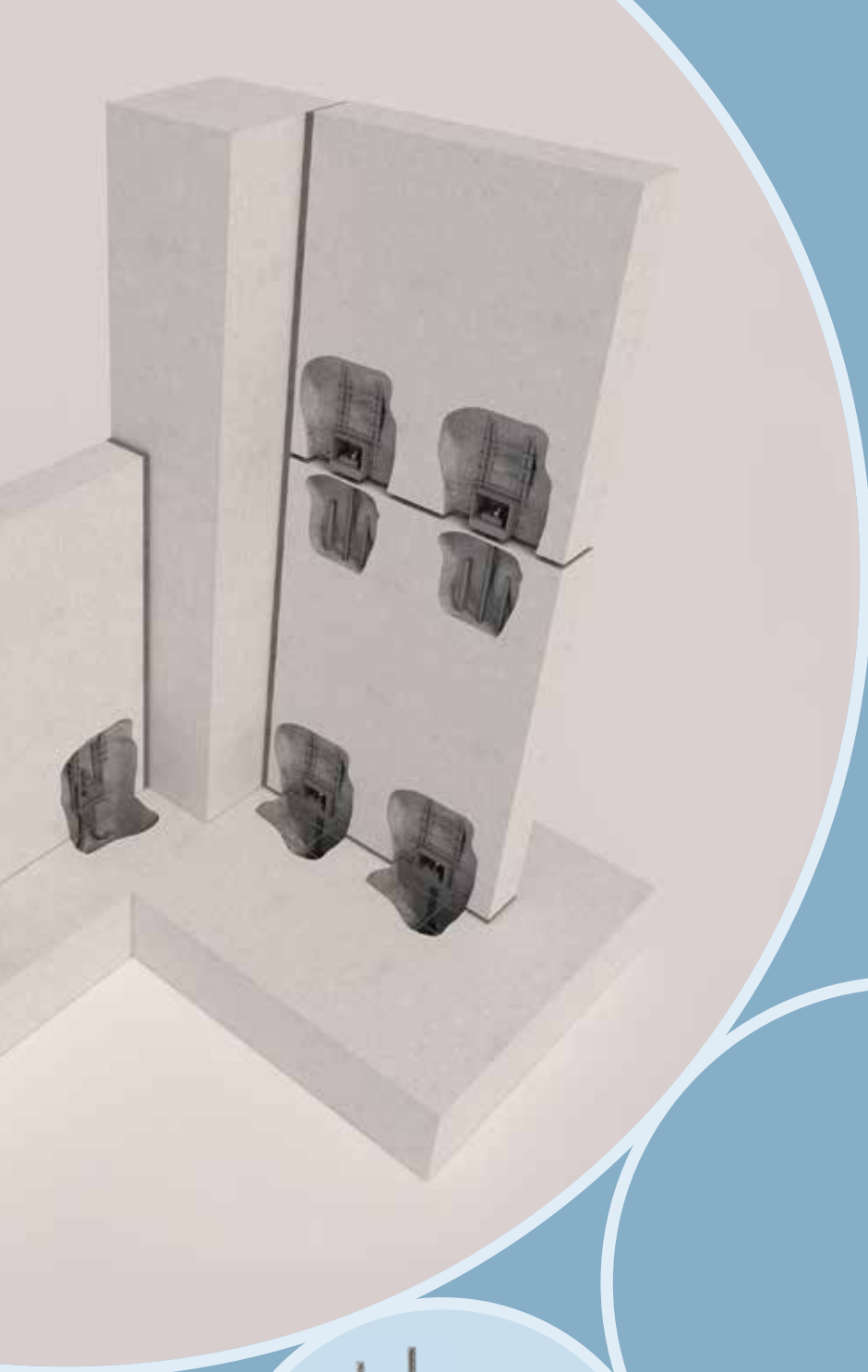




# Wall Shoe Systems

Screw connections  
for precast walls

**PFEIFER**



planning & installation



## Wall Shoes System PWC

|                    |    |
|--------------------|----|
| Advantages .....   | 3  |
| Products .....     | 4  |
| Dimensioning ..... | 6  |
| Installation ..... | 8  |
| Assembly .....     | 12 |

## Symbols and safety instructions used

### ATTENTION

This symbol indicates a potentially harmful situation. Failure to observe the safety instruction may result in damage to or destruction of the product and/or its components.

## Wall Shoes System PWS

|                    |    |
|--------------------|----|
| Advantages .....   | 13 |
| Products .....     | 14 |
| Dimensioning ..... | 16 |
| Installation ..... | 19 |
| Assembly .....     | 22 |

### ⚠ CAUTION

This symbol in conjunction with the signal word "Caution" indicates a potentially dangerous situation. Failure to observe the safety instruction may result in minor or moderate injury. May also be used to warn of property damage.



More information online:  
[pfeifer.info/wallshoe](https://pfeifer.info/wallshoe)

# Wall Shoes System PWC

## Your advantages at a glance

- Complete system for the transmission of tensile forces
- Screw connection
- Highest possible tolerances and adjustment options
- Fast simple installation of the wall connections
- Immediate functionality of the connection

## The system

The Wall Shoes PWC can be combined with the different foundation anchor types. The connections is completed by means of shim plates, which has to be ordered separately.

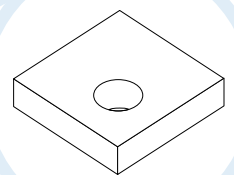
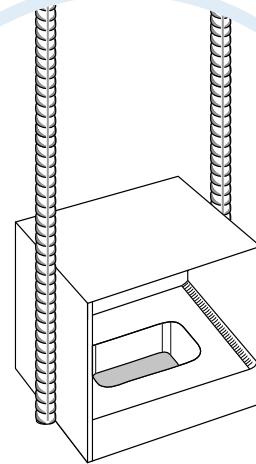


### Wall Shoe PWC

page 4

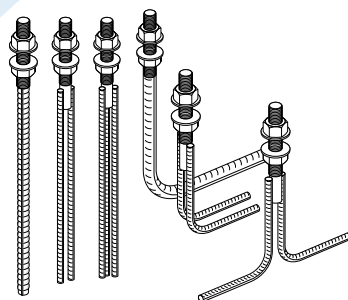
### Foundation anchors PGS (+ Connecting bolts PVB)

