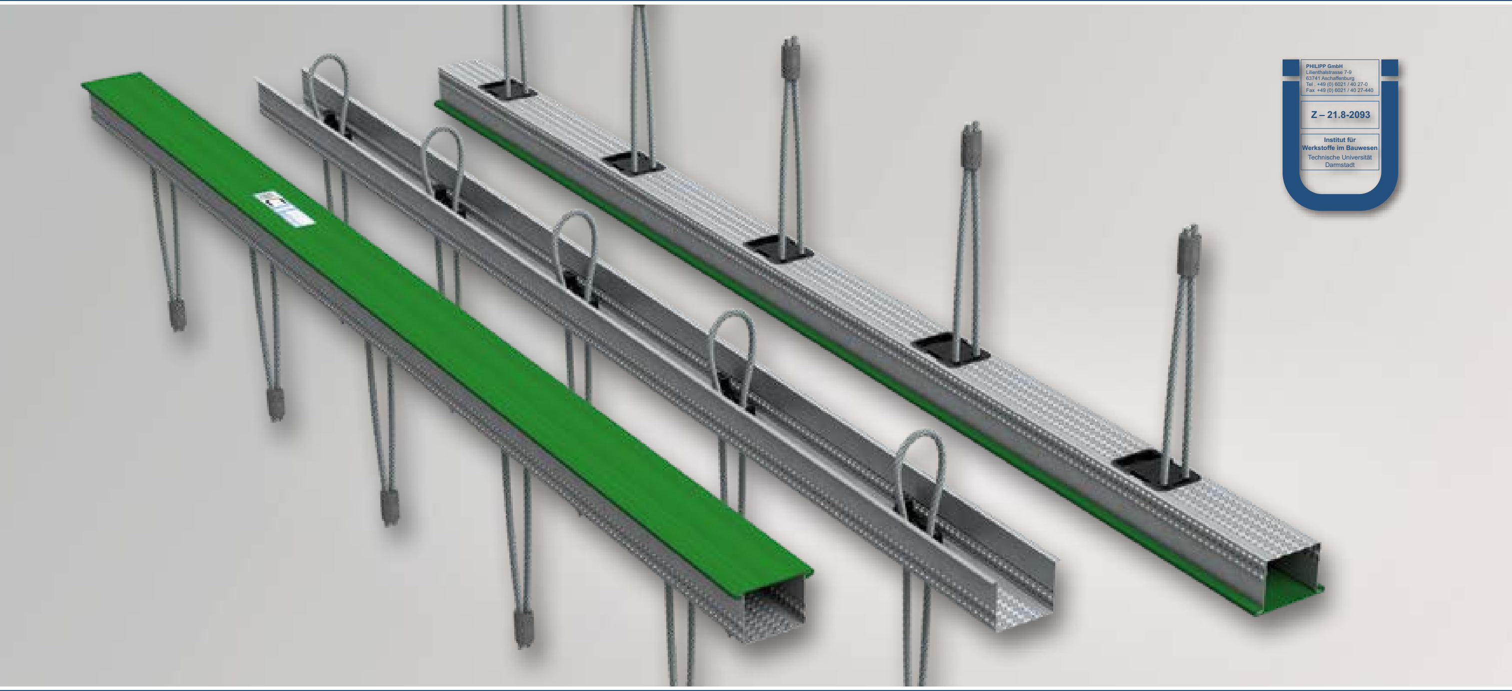
PHILIPPGROUP

PHILIPP Power One System



VB3-V-016-en - 09/19 - PDF

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.

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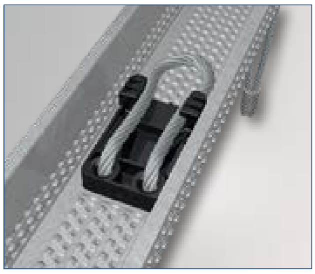
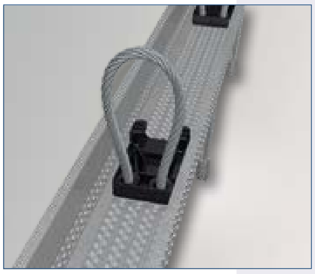
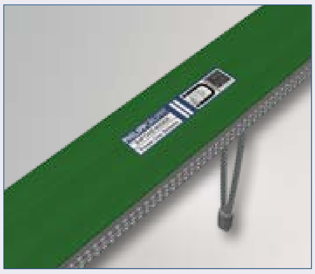
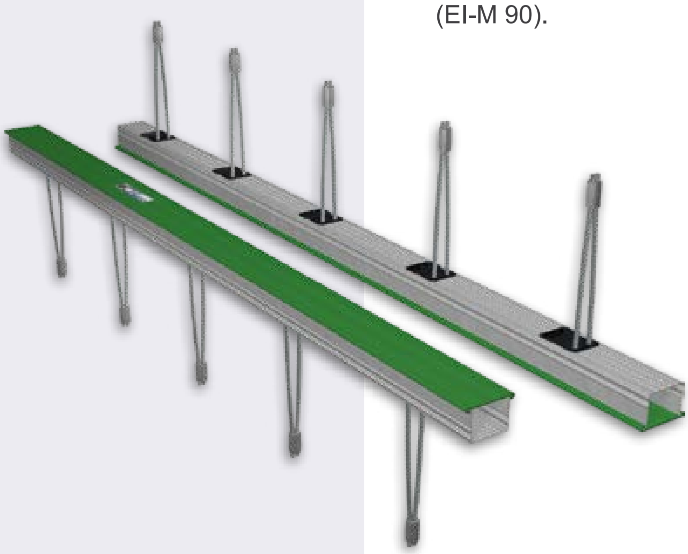
Content



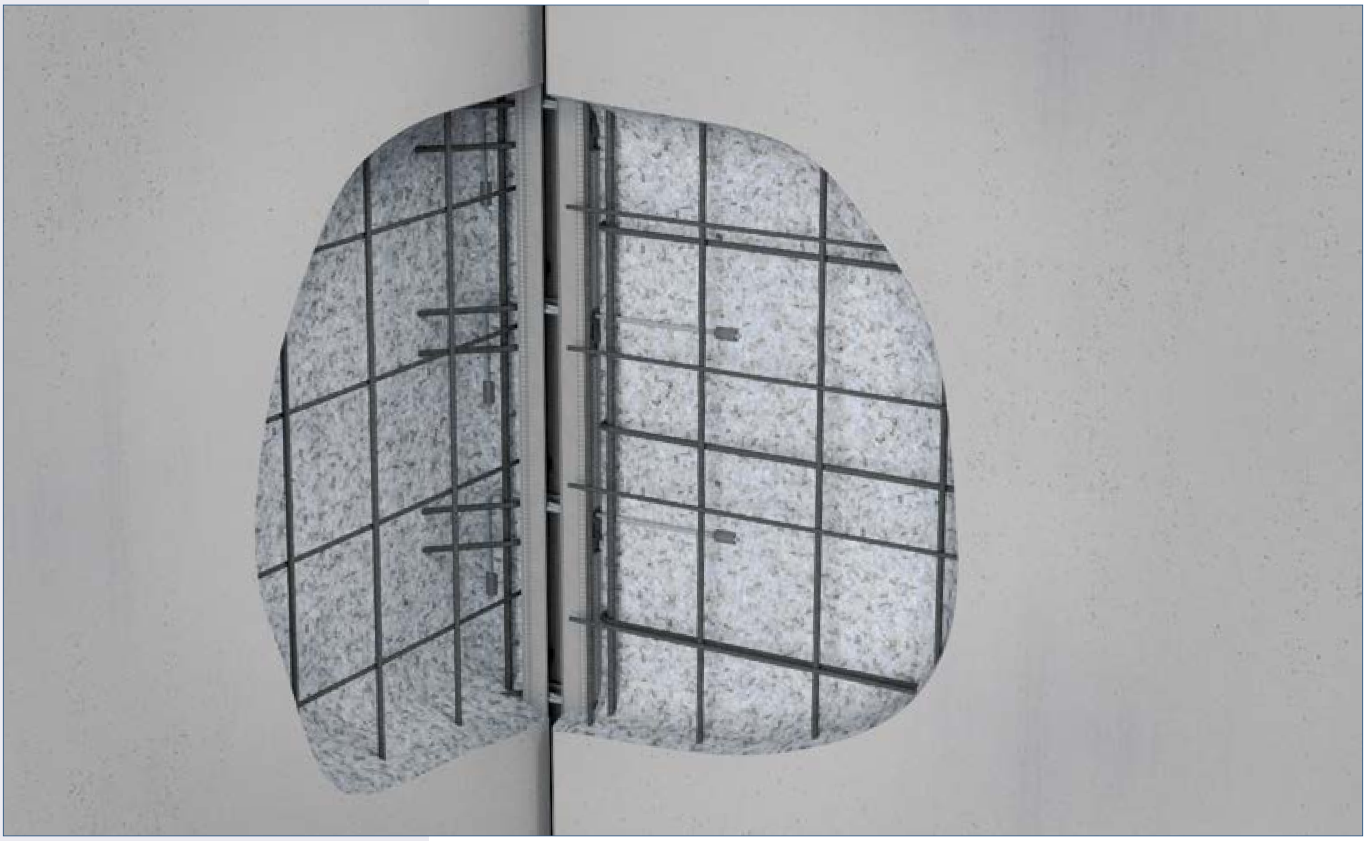



PHILIPP Power One System



Advantages at a glance:

- Small wall thicknesses from 10 cm possible.
- No installation direction because of symmetrical rail design.
- No mix-up risk, as only one rail type ist used.
- Forces in all directions transferable
  - tensile forces, shear forces parallel and right-angled to the joint.
- Tested and certified system with German approval.
- Use in loadbearing, fire-stressed walls (REI) and non-loadbearing fire walls (EI-M 90).

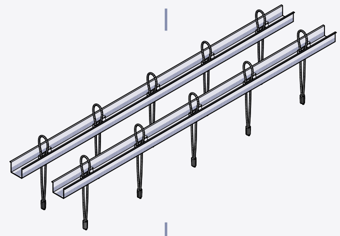


System components

System components and dimensions

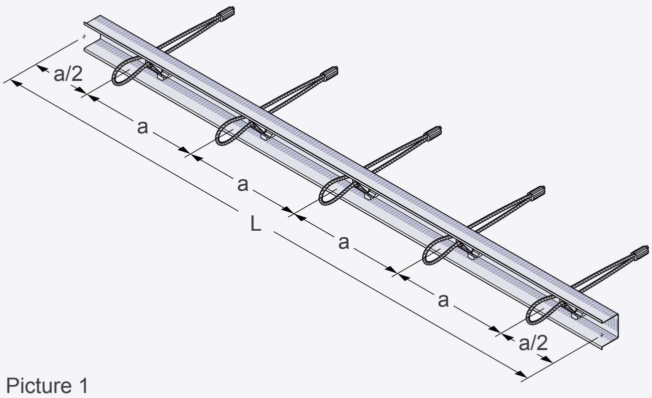
The Power One System is used to connect precast concrete units where high static forces have to be transferred and proofed. It is able to transfer shear and tensile forces plane to the wall (stiffening, support reactions) as well as shear forces right-angled to the wall (wind pressure, earth pressure). A simple installation and the joint geometry pre-defined by the rail guarantee an easy application.
The Power One system consists of only one profiled and galvanised rail. It is equipped with galvanised steel wire loops with a distance of 250 mm each. The rail is installed flush with the surface on the opposite side of each particular concrete unit. There is no need to check the direction of the rail as it is symmetrical!
After demoulding, the plastic cover is removed and the loops are folded down easily to the position needed. 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 the belonging grouting mortar (page 24) to generate a force transmitting and form-fit connection.

