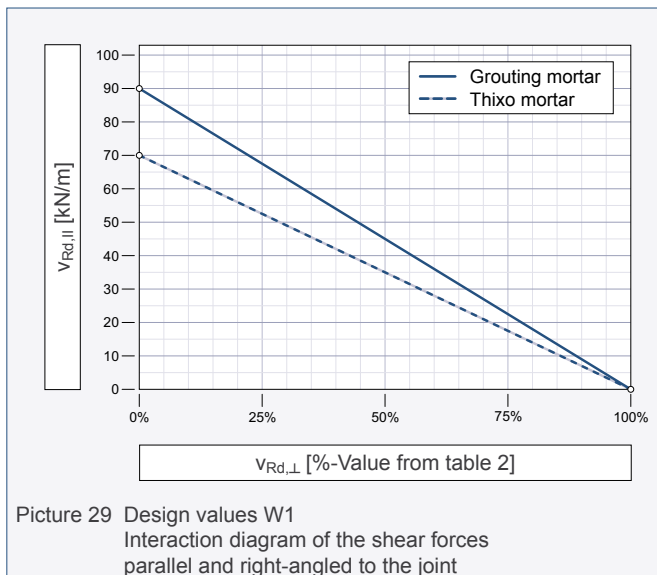
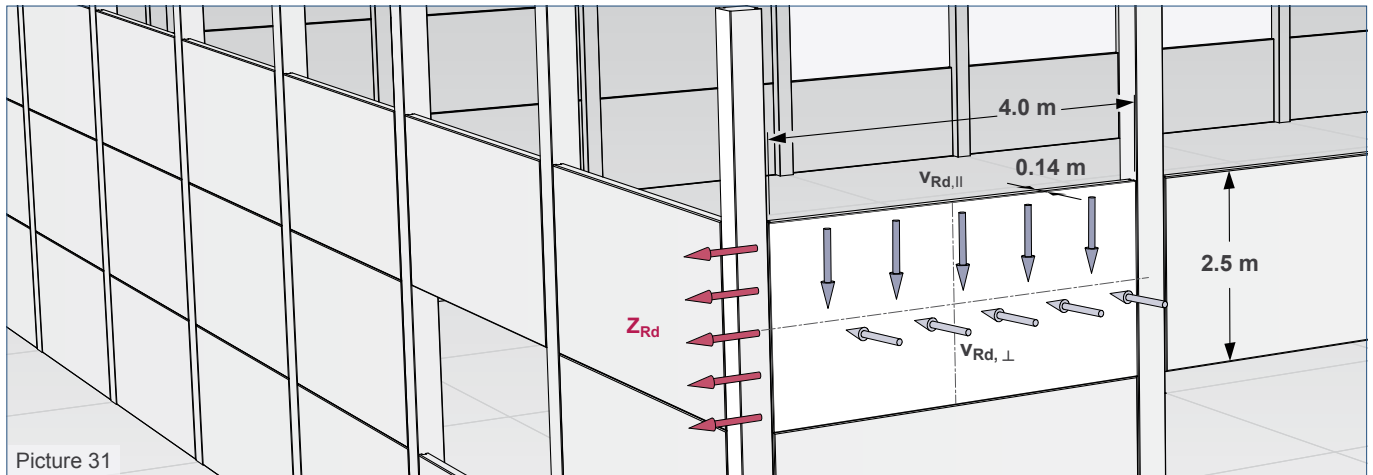


Table 4: Design value of the tensile force bearing capacity per wire rope loop

Wall thickness h [cm]	Design value of the tensile force bearing capacity $Z_{Rd,N}$ [kN/loop]			
	Design values W1		Design values W2	
	Grouting mortar BETEC® / EuroGrout®	Thixo mortar BETEC® / EuroGrout®	Grouting mortar BETEC® / EuroGrout®	Thixo mortar BETEC® / EuroGrout®
≥ 14	10.0	7.5	7.2	5.4

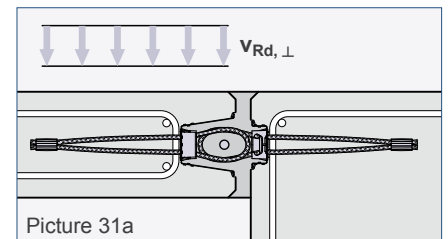
Design example case 1



Verification of tensile forces

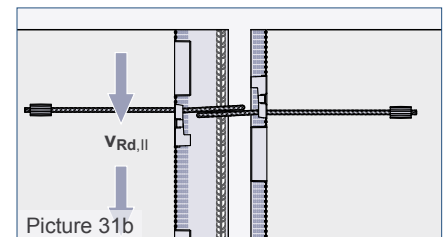
(No load transfer of tensile forces by constructive solutions)

Because of the different load directions (shear force parallel and right-angled to the joint) 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 5.



Design example: stiffening by a wall with tensile forces

This example shows a wall, which shall be installed as a stiffening member. The resulting shear forces parallel to the joint are taken by the Power Duo System with Thixo mortar and added with shear forces right-angled to the joint caused by wind.



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

n [1/m] : Numbers of wire loops per metre of joint, $n = 4$ loops/metre

Z_{Rd} [kN] : Design value of tensile force bearing capacity per wire loop according to table 4

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

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

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

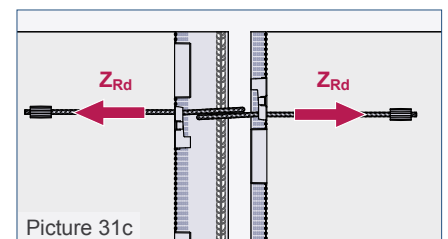


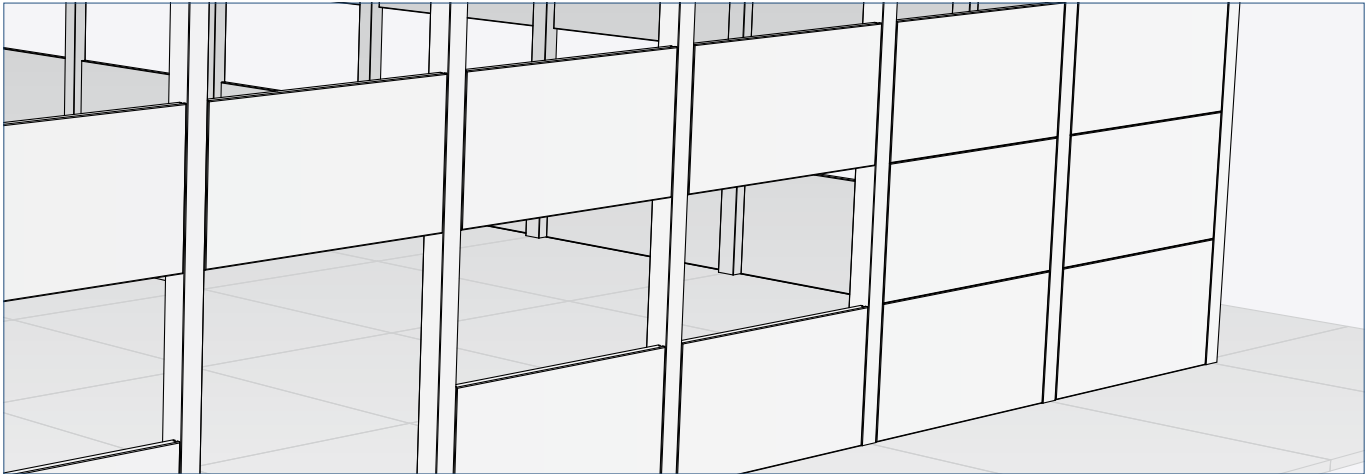
Table 5: Components of tensile force

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

Actions / boundary conditions:

- From wind
 - building height ≤ 10 m, wind load zone 3, midland, according to EC 1
 - $W_D = 1.5 \times (0.8 \text{ kN/m}^2 \times 1.0) = 1.2 \text{ kN/m}^2$
- Loads caused by the shear wall: 10.68 kN/m
- Wall thickness 14 cm
- Concrete strength C30/C37
- Tensile force: $Z_{Ed,N} = 10 \text{ kN/m}$
- Wall dimensions $L = 4.0 \text{ m}$; $H = 2.5 \text{ m}$
- Installation of the rails according to marking, vertical false position $\leq 30 \text{ mm}$

