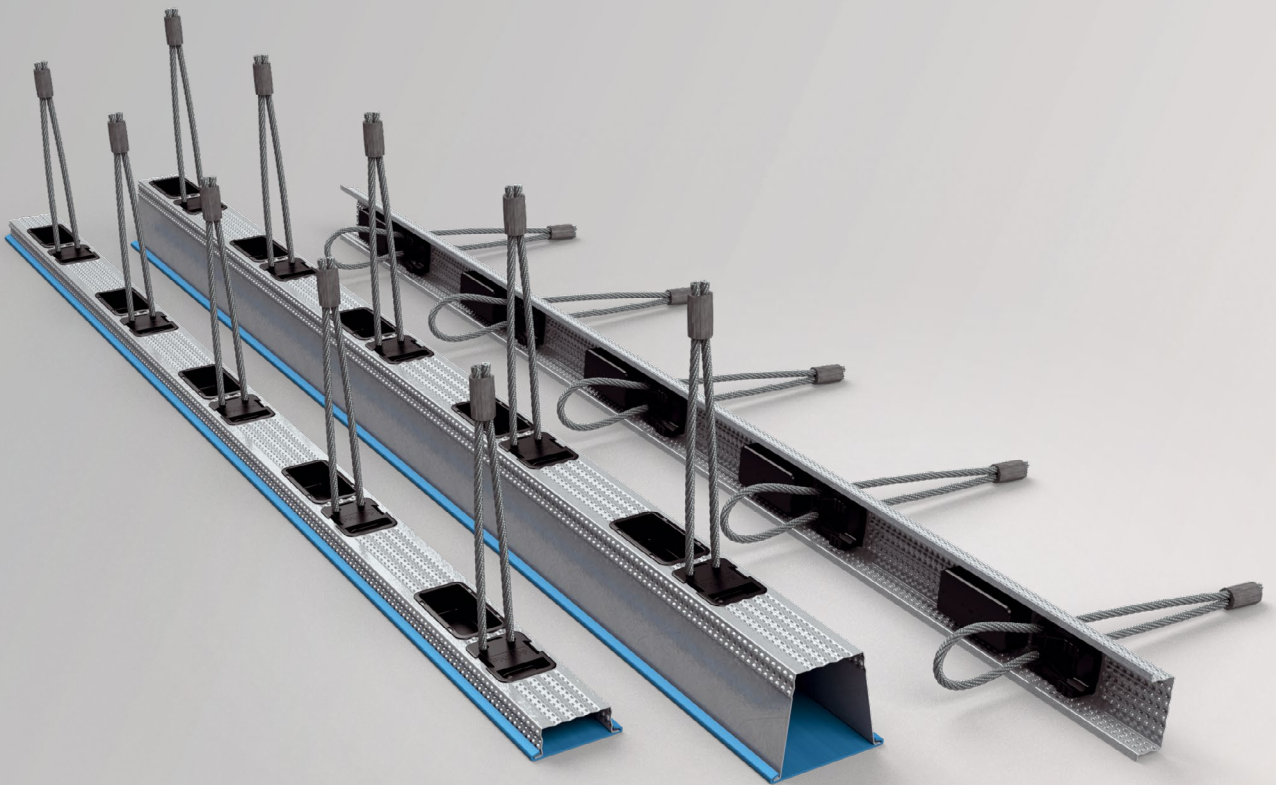


Power Duo System with BETEC® Thixo / Grouting mortar



Our products from the division BUILDING SOLUTIONS

SERVICES

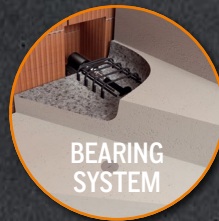
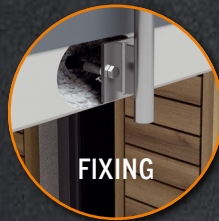
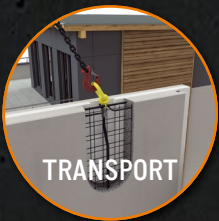
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Deutsches
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DIBt

Eine vom Bund und den Ländern gemeinsam
getragene Anstalt des öffentlichen Rechts

**Zulassungs- und Genehmigungsstelle
für Bauprodukte und Bauarten**

Datum:

Geschäftszeichen:

4 December 2025 | 25-1.21.8-73/25

**Allgemeine
bauaufsichtliche
Zulassung/
Allgemeine
Bauartgenehmigung**

Nummer:

Z-21.8-2028

Antragsteller:

PHILIPP GmbH

Lilienthalstraße 7–9
63741 Aschaffenburg

Geltungsdauer

vom:

bis: **8 December 2025**

8 December 2030

Gegenstand dieses Bescheides:

PHILIPP – Power Duo System with BETEC mortar for connecting precast concrete elements

The subject matter referred to above is hereby issued a national technical approval/
a general construction technique permit.

This decision contains eleven pages and 15 annexes.

The subject was first issued a national technical approval on 5 June 2014.

DIBt

DIBt | Kolonnenstraße 30 B | D-10829 Berlin | Tel.: +49 30 78730-0 | Fax: +49 30 78730-320 | E-Mail: dibt@dibt.de | www.dibt.de

I GENERAL PROVISIONS

- 1 This decision demonstrates the suitability and applicability of the subject matter within the meaning of the State Building Regulations.
- 2 This decision does not replace the permits, consents and certificates required by law for the implementation of building projects.
- 3 This decision is issued without prejudice to the rights of third parties, in particular private property rights.
- 4 Copies of this decision shall be made available to the user of the subject matter of the regulation, without prejudice to any further provisions in the 'Special Provisions'. Furthermore, the user of the subject matter of the regulation shall be informed that this decision shall be kept on site where it is used. Copies shall also be made available to the relevant authorities upon request.
- 5 This decision may only be reproduced in its entirety. Publication of extracts requires the consent of the Deutsches Institut für Bautechnik. Texts and drawings in promotional material shall not contradict this decision; translations shall include the statement 'Translation of the original German version not verified by the Deutsches Institut für Bautechnik'.
- 6 This decision is issued on a revocable basis. The provisions may be supplemented or amended at a later date, in particular if new technical findings so require.
- 7 This decision is based on the information provided and the documents submitted by the applicant. Any changes to these details are not covered by this decision and shall be disclosed to the Deutsches Institut für Bautechnik without delay.

II SPECIAL PROVISIONS

1 Subject matter of the regulation and scope of use or application

1.1 Subject of the approval and scope of use

The subject of the approval is the PHILIPP – Power Duo System, comprising the PHILIPP – connecting rails type 84PDS700905 and type 84PDS200905 and a grouting mortar (PHILIPP BETEC grouting mortar or BETEC grouting mortar) or a plastic mortar (PHILIPP–BETEC Thixo mortar or BETEC Thixo mortar). The connecting rails consist of a housing made of profiled galvanised sheet metal, in which flexible wire loops made of high-strength wire rope with a diameter of 6 mm are arranged at intervals of 250 mm.

The PHILIPP – Power Duo System is installed in precast reinforced concrete walls or corresponding reinforced concrete connection components and acts as permanent formwork in conjunction with the surrounding concrete.

1.2 Subject of approval and scope of application

The subject of approval is the planning, design and installation of the PHILIPP – Power Duo System for the connection of precast concrete elements.

Annex 1 shows the PHILIPP – Power Duo System in its installed state without joint grouting.

The PHILIPP Power Duo System may be used for connections or fixings between precast reinforced concrete walls or to other reinforced concrete components, in which forces from static and quasi-static loads are transferred.

The precast reinforced concrete elements shall comply with DIN EN 1992-1-1 in conjunction with DIN EN 1992-1-1/NA. The precast reinforced concrete elements shall be manufactured from normal concrete with a strength class of at least C25/30 in accordance with DIN EN 206-1.

The PHILIPP Power Duo System may be installed in walls subject to fire resistance requirements. Where fire resistance requirements apply, the provisions of this decision apply to the connection with the PHILIPP Power Duo System, whilst the provisions of DIN EN 1992-1-2 in conjunction with DIN EN 1992-1-2/NA and DIN EN 1992-1-2/NA/A1, as well as DIN 102-4, apply to the reinforced concrete components.

2 Specifications for the construction product

2.1 Properties and composition

2.1.1 Connecting rails

The connecting rails shall comply with the drawings and specifications set out in the annexes. The material properties, dimensions and tolerances of the connecting rails not specified in this decision shall comply with the data filed with the Deutsches Institut für Bautechnik, the notified body and the external quality control.