### Female bar PH-MU + Connecting bolts PVB

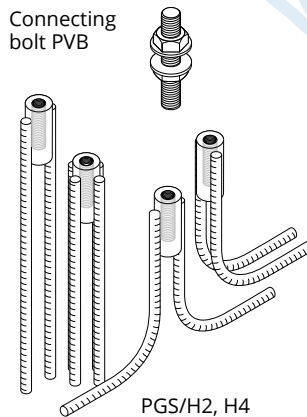


### UP shim plate

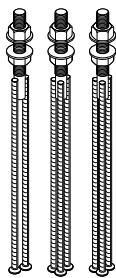
page 5



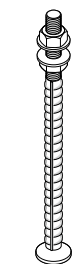
PGS/G1, G2, G3



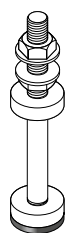
PGS/H2, H4



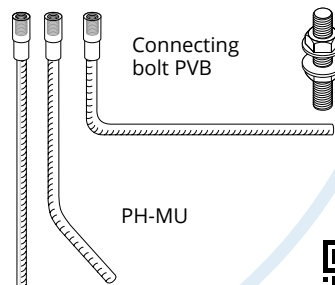
PGS/G2-K,  
G3-K, G4-K



PGS/G1-K



PGS/G1-DK



PH-MU

Connecting  
bolt PVB

Connecting  
bolt PVB



More information about  
the foundation anchors:  
[pfeifer.info/en/products/  
precast-lifting-systems/](https://pfeifer.info/en/products/precast-lifting-systems/)

- Quick, simple assembly of the wall connections
- Complete system for the transmission of tensile forces
- High assembly tolerances
- Detailed instructions for reinforcement routing
- Type-approved

#### Component recommendation

- Precast wall

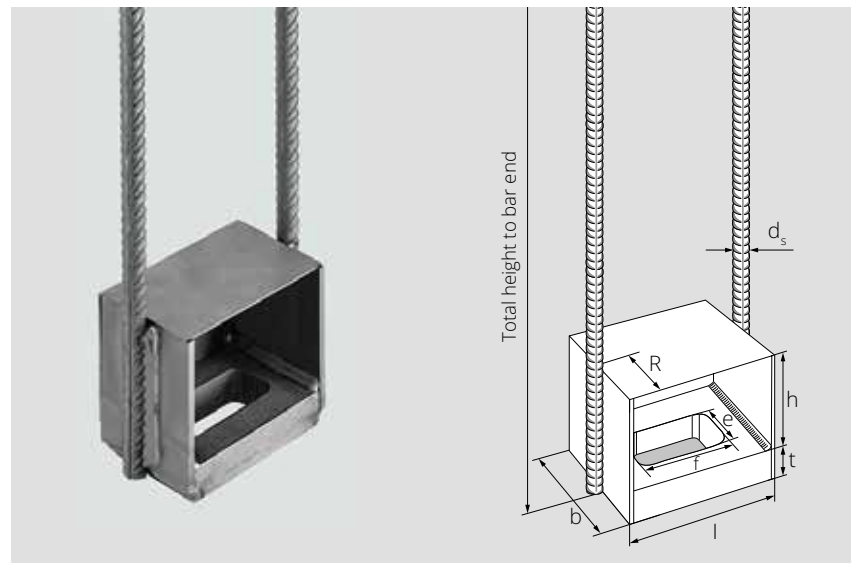
#### Technical data

- **material:** bright steel



## Wall Shoe PWC

- For dry screw connection of stiffening wall constructions made of concrete
- Absorption and transmission of tensile forces acting perpendicular to the joint tensile forces
- Wall shoes are installed in the wall element and screwed to the foundation anchors
- The recesses are then grouted
- Requires foundation anchor sets with UP shim plate (sold separately)



#### Wall Shoe PWC

| Type designation        |                |    | PWC-16 | PWC-20 | PWC-24 | PWC-30 | PWC-30-HF | PWC-36 | PWC-36-HF | PWC-39 |
|-------------------------|----------------|----|--------|--------|--------|--------|-----------|--------|-----------|--------|
| Total height            | h              | mm | 578    | 978    | 1078   | 1328   | 1590      | 1890   | 1955      | 1970   |
| Diameter concrete steel | d <sub>s</sub> | mm | 14     | 16     | 20     | 25     | 28        | 25     | 32        | 28     |
| Plate thickness         | t              | mm | 25     | 30     | 35     | 40     | 45        | 50     | 55        | 50     |
| Box length              | l              | mm | 125    | 132    | 147    | 156    | 161       | 161    | 180       | 180    |
| Box width               | b              | mm | 80     | 90     | 110    | 120    | 130       | 130    | 150       | 145    |
| Box height              | h              | mm | 87     | 97     | 102    | 117    | 132       | 132    | 132       | 132    |
| Recess width            | e              | mm | 36     | 40     | 49     | 55     | 55        | 61     | 61        | 64     |
| Recess length           | f              | mm | 76     | 80     | 84     | 90     | 90        | 96     | 96        | 99     |
| Edge distance           | R              | mm | 40     | 45     | 55     | 60     | 65        | 65     | 75        | 72,5   |
| Reference no.           |                |    | 475602 | 475603 | 475604 | 475605 | 475608    | 475606 | 475609    | 475607 |

#### Cover Plate PWS

|               |        |        |        |        |        |        |        |        |        |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Reference no. | 165352 | 165352 | 165352 | 165352 | 165352 | 165352 | 165352 | 165352 | 165352 |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

#### UP shim plate for PWC

|               |        |        |        |        |        |        |        |        |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|
| Reference no. | 478212 | 478216 | 478217 | 478218 | 478218 | 478219 | 478220 | 478222 |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|

- Eccentric bore in shim plate allows compensation of tolerances
- Type-tested

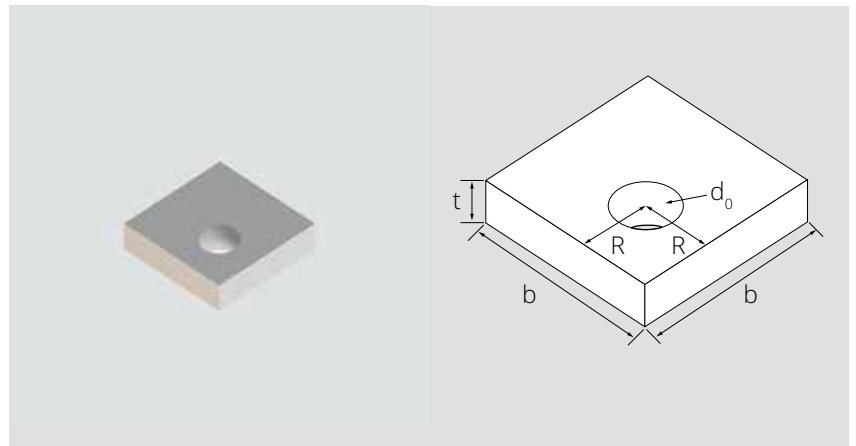
#### Technical data

- **material:** bright steel



## UP shim plate for PWC

- The UP shim plate for PWC enables the wall shoe to be connected to the selected connecting bolt/foundation anchor.
- The wall is set down from above with the Wall Shoe PWS installed in the underside over the foundation anchor located in the foundation or the wall below. When doing this, the foundation anchor bolts/connecting bolts are guided through the aperture in the underside of the Wall Shoe.
- The mounting plate can then be threaded over the bolt through the lateral assembly recess. A washer and a nut are finally fastened to the bolt, thereby fixing the connection.