Design example Case 1



Resultant shear force parallel to the joint:

$$v_{Ed,II} = 10.68 \text{ kN/m} \times 4.0 \text{ m} / 2 / 2.5 \text{ m} = 8.54 \text{ kN/m}$$

The shear force right-angled to the wall results from the wind load:

$$v_{Ed,\perp} = (1.2 \text{ kN/m}^2 \times 2.50 \text{ m} \times 4.0 \text{ m}) / 2 / 2.5 \text{ m} = 2.4 \text{ kN/m per joint}$$

Resistance values for Thixo mortar resulting from wall thickness and concrete strength:

Shear load parallel: $v_{Rd,II} = 70 \text{ kN/m}$ (value from table 2, design value W1)

Shear force right-angled: $v_{Rd,\perp} = 9.7 \text{ kN/m}$ (value from table 3)

If both forces occur at the same time an interaction (Picture 29) must be considered:

Percentage of shear force parallel: $V_{Ed,II} / V_{Rd,II} = 8.54 \text{ kN} / 70 \text{ kN} = 12 \%$

The linear interaction results in a permissible shear force right-angled to the joint: $100 \% - 12 \% = 88 \%$

The reduced shear force right-angled to the wall can be set to 88 %:

$$\text{red. } v_{Rd,\perp} = 0.88 \times 9.7 \text{ kN/m} = 8.5 \text{ kN/m}$$

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).

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

$$z_{Ed,VII} = 0.5 \times 8.54 \text{ kN/m} = 4.27 \text{ kN/m}$$

$$z_{Ed,V\perp} = 0.25 \times 2.40 \text{ kN/m} = 0.6 \text{ kN/m}$$

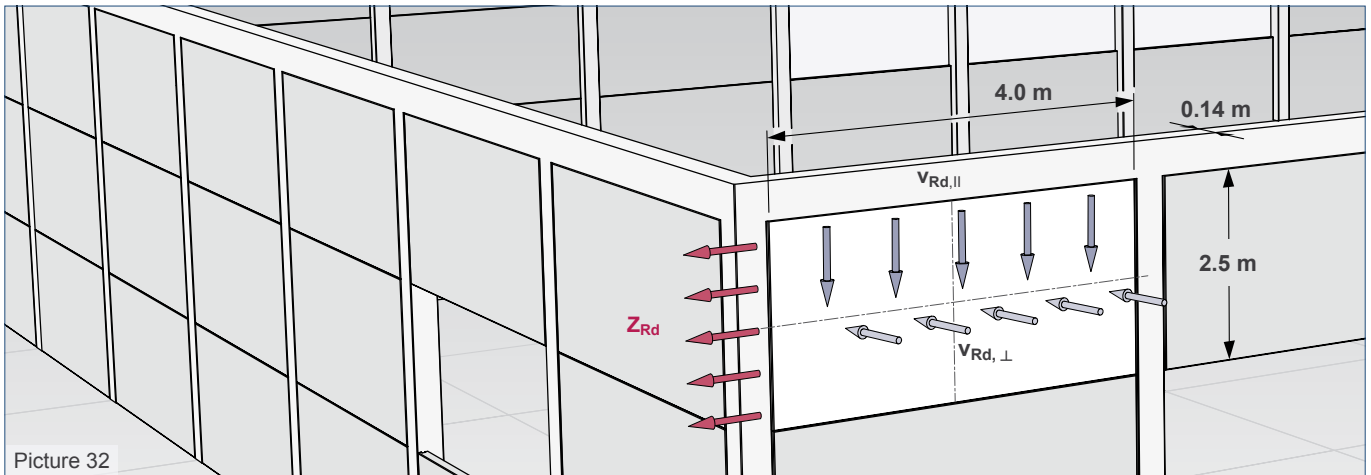
$$z_{Ed,N} = 10 \text{ kN/m}$$

Z_{Rd} for EuroGrout® Universalfüller = 7.5 kN/loop (Table 4)

per metre rail 4 loops $\Rightarrow 4 \times Z_{Rd} = 30 \text{ kN/m}$

$$30 \text{ kN/m} \geq 4.27 \text{ kN/m} + 0.6 \text{ kN/m} + 10 \text{ kN/m} = 14.87 \text{ kN/m}$$

Design example case 2



Design example stiffening by shear wall (Special case - load transfer of the tensile forces by constructive solutions e.g. ring beam)

In this example the shear loads of the wall are absorbed by the Power Duo system. The occurring tensile forces are absorbed by suitable tension members (ring beam) or other constructive solutions (fixed column, friction forces with wall elements standing full-surfaced on ground).

Verification of total tensile force: $Z_{Ed,ges} = Z_{Ed,V\perp} + Z_{Ed,N}$

$Z_{Ed,ges}$ [kN/m]: Total tensile force per metre of joint

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

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

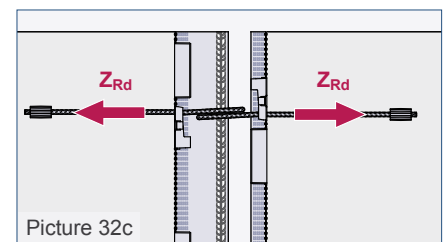
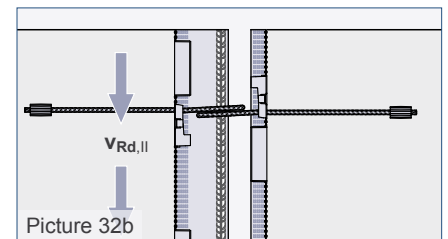
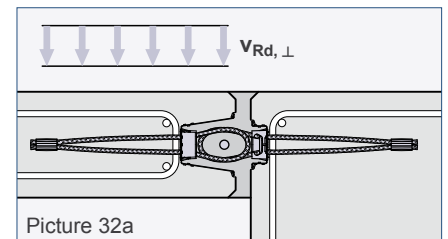


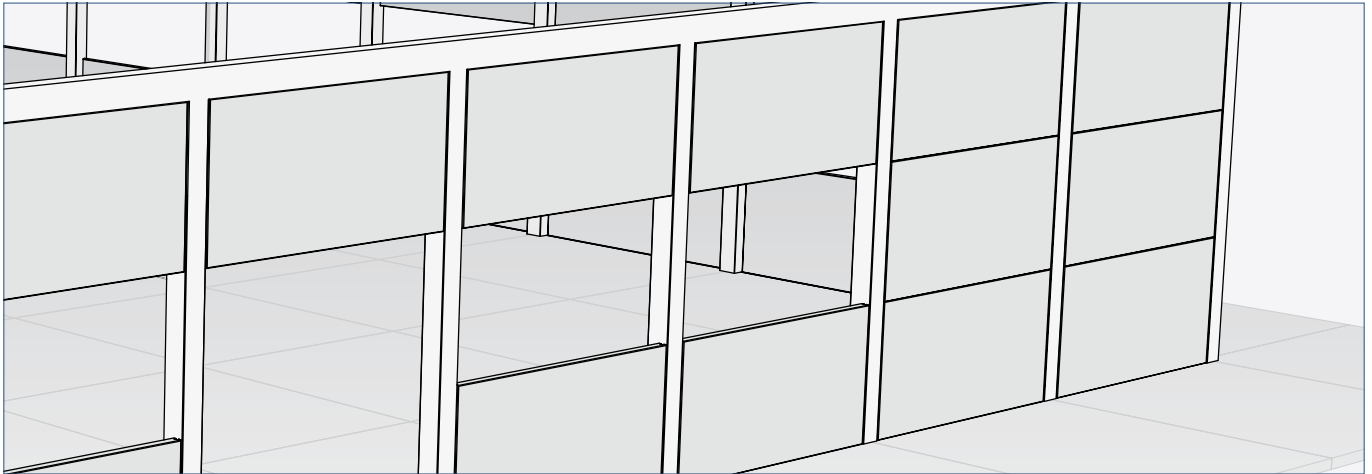
Table 6: Components of tensile force

Load from	Shear force at right angle $V_{Ed,\perp}$	External tensile force
Component of tensile force	$Z_{Ed,V\perp} = 0.25 \times V_{Ed,\perp}$	$Z_{Ed,N}$