2.1.2 PHILIPP–BETEC grouting mortar resp. BETEC grouting mortar

The PHILIPP–BETEC grouting mortar resp. BETEC grouting mortar shall comply with the DAfStb guideline “Production and use of cement-bound grouting concrete and grouting mortar” (July 2019 edition) and the specifications filed with the Deutsches Institut für Bautechnik.

2.1.3 PHILIPP–BETEC Thixo mortar resp. BETEC Thixo mortar

PHILIPP–BETEC Thixo mortar or BETEC Thixo mortar shall comply with the specifications filed with the Deutsches Institut für Bautechnik.

2.2 Packaging, storage and labelling

2.2.1 Connecting rails

The packaging, instruction leaflet or delivery note for the connecting rails shall be marked by the manufacturer with the conformity mark (Ü mark) in accordance with the conformity mark regulations of the federal states. The marking may only be applied if the requirements set out in Section 2.3 are met. In addition, the manufacturer's mark, the approval number and the full designation of the connecting rail shall be stated.

Each connecting rail shall be marked with the manufacturer's mark and the designation "Typ 84PDS700905" or "Typ 84PDS200905".

2.2.2 PHILIPP-BETEC grouting mortar resp. BETEC grouting mortar

Packaging, storage and labelling of PHILIPP-BETEC grouting mortar or BETEC grouting mortar shall be carried out in accordance with the provisions of the DAfStb guideline "Production and use of cement-bound grouting concrete and grouting mortar" (July 2019 edition).

2.2.3 PHILIPP-BETEC Thixo mortar resp. BETEC Thixo mortar

The packaging, package insert or delivery note for PHILIPP-BETEC Thixo mortar or BETEC Thixo mortar shall be marked by the manufacturer with the conformity mark (Ü mark) in accordance with the conformity mark regulations of the federal states. The marking may only be applied if the requirements set out in Section 2.3 are met. In addition, the manufacturer's mark, the approval number and the full designation of the PHILIPP-BETEC Thixo mortar or BETEC Thixo mortar shall be stated.

Furthermore, the provisions of the DAfStb guideline "Production and use of cement-bound grouting concrete and grouting mortar" (July 2019 edition) shall apply correspondingly.

2.3 Certificate of Conformity

2.3.1 Connecting rails

2.3.1.1 General

Confirmation of the conformity of the connecting rails with the provisions of this national technical approval shall be provided for each manufacturing plant by means of a manufacturer's declaration of conformity based on a factory production control and a certificate of conformity issued by a recognised notified body, as well as regular external quality control by a recognised inspection body in accordance with the following provisions: For the issue of the certificate of conformity and the external quality control, including the product tests to be carried out in this context, the manufacturer of the connecting rail shall engage a notified body recognised for this purpose and a inspection body recognised for this purpose.

The manufacturer shall issue the declaration of conformity by marking the construction product with the conformity mark (Ü mark), indicating its intended use.

The notified body shall provide the Deutsches Institut für Bautechnik with a copy of the certificate of conformity it has issued.

2.3.1.2 Factory production control

A factory production control shall be established and carried out at every manufacturing plant. Factory production control refers to the continuous monitoring of production to be carried out by the manufacturer, whereby the manufacturer ensures that the construction products it manufactures comply with the provisions of this national technical approval.

The scope, method and frequency of the factory production control are governed by the test plan filed with the Deutsches Institut für Bautechnik and the external control body.

The results of the factory production control shall be recorded and evaluated. The records shall contain at least the following information:

Description of the construction product resp. the raw material and its components

Type of inspection or test

Date of manufacture and testing of the construction product resp. raw material or components

Results of the checks and tests and, where applicable, a comparison with the requirements

Signature of the person responsible for the factory production control.

The records shall be kept for at least five years and submitted to the body engaged to carry out external quality controls. They shall be submitted to the Deutsches Institut für Bautechnik and the competent supreme building supervisory board upon request.

In the event of unsatisfactory test results, the manufacturer shall immediately take the necessary measures to rectify the defect. Construction products that do not meet the requirements shall be handled in such a way as to prevent any confusion with compliant products. Once the defect has been rectified, the existing test shall be repeated immediately insofar as this is technically possible and necessary to provide evidence that the defect has been rectified.

2.3.1.3 External quality control

At every manufacturing plant, the factory production control shall be regularly verified by an external quality control, at least once a year.

As part of the external quality control, an initial inspection shall be carried out and random samples shall be taken. Sampling and testing are the responsibility of the recognised inspection body.

The scope, method and frequency of an external quality control shall be governed by the test plan filed with the Deutsches Institut für Bautechnik and the external inspection body.

The results of the certification and external quality control shall be retained for at least five years. They shall be submitted by the certification body or the inspection body to the Deutsches Institut für Bautechnik and the competent supreme building supervisory board upon request.

2.3.2 PHILIPP-BETEC grouting mortar resp. BETEC grouting mortar

The compliance certificate for PHILIPP-BETEC grouting mortar or BETEC grouting mortar shall be issued in accordance with the provisions of the DAfStb guideline 'Production and use of cement-bound grouting concrete and grouting mortar' (July 2019 edition).

2.3.3 PHILIPP-BETEC Thixo mortar resp. BETEC Thixo mortar

2.3.3.1 General

The confirmation of the compliance of PHILIPP-BETEC Thixo mortar or BETEC Thixo Mortar with the provisions of this national technical approval shall be provided for each manufacturing plant by means of a manufacturer's declaration of conformity based on a factory production control and a certificate of conformity from a recognised certification body, as well as regular external quality control by a recognised inspection body in accordance with the following provisions: For the issue of the certificate of conformity and the external factory control, including the product tests to be carried out in this context, the manufacturer of PHILIPP-BETEC Thixo mortar or BETEC Thixo mortar shall engage a recognized notified body and a recognised inspection body.

The manufacturer shall issue the declaration of conformity by marking the construction product with the conformity mark (Ü mark), indicating its intended use.

The notified body shall provide the Deutsches Institut für Bautechnik with a copy of the certificate of conformity it has issued.

2.3.3.2 Factory production control

Factory production control shall be established and carried out at every manufacturing plant. Factory production control refers to the continuous monitoring of production to be carried out by the manufacturer, by means of which the manufacturer ensures that the construction products manufactured by them comply with the provisions of this national technical approval.

The provisions of the DAfStb guideline "Production and use of cement-bound grouting concrete and grouting mortar" (July 2019 edition) shall apply correspondingly to the scope, method and frequency of the factory production control.

2.3.3.3 External quality control

At each manufacturing plant, the factory production control shall be regularly inspected by an external quality control, at least once a year.

As part of the external monitoring, an initial test shall be carried out and random samples shall be taken. Sampling and testing are the responsibility of the recognised inspection body.

The provisions of the DAfStb guideline "Production and use of cement-bound grouting concrete and grouting mortar" (July 2019 edition) shall apply correspondingly to the scope, method and frequency of external quality control, including the initial inspection.

The results of the certification and external quality control shall be retained for at least five years. They shall be submitted by the notified body or the inspection body to the Deutsches Institut für Bautechnik and the competent supreme building supervisory board upon request.

3 Provisions for planning, design and execution

3.1 Planning

3.1.1 Precast reinforced concrete elements

Unless otherwise specified below, precast reinforced concrete elements shall be planned in accordance with DIN EN 1992-1-1 and DIN EN 1992-1-1/NA.

For precast reinforced concrete elements, normal concrete with a strength class of at least C25/30 in accordance with DIN EN 206-1 shall be used.

Precast reinforced concrete elements shall have a minimum wall thickness of 14 cm (exception: Annex 13, Figures 18 and 19). Where fire resistance requirements apply, the minimum wall thicknesses specified in DIN EN 1992-1-2 in conjunction with DIN EN 1992-1-2/NA and DIN EN 1992-1-2/NA/A1 shall also apply.

In the area of the connecting rails, to ensure the transfer of forces induced to the loops, a minimum reinforcement at the edges of the precast elements with stirrups and longitudinal bars shall be provided in accordance with the specifications in Annex 3 (Figure 5) as well as Annexes 6 (Table 2) and 7 (Table 3). The stirrups may be replaced by equivalent mesh reinforcement. Additional provisions regarding reinforcement for corner or T connections are given in Annex 13.