#### UP shim plate for PWC

| Type designation |                |    | UP 16  | UP 20  | UP 24  | UP 30/30-HF  | UP 36  | UP 36-HF  | UP 39  |
|------------------|----------------|----|--------|--------|--------|--------------|--------|-----------|--------|
| for type/size    |                |    | PWC 16 | PWC 20 | PWC 24 | PWC 30/30-HF | PWC 36 | PWC 36-HF | PWC 39 |
| Plate width      | b              | mm | 60     | 65     | 80     | 95           | 100    | 110       | 115    |
| Plate thickness  | t              | mm | 12     | 15     | 20     | 25           | 25     | 30        | 30     |
| Bore diameter    | d <sub>0</sub> | mm | 18     | 22     | 26     | 33           | 39     | 39        | 42     |
| Edge distance    | R              | mm | 25     | 27,5   | 30     | 37,5         | 40     | 45        | 47,5   |
| Reference no.    |                |    | 478212 | 478216 | 478217 | 478218       | 478219 | 478222    | 478220 |

## Working load limit

The load-bearing capacities of the Wall Shoes PWC are matched to the load-bearing capacities of the anchor bolts. Further information on the anchor bolts can be found in the anchor bolt user brochure or on our website.

| Wall Shoe | Shim plate | Foundation anchor/<br>female bar type | Connecting bolt | N <sub>Rd</sub><br>[kN] |       |
|-----------|------------|---------------------------------------|-----------------|-------------------------|-------|
| PWC 16    | UP 16      | PGS 16/G1                             | -               | 61,7                    |       |
|           |            | PGS 16/G1-K                           |                 |                         |       |
|           |            | PGS 16/G1-DK                          |                 |                         |       |
|           |            | PGS 16/H2                             | PVB 16          | 68,0                    |       |
|           |            | PH MU 12, M16                         |                 |                         | 49,2  |
| PWC 20    | UP 20      | PGS 20/G1                             | -               | 96,2                    |       |
|           |            | PGS 20/G1-K                           |                 |                         |       |
|           |            | PGS 20/G1-DK                          |                 |                         |       |
|           |            | PGS 20/H2                             | PVB 20          |                         | 87,4  |
|           |            | PGS 20/H4                             |                 |                         |       |
|           |            | PH MU 16, M20                         |                 |                         |       |
| PWC 24    | UP 24      | PGS 24/G1                             | -               | 138,7                   |       |
|           |            | PGS 24/G2                             |                 |                         |       |
|           |            | PGS 24/G3                             |                 |                         |       |
|           |            | PGS 24/G1-K                           |                 |                         |       |
|           |            | PGS 24/G1-DK                          |                 |                         |       |
|           |            | PGS 24/H2                             | PVB 24          |                         | 136,6 |
|           |            | PGS 24/H4                             |                 |                         |       |
|           |            | PH-MU 20, M24                         |                 |                         |       |
| PWC 30    | UP 30      | PGS 30/G1                             | -               | 220                     |       |
|           |            | PGS 30/G2                             |                 |                         |       |
|           |            | PGS 30/G3                             |                 |                         |       |
|           |            | PGS 30/G1-K                           |                 |                         |       |
|           |            | PGS 30/G2-K                           |                 |                         |       |
|           |            | PGS 30/G1-DK                          | PVB 30          |                         | 213,4 |
|           |            | PGS 30/H2                             |                 |                         |       |
|           |            | PH-MU 25, M30                         |                 |                         |       |
| PWC 36    | UP 36      | PGS 36 G1                             | -               | 320                     |       |
|           |            | PGS 36/G2                             |                 |                         |       |
|           |            | PGS 36/G3                             |                 |                         |       |
|           |            | PGS 36/G1-K                           |                 |                         |       |
|           |            | PGS 36/G4-K                           |                 |                         |       |
|           |            | PGS 36/G1-DK                          |                 |                         |       |
|           |            | PGS 36/H2                             | PVB 36          |                         | 267,7 |
|           |            | PGS 36/H4                             |                 |                         |       |
|           |            | PH-MU 28, M36                         |                 |                         |       |
| PWC 39    | UP 39      | PGS 39 G1                             | -               | 383,4                   |       |
|           |            | PGS 39/G2                             |                 |                         |       |
|           |            | PGS 39/G3                             |                 |                         |       |
|           |            | PGS 39/G1-K                           |                 |                         |       |
|           |            | PGS 39/G3-K                           |                 |                         |       |
|           |            | PGS 39/H2                             | PVB 39          |                         |       |
|           |            | PGS 39/H4                             |                 |                         |       |
| PWC 30 HF | UP 30-HF   | PGS 30/G2                             | -               | 299,0                   |       |
|           |            | PGS 30/G3                             |                 |                         |       |
|           |            | PGS 30/G2-K                           |                 |                         |       |
|           |            | PGS 30/G1-DK                          |                 |                         |       |
|           |            | PGS 30/H2                             | PVB 30          |                         |       |
|           |            | PGS 30/H4                             |                 |                         |       |
| PWC 36 HF | UP 36-HF   | PGS 36/G2                             | -               | 436,0                   |       |
|           |            | PGS 36/G3                             |                 |                         |       |
|           |            | PGS 36/G4-K                           |                 |                         |       |
|           |            | PGS 36/G1-DK                          |                 |                         |       |
|           |            | PGS 36/H2                             | PVB 30          |                         |       |
|           |            | PGS 36/H4                             |                 |                         |       |



- In the type designation HF, the wall shoe is used in combination with a foundation anchor with a high-strength bolt (PGS G2 or PGS H2). The use of the PGS H2 foundation anchor brings the advantage of the two-part system of foundation anchor and threaded connection bolt. Thus, nothing protrudes from the foundation on the construction site.
- Dimensioning values apply to the concrete quality of the wall element C30/37.
- The compressive forces are usually transmitted via the direct contact of the individual structural elements (if necessary, with suitable timber packing or shim plates).

Table 1

## Load-bearing behaviour

The connection system may be used for the production of articulated as well as rigid connections in order to transmit tensile forces according to plan. The joint between precast wall and foundation or between precast wall and precast wall is grouted after assembly. The compressive forces can thus be transmitted via contact.

In the assembly state (recess not grouted), the wall shoes are positively connected to the foundation anchors by means of nuts and special washers.

The tensile forces in the lower or middle precast wall elements are transferred from the lower area (wall shoes) to the upper area (anchor bolts) by the continuous vertical reinforcement. The load-bearing capacity of the wall shoes is verified for static or quasi-static loads due to positive normal forces (tensile forces).