The German approved
PHILIPP Power One System
(Z-21.8-2093)
Power One rails

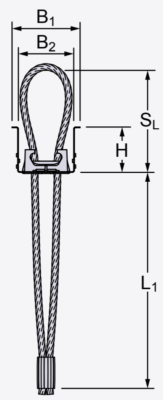


BETEC®
Grouting mortar

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



Picture 1



Picture 2

Table 1: Dimension of the Power One rail

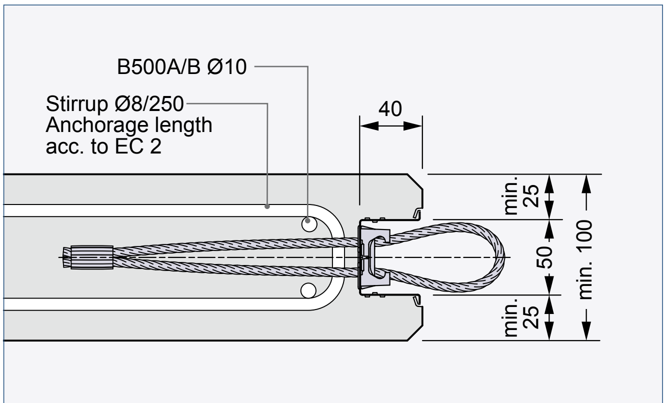
Ref.-No.	Dimensions							Weight per rail
	B_1 [mm]	B_2 [mm]	H [mm]	L [mm]	L_1 [mm]	S_L [mm]	a [mm]	[kg]
84PONE400905	60	50	40	1250	190	90	250	1.55

Application

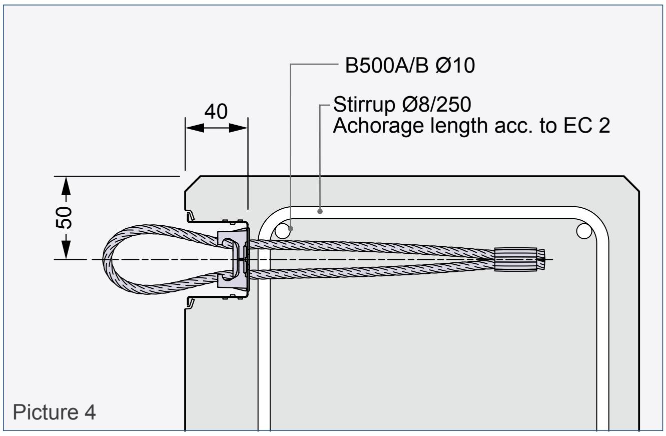
Dimensions of concrete units

Due to the required concrete cover of 25 mm for the Power One rail the min. resulting wall thickness is 100 mm (picture 3).

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



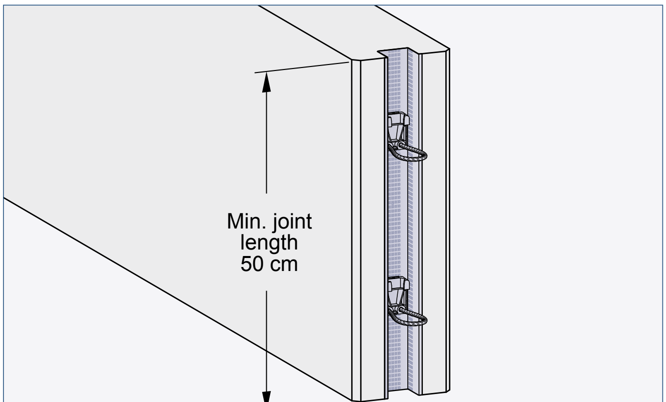
Picture 3



Picture 4

Length of joints

The minimum length of a joint must be 50 cm for the Power One system (minimum 2 loops are required so that a strut-and-tie-model can work). So, it is possible to install the Power One rails in shorter parts (page 22).

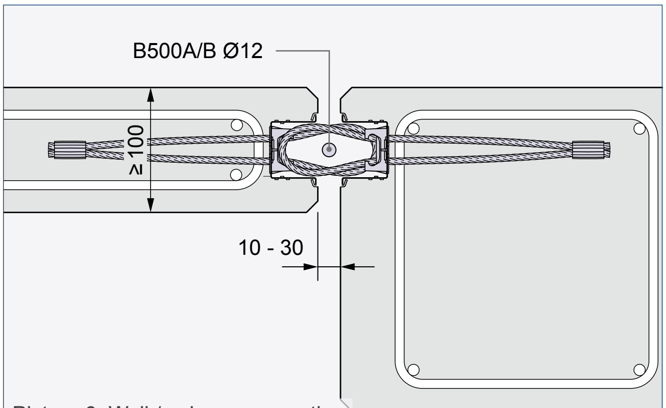


Picture 5 Joint length

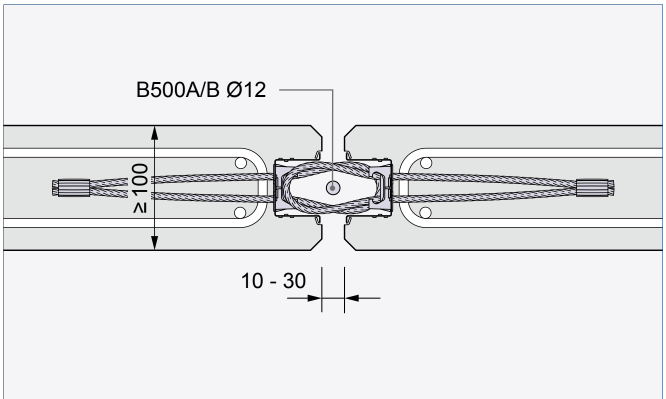
Application

Range of applications

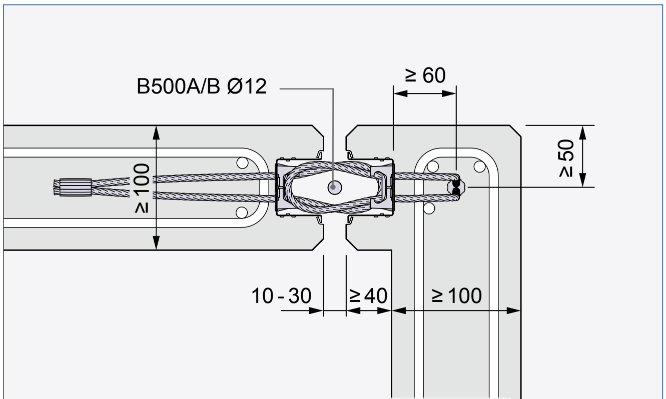
The Power One system can be used for various connections of reinforced concrete elements. It transfers primarily static shear forces parallel and right-angled to the wall as well as tensile forces from predominantly static loads.



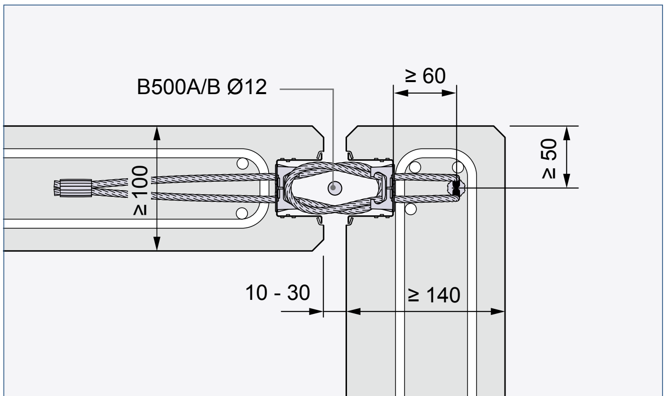
Picture 6 Wall / column connection



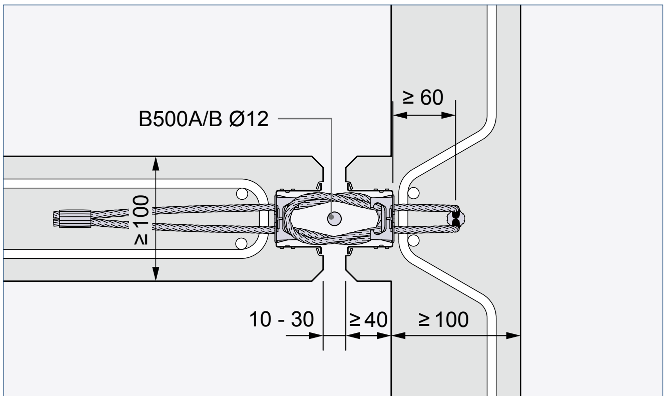
Picture 7 Wall / wall connection



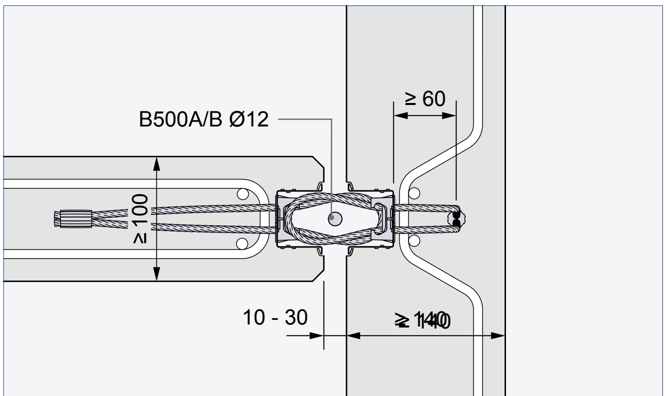
Picture 8 Wall / wall connection (corner connection)



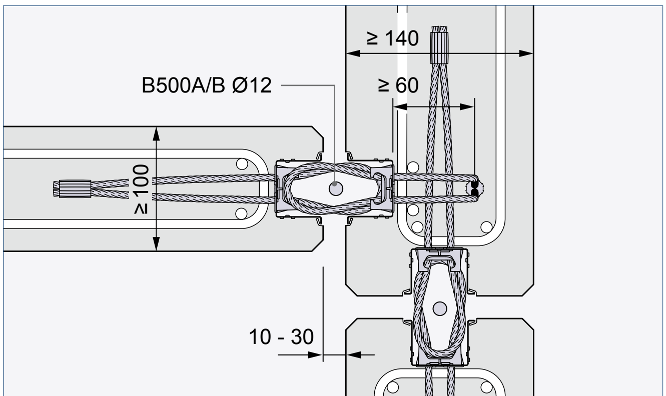
Picture 9 Wall / wall connection (corner connection)



Picture 10 Wall / wall connection (T-connection, 2 walls)



Picture 11 Wall / wall connection (T-connection, 2 walls)

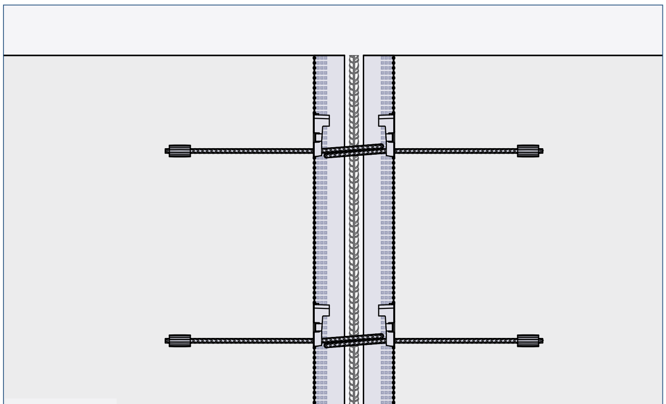


Picture 12 Wall / wall connection (T-connection, 3 walls)

Application

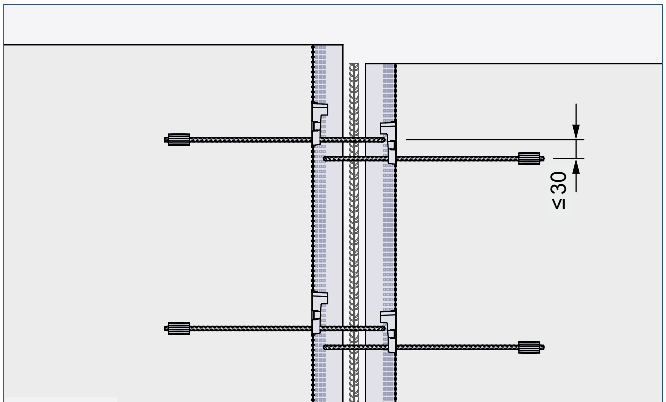
Installation of the rails

The installation of the Power One rails is not dependent on the direction. As only one rail type is used, there is no risk of mix-up. The wire rope loops do not have a false position in vertical direction.