The connecting rails are marked on the housing with arrows and the designation 'Top side'. The arrows on opposing rails may both point towards the upper edge of the precast element (installation option A, with a maximum vertical tolerance of 30 mm) or be oriented in opposite directions, i.e. one connecting rail is installed with the arrow pointing towards the lower edge of the precast element (installation option B, with a maximum vertical tolerance of 125 mm). If both rails are aligned in the same direction, installation option B is also to be assumed for a vertical tolerance between 30 mm and 125 mm.

Edge distances as well as horizontal and vertical tolerances for the wire loop alignment as specified in Annexes 3 to 5 shall be observed.

3.1.2 Precast reinforced concrete element – connection

The connection between the precast reinforced concrete elements shall be capable of transferring forces from static and quasi-static loads.

The joints may be filled with either PHILIPP-BETEC grouting mortar resp. BETEC grouting mortar, or with PHILIPP-BETEC Thixo mortar resp. BETEC Thixo mortar. When using PHILIPP-BETEC Thixo Mortar resp. BETEC Thixo Mortar, the specific application instructions in Section 3.3.2 shall be followed.

As a general rule, a grouting height of 3.75 m may be achieved using PHILIPP-BETEC grouting mortar resp. BETEC grouting mortar. Higher joints are only permitted if the subsequent grouting of the joints is carried out in sections using a grouting hose, each section being 3.75 m long.

Any constraint forces on the precast reinforced concrete connection resulting from temperature changes or exposure shall be ruled out. An exception to this may be made if, for the specific application, evidence of crack width limitation in accordance with Section 3.2.5 is provided.

The precast reinforced concrete connection shall be designed in accordance with the specifications in the Annexes. All connections shall be planned such that the target value for the overlap length of the wire loops, as specified in the Annexes, is adhered to.

3.2 Design

3.2.1 General

A structural verification of the load-bearing capacity of the precast reinforced concrete elements and their connections shall be provided in each individual case.

Precast reinforced concrete elements shall be designed in accordance with DIN EN 1992-1-1 and DIN EN 1992-1-1/NA. For fire resistance requirements, see Section 3.2.6.

The following design values apply only to precast reinforced concrete elements with a concrete strength class of at least C25/30 in accordance with DIN EN 206-1.

The connection of precast reinforced concrete elements using connecting rails can transfer tensile forces as well as shear forces parallel and right-angled to the joint (see Annex 1, Figure 2).

Verifications at the ultimate limit state under loading from tensile forces and shear forces parallel and right-angled to the joint shall be carried out in accordance with Annex 8 and 9. A verification at the ultimate limit state is deemed to satisfy the verification at the serviceability limit state.

Shear forces parallel and right-angled to the joint rise expansion forces within the joint. The resulting tensile forces (see Annex 9, Table 5) shall be taken into account in the tensile force verification in addition to the 'external' tensile forces.

The tensile force verification in accordance with Annex 9 may be omitted under the following conditions:

loading exclusively due to shear forces parallel to the joint, or

the sum of 'external' tensile forces and tensile forces arising from shear forces right-angled to the joint (see Annex 10) is transferred by appropriately arranged reinforcement (e.g. ring beam) or by other structural measures (fix-ended columns, frictional forces in wall elements supported over their entire area, etc.).

For the two installation options (A and B) with the corresponding vertical tolerances different design resistances apply to (Annexes 6 and 7).

3.2.2 Tensile force bearing capacity

For the tensile force bearing capacity of the joint reinforced with the connecting rail, the design values Z_{Rd} in accordance with Annex 6, Table 1 (installation option A) or Annex 7, Table 3 (installation option B) may be used for the ultimate limit state.

3.2.3 Shear force bearing capacity parallel to the joint

For the shear force bearing capacity parallel to the joint reinforced with the connecting rail, the design values $v_{Rd,II}$ may be taken for the ultimate limit state, depending on the concrete strength class and the mortar used, in accordance with Annex 6, Table 2 (installation option A) or Annex 7, Table 4 (installation option B).

If shear forces right-angled acting simultaneously to the joint, the design value $v_{Rd,II}$ shall be reduced in accordance with the interaction correlation given in Annex 8, Diagram 1.

3.2.4 Shear force bearing capacity right-angled to the joint

For the shear force bearing capacity right-angled to the joint reinforced with the connecting rail, the design values v_{Rd} may be taken for the ultimate limit state, depending on the element thickness, the concrete strength class and the mortar used, in accordance with Annex 6, Table 2 (installation option A) or Annex 7, Table 4 (installation option B).

If shear forces parallel acting simultaneously to the joint, the design value $v_{Rd,\perp}$ shall be reduced in accordance with the interaction correlation given in Annex 8, Diagram 1.

3.2.5 Limitation of crack width

If constrained forces on the precast reinforced concrete connection due to temperature changes or exposure to the elements cannot be ruled out, it shall be verified that, in the area of the precast reinforced concrete connection, the crack width resulting from these forces remains limited to $w_k \leq 0.3 \text{ mm}$. Shear forces do not result in additional crack widths.

3.2.6 Load-bearing capacity under fire exposure

3.2.6.1 General

Joints formed in reinforced concrete walls resp. between reinforced concrete walls and other reinforced concrete elements using the Power Duo System may be used for the following requirements regarding fire resistance:

- fire-retardant
- highly fire-retardant
- fire-resistant
- firewall

Only the grouting mortars and mortars specified in Sections 2.1.2 and 2.1.3 may be used for this purpose.

The reinforced concrete walls resp. wall elements or other reinforced concrete elements into which the Power Duo System is installed shall be planned and constructed in accordance with the relevant technical building regulations; in particular, the provisions of DIN EN 1992-1-2 in conjunction with DIN EN 1992-1-2/NA and DIN EN 1992-1-2/NA/A1 are to be observed.

The room connection for the joint construction of reinforced concrete walls connected via the Power Duo System or joined to other reinforced concrete components meets the fire resistance requirements given above.

In addition to the aforementioned scope of application, the precast reinforced concrete connections made using the Power Duo System may be regarded as equivalent to the connections specified in DIN 4102-4, Sections 5.12.5 to 5.12.7.

3.2.6.2 Reinforced concrete components for which the fire resistance is specified as 'fire-retardant' up to 'fire-resistant'

For the load-bearing capacity of the joint connection under fire exposure using the Power Duo System, the design resistances $Z_{Rd,fi}$ and $v_{Rd,fi,II}$ may be taken as specified in Annex 11, Table 7.

The design value of the shear strength $v_{Rd,fi}$, right-angled to the joint and the wall plane is in the event of fire (exceptional design situation), $v_{Rd,fi}$ 2.5 kN/m. This value applies until the aforementioned design resistances for $Z_{Rd,fi}$ and $v_{Rd,fi}$ are exhausted.

3.2.6.3 Walls subject to the 'fire wall' requirement

The verification of the load-bearing capacity of the joint configuration for the 'fire wall' requirement is deemed to have been satisfied under the following boundary conditions:

- In the verification under normal temperatures (cold load case), the design values of the actions do not exceed the load-bearing capacity values $v_{Rd,II}$ as given in Annex 6, Table 2 or Annex 7, Table 4.
- The design value of the shear resistance $v_{Rd,fi}$, right-angled to the joint and the wall plane shall not exceed 2.5 kN/m in the event of fire (exceptional design situation).
- The design value of the tensile strength $Z_{Rd,fi}$ shall not exceed 2.5 kN/m in the event of fire (exceptional design situation).
- Concrete strength class at least C30/37

3.3 Execution

3.3.1 General

The company executing the contract shall submit a declaration of conformity in accordance with Sections 16a (5) in conjunction with 21 (2) MBO to confirm that the construction method complies with the general construction technique permit covered by this decision.

3.3.2 Manufacture of precast reinforced concrete elements

The connecting rails shall be installed in accordance with the manufacturer's installation instructions and the annexes.

The arrows on the housing indicate the direction of installation of the connecting rails in the precast element.

The end anchorages of the wire loops shall be aligned at an angle of 90° to the housing within the precast element. In the case of a corner or T connection, the wire loops may be bent by adding supplementary reinforcement in accordance with Annexes 12 and 13.

Where the connecting rails are installed vertically in the formwork, the stability of the end anchorages for the wire ends in the precast element during installation shall be ensured by tying them to the reinforcement with wire.

To limit additional deformation caused by shrinkage, the precast elements shall be stored appropriately prior to delivery.

3.3.3 Manufacture of the precast reinforced concrete connection

The reinforced concrete precast element connection using connecting rails shall be produced in accordance with the manufacturer's installation instructions and the specifications in the annexes.