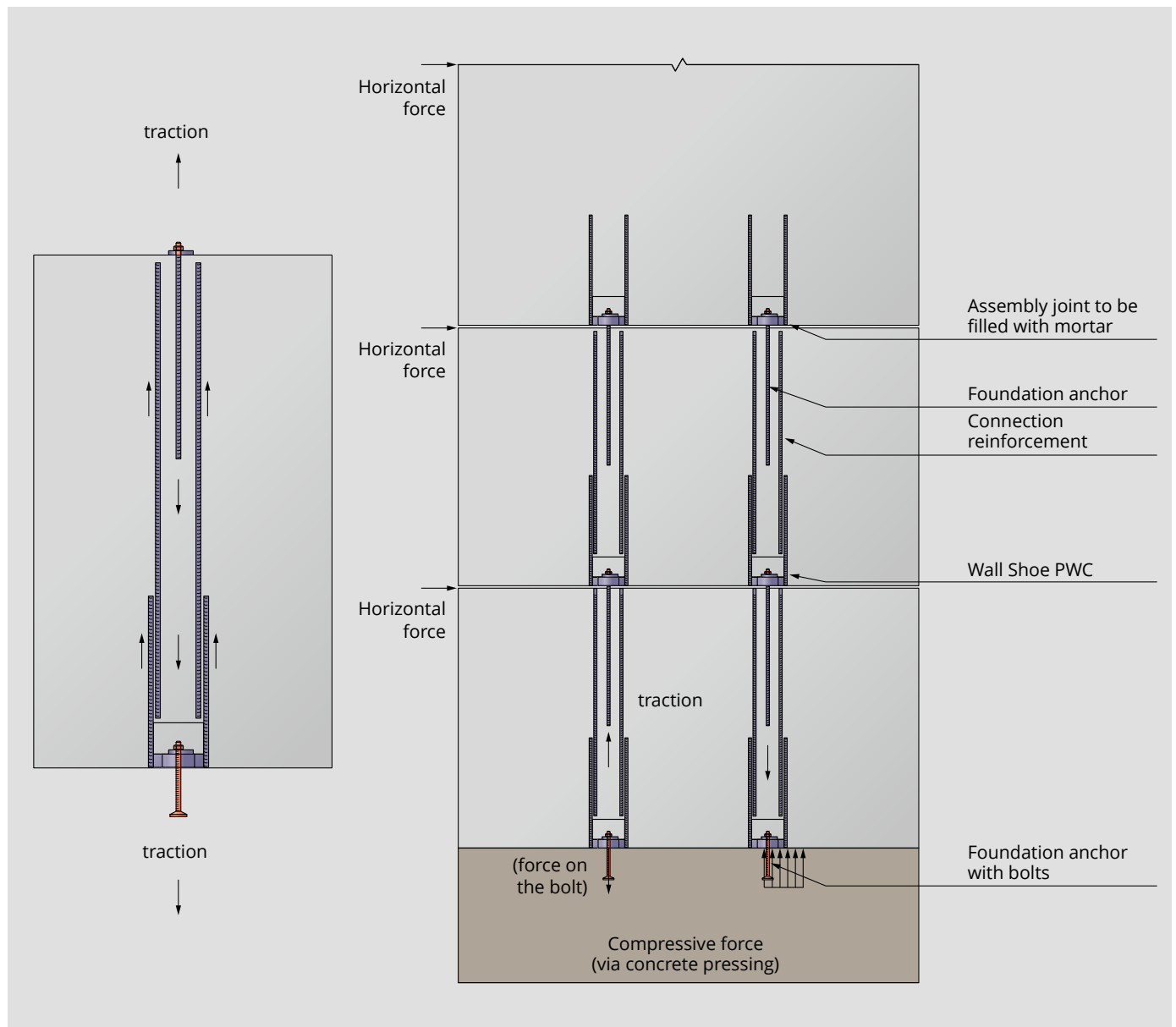


Figure 1

## Installation instruction – precast plant

### Positioning the Wall Shoes

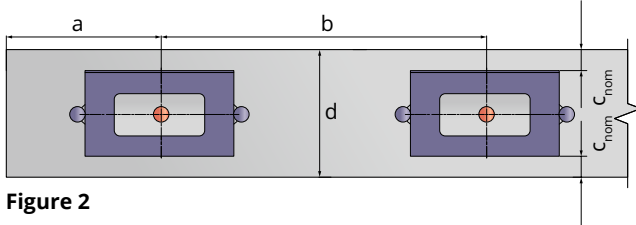


Figure 2

When installing the Wall Shoe PWC, the required concrete cover  $c_{nom}$  according to EN 1992-1-1 must be complied with for the edge distances and the minimum wall thickness.

The minimum wall thicknesses result from the wall shoe width and the concrete cover per wall side to be determined during the planning. Thanks to the arrangement of the slots in the base plate of the wall shoe, generous tolerances are possible. Inaccuracies can thus be compensated easily when installing in the precast plant and when adjusting on the building site.

### Minimum distances and dimensions

The following edge and axis distances as well as the minimum wall thicknesses result from the wall shoe dimensions, the required additional reinforcement and the concrete cover.

| Wall Shoe type | Edge distance<br>a<br>[mm] | Axis distance<br>b<br>[mm] | Minimum wall thicknesses<br>d<br>[mm] |
|----------------|----------------------------|----------------------------|---------------------------------------|
| PWC 16         | 160                        | 320                        | $82 + 2 \times c_{nom}$               |
| PWC 20         | 170                        | 340                        | $92 + 2 \times c_{nom}$               |
| PWC 24         | 190                        | 380                        | $112 + 2 \times c_{nom}$              |
| PWC 30         | 210                        | 420                        | $122 + 2 \times c_{nom}$              |
| PWC 36         | 220                        | 440                        | $132 + 2 \times c_{nom}$              |
| PWC 39         | 240                        | 480                        | $147 + 2 \times c_{nom}$              |
| PWC 30 HF      | 220                        | 440                        | $132 + 2 \times c_{nom}$              |
| PWC 36 HF      | 250                        | 500                        | $152 + 2 \times c_{nom}$              |

Table 2: Distances and minimum wall thicknesses

### Assembly tolerances of the Wall Shoe and Foundation anchor

Wall Shoes are fixed as built-in parts to the front side of the formwork of the wall panels. The following tolerances must be observed when installing the wall shoes.