Actions / boundary conditions:

- From wind
 - building height ≤ 10 m, wind load zone 3, midland, according to EC 1
 - $W_D = 1.5 \times (0.8 \text{ kN/m}^2 \times 1.0) = 1.2 \text{ kN/m}^2$
- Loads caused by the shear wall: 10,68 kN/m
- Wall thickness 14 cm
- Concrete strength C30/C37
- Tensile force: $Z_{Ed,N} = 10 \text{ kN/m}$
- Wall dimensions $L = 4.0 \text{ m}$; $H = 2.5 \text{ m}$
- Installation of the rails according to marking, vertical false position $\leq 30 \text{ mm}$

Design example case 2



Resultant shear force parallel to the joint:

$$v_{Ed,II} = 10.68 \text{ kN/m} \times 4.0 \text{ m} / 2 / 2.5 \text{ m} = 8.54 \text{ kN/m}$$

The shear force right-angled to the wall results from the wind load:

$$v_{Ed,\perp} = (1.2 \text{ kN/m}^2 \times 2.50 \text{ m} \times 4.0 \text{ m}) / 2 / 2.5 \text{ m} = 2.4 \text{ kN/m per joint}$$

Resistance values for Thixo mortar resulting from wall thickness and concrete strength:

Shear load parallel: $v_{Rd,II} = 70 \text{ kN/m}$ (value from table 2, design value W1)

Shear force right-angled: $v_{Rd,\perp} = 9.7 \text{ kN/m}$ (value from table 3)

If both forces occur at the same time an interaction (Picture 29) must be considered:

Percentage of shear force parallel: $V_{Ed,II} / V_{Rd,II} = 8.54 \text{ kN} / 70 \text{ kN} = 12 \%$

The linear interaction results in a permissible shear force right-angled to the joint: $100 \% - 12 \% = 88 \%$

The reduced shear force right-angled to the wall can be set to 88 %:

$$\text{red. } v_{Rd,\perp} = 0.88 \times 9.7 \text{ kN/m} = 8.5 \text{ kN/m}$$

It is shown that the interaction of both shear forces can be absorbed. The tensile force to be absorbed by the tension member is calculated by using the formula given in table 6.

Resulting design tension resistance

$$Z_{Ed,ges} = Z_{Ed,V\perp} + Z_{Ed,N} \text{ [kN/m]}$$

$$Z_{Ed,V\perp} = 0.25 \times v_{Ed,\perp} \text{ [kN/m]}$$

$Z_{Ed,N}$ = acting "external" tensile forces per metre of joint [kN/m]

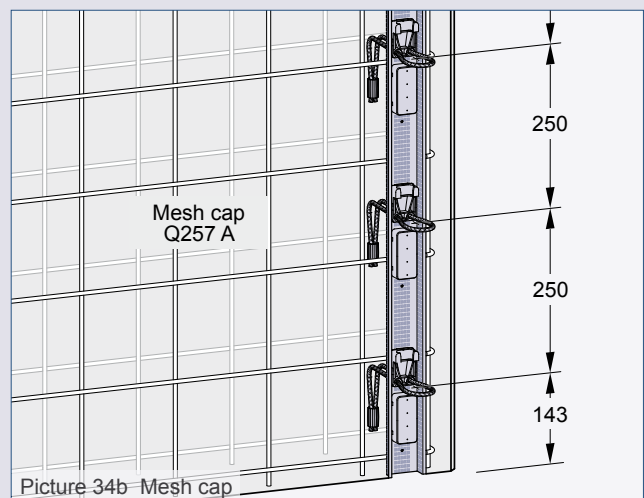
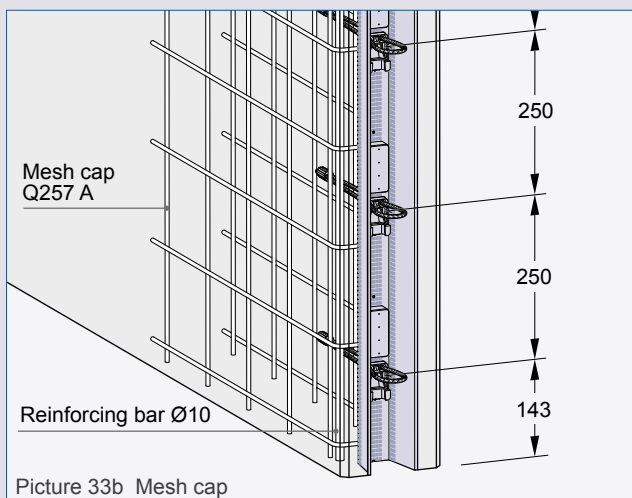
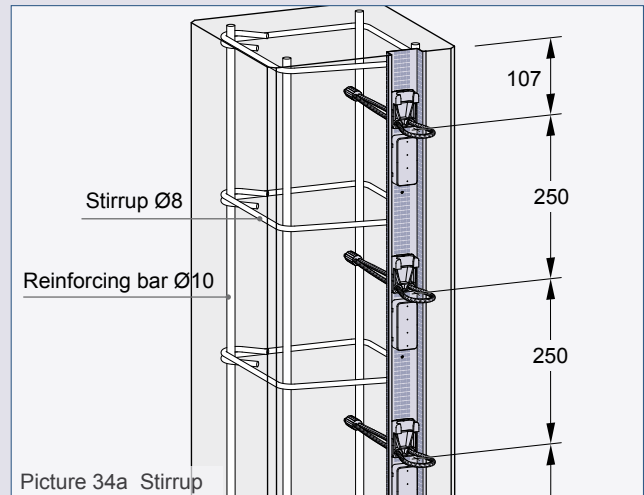
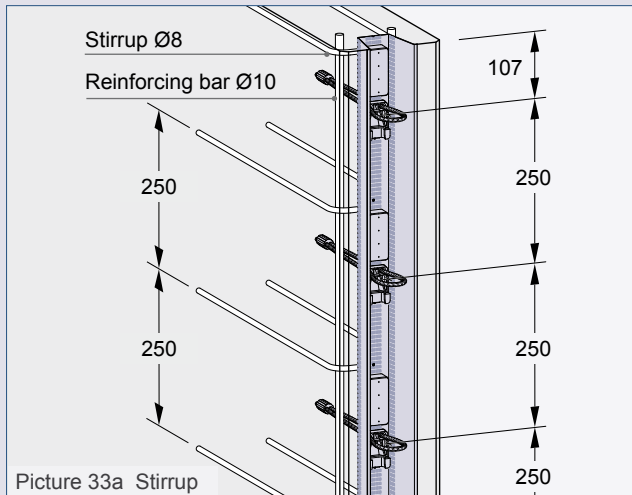
$$Z_{Ed,ges} = 0.25 \times 2.4 \text{ kN/m} + 10 \text{ kN/m} = 10.6 \text{ kN/m}$$

The calculated tensile force must be absorbed e.g. by a ring beam or other constructive solutions.

Reinforcement

If the Power Duo rails are installed flush and according to the direction of the arrow-marking all requirements of the German approval for the edge distances are met (Picture 33a, 33b, 34a, 34b). Please note also the part "Production of precast reinforced concrete elements" in the approval.

In the range of the Power Duo rails the precast elements must be provided with a minimum reinforcement. This reinforcement shall be stirrups $\varnothing 8/25$ for each wire loop and longitudinal reinforcement $2 \varnothing 10$ (Picture 33a, 34a).



Alternatively the stirrups can be replaced by a comparable mesh reinforcement (picture 33b and 34b).

This requirement is fulfilled by a mesh reinforcement e.g. type Q257 A (equal: $2.57 \text{ cm}^2/\text{m}$). Existing reinforcement can be taken into account.

The anchorage of the connecting loops in the precast element must be aligned in an angle of 90° to the Power Duo rails. 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.