During the concreting process in the production of the precast elements, the wire loops are folded into the housing, and the housing is sealed against the ingress of concrete using a plastic cover (on the long side) and adhesive tape (at the ends). To install the cured precast elements, the cover is opened and removed, and the loops are folded out at a 90° angle to the housing.

When the wire loops are correctly aligned, they overlap horizontally within the tolerance range specified in Annex 5 and are positioned vertically one above the other at a maximum distance of 125 mm.

The joint mortar – PHILIPP–BETEC grouting mortar resp. BETEC grouting mortar, or PHILIPP BETEC Thixo mortar resp. BETEC Thixo mortar – shall be mixed in accordance with the manufacturer's instructions for use and applied with care. In addition, the provisions of the DAfStb guideline 'Production and use of cement-bound grouting concrete and grouting mortar' (July 2019 edition) apply.

Significant voids in the joints shall be avoided.

Specific requirements for the mortar PHILIPP–BETEC Thixo Mortar resp. BETEC Thixo Mortar:

When mixing and applying the PHILIPP–BETEC Thixo Mortar resp. BETEC Thixo Mortar, the processing instructions in Annex 14 shall be followed. Particular attention shall be paid to ensuring the correct consistency of the mortar; to this end, the flow diameter specified in Annex 14 shall be adhered to. Only screw pumps or continuous mixers may be used for grouting. The mortar shall be applied via the specially curved hose end as specified in Annex 14.

The operational requirements for carrying out the joint grouting with PHILIPP–BETEC Thixo mortar resp. BETEC Thixo mortar, as given in Annex 15, shall be observed.

Reference is made to the following technical specifications:

DIN EN 1992-1-1:2011-01	Eurocode 2: Design of concrete structures – Part 1-1: General rules and rules for buildings, bridges and civil engineering structures; German version EN 1992-1-1:2004 + AC:2010
DIN EN 1992-1-1/NA:2013-04	National Annex – Nationally determined parameters – Eurocode 2: Design of concrete structures – Part 1-1: General rules and rules for buildings
DIN EN 206-1:2001-07	Concrete - Specification, performance, production and conformity – Part 1: Performance, requirements, factory production control and assessment criteria for individual values; German version EN 206-1:2000
DIN EN 1992-1-2:2010-12	Eurocode 2: Design of concrete structures – Part 1-2: Structural fire design; German version EN 1992-1-2:2004 + AC:2008
DIN EN 1992-1-2/NA:2010-12	National Annex – Nationally determined parameters – Eurocode 2: Design of concrete structures – Part 1-2: General rules – Structural fire design
DIN EN 1992-1-2/NA/A1:2015-09	National Annex – Nationally determined parameters – Eurocode 2: Design of concrete structures – Part 1-2: General rules – Structural fire design; Amendment A1
DIN 4102-4:2016-05	Fire behaviour of building materials and building components – Part 4: Synopsis and application of classified building materials, components and special components

DIN EN 1015-3:2007-05

Methods of tests for mortar for masonry – Part 3: Determination of
consistence of fresh mortar (by flow table); German version EN 1015-
3:1999+A1:2004+A2:2006

Beatrix Wittstock, Dipl.-Ing.
Head of Division

Certified
Tempel

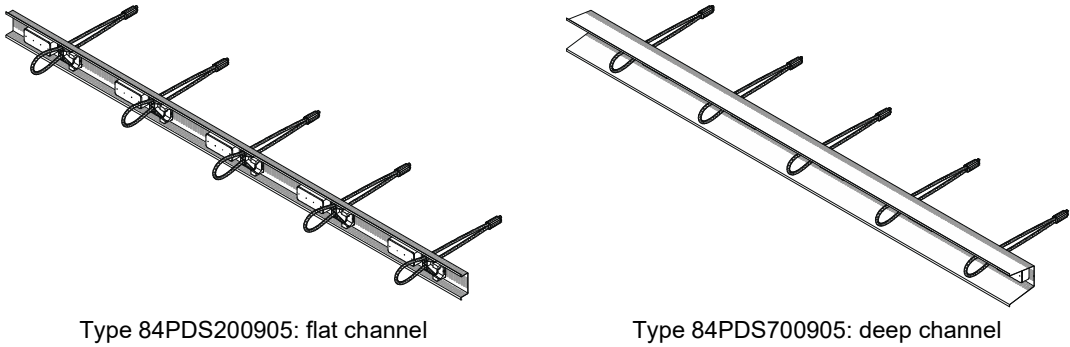


Fig. 1: Channel with integrated wire loops (clipped-in for transport)

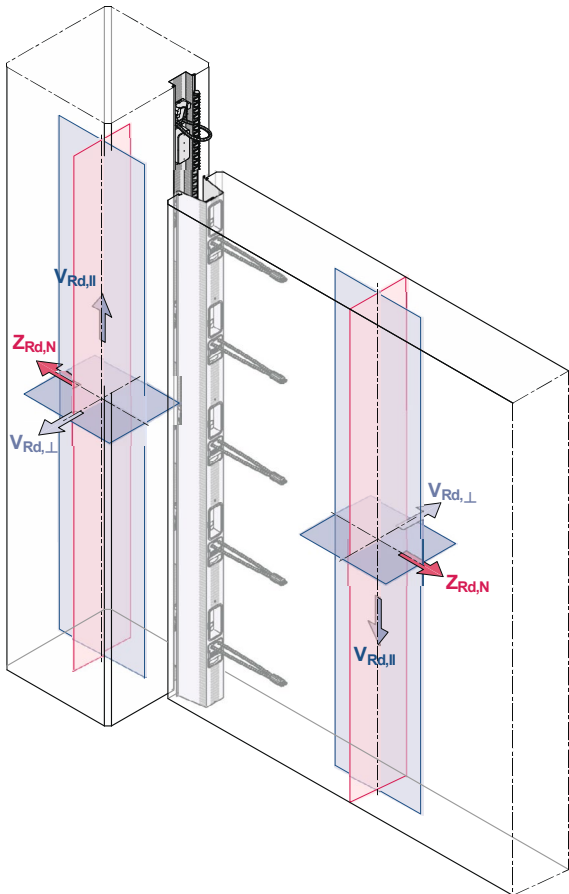
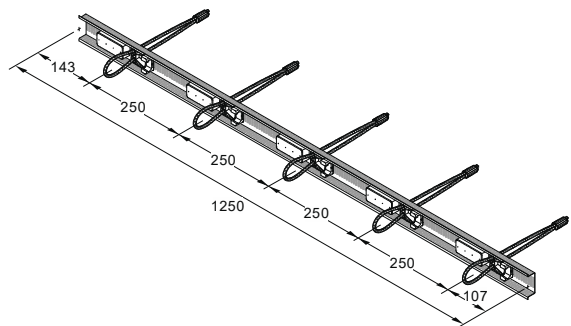
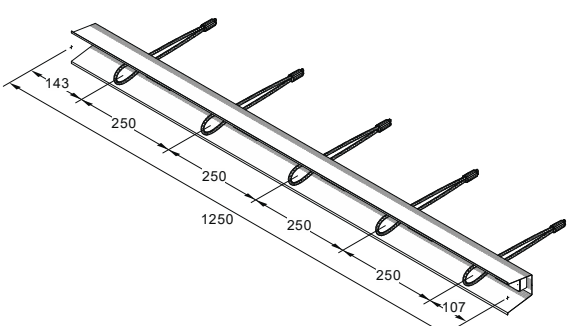


Fig. 2: Illustration of the installation without joint grouting and the permissible load directions

PHILIPP – Power Duo System with mortar system BETEC for the connection of precast concrete elements	Annex 1
Product, installation and permissible load directions	

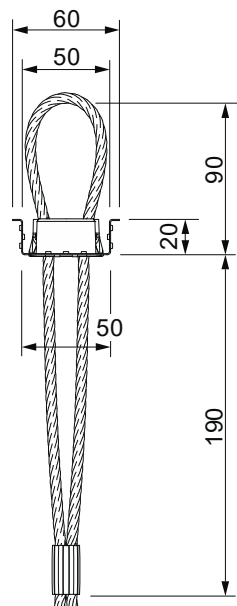


Type 84PDS200905: flat channel

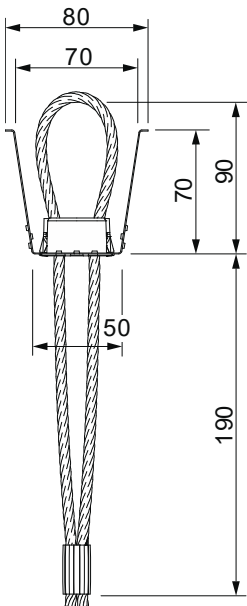


Type 84PDS700905: deep channel

Fig. 3: Channel with integrated wire loops



Type 84PDS200905: flat channel



Type 84PDS700905: deep channel

Fig. 4: Channel with wire loop – cross section

PHILIPP – Power Duo System with mortar system BETEC for the connection of precast concrete elements		Annex 2
Product dimensions		