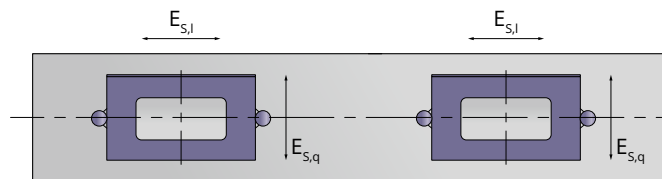


Figure 3



Figure 4

| Wall Shoe type | Wall Shoe installation tolerance            |                                            | Foundation anchor installation tolerance    |                                            |
|----------------|---------------------------------------------|--------------------------------------------|---------------------------------------------|--------------------------------------------|
|                | Longitudinal direction<br>$E_{s,l}$<br>[mm] | Transversal direction<br>$E_{s,q}$<br>[mm] | Longitudinal direction<br>$E_{A,l}$<br>[mm] | Transversal direction<br>$E_{A,q}$<br>[mm] |
| PWC 16         | ± 5                                         | ± 2                                        | ± 3                                         | ± 3                                        |
| PWC 20         | ± 5                                         | ± 2                                        | ± 3                                         | ± 3                                        |
| PWC 24         | ± 5                                         | ± 3                                        | ± 3                                         | ± 3                                        |
| PWC 30         | ± 5                                         | ± 3                                        | ± 3                                         | ± 3                                        |
| PWC 36         | ± 5                                         | ± 3                                        | ± 3                                         | ± 3                                        |
| PWC 39         | ± 5                                         | ± 3                                        | ± 3                                         | ± 3                                        |
| PWC 30 HF      | ± 5                                         | ± 3                                        | ± 3                                         | ± 3                                        |
| PWC 36 HF      | ± 5                                         | ± 3                                        | ± 4                                         | ± 4                                        |

Table 3

## Installation instruction – precast plant/building site

### Joint height between wall and wall/foundation

The wall is installed on leveled lining sheets. The joint height during installation (assuming maximum installation tolerances for the foundation anchors and Wall Shoes PWC) can be found in the table below.

The following tolerances must be observed when installing the Wall Shoes PWC and PGS foundation anchors.

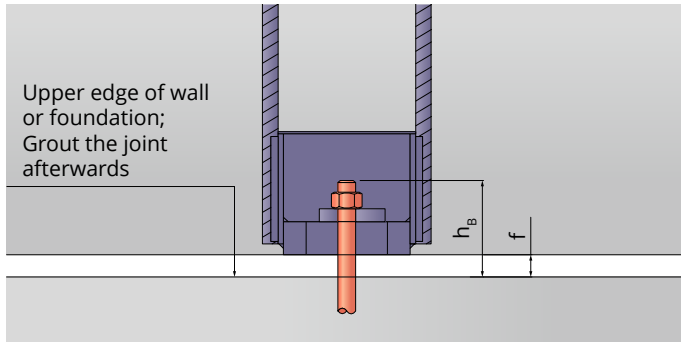


Figure 5

| Foundation anchor/Female bar Typ                     |                        |                |      | Wall Shoe type |        |        |        |        |        |           |           |
|------------------------------------------------------|------------------------|----------------|------|----------------|--------|--------|--------|--------|--------|-----------|-----------|
|                                                      |                        |                |      | PWC 16         | PWC 20 | PWC 24 | PWC 30 | PWC 36 | PWC 39 | PWC 30 HF | PWC 36 HF |
| PGS G1<br>PGS G1-K                                   | Protruding bolt length | $h_B$          | [mm] | 100            | 110    | 120    | 140    | 170    | 170    | –         | –         |
|                                                      | Joint height           | $f_{min}$      | [mm] | 10             | 10     | 10     | 15     | 25     | 30     | –         | –         |
|                                                      |                        | $f_{max}^{1)}$ | [mm] | 35             | 35     | 35     | 35     | 50     | 45     | –         | –         |
| PGS G2<br>PGS G3<br>PGS G2-K<br>PGS G3-K<br>PGS G4-K | Protruding bolt length | $h_B$          | [mm] | –              | –      | 120    | 140    | 170    | 170    | 140       | 170       |
|                                                      | Joint height           | $f_{min}$      | [mm] | –              | –      | 10     | 15     | 20     | 30     | 2         | 15        |
|                                                      |                        | $f_{max}^{1)}$ | [mm] | –              | –      | 35     | 35     | 45     | 45     | 30        | 35        |
| PGS G1-DK                                            | Protruding bolt length | $h_B$          | [mm] | 110            | 120    | 130    | 150    | 160    | –      | 150       | 160       |
|                                                      | Joint height           | $f_{min}$      | [mm] | 20             | 15     | 20     | 25     | 15     | –      | 5         | 10        |
|                                                      |                        | $f_{max}^{1)}$ | [mm] | 45             | 45     | 40     | 45     | 40     | –      | 40        | 30        |
| PGS H2<br>PGS H4                                     | Protruding bolt length | $h_B$          | [mm] | 106            | 115    | 124    | 150    | 176    | 181    | 150       | 176       |
|                                                      | Joint height           | $f_{min}$      | [mm] | 15             | 10     | 15     | 25     | 30     | 40     | 5         | 25        |
|                                                      |                        | $f_{max}^{1)}$ | [mm] | 40             | 40     | 35     | 45     | 55     | 55     | 40        | 45        |
| PH-MU                                                | Protruding bolt length | $h_B$          | [mm] | 110            | 121    | 128    | 155    | 188    | –      | –         | –         |
|                                                      | Joint height           | $f_{min}$      | [mm] | 20             | 20     | 20     | 30     | 45     | –      | –         | –         |
|                                                      |                        | $f_{max}^{1)}$ | [mm] | 40             | 40     | 35     | 45     | 55     | –      | –         | –         |

<sup>1)</sup> For a joint height  $f \geq 40$  mm, transverse tensile reinforcement must be provided in the area of the unreinforced joint

**Table 4:** Joint height between wall and wall/foundation

## Installation instruction – precast plant

### Reinforcement layout

Additional reinforcement must be provided for the introduction and transfer of the loads.

| Wall Shoe type | Additional lap reinforcement   |                                                         |
|----------------|--------------------------------|---------------------------------------------------------|
|                | Longitudinal reinforcement [-] | Length of the welded-on longitudinal reinforcement [cm] |
| PWC 16         | 2 Ø 14                         | 47                                                      |
| PWC 20         | 2 Ø 16                         | 85                                                      |
| PWC 24         | 2 Ø 20                         | 94                                                      |
| PWC 30         | 2 Ø 25                         | 117                                                     |
| PWC 36         | 2 Ø 25                         | 171                                                     |
| PWC 39         | 2 Ø 28                         | 179                                                     |
| PWC 30 HF      | 2 Ø 28                         | 141                                                     |
| PWC 36 HF      | 2 Ø 32                         | 177                                                     |

**Table 5:** Lap reinforcement (pos.1)

The acting tensile forces must be relayed into the components and guided into the foundation by additional reinforcements and corresponding overlapping joints. The required longitudinal reinforcement (laps) is illustrated in table 5.

At maximum utilisation, the lap reinforcement is to be led up to the upper edge of the wall shoe box and butted with the welded-on reinforcement of the wall shoe. The length of the welded-on bars is selected so that the lap length is maintained at maximum utilisation.