Picture 13

False positions in vertical direction up to 30 mm are covered by a design value.



Picture 14

Application in case of fire

Loadbearing, fire-stressed wall (REI)

The Power One System is suitable for load bearing, fire-stressed connections, if the bearing capacities are reduced according to the calculation example case 3 (Page 18).

Forces on loadbearing fire-stressed walls

permissible: Self-weight, additional loads, use as stiffening element

inadmissible: Stress right-angled to the joint (wind load), criterion M (DIN EN 1992-1-2:2010-12)

Non-loadbearing fire wall (EI 90-M)

The Power One system can be installed in most fire wall constructions as a connection solution. Based on the approval the Power One system provides connections equivalent to the construction details mentioned in DIN 4102-4:2016-05, chap. 5.12.5 - 5.12.7.
These details primarily refer to connection possibilities of non-loadbearing, lying resp. standing walls. The term ″non-loadbearing wall” is defined (in DIN 4102-4:2016-05, chap. 5.1.1) approx. as follows:

Forces on non-loadbearing fire walls

permissible: Self-weight, stress right-angled to the joint (wind load), criterion M (DIN EN 1992-1-2:2010-12)

impermissible: Additional loads, use as stiffening element

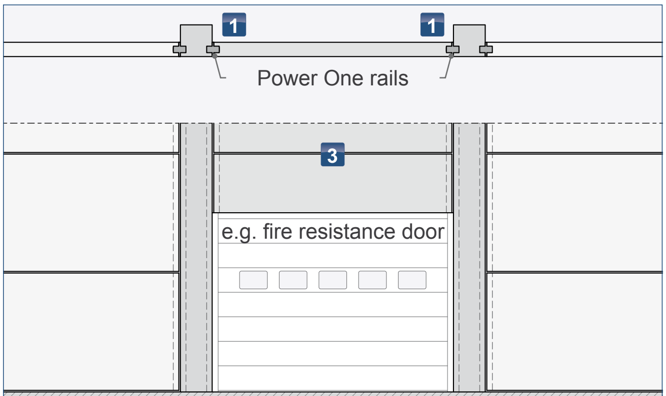
For the planning of non-loadbearing fire walls DIN EN 1992-1-2:2010-12 in combination with DIN EN 1992-1-2/NA:2010-12 and DIN 4102-4:2016-05 must be considered.

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.

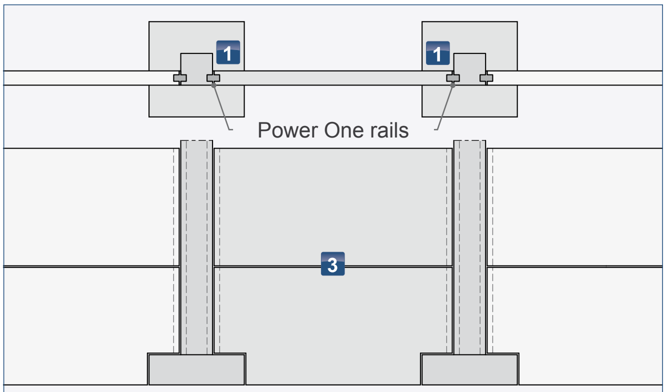
Lying, non-loadbearing walls

Following applications and construction details show connections of lying, non-loadbearing wall elements according to DIN 4102-04:2016-05, chap. 5.12.5 - 5.12.7. Lying elements of a fire wall can be connected to columns directly by the installation of the Power One system 1 (Picture 15 and 16). 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 15). Horizontal joints 3 have to be executed according to DIN 4102-4 (Picture 24 and 25).

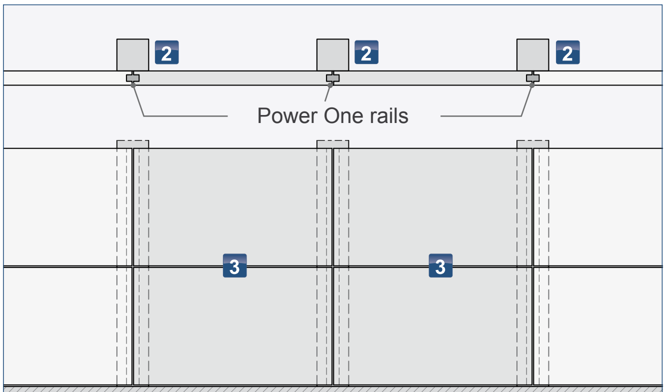
Details of the given connection possibilities in Picture 15 to 19 are shown on page 10.



Picture 15 Lying walls, non-loadbearing



Picture 16 Lying walls, non-loadbearing

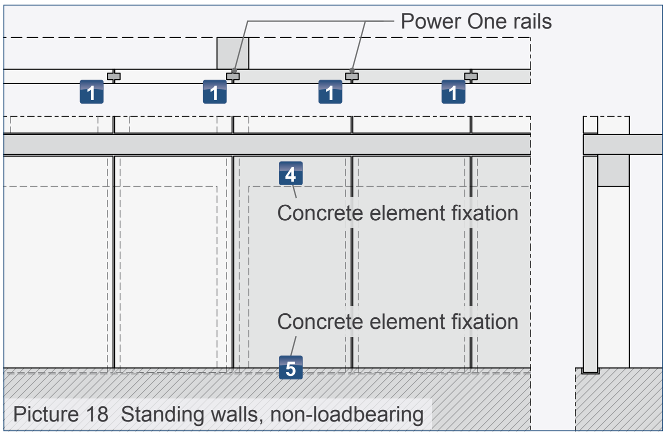


Picture 17 Lying walls, non-loadbearing

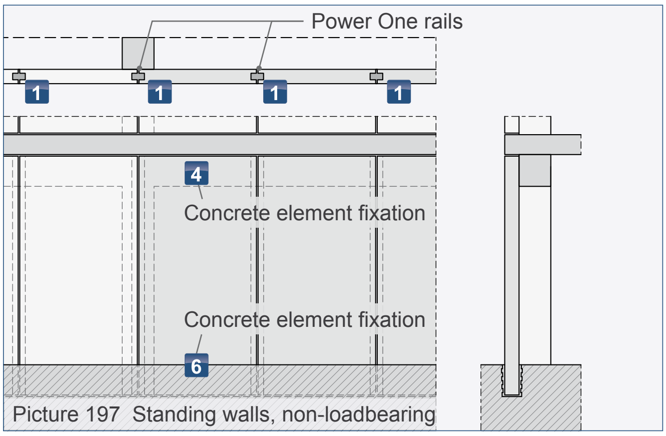
Application in case of fire

Standing, non-loadbearing walls

Following applications and construction details show connections of standing, non-loadbearing wall elements according to DIN 4102-04:2016-05, chap. 5.12.5. Standing elements of a fire wall can be connected to columns directly by the installation of the Power One system 1 (Picture 18 and 19). Here, it is required to fix the walls at the top and the bottom according to DIN 4102-04:2016-05 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.

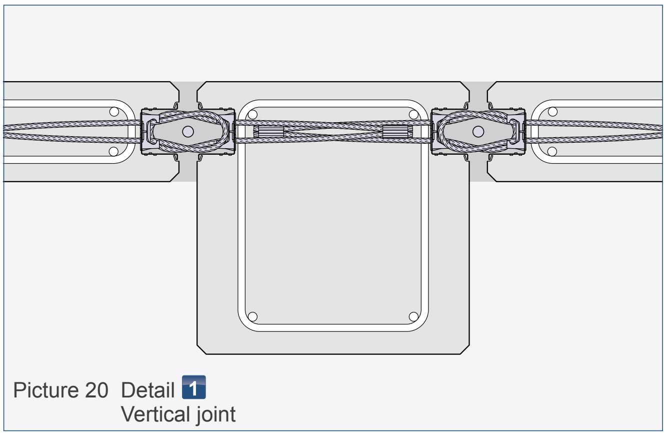


Picture 18 Standing walls, non-loadbearing

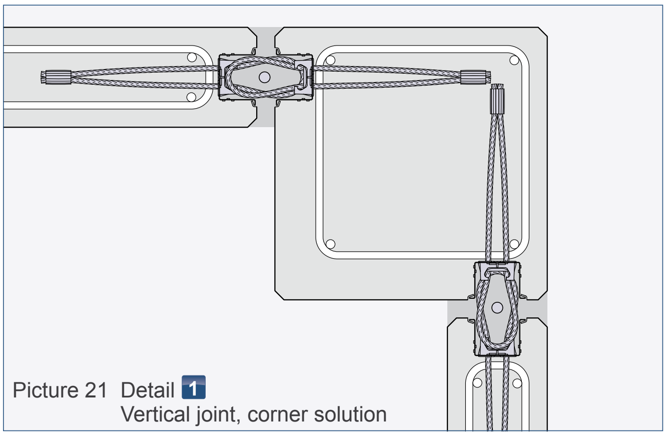


Picture 197 Standing walls, non-loadbearing

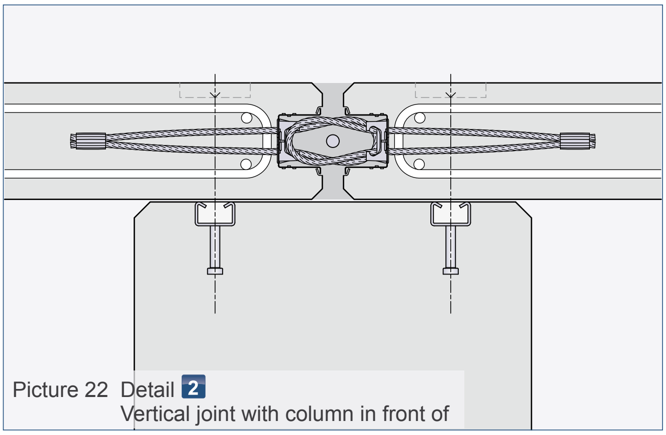
Detailed illustrations of vertical joints



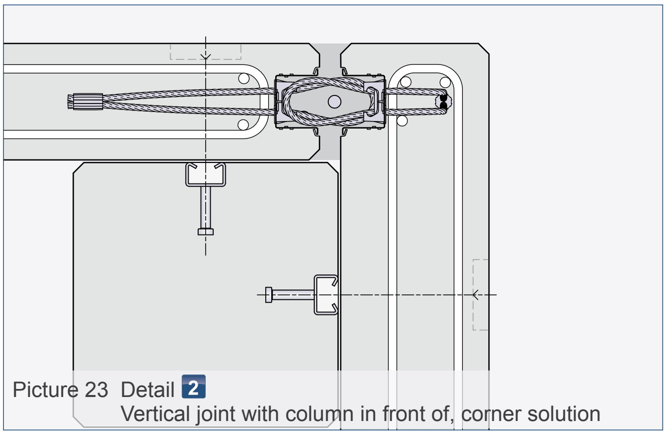
Picture 20 Detail 1
Vertical joint



Picture 21 Detail 1
Vertical joint, corner solution



Picture 22 Detail 2
Vertical joint with column in front of

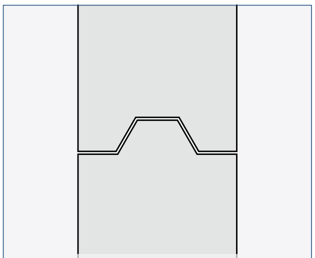


Picture 23 Detail 2
Vertical joint with column in front of, corner solution

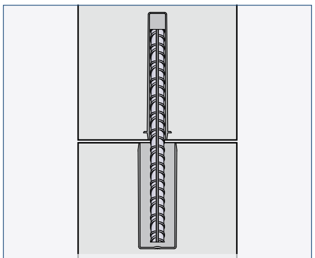
Application in case of fire

Horizontal joints

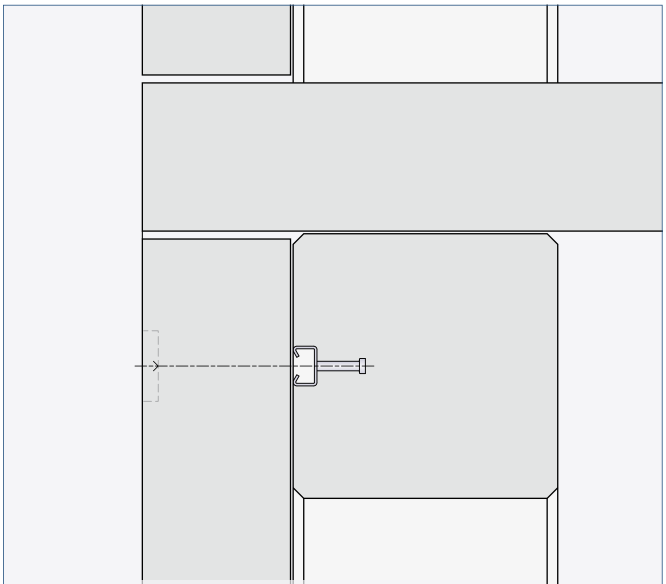
Construction details of horizontal joints between lying walls are given in chap. 5.12.7 of DIN 4102-04:2016-05. Both tongue-and-groove joints as well as plain joints with dowel connections (e.g. PHILIPP Dowelling system) are possible and must be done with a joint sealer based on cement mortar or synthetic resin-based mortar.