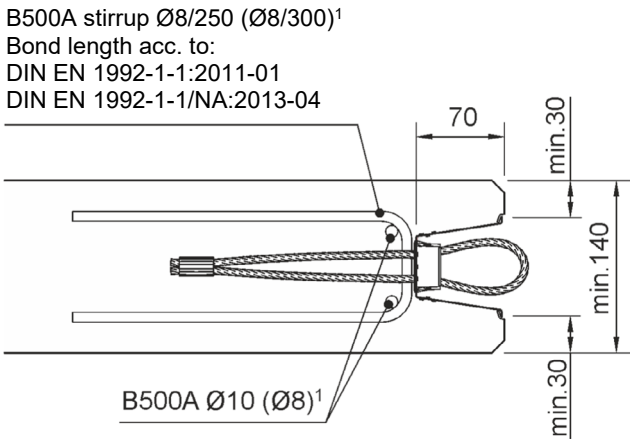


Fig. 5: Reinforcement

¹ Only when using the resistance values for C25/30 in Annex 6, Table 2

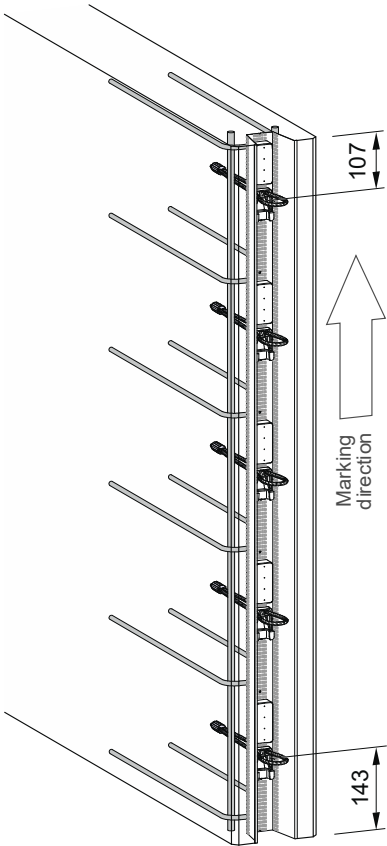


Fig. 6: Edge distances of flat and deep channel

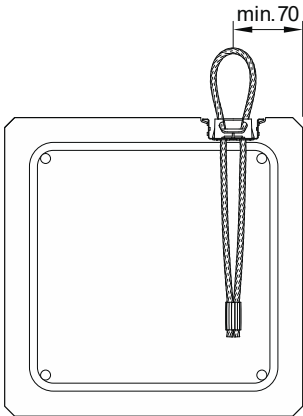
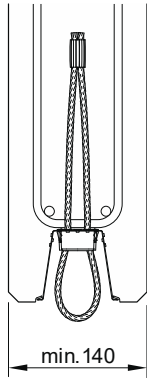


Fig. 7: Element thickness

PHILIPP – Power Duo System with mortar system BETEC for the connection of precast concrete elements	Annex 3
Intended use, element thicknesses, edge distances, reinforcement	

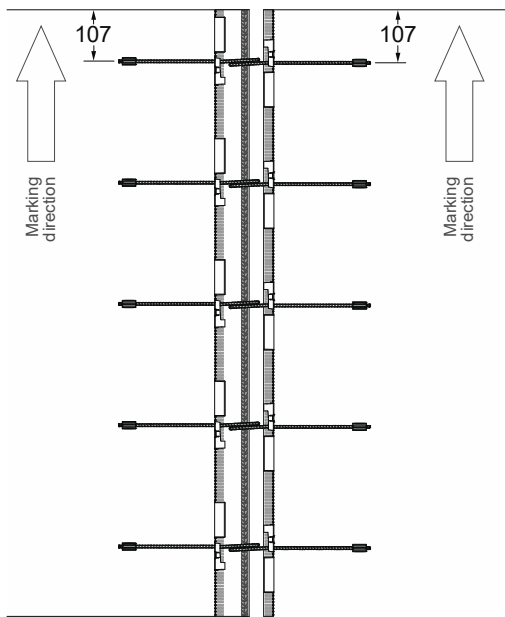


Fig. 8a: Installation option A
Design values acc. to Annex 6

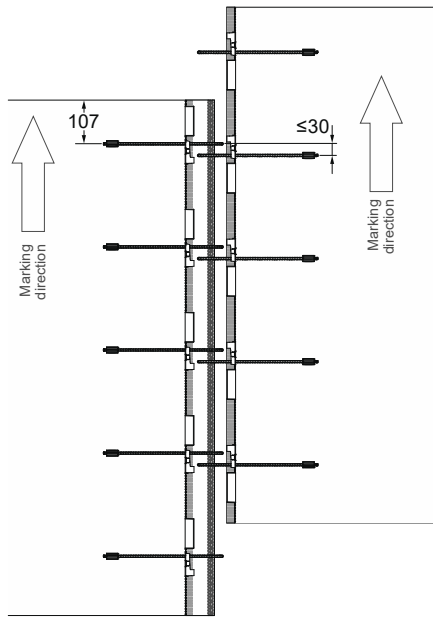


Fig. 8b: Installation option A
Design values acc. to Annex 6

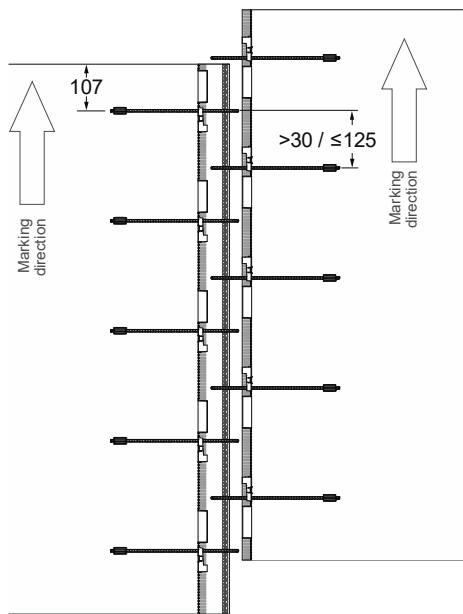


Fig. 9: Installation option B
Design values acc. to Annex 7

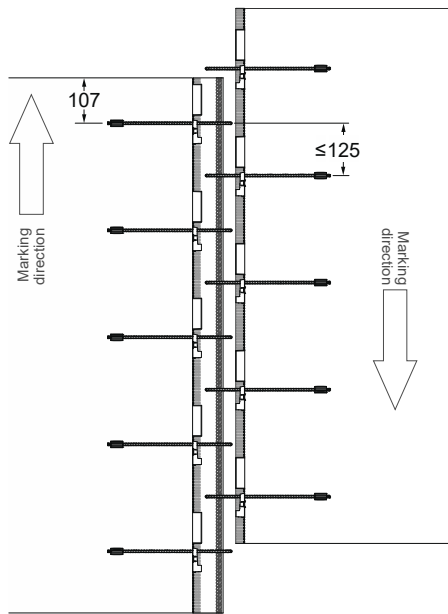


Bild 10: Installation option B
Design values acc. to Annex 7

PHILIPP – Power Duo System with mortar system BETEC for the connection of precast concrete elements	Annex 4
Intended use, intended position and maximum vertical tolerances of wire loops	