The lap lengths are calculated with concrete quality C30/37 and assuming a good bond. In case of lower utilisation or higher concrete quality, the lap length can be reduced linearly from the specified lengths by the planning engineer.

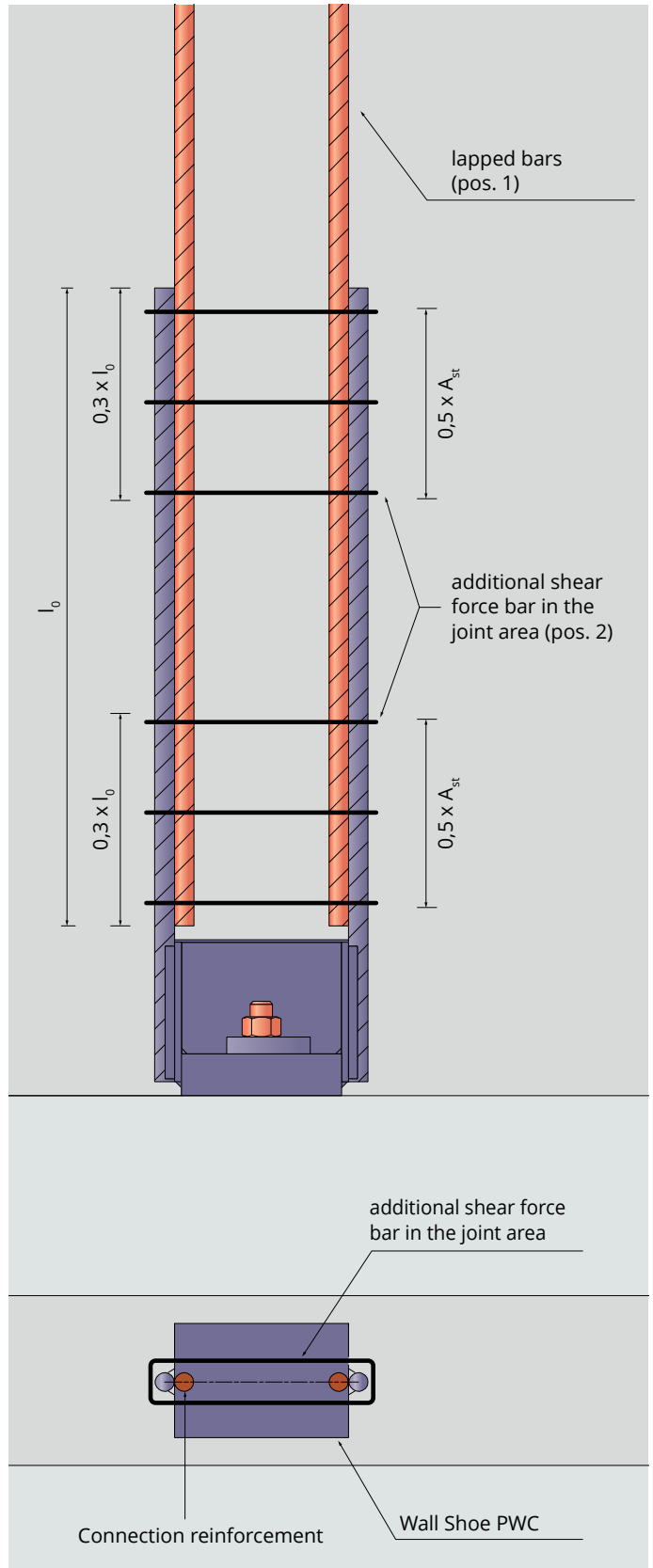
| Wall Shoe type | Additional shear reinforcement – closed stirrup     |                                        |
|----------------|-----------------------------------------------------|----------------------------------------|
|                | Quantity and diameter <sup>1)</sup><br>$A_{st}$ [-] | Joint area<br>$0,3 \times l_0$<br>[cm] |
| PWC 16         | 4 Ø 6 <sup>2)</sup>                                 | 14                                     |
| PWC 20         | 6 Ø 6 <sup>2)</sup>                                 | 26                                     |
| PWC 24         | 6 Ø 6 <sup>2)</sup>                                 | 28                                     |
| PWC 30         | 6 Ø 8                                               | 35                                     |
| PWC 36         | 10 Ø 8                                              | 51                                     |
| PWC 39         | 10 Ø 8                                              | 54                                     |
| PWC 30 HF      | 8 Ø 8                                               | 42                                     |
| PWC 36 HF      | 10 Ø 10                                             | 53                                     |

<sup>1)</sup> Total number of stirrups per overlapping joint; to be divided in half into joint start and end.

<sup>2)</sup> If the conditions of subsection (2), section 8.7.4.1 of DIN EN 1992-1-1 + NA are met, the transverse reinforcement or stirrups provided for other reasons may be considered sufficient to absorb the transverse tensile forces without any further verification.

**Table 6:** Transverse reinforcement at the lap joint (pos. 2)

According to EN 1992-1-1, paragraph 8.7.4, shear reinforcement is to be provided in the lap area in order to absorb shear forces. This shear reinforcement is to be installed in the form of closed stirrups and concentrated in the start and end area of the lap length.



**Figure 6:** Arrangement of reinforcement

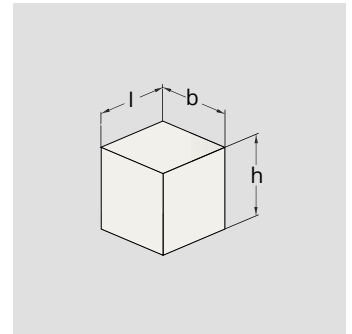
## Dimensions of recessing block

The required mounting recess in the wall can be formed with the help of a polystyrene recessing block. The dimensions of the recessing block are described below depending on the wall thickness. These apply to the axial installation of a Wall Shoe in a wall with the thickness D.

| Wall Shoe type<br>[-] | Recessing block dimensions |           |           |
|-----------------------|----------------------------|-----------|-----------|
|                       | b <sup>1)</sup><br>[mm]    | h<br>[mm] | l<br>[mm] |
| <b>PWC 16</b>         | 0,5 x (D + 80)             | 85        | 115       |
| <b>PWC 20</b>         | 0,5 x (D + 90)             | 95        | 120       |
| <b>PWC 24</b>         | 0,5 x (D + 110)            | 100       | 135       |
| <b>PWC 30</b>         | 0,5 x (D + 120)            | 115       | 140       |
| <b>PWC 36</b>         | 0,5 x (D + 130)            | 130       | 145       |
| <b>PWC 39</b>         | 0,5 x (D + 145)            | 130       | 160       |
| <b>PWC 30 HF</b>      | 0,5 x (D + 130)            | 130       | 145       |
| <b>PWC 36 HF</b>      | 0,5 x (D + 150)            | 130       | 160       |

<sup>1)</sup> depending on the wall thickness D

**Table 7**



Polystyrene recessing block

# PWC assembly instructions – building site

## Identification

The Wall Shoes are provided with an identification sticker on the top. This provides information about the size or type of the Wall Shoe, the parts or reference number and the address of the manufacturer with all relevant data.