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

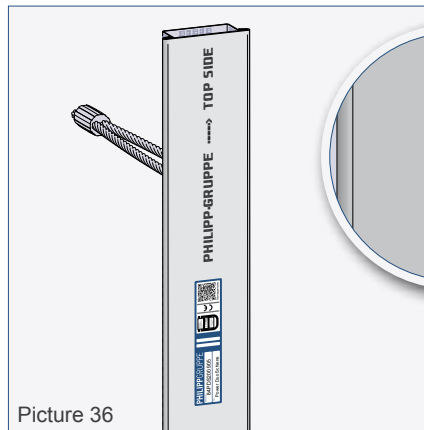


Installation

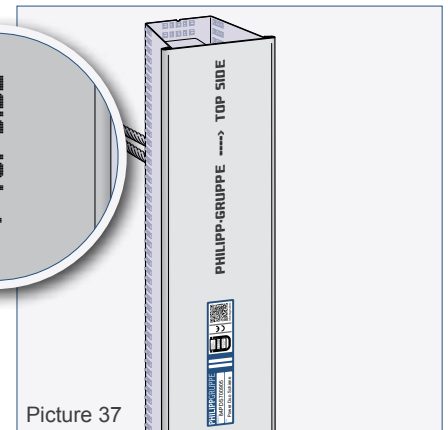
Installation of the Power Duo rails

The Power Duo system consists of a flat and a deep rail. An identification for the installation direction is visible on the plastic covering.

Both rails are labelled with manufacturer, product name and CE mark.



Picture 36

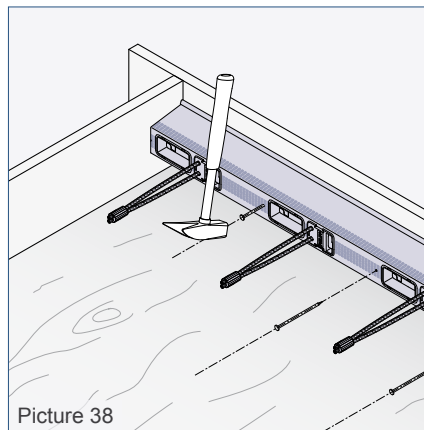


Picture 37

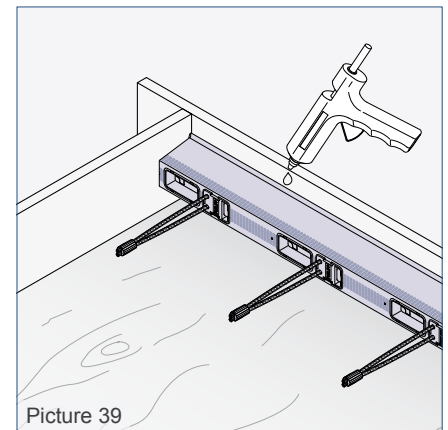
The Power Duo rails can be fixed to the mould by nailing and also by hot bonding (Picture 38 and 39).



During concreting of elements attention must be paid to the ventilation of all plastic recesses to guarantee a complete filling with concrete.



Picture 38

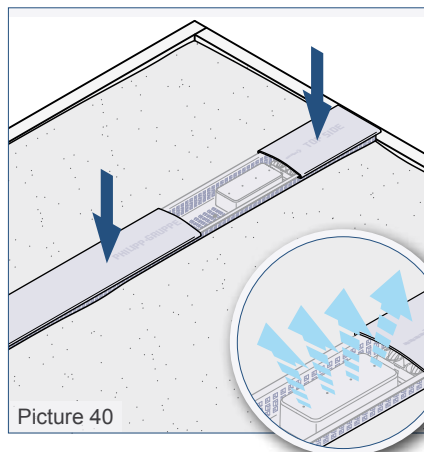


Picture 39

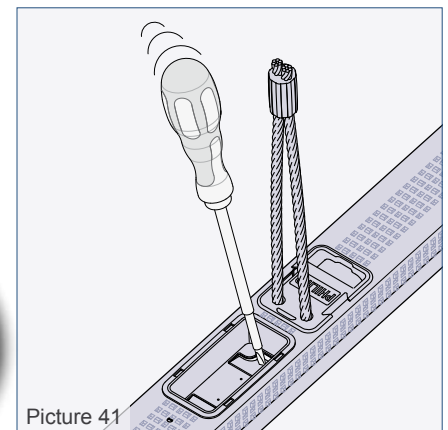
In order to ventilate a plastic recess box, e.g. when the Power Duo rails are installed on the concrete surface (plastic cover on the top, Picture 40), it has four little holes on the top the air can pass off.

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.

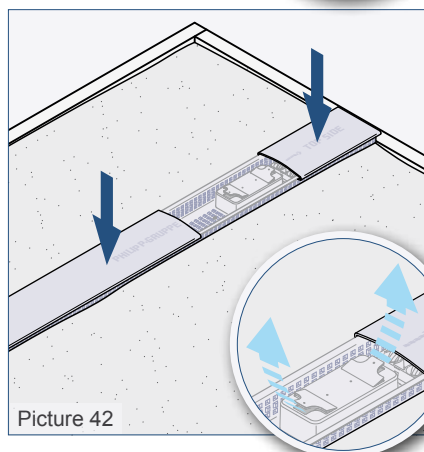


Picture 40

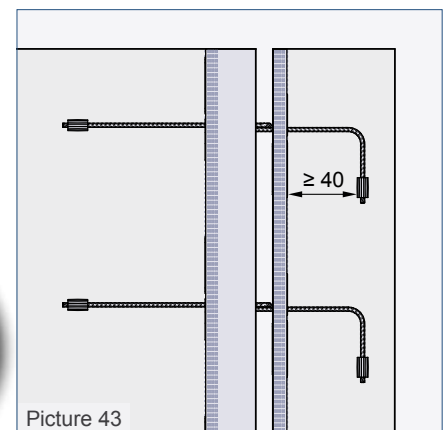


Picture 41

If the anchorage of the wire rope loop is bent, attention must be paid that the horizontal anchorage part is ≥ 40 mm (Picture 43).



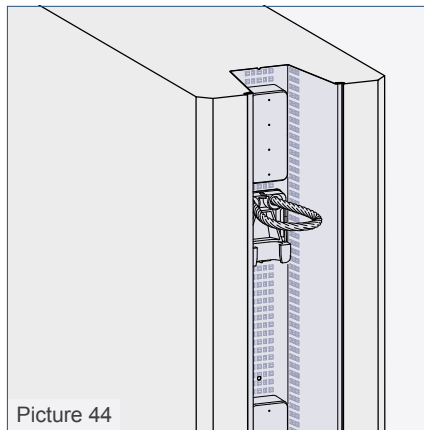
Picture 42



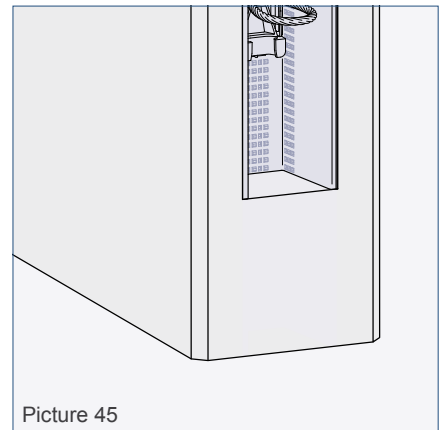
Picture 43

Installation

For elements with the same height it is recommended to start the installation at the upper elements edge (picture 44). So it is possible to concrete the rail-free part at the bottom of the element (Picture 45).



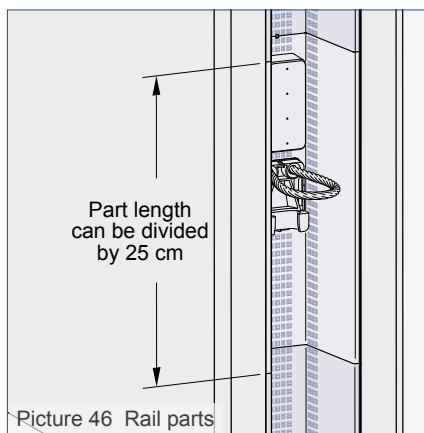
Picture 44



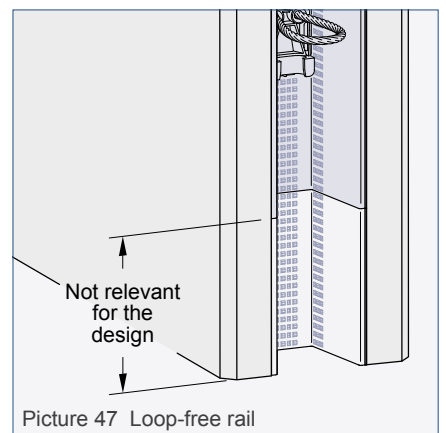
Picture 45

In order to get a continuous poured joint it is also possible to arrange the Power Duo in parts. However, these rail parts should be divided only in steps of 25 cm length. Thus, joints with Power Duo rails are only possible in steps of 25 cm length.