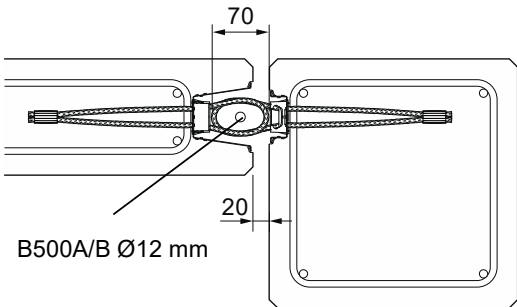


Fig. 11: Horizontal intended position

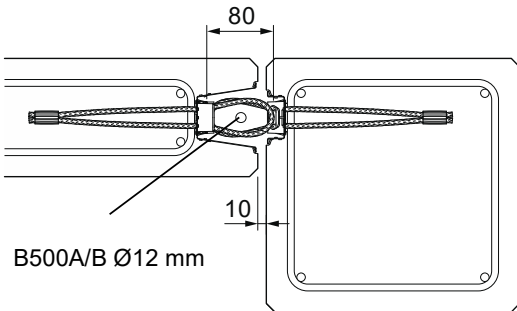


Fig. 12: Minimum joint width

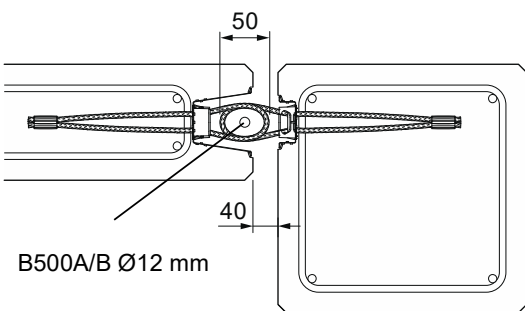


Fig. 13: Maximum joint width (minimal permissible overlap of the wire loops)

PHILIPP – Power Duo System with mortar system BETEC for the connection of precast concrete elements	Annex 5
Intended use, intended position and maximum horizontal tolerances of wire loops	

Installation option A:

Channels aligned, vertical tolerance ≤ 30 mm (Figures 8a and 8b)

Wall thickness [cm]	Grouting mortar ¹	Thixo mortar ²
≥ 14	10,0	7,5

¹ Grouting mortar = PHILIPP-BETEC® Grouting mortar or BETEC® Grouting mortar

² Thixo mortar = PHILIPP-BETEC® Thixo mortar or BETEC® Thixo mortar

Table 1: Design value of the tensile force bearing capacity per wire loop Z_{Rd} [kN]
(4 wire loops per metre)

Concrete grade	C25/30				C30/37				C35/45				C40/50				C45/55			
Reinf.- Stirrup Long. reinf.	Ø8 / 300 Ø8				Ø8 / 250 Ø10															
Wall thickness	Grouting mortar ¹		Thixo mortar ²		Grouting mortar ¹		Thixo mortar ²		Grouting mortar ¹		Thixo mortar ²		Grouting mortar ¹		Thixo mortar ²		Grouting mortar ¹		Thixo mortar ²	
[cm]	V _{Rd,II}	V _{Rd,⊥}	V _{Rd,II}	V _{Rd,⊥}	V _{Rd,II}	V _{Rd,⊥}	V _{Rd,II}	V _{Rd,⊥}	V _{Rd,II}	V _{Rd,⊥}	V _{Rd,II}	V _{Rd,⊥}	V _{Rd,II}	V _{Rd,⊥}	V _{Rd,II}	V _{Rd,⊥}	V _{Rd,II}	V _{Rd,⊥}	V _{Rd,II}	V _{Rd,⊥}
14	60	8,4			90	9,7	70	9,7	90	11,1	70	11,1	90	11,9	70	11,9	90	12,6	70	12,6
15		9,7				11,2		11,2		12,7		12,7		13,7		13,7		14,5		14,5
16		11				12,7		12,7		14,4		14,4		15,5		15,5		16,5		16,5
17		12,4				14,2		14,2		16,2		16,2		17,4		17,4		18,6		18,6
18		13,8				15,9		15,9		18,1		18,1		19,4		19,4		20,7		20,7
19		15,3				17,5		17,5		20		20,0		21,4		21,4		22,8		22,8
20		16,7				19,3		19,3		21,9		21,9		23,5		23,5		25,1		25,1
21		18,3				21,0		21,0		24		24,0		25,7		25,7		27,4		27,4
22		19,9				22,8		22,8		26		26,0		27,9		27,9		29,7		29,7
23		21,5				24,7		24,7		28,1		28,1		30,2		30,2		32,2		32,2
24		23,1				26,6		26,6		30,3		30,3		32,5		32,5		34,6		34,6
25		24,8				28,5		28,5		32,5		32,5		34,9		34,9		37,2		37,2
26		26,5				30,5		30,5		34,8		34,8		37,3		37,3		37,5		37,5
27		28,3				32,5		32,5		37,1		37,1		37,5		37,5		37,5		37,5
28		30,1				34,6		34,6		37,5		37,5		37,5		37,5		37,5		37,5
29		31,9				36,7		36,7		37,5		37,5		37,5		37,5		37,5		37,5
≥ 30		33,8				37,5		37,5		37,5		37,5		37,5		37,5		37,5		37,5

$V_{Rd,II}$ = Shear forces parallel to the joint $V_{Rd,L}$ = Shear forces right-angled to the joint

Table 2: Design value of the shear force bearing capacity parallel and right-angled to the joint [kN/m]

PHILIPP – Power Duo System with mortar system BETEC for the connection of precast concrete elements	Annex 6
Design resistances installation option A	

Installation option B:

- Channels aligned, vertical tolerance > 30 mm and ≤ 125 mm (fig. 9)
- Channels aligned contrarily, vertical tolerance ≤ 125 mm (fig. 10)

Wall thickness [cm]	Grouting mortar ¹	Thixo mortar ²
≥ 14	7,2	5,4

¹ Grouting mortar = PHILIPP-BETEC® Grouting mortar or BETEC® Grouting mortar

² Thixo mortar = PHILIPP-BETEC® Thixo mortar or BETEC® Thixo mortar

Table 3: Design value of the tensile force bearing capacity per wire loop Z_{Rd} [kN]
(4 wire loops per metre)

Concrete grade	C30/37				C35/45				C40/50				C45/55			
Reinf.- Stirrup Long. reinf.	Ø8 / 250 Ø10															
Wall thickness	Grouting mortar ¹		Thixo mortar ²		Grouting mortar ¹		Thixo mortar ²		Grouting mortar ¹		Thixo mortar ²		Grouting mortar ¹		Thixo mortar ²	
[cm]	V _{Rd,II}	V _{Rd,L}	V _{Rd,II}	V _{Rd,L}	V _{Rd,II}	V _{Rd,L}	V _{Rd,II}	V _{Rd,L}	V _{Rd,II}	V _{Rd,L}	V _{Rd,II}	V _{Rd,L}	V _{Rd,II}	V _{Rd,L}	V _{Rd,II}	V _{Rd,L}
14	65	9,7	50	9,7	65	11,1	50	11,1	65	11,9	50	11,9	65	12,6	50	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								

$V_{Rd,II}$ = Shear forces parallel to the joint $V_{Rd,L}$ = Shear forces right-angled to the joint

Table 4: Design value of the shear force bearing capacity parallel and right-angled to the joint [kN/m]

PHILIPP – Power Duo System with mortar system BETEC for the connection of precast concrete elements	Annex 7
Design resistances installation option B	

Verification of actions resulting from shear forces parallel to the joint (II)

For the shear force bearing capacity parallel to the joint, the design values $V_{Rd,II}$ given in Annex 6, Table 2, or Annex 7, Table 4, may be used in the ultimate limit state.

$$\frac{V_{Ed,II}}{V_{Rd,II}} \leq 1,0$$

$V_{Ed,II}$ [kN/m]: acting shear force parallel per metre of joint length

$V_{Rd,II}$ [kN/m]: design value of the shear force bearing capacity per metre of joint length

Verification of actions resulting from shear forces right-angled to the joint (⊥)

For the shear force bearing capacity right-angled to the joint, the design values $V_{Rd,⊥}$ given in Annex 6, Table 2, or Annex 7, Table 4, may be used in the ultimate limit state.

$$\frac{V_{Ed,⊥}}{V_{Rd,⊥}} \leq 1,0$$

$V_{Ed,⊥}$ [kN/m]: acting shear force right-angled per metre of joint length

$V_{Rd,⊥}$ [kN/m]: design value of the shear force bearing capacity per metre of joint length

Loads acting right-angled to the joint result in tensile forces. These tensile forces can be transferred and verified either by the wire loops or by appropriately positioned additional reinforcement resp. other constructive measures. The methods for verifying the tensile forces are shown in Annexes 9 and 10.