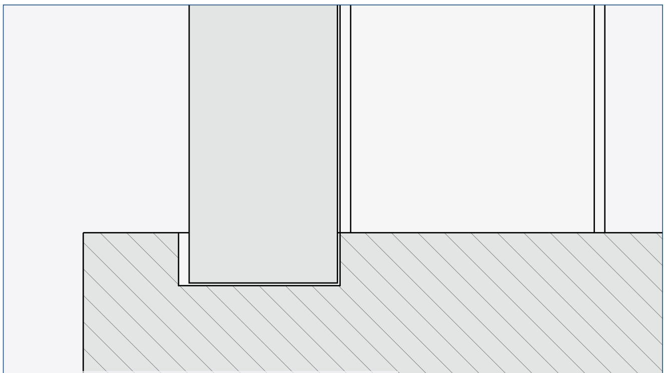
Picture 24 Detail 3 example 1: Horizontal joint



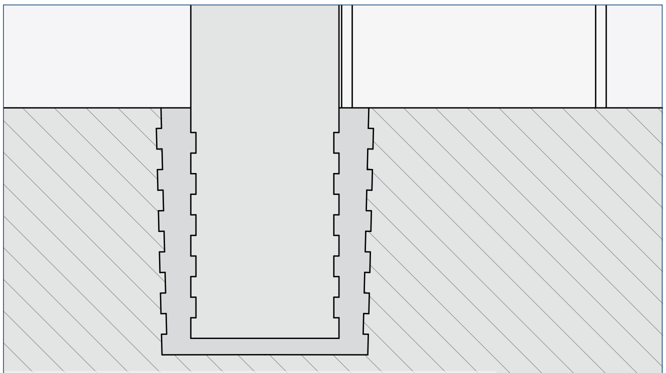
Picture 25 Detail 3 example 2: Horizontal joint



Picture 26 Detail 4 element top: Element fixation with cast-in anchor channel



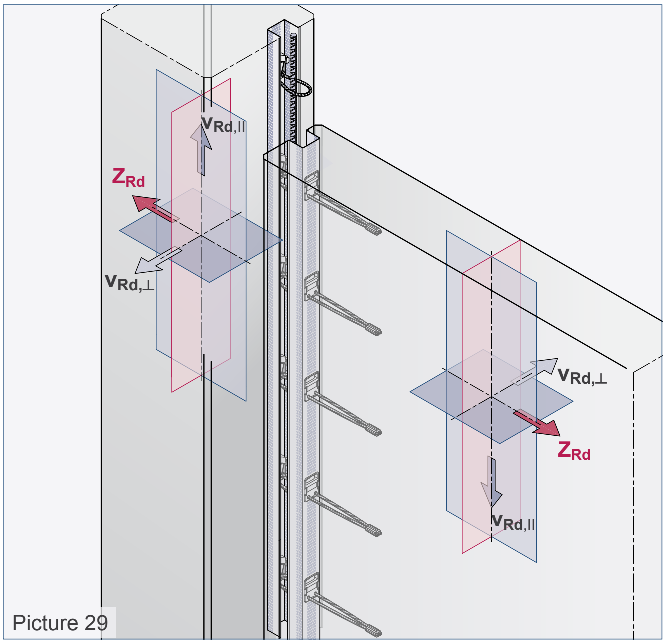
Picture 27 Detail 5 element bottom: Element fixation with recess



Picture 28 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. Furthermore, the precast units have to be made of normal weight concrete with a strength class of at least C30/37 according to EN 206.
It is part of the structural engineer to design the units and prove the joint connections according to the national German approval. In table 2 shear loads parallel to the joint ($v_{Rd,II}$) and in table 4 shear loads right-angled to the joint ($v_{Rd,\perp}$) are listed according to the approval.
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 diagram in Picture 31.
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. The sum of these single components has to be smaller than the tensile load capacity (Z_{Rd}). The verification of the total tensile force must be done.



Picture 29

Here, the following cases have to be differentiate:

Case 1: (Design example from page 14)
No constructive solution, which takes the acting tensile force (table 5).

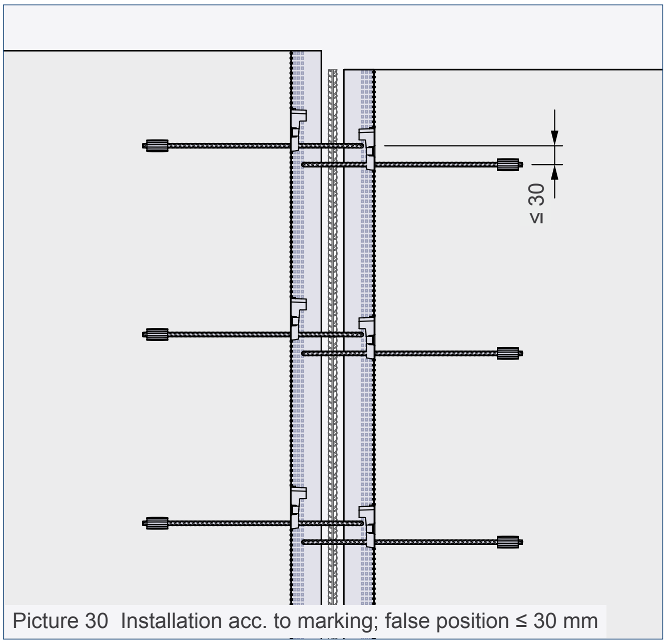
$$z_{Ed,ges} = z_{Ed,N} + 0.5 \times v_{Ed,II} + 0.25 \times v_{Ed,\perp}$$

Case 2: (Design example from page 16)
Constructive solution, which takes the acting tensile force (table 6).

$$z_{Ed,ges} = z_{Ed,N} + 0.25 \times v_{Ed,\perp}$$

Case 3: (Design example from page 18)
No constructive solution, which takes the acting tensile force (table 5) in case of fire.

$$z_{Ed,ges} = V_{Rd,fi,II} \ (\alpha_{fi} \times V_{Rd,II}) + Z_{Rd,fi,II} \ (\alpha_{fi} \times Z_{Rd,II})$$



Picture 30 Installation acc. to marking; false position ≤ 30 mm

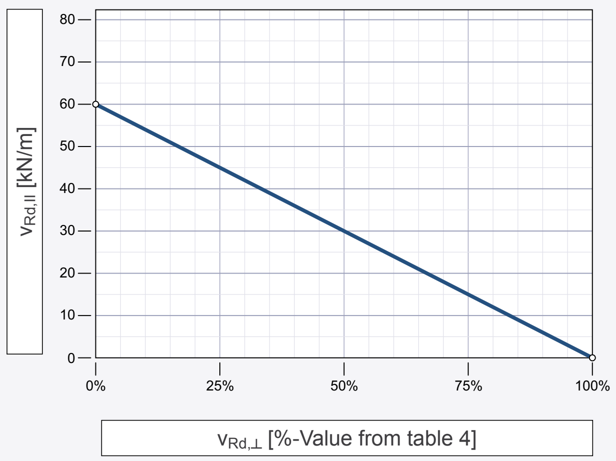
Design and construction

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

Wall thickness h [cm]	Design value of the shear force bearing capacity $v_{Rd,II}$ [kN/m] C30/37	C35/45	C40/50	C45/55
≥ 10	60.0			

Table 3: Design value of the tensile force bearing capacity per wire rope loop Z_{Rd}

Wall thickness h [cm]	Design value of the tensile force bearing capacity Z_{Rd} [kN/loop] C30/37	C35/45	C40/50	C45/55
≥ 10	10.0			



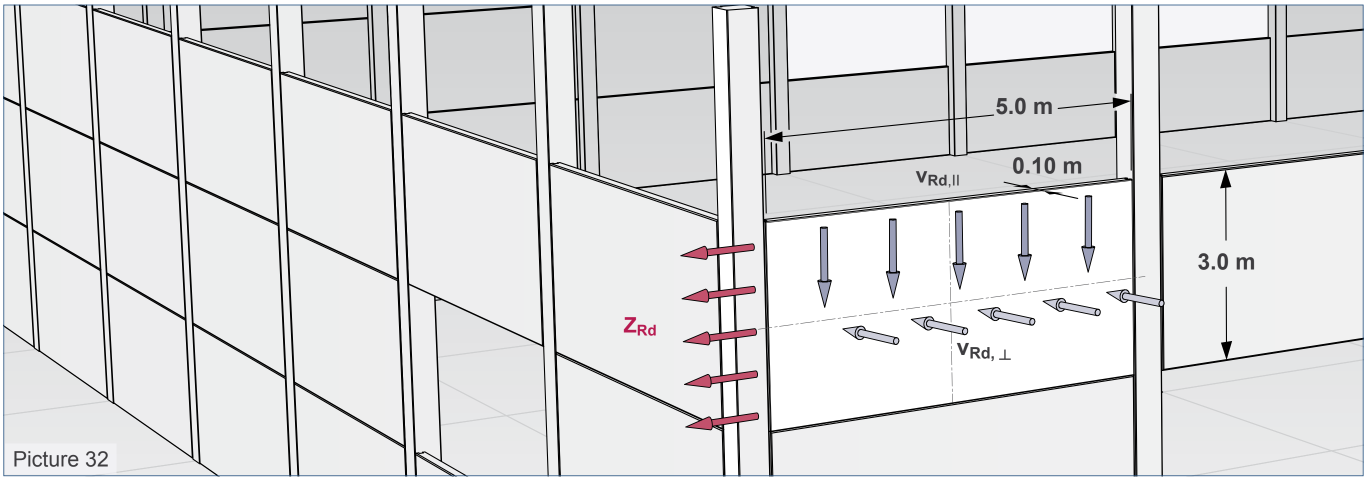
Picture 31 Interaction diagram of the shear forces parallel and right-angled to the joint

Table 4: 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] C30/37	C35/45	C40/50	C45/55
10 ①	4.5	5.2	5.5	5.9
11 ①	5.7	6.5	7.0	7.4
12 ①	7.0	8.0	8.5	9.1
13 ①	8.3	9.5	10.2	10.8
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	22.8	26.0	27.9	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

① Consideration of shear load capacities $v_{Rd,\perp}$ for wall thicknesses h < 14 cm only permissible from joint lengths ≥ 1.0 m

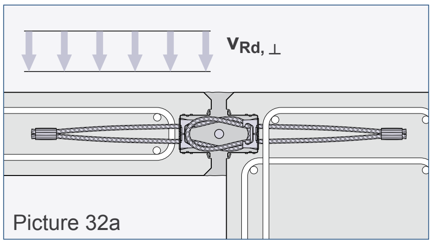
Design example case 1



Picture 32

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

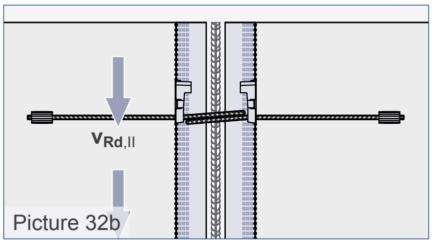
Because of the different load directions (shear force parallel and right-angled to the joint) single components of tensile forces result, which act in the direction of the wire rope. The sum of these single components (total tensile force) is verified on a basis of the tensile force resistance Z_{Rd}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



Picture 32a

Design example: stiffening by a wall with tensile forces

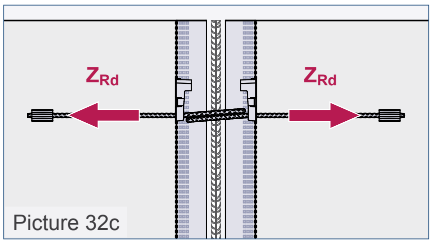
This example shows a wall, which shall be installed as a stiffening member. The resulting shear forces parallel to the joint are taken by the Power One system with PHILIPP - BETEC® grouting mortar and added with shear forces right-angled to the joint caused by wind.