If the joint length cannot be divided by 25 cm the rail-free part can be completed with a loop-free rail (Ref.-no. 84VS20 and 84VS70) or timber (Picture 48) to create a recess.



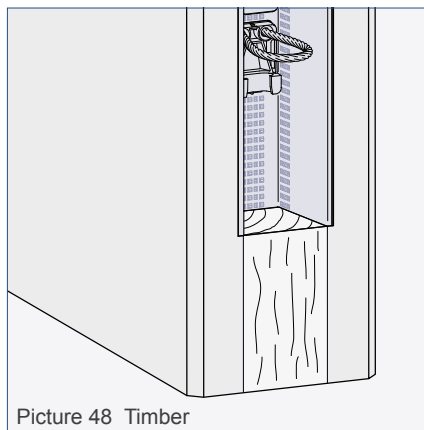
Picture 46 Rail parts



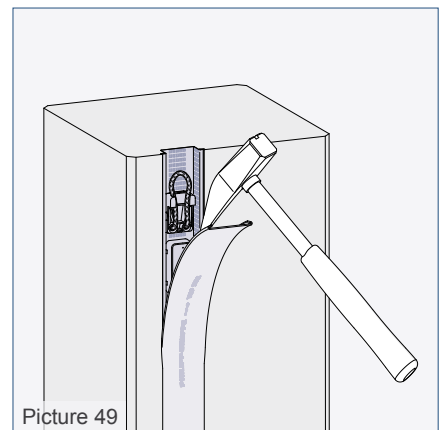
Picture 47 Loop-free rail

Preparing for mounting

The plastic cover of the installed rail must be released at one rail end. Then, it can be removed easily from the rail (Picture 49).



Picture 48 Timber

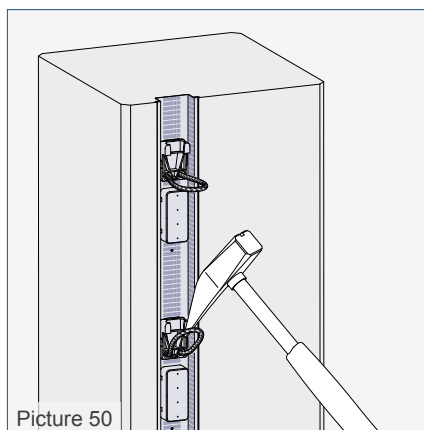


Picture 49

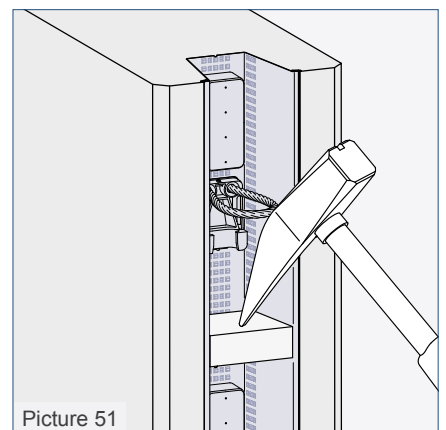
Now, the wire rope loops of the flat and the deep rail have to be folded right-angled to the rail (Picture 50).



From the deep Power Duo rail the polystyrene spacers have to be removed (Picture 51).



Picture 50



Picture 51

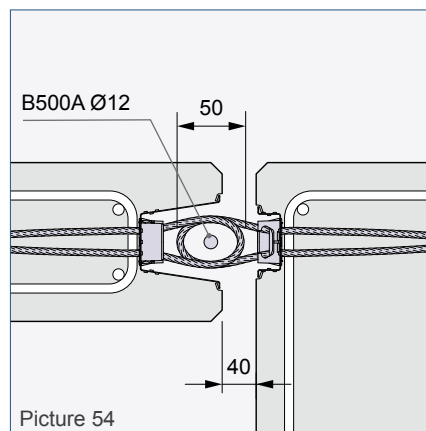
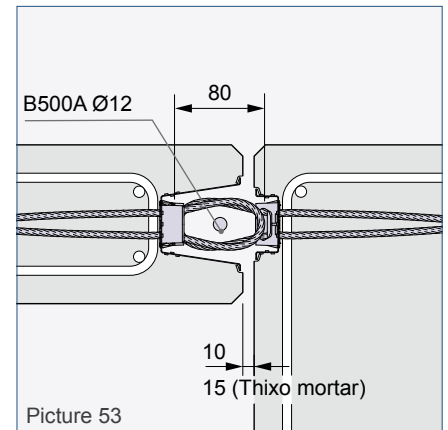
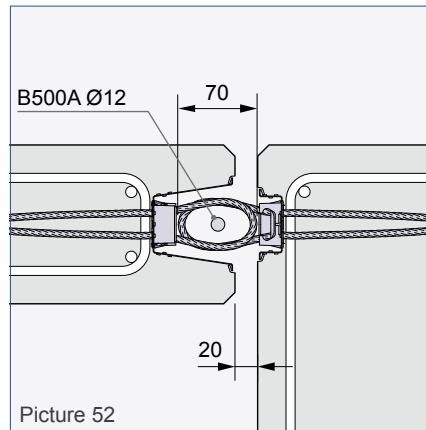
Mounting

Mounting of the precast elements

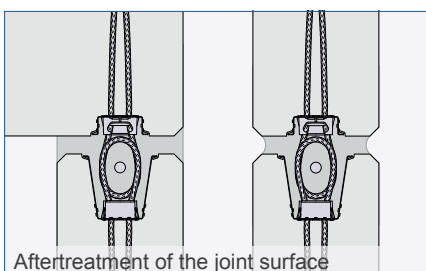
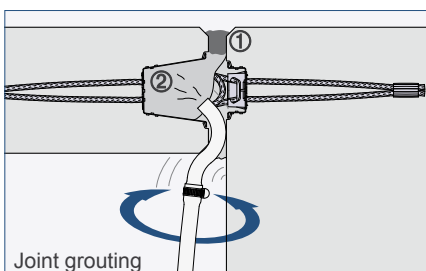
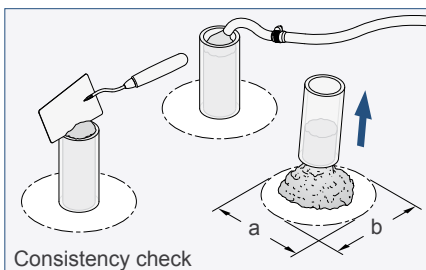
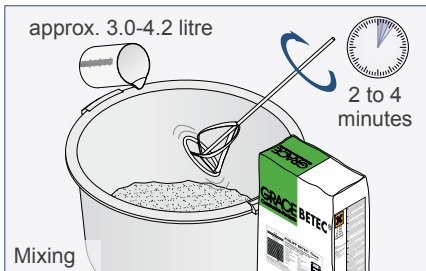
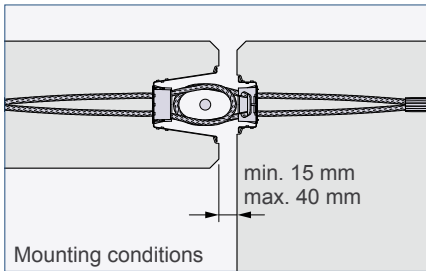
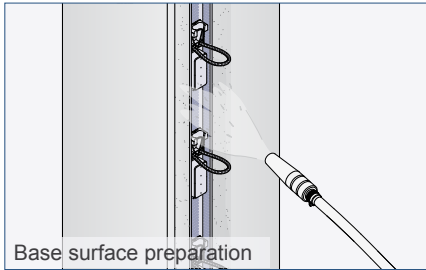
If the Power Duo rails are installed correctly the loops overlap horizontally with the nominal dimension of 70 mm as shown in picture 52 and lie on top of each other in vertical direction.