## Assembly of the wall elements

To install the wall elements, the following steps must be carried:

- Remove the nuts and washers of the foundation anchor
- Create the appropriate joint with the help of steel plates
- Position the wall element on the steel plates
- Check the correct position of the wall element
- Screw on the nuts and washers and tighten firmly
- Grout the assembly recess and the wall joint
- Connection is ready after hardening of joint filling mortar



Figure 7: Identification Wall Shoe

## Assembly and tolerances

When adjusting the walls on the building site, the tolerances of the system allow a practical alignment of the components. The following tolerances are available for any inaccuracies that may occur when installing the foundation anchors.

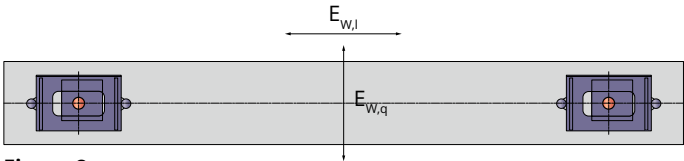


Figure 8

| Wall Shoe type | Tolerance wall connection                   |                                           |
|----------------|---------------------------------------------|-------------------------------------------|
|                | Longitudinal direction<br>$E_{w,l}$<br>[mm] | Transverse direction<br>$E_{w,q}$<br>[mm] |
| PWC 16         | ± 20                                        | ± 5                                       |
| PWC 20         | ± 20                                        | ± 5                                       |
| PWC 24         | ± 20                                        | ± 5                                       |
| PWC 30         | ± 20                                        | ± 5                                       |
| PWC 36         | ± 20                                        | ± 5                                       |
| PWC 39         | ± 20                                        | ± 5                                       |
| PWC 30 HF      | ± 20                                        | ± 5                                       |
| PWC 36 HF      | ± 20                                        | ± 5                                       |

Table 8: Assembly tolerances when adjusting

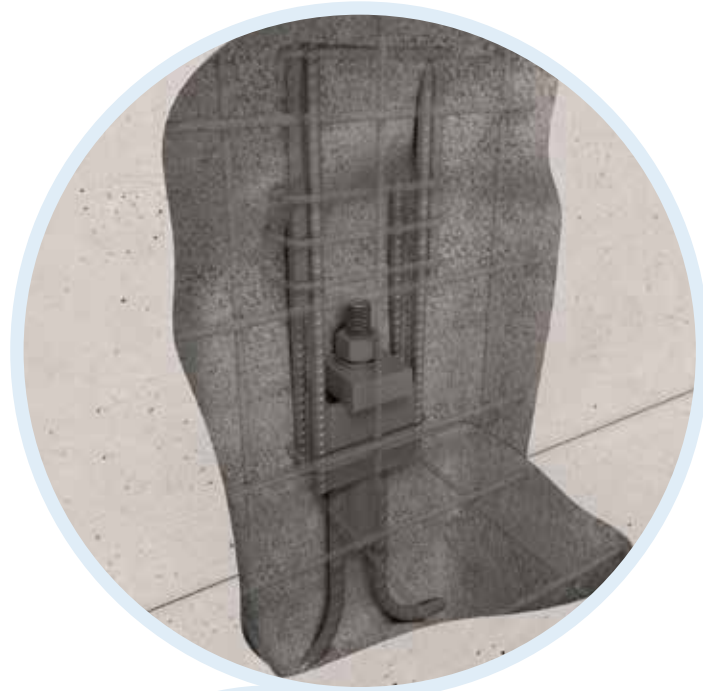
# Wall Shoes System PWS

## Your advantages at a glance

- Complete system for the transmission of shear and tensile forces
- Screw connection
- Highest possible tolerances and adjustment options
- Fast simple installation of the wall connections
- Immediate functionality of the connection

## The system

The Wall Shoes PWS can be combined with the different foundation anchor types by means of connecting bolts and plats PAP. The connecting elements has to be ordered separately.

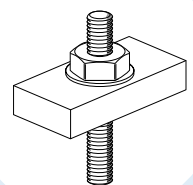
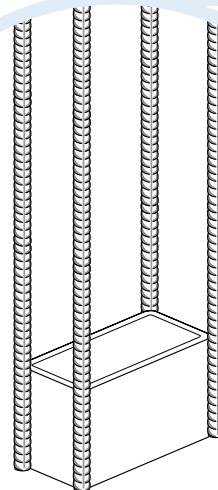


### Wall Shoe PWS

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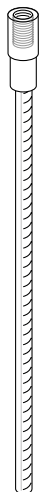
### Foundation anchors PGS

### Reinforcement connection

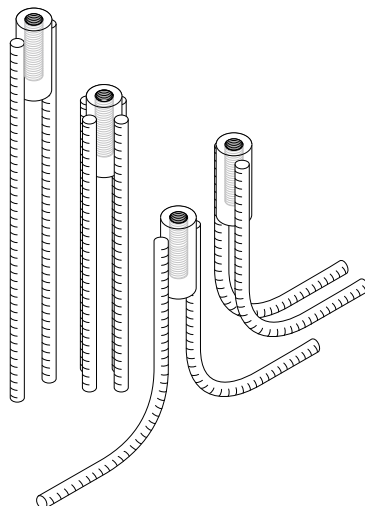


### Connecting bolts PAP

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PH-MU



PGS/H2, H4



More information about the foundation anchors/PH system:  
[pfeifer.info/en/products/precast-lifting-systems/](https://pfeifer.info/en/products/precast-lifting-systems/)

- Complete system for the transmission of tensile and transversal shear forces
- Can be used from the thinnest walls from 160 mm
- Flexible due to realistic tolerance ranges
- Cast with prepared grout mix
- Short construction times and thus cost savings
- Type-approved