Picture 32b

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 rope loops per metre of joint, n = 4 loops/metre
Z_{Rd}	[kN]	: Design value of tensile force bearing capacity per wire rope loop acc. to table 3
$z_{Ed,N}$	[kN/m]	: Acting „external" tensile force per metre of 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



Picture 32c

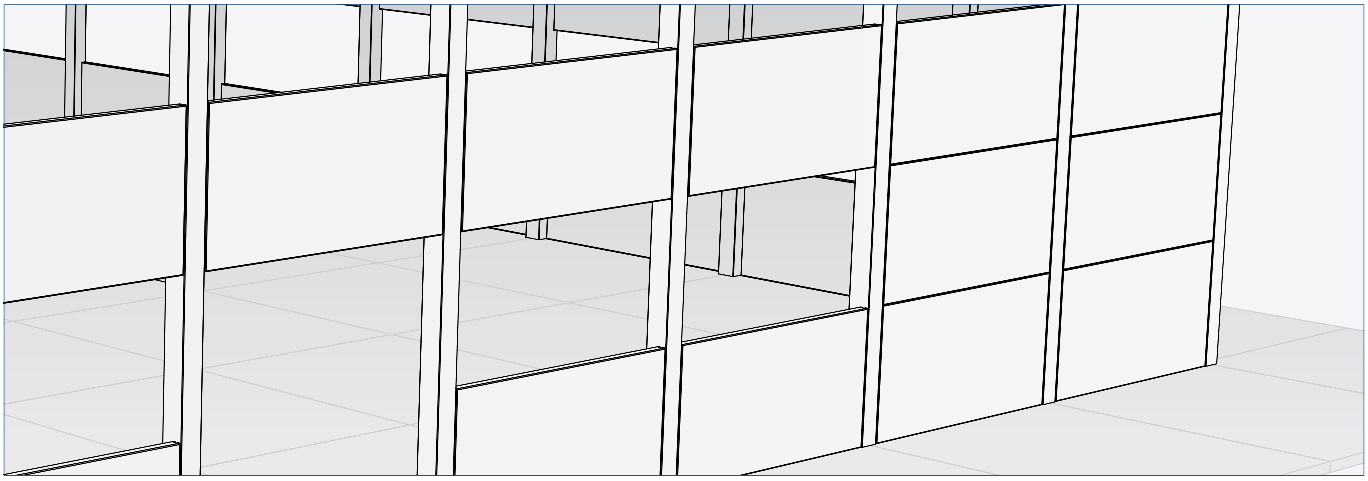
Table 5: Components of tensile force

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
  - $W_D = 1.5 \times (0.8\ kN/m^2 \times 1.0) = 1.2\ kN/m^2$
- Loads caused by the shear wall: 59.06 kN/m
- Wall thickness: 10 cm
- Concrete strength: C30/C37
- Tensile force: $z_{Ed,N}$ = 10 kN/m
- Wall dimensions: L = 5.0 m; H = 3.0 m

Design example case 1



Resultant shear force parallel to the joint:
$v_{Ed,II}$ = 59.06 kN/m / 2 / × 4.0 m = 9.84 kN/m

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

$v_{Ed,\perp}$ = (1.2 kN/m² × 5.00 m × 3.0 m) / 2 / 3.0 m = 3.0 kN/m per joint

Resistance values resulting from wall thickness and concrete strength:
Shear load parallel: $v_{Rd,II}$ = 60 kN/m (value from table 2) ≥ 9.84 kN/m → OK
Shear force right-angled: $v_{Rd,\perp}$ = 4.5 kN/m (value from table 4) ≥ 3.0 kN /m → OK

If both forces occur at the same time, the interaction (Picture 31) must be considered:
Percentage of shear force parallel: $v_{Ed,II}$ / $v_{Rd,II}$ = 9.84 kN/m / 60 kN/m = 16.4 %
The linear interaction results in a permissible shear force right-angled to the joint: 100 % - 16.4 % = 83.6 %

The reduced shear force right-angled to the wall can be set to 83.6 %:

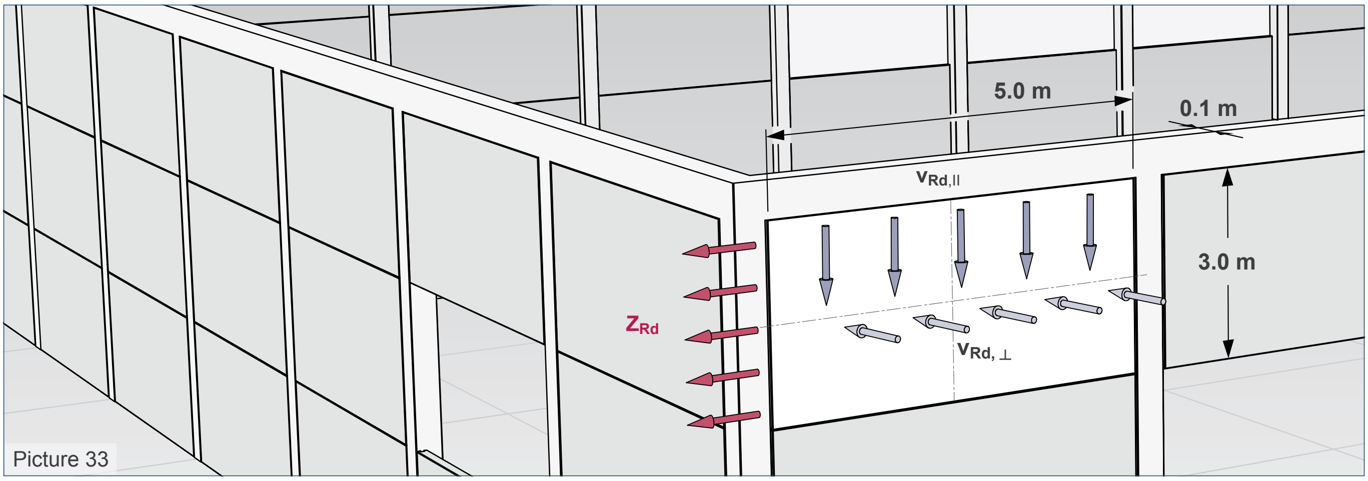
red. $v_{Rd,\perp}$ = 0.836 × 4.5 kN/m = 3.76 ≥ 3.0 kN/m → OK

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).

$n \times Z_{Rd} \geq z_{Ed,VII} + z_{Ed,V\perp} + z_{Ed,N}$
$z_{Ed,VII}$ = 0.5 × 9.84 kN/m = 4.92 kN/m
$z_{Ed,V\perp}$ = 0.25 × 2.40 kN/m = 0.75 kN/m
$z_{Ed,N}$ = 10 kN/m

Z_{Rd} = 10.0 kN/loop (Table 3)
4 loops per metre rail => 4 × Z_{Rd} = 40 kN/m
40 kN/m ≥ 4.92 kN/m + 0.75 kN/m + 10 kN/m = 15.67 kN/m → OK

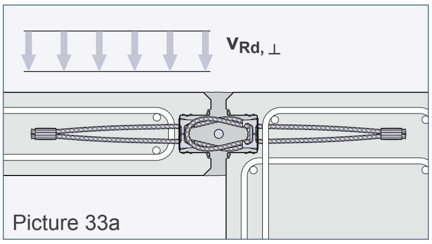
Design example case 2



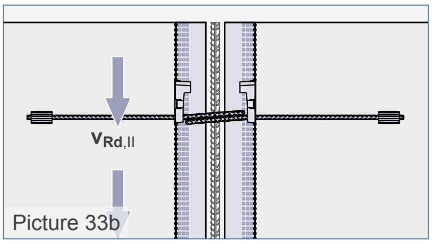
Picture 33

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

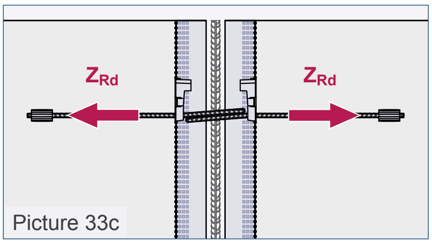
In this example the shear loads of the wall are absorbed by the Power One system. The occurring tensile forces are absorbed by suitable tension members (ring beam) or other constructive solutions (fixed column, friction forces with wall elements standing full-surfaced on ground).



Picture 33a



Picture 33b



Picture 33c

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

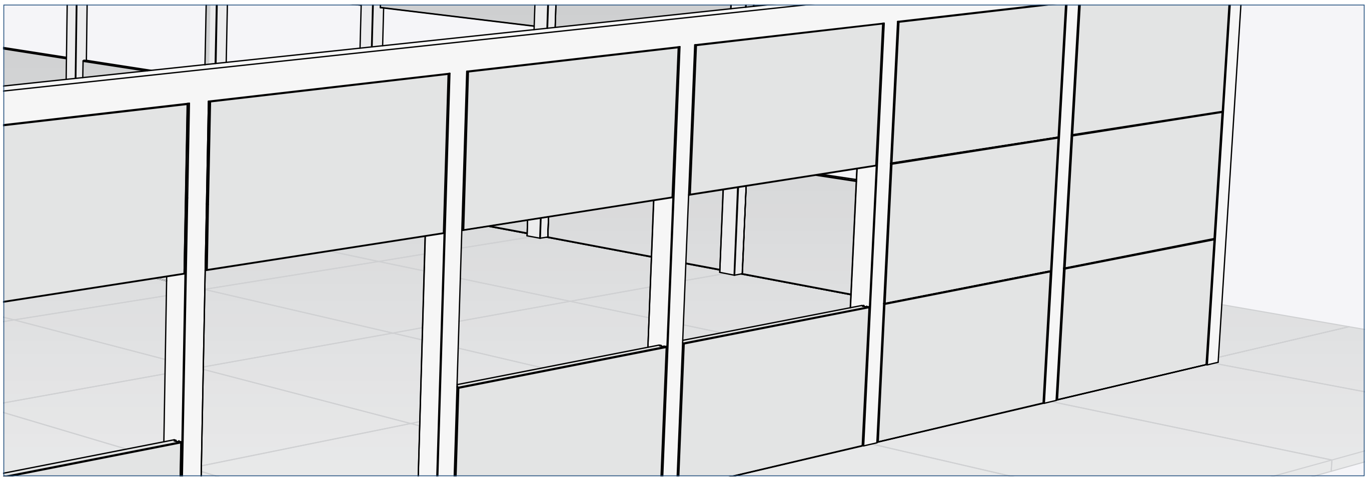
Table 6: Components of tensile force

Load from	Shear force right-angled $v_{Ed,\perp}$	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
  - $W_D = 1.5 \times (0.8\ kN/m^2 \times 1.0) = 1.2\ kN/m^2$
- Loads caused by the shear wall: 59.06 kN/m
- Wall thickness: 10 cm
- Concrete strength: C30/C37
- Tensile force: $z_{Ed,N} = 10$ kN/m
- Wall dimensions: L = 5.0 m; H = 3.0 m