Nevertheless, the Power Duo system approval already considers horizontal and vertical mounting tolerances. The maximum permissible horizontal deviations are shown in picture 53 and 54.

Prior the filling of the joint a reinforcing bar ($\varnothing 12$ mm) shall be positioned along the entire joint length through the overlapping loops. The correct installation is to be checked visually.



PHILIPP - BETEC® Thixo Mortar



Mortar grouting with PHILIPP - BETEC® Thixo mortar

The system-approved, high-quality, stiff-plastic and thixotropically adjusted PHILIPP - BETEC® mortar is ready for use and consists of approved raw material components. More details can be found in the approval (no. Z-21.8-2028) as well as the technical data sheet „PHILIPP - BETEC® Thixo“.

Base surface preparation

The concrete surface has to be cleaned from dirt, grease and adhesion-reducing parts and layers until the core concrete is exposed. A pre-watering of the concrete surface must be done until the water saturation is reached. At the time of the joint filling the concrete surface shall only look pale damp, stagnant water must be removed.

Mounting conditions

The distance of 15 - 40 mm between the concrete elements must be taken attention to. Both the temperature of the concrete elements and the processing temperature is set between +5° and +30°C. With lower temperatures specific measures in winter time must be started.

Mixing process

The PHILIPP - BETEC® materials are stirred in a suitable mixing machine (e.g. compulsory mixer). Depending on the mixer the mixing time is different, as a rule between 2 - 4 minutes. A homogeneous, lump-free mixture is to be produced. Normally, 4/5 of the required amount of water is filled in, the powder component is added, the mixture is mixed for approx. 2 minutes and then the remaining water is added. Finally the mixture is mixed for 1 - 2 minutes again. Then, the grouting starts immediately.

Consistency check

The flow diameter $(a + b) / 2$ for the stiff-plastic PHILIPP - BETEC® Thixo mortar shall be greater than 15 cm and less than 19 cm. Corresponding consistency is dependent on the amount of water added, the mixing intensity and powder temperature. At high temperatures the mortar hardens faster. According to DIN EN 1015-3 the flow diameter is determined with a defined funnel.

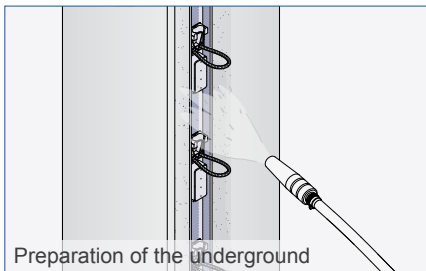
Joint grouting

Grouting starts immediately after the mixing process is finished. For this suitable, electrically operated screw pumps are used. First, one of the two joint flanks is closed resp. sealed. Usually, a sealing cord resp. sealing hose or the Thixo mortar itself can be used ①. The grouting is then done slowly and continuously from the bottom to the top ②. A hose end suitable for the grouting (e.g. bent or curved tube) has to be turned during grouting from the left to the right (alternating) in order to ensure a filling without any voids.

Aftertreatment of the joint surface

After grouting the joint must be trowelled. This has to be done as long as the mortar is still fresh and not hardened.

P&T EuroGrout® Universalfüller (Thixo mortar)

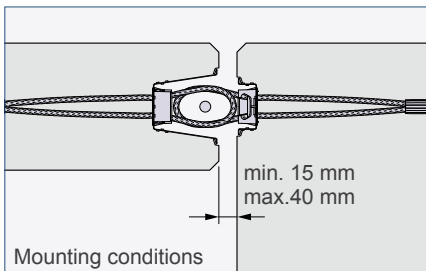


Grouting with EuroGrout® Universalfüller

The EuroGrout® Universalfüller is a mortar approved for the Power Duo System. Its dry mix can be mixed quickly and easily and is filled in the joint by using a mixing pump afterwards. As a sealing of the joint is not necessary the effort and therefore the time spent is reduced significantly.

Preparation of the underground

The joint flanks must be wetted before filling the Thixo mortar and pale damp-dried. Both the cross section of the joint and the flanks must meet the surface quality specified in the DIN. Adhesion-reducing parts in the joints have to be removed, the flanks must be free from dirt, cement slurry and grease.



Mounting conditions

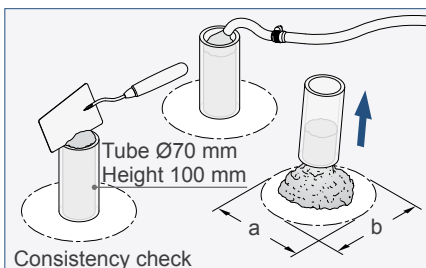
The distance of 15 - 40 mm between the concrete elements must be taken attention to. The unit and processing temperature of the Universalfüller must comply with the latest corresponding DAfStb regulation.



Mixing process

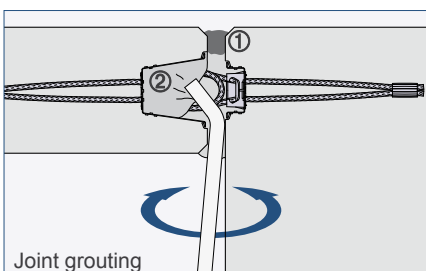
The Universalfüller is designed for a machine processing with mixing pumps. A machining with small, handy mixing pumps allows long draws without changing the position of the pump frequently.

For a manual processing, the Universalfüller must be mixed in a compulsory mixer or with a slow-running stirrer. Here, 4/5 of the water amount is filled in the mixer, then the powder is added and after a short time of mixing the remaining water.



Consistency check

The flow diameter $(a + b) / 2$ must be between 11 and 15 cm and must be done according to the latest DAfStb regulation for cement based grouting concrete and mortar, appendix C. Instead of an ebonite ring a plastic tube (prepared with separating agent) with an inner diameter of $d = 70 \text{ mm}$ and a height of $h = 100 \text{ mm}$ can be used. The grouting of the plastic tube must be done by using the equipment mentioned below in "Joint grouting".

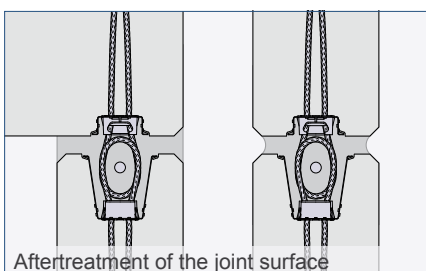


Joint grouting

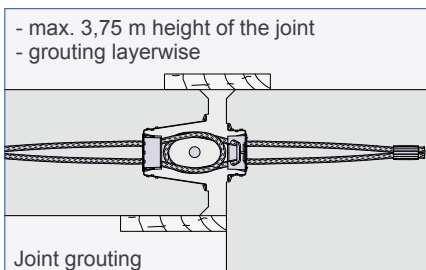
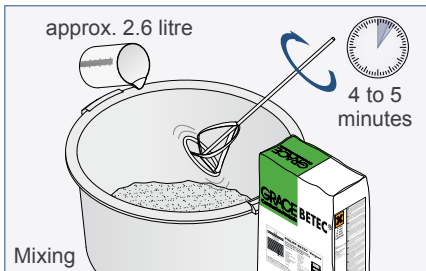
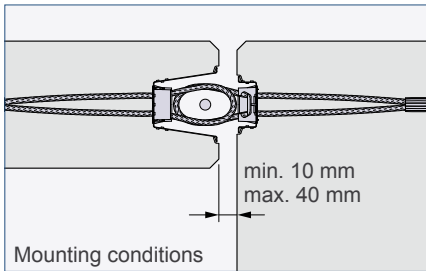
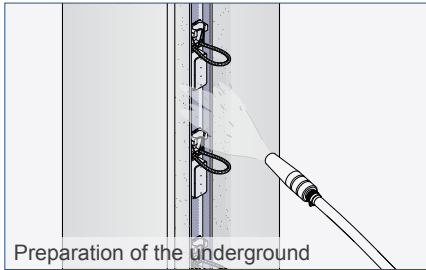
The grouting is done with snail pumps and pass mixers. First, one joint flank is closed completely. Usually, a sealing cord resp. sealing hose or the Thixo mortar itself can be used here ①. Then, the remaining space of the joint is filled from the opposite side and from the bottom to the top using a bent tube (according to the Technical Data Sheet EuroGrout® Universalfüller) ②. The tube has to be turned during grouting from the left to the right (alternating) in order to ensure a filling without any voids.