Verification of interaction due to shear forces

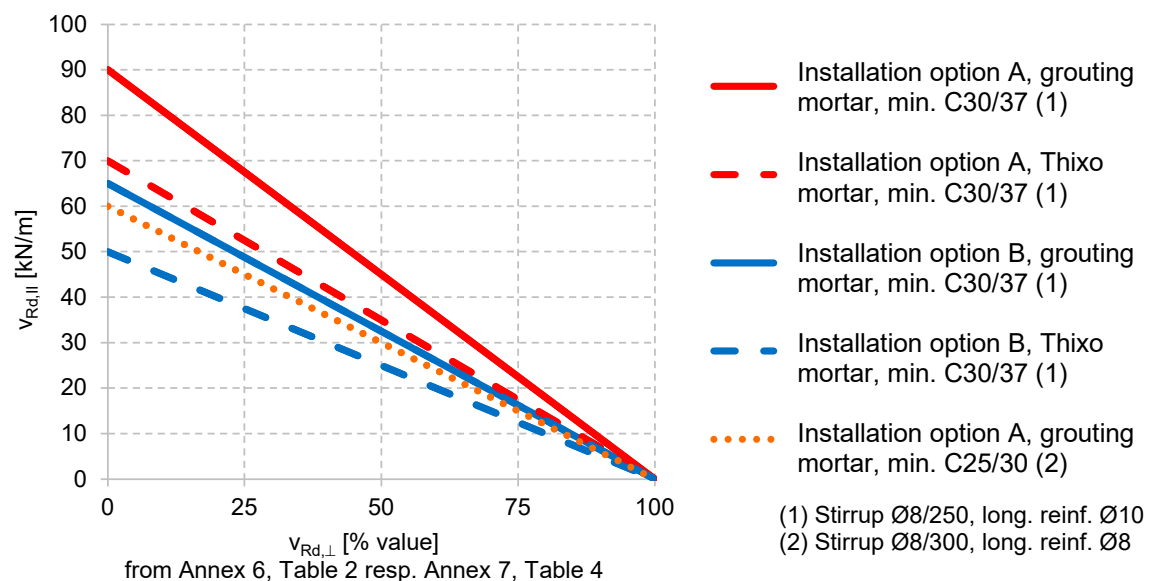


Diagram 1: Interaction diagram of the shear forces parallel and right-angled to the joint

**PHILIPP – Power Duo System with mortar system BETEC
for the connection of precast concrete elements**

Annex 8

Verification of shear force bearing capacity with interaction

Verification of tensile forces

Different loading directions result in individual tensile force components acting in the direction of the wire loop (Table 5). The sum of these individual components (total tensile force) is verified using the tensile strength Z_{Rd} of the wire loops in accordance with Annex 6, Table 1 or Annex 7, Table 3.

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	$Z_{Ed,VII} = 0,5 \times V_{Ed,II}$	$Z_{Ed,V\perp} = 0,25 \times V_{Ed,\perp}$	$Z_{Ed,N}$

Verification of total tensile 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 the tensile force bearing capacity per loop acc. to Annex 6, Table 1 resp. Annex 7, Table 3
$Z_{Ed,VII}$	[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
$Z_{Ed,N}$	[kN/m]:	acting „external“ tensile force per metre of joint

**PHILIPP – Power Duo System with mortar system BETEC
for the connection of precast concrete elements**

Annex 9

Verification of tensile forces

Special case – Transfer of tensile forces through additional constructive solutions

The sum of the tensile forces Z_{Ed} is distributed across suitable tension members or other constructive solutions. The wire loops are not used to transfer the tensile forces. Instead, suitable tension members (e. g. ring beams) or other constructive solutions (fixed-ended columns, frictional forces with wall elements having full-floor contact, etc.) shall be taken into account. The tensile forces resulting from the individual load directions are given in Table 6.

Table 6: Components of tensile force

Load from	Shear force right-angled $V_{Ed,\perp}$	External tensile force
Component of tensile force	$Z_{Ed,V\perp} = 0,25 \times V_{Ed,\perp}$	$Z_{Ed,N}$

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

Z_{Ed}	[kN/m]:	total tensile force per metre of joint
$Z_{Ed,V\perp}$	[kN/m]:	expansion force resulting from shear force right-angled per metre of joint
$Z_{Ed,N}$	[kN/m]:	acting „external“ tensile force per metre of joint

**PHILIPP – Power Duo System with mortar system BETEC
for the connection of precast concrete elements**

Annex 10

Constructive solutions to transfer tensile forces

Verification of tensile and shear force bearing capacity parallel to the joint in case of fire

For the verification of load bearing, fire-stressed connections the capacities acc. to Table 7 may be used. Depending on the temperature acting on the wire loop (e. g. temperature profile DIN EN 1992-1-2, picture A.2) the design resistances shall be reduced by α_{fi} .

For walls subject to the “fire wall” requirement, Section 3.2.6.3. applies.

Table 7: Bearing capacities in case of fire

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

$V_{Rd,II}$ [kN/m]: design value of the shear force bearing capacity in case of fire per metre of joint length acc. to Annex 6, Table 2 resp. Annex 7, Table 4

Z_{Rd} [kN]: design value of the tensile force bearing capacity in case of fire per metre of joint length acc. to Annex 6, Table 1 resp. Annex 7, Table 3

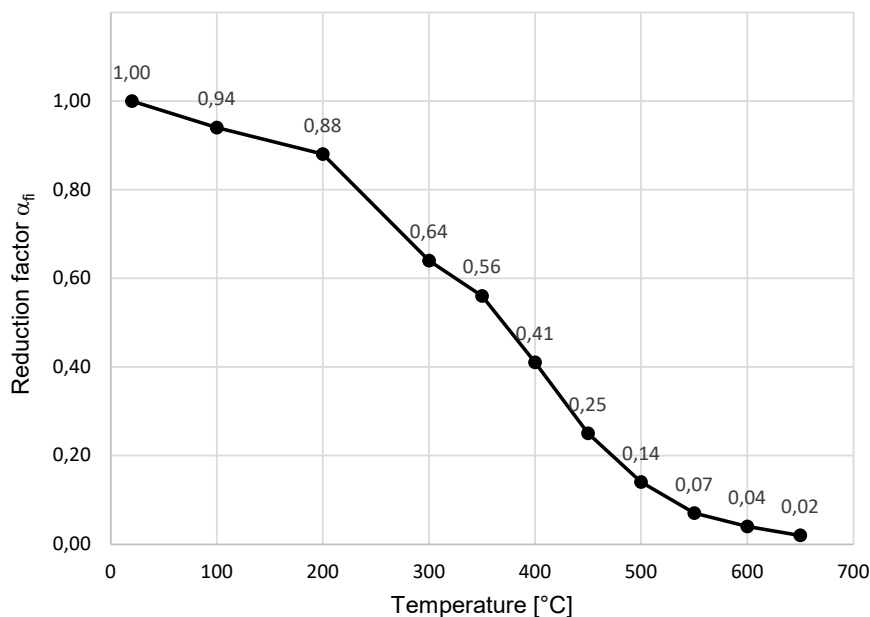


Diagram 2: Reduction factor α_{fi} depending on the wire loop temperature

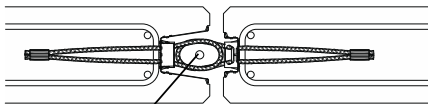
Verification of the total tensile force: $n \times Z_{Rd,fi} \geq Z_{Ed,fi,VII} + Z_{Ed,fi,N}$