Design example case 2



Resultant shear force parallel to the joint:
$v_{Ed,II}$ = 59.06 kN/m / 2 / 3.0 m = 9.84 kN/m

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

$v_{Ed,\perp}$ = (1.2 kN/m² × 5.0 m × 3.0 m) / 2 / 3.0 m = 3.0 kN/m per joint

Resistance values resulting from wall thickness and concrete strength:
Shear load parallel: $v_{Rd,II}$ = 60 kN/m (value from table 2) ≥ 9.84 kN/m → OK
Shear force right-angled: $v_{Rd,\perp}$ = 4.5 kN/m (value from table 4) ≥ 3.0 kN /m → OK

If both forces occur at the same time, the interaction (Picture 31) must be considered:
Percentage of shear force parallel: $v_{Ed,II}$ / $v_{Rd,II}$ = 9.84 kN/m / 60 kN/m = 16.4 %
The linear interaction results in a permissible shear force right-angled to the joint: 100 % - 16.4 % = 83.6 %

The reduced shear force right-angled to the wall can be set to 83.6 %:

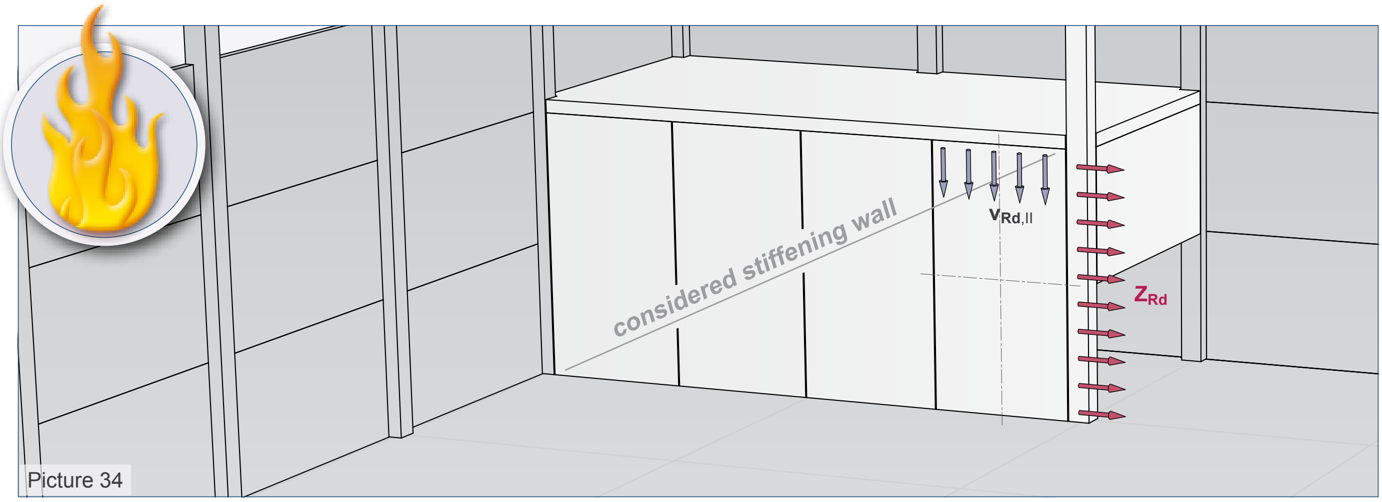
red. $v_{Rd,\perp}$ = 0.836 × 4.5 kN/m = 3.76 kN/m ≥ 3.0 kN/m → OK

It is shown that 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
$z_{Ed,ges}$ = $z_{Ed,V\perp}$ + $z_{Ed,N}$ [kN/m]
$z_{Ed,V\perp}$ = 0.25 × $v_{Ed,\perp}$ [kN/m]
$z_{Ed,N}$ = acting ”external” tensile forces per metre of joint [kN/m]
$z_{Ed,ges}$ = 0.25 × 3.0 kN/m + 10 kN/m = 10.75 kN/m

The calculated tensile force $z_{Ed,ges}$ must be absorbed e.g. by a ring beam or other constructive solutions.

Design example case 3 (loadbearing fire-stressed wall)

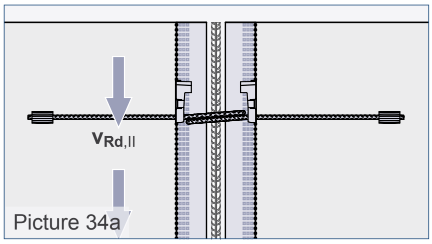


Picture 34

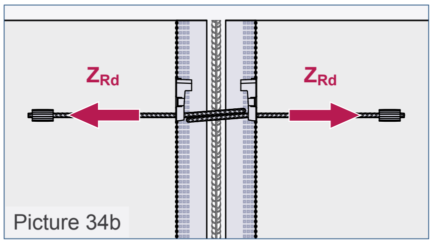
Proof of tensile force and shear force capacity parallel to the joint under fire stress

(No load transfer of tensile forces by constructive solutions)

For the proof of loadbearing, fire-stressed connections the loadbearing capacities according to table 7 may be used. Depending on the temperatures acting on the wire rope loop (see temperature profile DIN EN 1992-1-2:2012-12, picture A.2) the design resistances shall be reduced by α_{fi} as shown in picture 36. Loads right-angled to the joint cannot be proofed in case of fire.



Picture 34a



Picture 34b

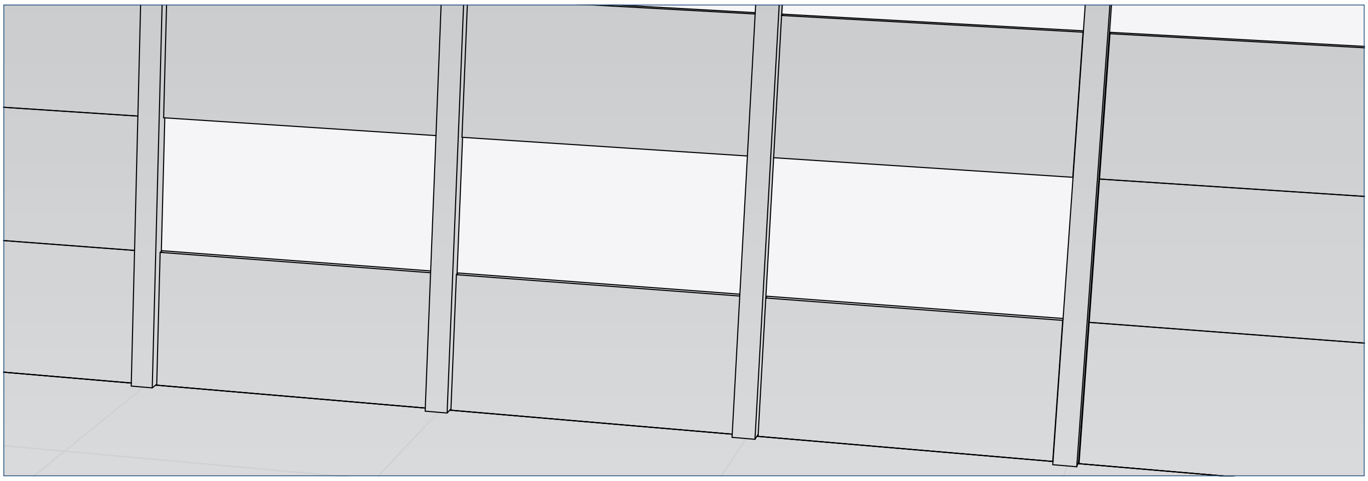
Table 7: Load bearing capacities in case of fire

Load from	Shear force parallel $v_{Rd,fi,II}$	Tensile force $z_{Rd,fi}$
Design value of the load bearing capacity	$v_{Rd,fi,II} = \alpha_{fi} \times v_{Rd,II}$	$z_{Rd,fi,II} = \alpha_{fi} \times z_{Rd,II}$

Actions / boundary conditions:

- Wall thickness: d = 140 mm
- Joint height: h = 3.00 m
- Concrete strength class: C30/37
- Mortar: Grouting mortar
- Outer shear force parallel to the joint $v_{Ed,II}$ = 30 kN/m (e.g. stiffening loads)
- Outer tensile force $z_{Ed,N}$ = 2 kN/m
- No load transfer of tensile forces by constructive solutions!
- Installation of the rails with false position ≤ 30 mm
- Fire exposure R 90, one-sided fire exposure

Design example case 3 (loadbearing fire-stressed wall)



Verification: calculation of reduced load bearing capacities in case of fire

Determination of the temperature at the wire rope:

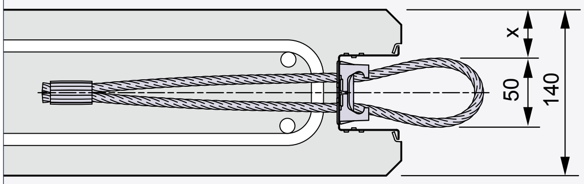
Distance x from the fire-stressed surface:

- Wall thickness d = 140 mm
- Width of the loop b = 50 mm

x = (d - b) / 2 = (140 - 50) / 2 = 45 mm

Reading the temperature at the wire rope θ (°C) in diagram "Temperature profile for one-sided fire-stressed elements" (see DIN EN 1992-1-2, picture A.2)

Determined temperature: θ (°C) = 350 °C



Picture 35 Distance x from the fire-stressed surface

Calculation of reduced load bearing capacities in case of fire:

$v_{Rd,fi,II} = v_{Rd,II} \times \alpha_{fi} = 60$ kN/m × 0.56 = 33.6 kN/m

$z_{Rd,fi} = z_{Rd} \times \alpha_{fi} = 40$ kN/m × 0.56 = 22.4 kN/m

Calculation of the tensile forces components caused by shear loads:

$z_{Ed,VII} = 0.5 \times v_{Ed,II} = 0.5 \times 30$ kN/m = 15 kN/m

Calculation of total tensile force:

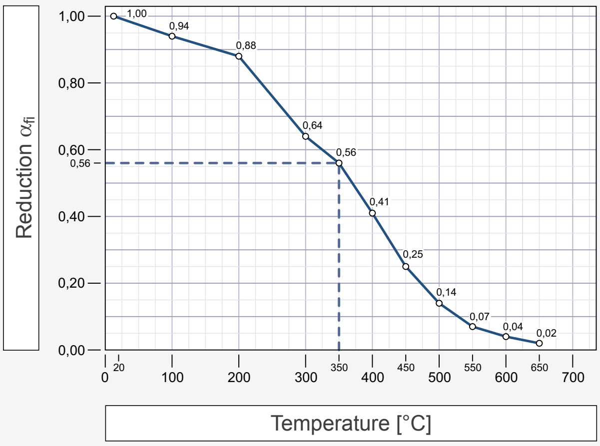
$z_{Ed,fi} = z_{Ed,VII} + z_{Ed,N} = 15 + 2 = 17$ kN/m

Proof of total tensile force:

$z_{Rd,fi} = 22.4$ kN/m ≥ 17 kN/m = z_{Ed} → OK

Proof of shear forces parallel to the joint:

$v_{Rd,fi,II} = 33.6$ kN/m ≥ 30 kN/m = $v_{Ed,II}$ → OK

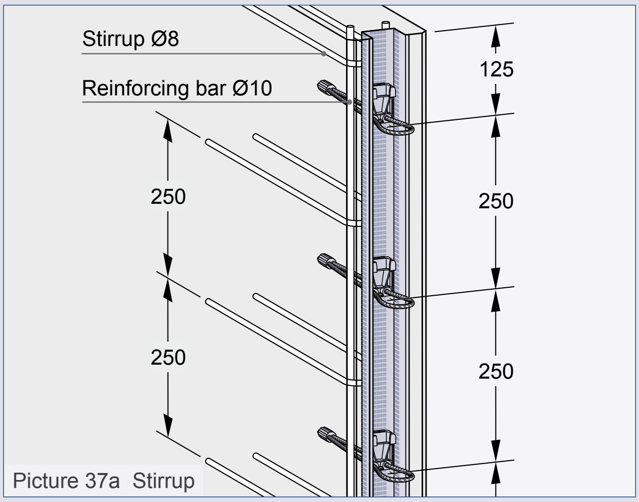


Picture 36 Reduction factor α_{fi} depending on the wire rope temperature

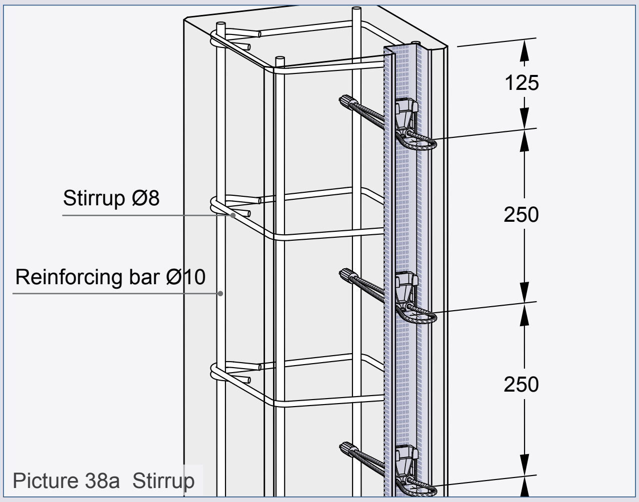
Reinforcement

If the Power One rails are installed flush all requirements of the German approval for the edge distances are met (Picture 37a, 37b, 38a, 38b). Please note also the part "Production of precasted reinforced concrete elements" in the approval.

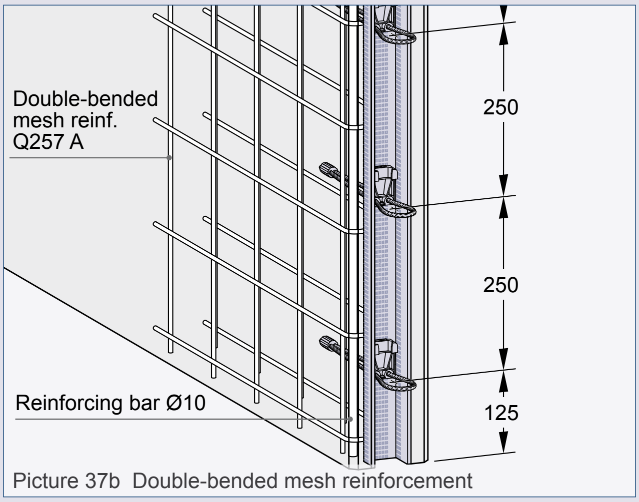
In the range of the Power One rails the precast elements must be provided with a minimum reinforcement. This reinforcement shall be stirrups Ø8/25 for each wire rope loop and longitudinal reinforcement 2Ø10 (Picture 37a, 38a).



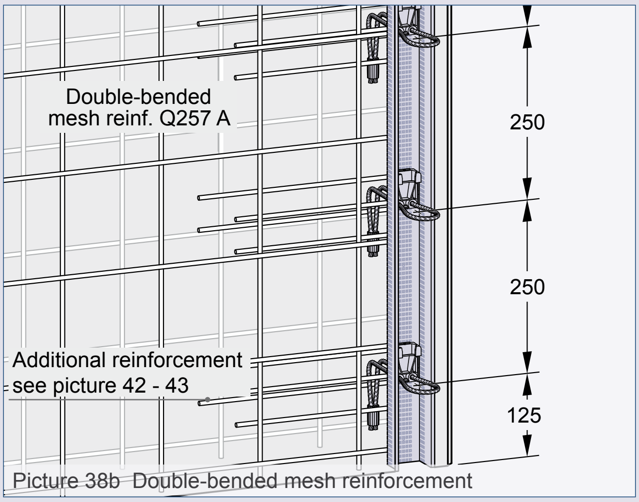
Picture 37a Stirrup



Picture 38a Stirrup



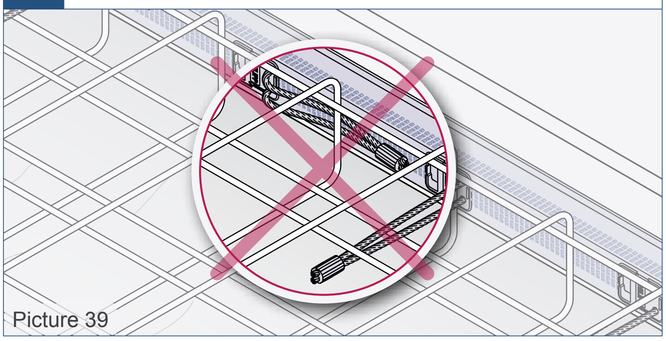
Picture 37b Double-bended mesh reinforcement



Picture 38b Double-bended mesh reinforcement

Alternatively the stirrups can be replaced by a comparable mesh reinforcement (Picture 37b and 38b).

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

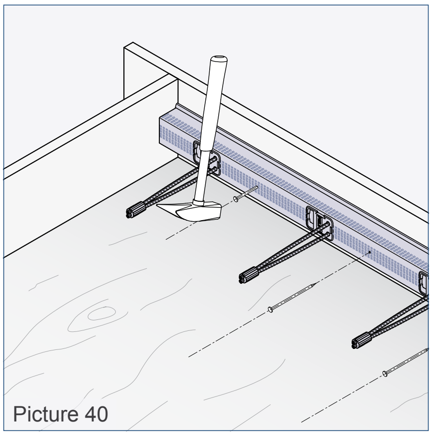

Picture 39

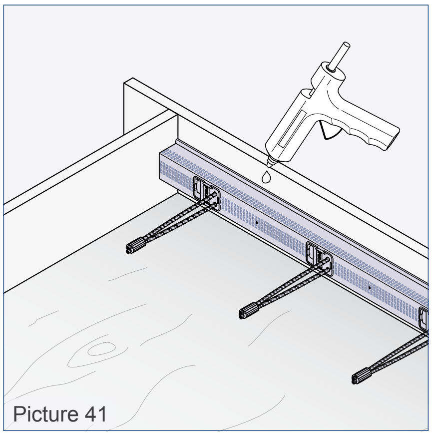
This requirement is fulfilled by a mesh reinforcement e.g. type Q257 A (equal: 2.57 cm²/m). Existing reinforcement can be taken into account.
The anchorage of the connecting loops in the precast element must be aligned in an angle of 90° to the Power One rails. With a vertical installation in the mould the stability of the rope ends in the precast unit shall be ensured by tying them to the reinforcement with wire.

Installation

Installation of the Power One rails

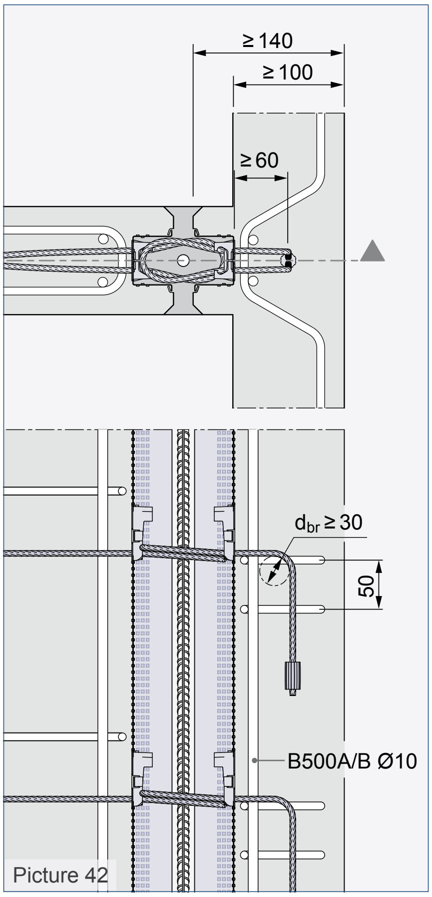
A fixation of the Power One rails to the mould is possible by nailing as well as hot bonding (Picture 40 and Picture 41).


Picture 40


Picture 41

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 42 and 43). Depending on the installation situation, additional reinforcement as shown in Picture 42 or 43 must be provided.



Picture 42

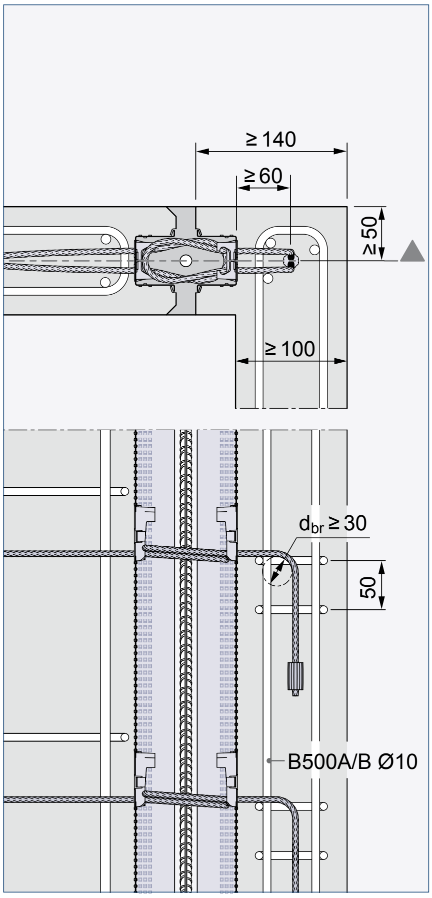
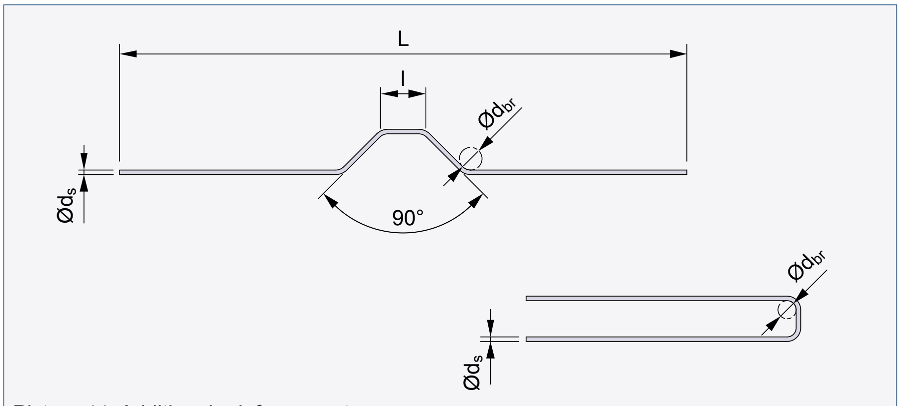


Table 8: Reinforcement (B500A/B)

$Ød_s$ [mm]	L [mm]	l [mm]	$Ød_{br}$ [mm]
Ø8	1000	70	Ø32

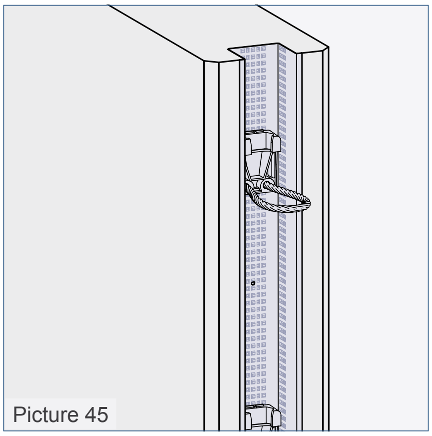


Picture 44 Additional reinforcement

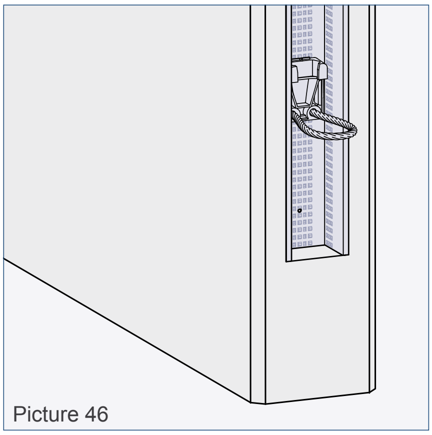
Installation

Installation of the Power One rails

For elements with the same height, it is recommended to start the installation at the upper elements edge (Picture 45). So it is possible to concrete the rail-free part at the bottom of the element (Picture 46).