Aftertreatment of the joint surface

After grouting the joint must be trowelled. Waste material has to be removed for optical reasons before hardening.



PHILIPP - BETEC® Grouting mortar



Hints

Bear in mind when grouting air must be able to leak. A careful vibration can avoid entrapped air. The processing time is about 30 minutes at 20°C.

Mortar grouting with PHILIPP - BETEC® Grouting mortar

The PHILIPP - BETEC® system-approved, high-quality grouting mortar is a ready-to-use mortar. It consists of approved raw material components.

Preparation of the underground

The concrete surface has to be cleaned from dirt, grease and adhesion-reducing parts and layers until the core concrete is exposed. A pre-watering of the concrete surface must be done until the water saturation is reached. At the time of the joint filling the concrete surface shall only look pale damp, stagnant water must be removed.

Properties

The grouting mortar is free from chlorides. Because of the controlled swelling the mortar is shrink-free and thus guarantees a force transmitting connection. It has a good adhesion to steel and concrete and shows no signs of segregation. Furthermore, it has a good pumpability as well as resistance to frost and de-icing salt. The grouting mortar is produced always in constant quality and is easy to process. Due to its flowability the mortar is self-levelling and fills all accessible ventilated voids.

Mixing

Mixing can be done:

- by a separated mixing in a compulsory mixer first and following pumping of the mixture with a suitable screw pump. A mixing time of approximately 4 - 5 minutes is to be aimed. First 4/5 of the water amount has to be given, the powder added and after 2 - 3 minutes the balance of the water added until the wanted consistency is reached and a homogeneous matrix of mortar satisfies.
- or by using a suitable continuous mixer. Hereby it must be proved that no reduction of the strength can arise.

Joint grouting

Both sides of the joint are sealed before the grouting mortar is filled into. Here, the use of a grouting hose with a hopper eases the process considerably. To reduce the concreting pressure it is recommended to fill in the grouting mortar in sections. When using a joint tape be careful that it does not impede the grouting section or reduces the required concrete cover for the Power Duo System.

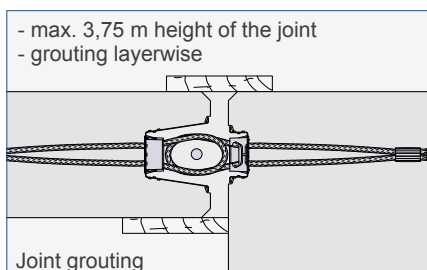
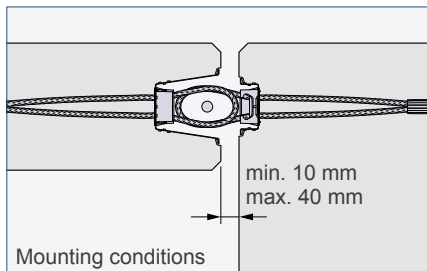
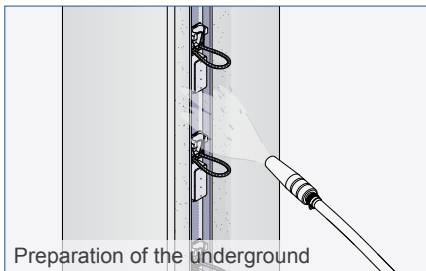
Processing temperature

The processing temperature of the grouting mortar is at least +5°C and maximum +30°C. With lower temperatures specific measures in winter time must be started.

Aftertreatment

It should be prevented that grouting mortar dries up too fast for at least three days after application. Appropriate measures are covering with plastic sheets, wet tissues or irrigation.

P&T EuroGrout® Varix (Grouting mortar)



Hints

Bear in mind when grouting air must be able to leak. The processing time is approximately 60 minutes at 20°C.

Mortar grouting with EuroGrout® Varix

The EuroGrout® Varix grouting mortar is a mortar approved for the Power Duo System. It consists of a ready-for-use dry mixture based on cement and is used to grout precast concrete elements. It is shrink-free, has a high early strength and a good flowability.

Base surface preparation

The surface must be free from dirt, oils, greases etc. and cement slurry rests on the surface shall be removed. A board formwork or other equipment should be used to seal the joint. To improve the adhesion, the joint surface should be pre-wetted thoroughly.

Properties

The grouting mortar is free from chlorides. It has a good adhesion to steel and concrete and shows no signs of segregation. Furthermore it has a good pumpability and resistance to frost deicing salt. The grouting mortar is produced in consistent high quality and is easy to process. Due to its flowable consistency the mortar is self-levelling and fills out all accessible venting hollow spaces.

Mixing

Approximately 4/5 of the mixing water is put into the mixer, then the grouting mortar is stirred completely. Afterwards the remaining water is used to adjust the consistency. The mixing time is 4 - 6 minutes depending on the type of mixing.

Joint grouting

Both sides of the joint are sealed before the grouting mortar is filled into. Here, the use of a grouting hose with a hopper eases the process considerably. To reduce the concreting pressure it is recommended to fill in the grouting mortar in sections. When using a joint tape be careful that it does not impede the grouting section or reduces the required concrete cover for the Power Duo System.

Processing temperature

The processing temperature of the grouting mortar is at least +5°C and maximum +30°C. With lower temperatures specific measures in winter time must be started.

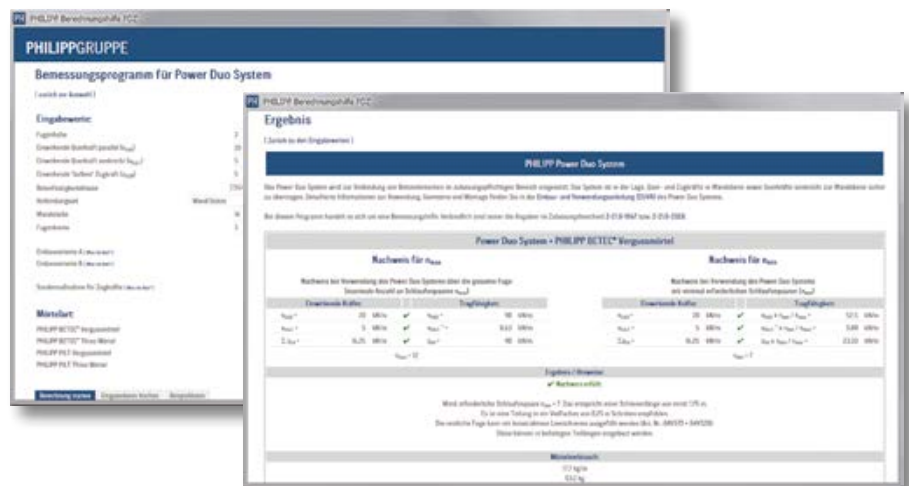
Aftertreatment

It should be prevented that the grouting mortar runs dry too fast for three to five days after application. Appropriate measures are covering with plastic sheets, wet tissues or watering.