Verification of the shear force parallel: $V_{Rd,fi,VII} \geq V_{Ed,fi,II}$

**PHILIPP – Power Duo System with mortar system BETEC
for the connection of precast concrete elements**

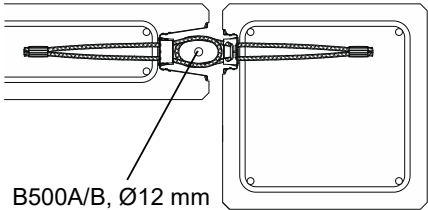
Annex 11

Verification of the bearing capacity in case of fire



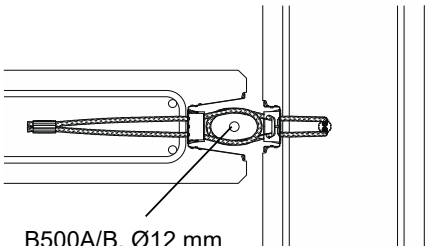
B500A/B, Ø12 mm

Fig. 14: Wall – wall connection, face-sided connection



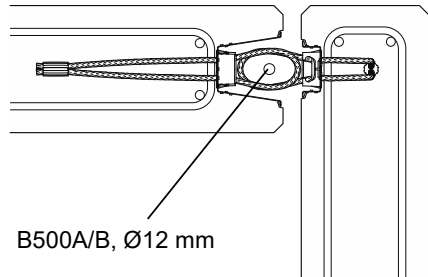
B500A/B, Ø12 mm

Fig. 15: Wall – column connection



B500A/B, Ø12 mm

Fig. 16: Wall – wall connection, T-connection



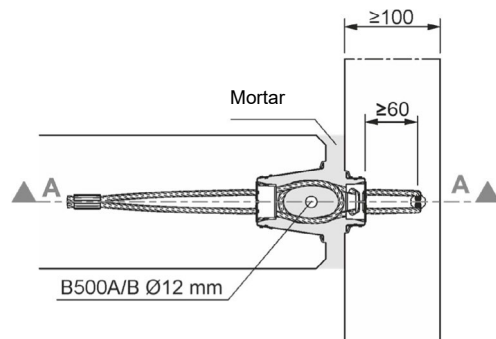
B500A/B, Ø12 mm

Fig. 17: Wall – wall connection, corner connection

**PHILIPP – Power Duo System with mortar system BETEC
for the connection of precast concrete elements**

Annex 12

Applications



Section A-A

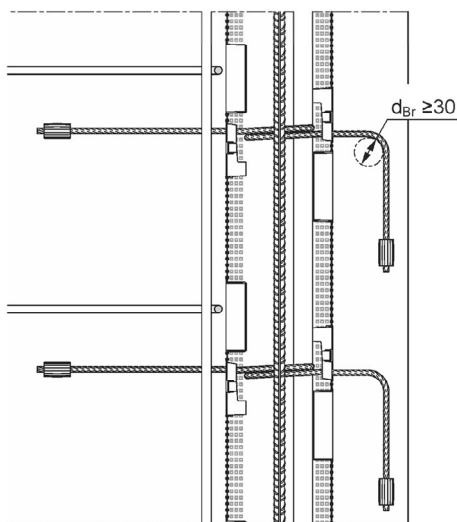
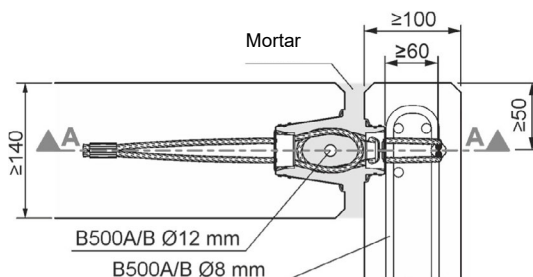


Fig. 18: T-connection with bent end anchorage (1)



Section A-A

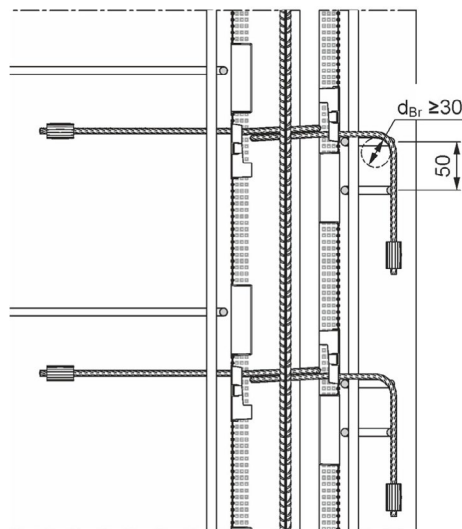


Fig. 19: Corner connection with bent end anchorage (1) (2)

(1) No reduced reinforcement with C25/30

For the T- and corner connection in a wall with a bent end anchorage no reduced reinforcement (stirrups Ø8/300) is possible when using the resistance values for C25/30. The longitudinal bars shown can be selected with a diameter of Ø8 instead of Ø10 when using the resistance values for C25/30.

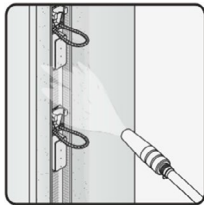
(2) Reduction of load-bearing capacity

If a corner connection is made without additional reinforcement for the bent end anchorage, the design values for the shear force parallel to the joint $v_{Rd,II}$ and the tensile force Z_{Rd} shall be reduced to 70 %.

**PHILIPP – Power Duo System with mortar system BETEC
for the connection of precast concrete elements**

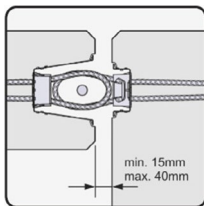
Annex 13

Bent end anchorage, additional reinforcement



Grouting the joint with PHILIPP-BETEC® Thixo mortar or BETEC® Thixo mortar

The system-approved, high-quality, stiff-plastic and thixotropically adjusted PHILIPP-BETEC® Thixo mortar or BETEC® Thixo mortar is ready for use and consists of approved raw material components. Further details can be found in the system approval and in the technical data sheets for "PHILIPP-BETEC® Thixo mortar" and "BETEC® Thixo mortar".



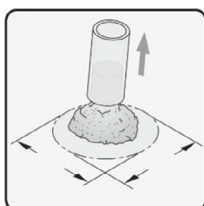
Base surface preparation

Pre-wet the surface well in order to improve the adhesion. If necessary, adhesion-reducing parts in the joints have to be removed, the flanks shall be free from dirt, cement slurry and grease.



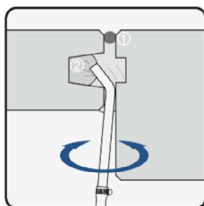
Mounting conditions

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



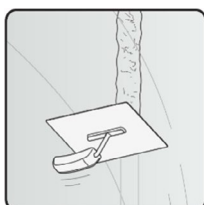
Mixing process

The PHILIPP-BETEC® or 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 1-2 minutes again. Then, the grouting starts immediately.



Consistency check

The flow diameter $(a + b) / 2$ for the stiff-plastic Thixo mortar shall be greater than 15 cm and less than 19 cm. Corresponding consistency is dependent on the amount of water, the mixing intensity and powder temperature. At high temperatures the mortar hardens faster. According to DIN EN 1015-3:2007-05 the flow diameter is determined with a defined funnel.



Mortar 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 here (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 shall be trowelled. This has to be done as long as the mortar is still fresh and not hardened.

PHILIPP – Power Duo System with mortar system BETEC for the connection of precast concrete elements

Processing instructions for PHILIPP-BETEC® Thixo mortar
and BETEC® Thixo mortar

Annex 14

Requirements for the company carrying out the joint grouting using PHILIPP-BETEC® Thixo mortar and BETEC® Thixo mortar, in accordance with the processing instructions in Annex 14

1 General

The grouting of joints between two precast reinforced concrete elements using PHILIPP-BETEC® Thixo mortar or BETEC® Thixo mortar shall be carried out by companies whose staff have been trained or instructed in the application of the joint mortar. A training of a responsible skilled person is to be provided by the applicant and/or the manufacturer of the dry mortar. Each participation in the training should be confirmed by a certificate. The trained responsible skilled person shall instruct the remaining site personnel.

The certificate is to be presented to the client and/or the building control authority upon request.

2 Staff requirements

2.1 Responsible skilled person (foreman, site foreman or site manager)

The trained skilled person is responsible for manufacturing of the force-fit joint using PHILIPP-BETEC® Thixo mortar or BETEC® Thixo mortar.

Among other things the tasks of the responsible skilled person are:

- Training of site personnel on the practical procedure of grouting, including mixing and consistency check of the grout
- Supervising the practical procedure of grouting
- Preparation of a report about the grouting work

Content of the protocol: construction phase, period of execution, details of consistency check, site personnel involved, signature of responsible skilled person

2.2 Site personnel

Trained personnel carry out the grouting on site using PHILIPP-BETEC® Thixo mortar or BETEC® Thixo mortar.

The site personnel's tasks include, amongst other things:

- Practical carrying out of the grouting, including mixing and consistency check of the grout, in accordance with the code of practice and the requirements of this national technical approval. The processing instructions in Annex 14 shall be followed.

3 Training content

An explanation of the relevant theoretical principles for a proper mixing and application of the grout, including the necessary equipment and application instructions.

Erläuterung der maßgebenden theoretischen Grundlagen zur ordnungsgemäßen Herstellung und Verarbeitung des Fugenmörtels, wie notwendige Gerätschaften sowie Verarbeitungshinweise.

Hands-on training in:

- Preparation of the joints to be filled between precast elements
- Mixing the grout using the appropriate equipment
- Checking and grading the quality of the mixed mortar
- Prüfung und Beurteilung der Qualität des angemischten Mörtels
- Filling of the complete joint space

PHILIPP – Power Duo System with mortar system BETEC for the connection of precast concrete elements

Requirements for the company carrying out the joint grouting using PHILIPP-BETEC® Thixo mortar and BETEC® Thixo mortar

Annex 15

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