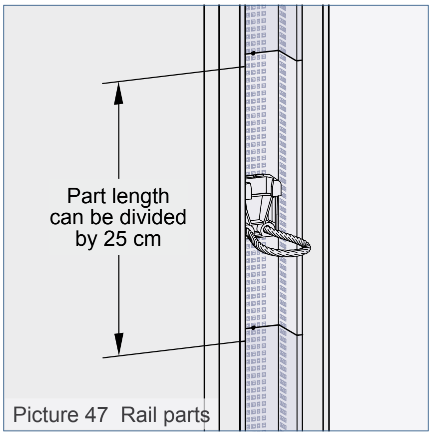
Picture 45



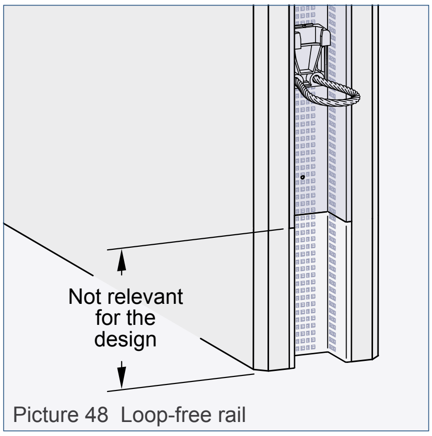
Picture 46

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

If the joint length cannot be divided by 25 cm the rest can be completed with a loop-free rail (Ref.-no. 84VS40, Picture 48) or timber (Picture 49) to create a recess.



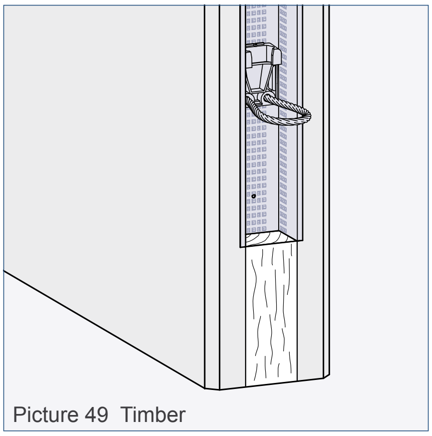
Picture 47 Rail parts



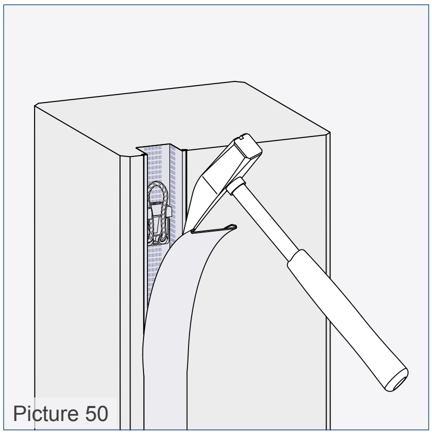
Picture 48 Loop-free rail

Preparation for mounting

The plastic cover of the installed rail must be released at one rail end. Then, it can be removed easily from the complete rail (Picture 50).

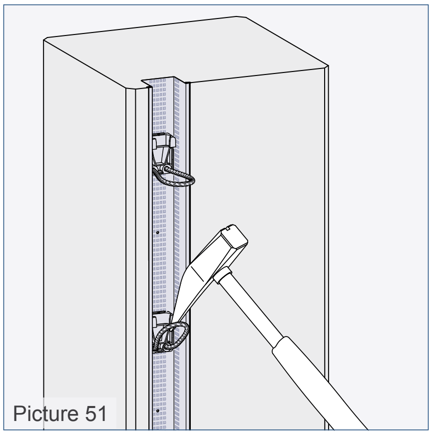


Picture 49 Timber



Picture 50

Now, the wire rope loops of the rail have to be folded right-angled to the rail (Picture 51).



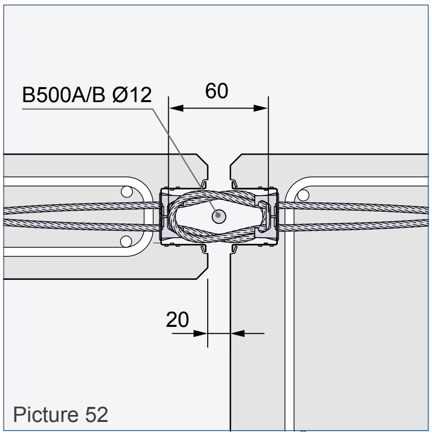
Picture 51

Mounting

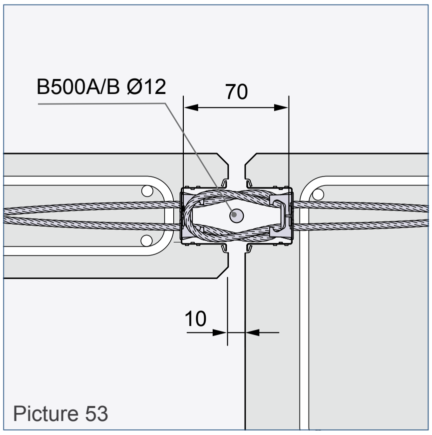
Mounting of the precast elements

If the Power One rails are installed correctly, the loops overlap horizontally with the nominal dimension of 60 mm as shown in Picture 52 and lie on top of each other in vertical direction. Nevertheless, the Power One system approval already considers horizontal and vertical mounting tolerances. The maximum permissible horizontal deviations are shown in Picture 53 and 54.

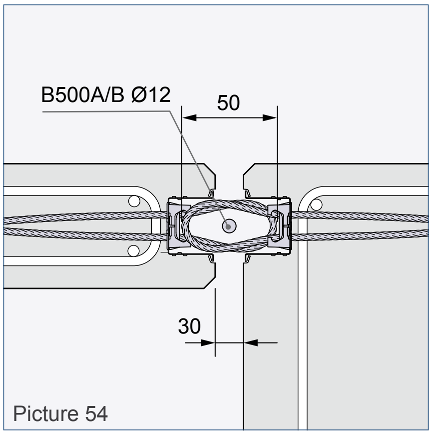
Prior the filling of the joint a reinforcing bar (Ø12 mm) shall be positioned along the entire joint length through the overlapping loops. The correct installation is to be checked visually.



Picture 52

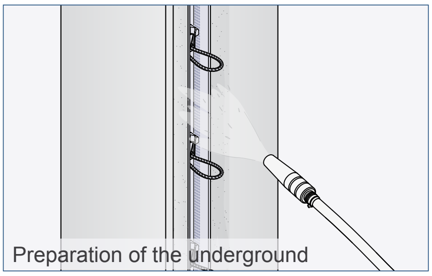


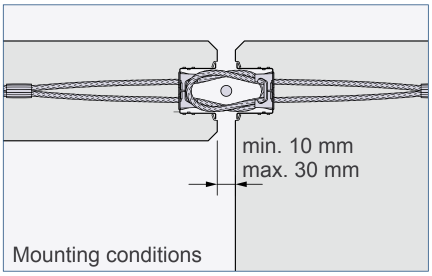
Picture 53



Picture 54

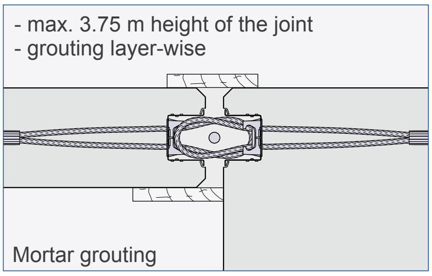
PHILIPP - BETEC® Grouting mortar


Preparation of the underground



Mounting conditions

Mixing



Mortar grouting

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 of 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.

Mortar 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 layers. (When using a joint tape be careful that it does not impede the grouting section or reduces the required concrete cover for the Power One 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 to fast for at least three days after application. Appropriate measures are covering with plastic sheets, wet tissues or irrigation.

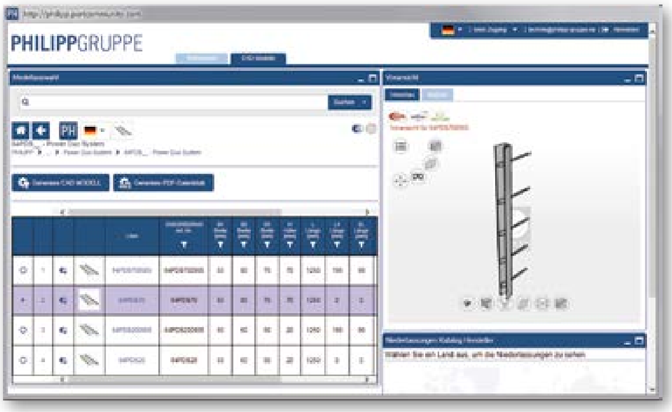
CAD

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)
- Standard PartCommunity:
  philipp.partcommunity.com

  BIM spezifische PartCommunity:
  bimcatalogs.partcommunity.com



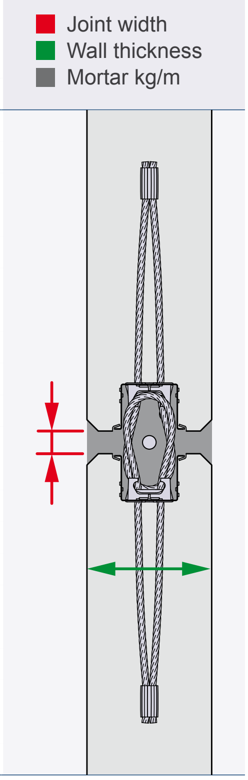
General notes

Table 9: Site check list

Step	What to do	Comment	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	Demoulding	After hardening of the mortar	✓
10	Aftertreatment of joint	Protection against too fast drying	✓

Table 10: Mortar consumption for 1 metre joint [kg/m]

Wall thickness [cm]	BETEC® Grouting mortar Joint width [cm] 1.0	2.0	3.0	4.0
10	9.3	11.2	13.1	15.0
11	9.5	11.6	13.7	15.8
12	9.6	12.0	14.3	16.6
13	9.8	12.3	14.8	17.3
14	10.0	12.7	15.4	18.1
15	10.2	13.1	16.0	18.9
16	10.4	13.5	16.6	19.6
17	10.6	13.9	17.1	20.4
18	10.8	14.3	17.7	21.2
19	11.0	14.6	18.3	22.0
20	11.2	15.0	18.9	22.7
21	11.4	15.4	19.5	23.5
22	11.6	15.8	20.0	24.3
23	11.8	16.2	20.6	25.0
24	12.0	16.6	21.2	25.8
25	12.1	17.0	21.8	26.6
26	12.3	17.3	22.3	27.3
27	12.5	17.7	22.9	28.1
28	12.7	18.1	23.5	28.9
29	12.9	18.5	24.1	29.6
30	13.1	18.9	24.6	30.4



Given consumption data are only guide values.

Table 11: Packing units (BETEC®)

Mortar Type	PU [kg]	Finished volume [l]
Grouting mortar	25	13.0

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Please refer also to the German approval of the Power One system and the Technical Data Sheet of the grouting mortar.
These can be found at www.philipp-gruppe.de/en or are available on request.

Notes:

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