Software / CAD

Calculation tool

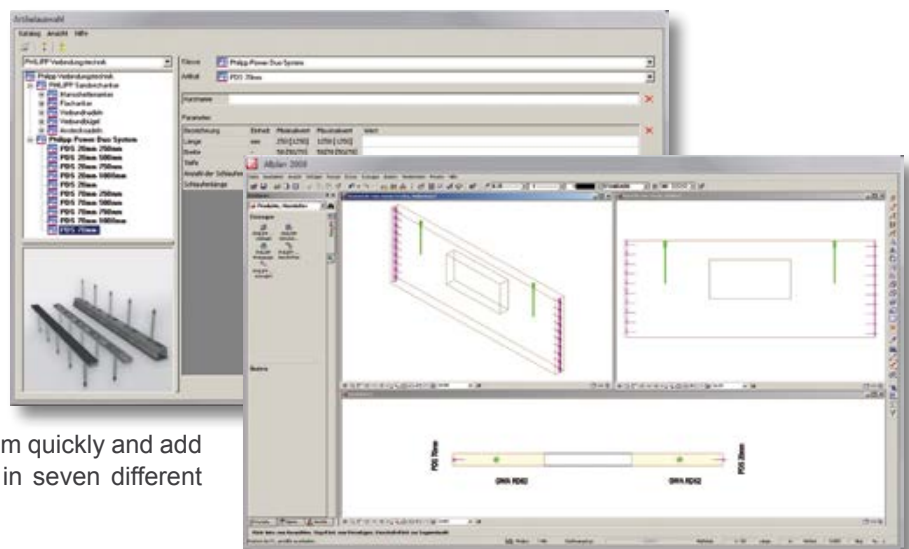
In order to design connections with the PHILIPP Power Duo System you can find an online calculation tool on our website (www.philipp-group.de), easy-to-use, understandable and without registration.



ALLPLAN of company Nemetschek

Customers using the powerful CAD system ALLPLAN from Nemetschek can use the PHILIPP 3D part library already implemented. This CAD library makes the construction of connections with the PHILIPP Power Duo System much easier.

In the CAD library for ALLPLAN itself the products are logically structured and classified.



The user is able to choose the needed item quickly and add it to his plan. The products are offered in seven different views, as 3D model and symbol.

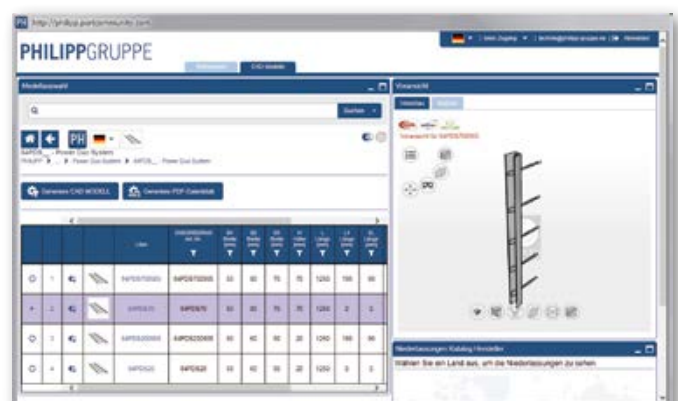
Tekla Structures of company Trimble

Also for the CAD software Tekla Structures from Trimble a library of the Power Duo System is available. This includes 3D models of the deep and the flat rail as well as rails without any loops, all in different lengths.

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.

- More than 1,200 PHILIPP products are available as 3D model
- Universal CAD library with many export formats suitable 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 (e.g. weight, dimensions, material and documentations)

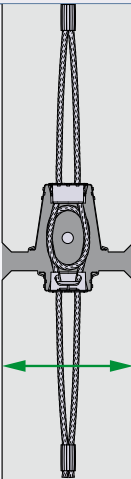


General notes

Table 7: Site check list

Step	What	Comment	Thixo mortar	Grouting mortar
1	Open the rail	Remove cover	✓	✓
2	Check of joint	Pay attention to a clean surface , when necessary clean again	✓	✓
3	Fold down the connecting loops	Pay attention to the 90° position	✓	✓
4	Align concrete units	Pay attention to admissible tolerances	✓	✓
5	Install joint reinforcement	Along the entire length of the joint	✓	✓
6	Pre-wetting of joints	Improvement of adhesion	✓	✓
7	Sealing on both sides	Use formwork, timber boards or joint tapes	-	✓
8	Mortar grouting	Pay attention to the required ambient temperature, compacting as well as processing time and instructions	✓	✓
9	Filling the joint	Screw pump or continuous mixer	✓	-
10	Demoulding	After hardening of the mortar	-	✓
11	Aftertreatment of joint	Protection against too fast drying	✓	✓
12	Aftertreatment of the joint before mortar is hardened	Joint has to be trowelled	✓	-

Table 8: Mortar consumption for 1 metre joint [kg/m] for the PHILIPP Power Duo System (BETEC® / EuroGrout®)

Wall thickness [cm]	BETEC® Grouting mortar				BETEC® Thixo mortar				<div><div></div>Joint width</div> <div><div></div>Wall thickness</div> <div><div></div>Mortar kg/m</div>		Wall thickness [cm]	EuroGrout® Varix				EuroGrout® Universalfüller			
	Joint width [cm]				Joint width [cm]							Joint width [cm]							
	1.0	2.0	3.0	4.0	1.0	2.0	3.0	4.0				1.0	2.0	3.0	4.0				
14	12.1	14.9	17.7	20.5	11.0	13.5	16.1	18.6		14	12.1	14.9	17.7	20.5	11.0	13.5	16.1	18.6	
15	12.3	15.3	18.3	21.3	11.1	13.9	16.6	19.3		15	12.3	15.3	18.3	21.3	11.1	13.9	16.6	19.3	
16	12.5	15.7	18.9	22.1	11.3	14.2	17.1	20.1		16	12.5	15.7	18.9	22.1	11.3	14.2	17.1	20.1	
17	12.7	16.1	19.5	22.9	11.5	14.6	17.7	20.8		17	12.7	16.1	19.5	22.9	11.5	14.6	17.7	20.8	
18	12.9	16.5	20.1	23.7	11.7	15.0	18.2	21.5		18	12.9	16.5	20.1	23.7	11.7	15.0	18.2	21.5	
19	13.1	16.9	20.7	24.5	11.9	15.3	18.8	22.2		19	13.1	16.9	20.7	24.5	11.9	15.3	18.8	22.2	
20	13.3	17.3	21.9	26.1	12.8	16.6	20.4	24.3		20	13.3	17.3	21.3	25.3	12.1	15.7	19.3	23.0	
21	13.5	17.7	21.9	26.1	12.2	16.1	19.9	23.7		21	13.5	17.7	21.9	26.1	12.2	16.1	19.9	23.7	
22	13.7	18.1	22.5	26.9	12.4	16.4	20.4	24.4		22	13.7	18.1	22.5	26.9	12.4	16.4	20.4	24.4	
23	13.9	18.5	23.1	27.7	12.6	16.8	21.0	25.1		23	13.9	18.5	23.1	27.7	12.6	16.8	21.0	25.1	
24	14.1	18.9	23.7	28.5	12.8	17.1	21.5	25.9		24	14.1	18.9	23.7	28.5	12.8	17.1	21.5	25.9	
25	14.3	19.3	24.3	29.3	13.0	17.5	22.1	26.6		25	14.3	19.3	24.3	29.3	13.0	17.5	22.1	26.6	
26	14.5	19.7	24.9	30.1	13.1	17.9	22.6	27.3		26	14.5	19.7	24.9	30.1	13.1	17.9	22.6	27.3	
27	14.7	20.1	25.5	30.9	13.3	18.2	23.1	28.1		27	14.7	20.1	25.5	30.9	13.3	18.2	23.1	28.1	
28	14.9	20.5	26.1	31.7	13.5	18.6	23.7	28.8		28	14.9	20.5	26.1	31.7	13.5	18.6	23.7	28.8	
29	15.1	20.9	26.7	32.5	13.7	19.0	24.2	29.5		29	15.1	20.9	26.7	32.5	13.7	19.0	24.2	29.5	
30	15.3	21.3	27.3	33.3	13.9	19.3	24.8	30.2		30	15.3	21.3	27.3	33.3	13.9	19.3	24.8	30.2	

Given consumption data are only guide values.

Table 9: Packing units (BETEC® / EuroGrout®)

Mortar Type	PU [kg]	Finished volume [l]	
		BETEC®	EuroGrout®
Thixo	25	13.00	13.75
Grouting	25	13.00	12.50

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Please refer also to the approvals of the PHILIPP Power Duo System, Technical Data sheets of Thixo mortar and Grouting mortar as well as the fire protection expert report. You can find all these brochures at www.philipp-group.de or are available on request.



Our customers trust us to deliver. We do everything in our power to reward their faith and we start each day intending to do better than the last. We provide strength and stability in an ever-changing world.

Welcome to the PHILIPP Group

Sustainable
solutions



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