#### Component recommendation

- Precast wall

#### Technical data

- **Material:** bright steel

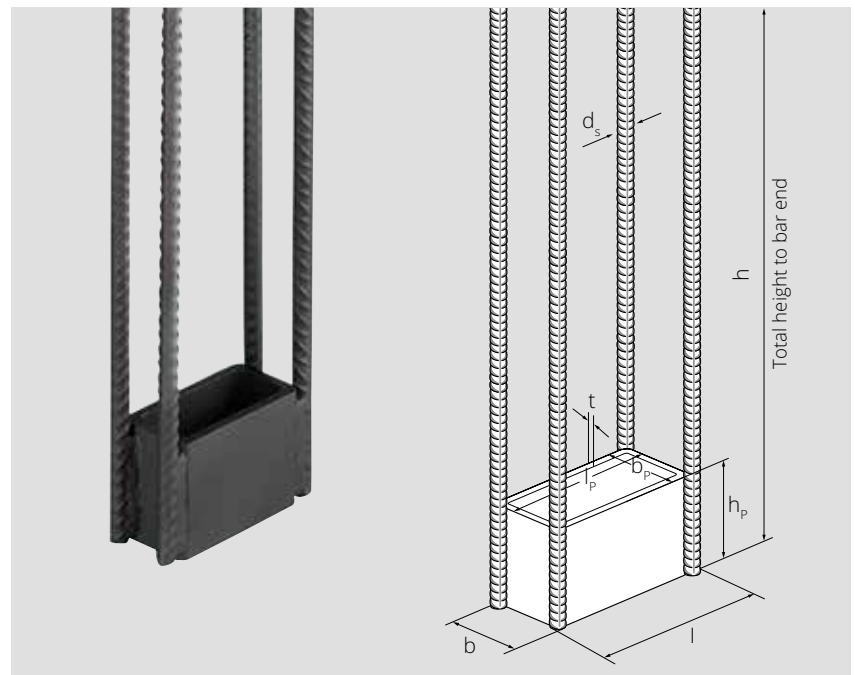
#### Options on request

- Further lengths



## Wall Shoe PWS

- For bolted connection of stiffening concrete wall constructions
- Absorption and transmission of tensile forces acting perpendicular to the joint
- forces acting perpendicular to the joint as well as transverse forces in the longitudinal joint axes.
- Wall Shoes are installed in the wall element and connected to the anchors in the foundation or in an underlaying wall. Alternatively two wall shoes can be connected to each other. Subsequently the recesses are grouted



#### Wall Shoe PWS

| Type designation         |                |    | PWS-120 | PWS-200 | PWS-330 | PWS-400 | PWS-650 | PWS-900 |
|--------------------------|----------------|----|---------|---------|---------|---------|---------|---------|
| Total length             | h              | mm | 880     | 1360    | 1750    | 1740    | 2330    | 2540    |
| Diameter concrete steel  | d <sub>s</sub> | mm | 14      | 16      | 20      | 25      | 28      | 32      |
| Sheet thickness          | t              | mm | 8       | 8       | 10      | 10      | 14,2    | 14,2    |
| Length of hollow profile | l <sub>p</sub> | mm | 120     | 120     | 140     | 140     | 180     | 180     |
| Width of hollow profile  | b <sub>p</sub> | mm | 60      | 60      | 70      | 80      | 100     | 100     |
| Height of hollow profile | h <sub>p</sub> | mm | 80      | 95      | 120     | 140     | 165     | 190     |
| Outside length           | l              | mm | 147     | 151     | 178     | 180     | 235     | 238     |
| Width outside            | b              | mm | 60      | 64      | 80      | 100     | 112     | 128     |
| Reference no.            |                |    | 199442  | 199443  | 199444  | 199445  | 199446  | 199447  |

#### Cover Plate PWS

|               |        |        |        |        |        |        |
|---------------|--------|--------|--------|--------|--------|--------|
| Reference no. | 165352 | 165352 | 165352 | 165352 | 165352 | 165352 |
|---------------|--------|--------|--------|--------|--------|--------|

- ▶ Simple screw connection with Wall Shoe via Connecting Bolt
- ▶ High-tensile material
- ▶ Complete system for the transmission of tensile and transversal shear forces
- ▶ Shorter construction times and thus lower costs
- ▶ Tolerances up to 40 mm in longitudinal direction
- ▶ Type-approved

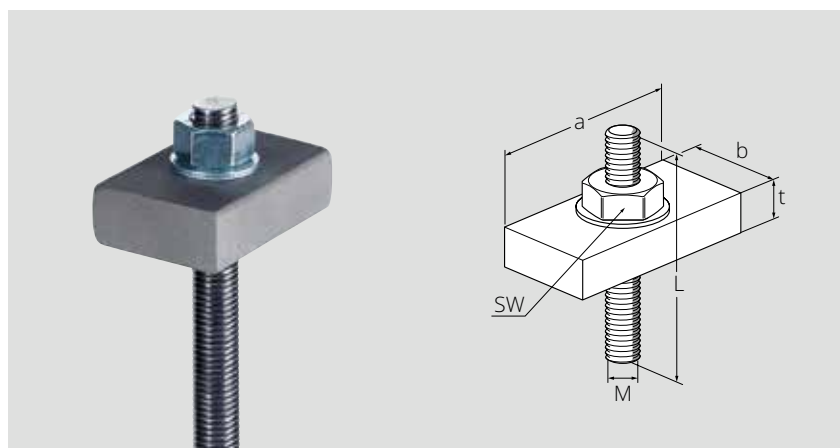
#### Technical data

- ▶ **Material:** bright steel



## Connecting bolts PAP for PWS

- ▶ For connecting Wall Shoe and Foundation anchor type H
- ▶ Bolt can be screwed into the foundation anchor easily. The Wall Shoe can then be positioned on it and fastened



#### Connecting bolts PAP for PWS

| Type designation    |    |    | PAP-16 | PAP-20 | PAP-24 | PAP-30 | PAP-36 | PAP-42 | PAP-48 | PAP-56 |
|---------------------|----|----|--------|--------|--------|--------|--------|--------|--------|--------|
| Thread type         |    |    | M 16   | M 20   | M 24   | M 30   | M 36   | M 42   | M 48   | M 56   |
| Plate width         | b  | mm | 50     | 60     | 70     | 80     | 100    | 110    | 130    | 130    |
| Plate thickness     | t  | mm | 20     | 25     | 25     | 30     | 35     | 45     | 45     | 50     |
| Plate length        | a  | mm | 100    | 100    | 100    | 110    | 130    | 150    | 150    | 140    |
| Wrench size         | SW | mm | 24     | 30     | 36     | 46     | 55     | 65     | 75     | 85     |
| Washer diameter     | D  | mm | 30     | 37     | 44     | 56     | 66     | 78     | 92     | 105    |
| Threaded rod length | L  | mm | 180    | 200    | 220    | 270    | 320    | 370    | 410    | 440    |
| Reference no.       |    |    | 199401 | 199402 | 199403 | 199404 | 199405 | 199406 | 199407 | 199408 |

## Working load limit

Absorbable tensile forces per Wall Shoe PWS

| Type                       | PWS 120 | PWS 200 | PWS 330 | PWS 400 | PWS 650 | PWS 900 |
|----------------------------|---------|---------|---------|---------|---------|---------|
| <b>N<sub>Rd</sub> [kN]</b> | 120     | 200     | 330     | 400     | 650     | 900     |

The following design shear resistances may only be applied if the horizontal joint between the component element and the foundation is completely grouted.

Absorbable shear forces with concrete quality **C20/25**

| Type                       | PAP 16 | PAP 20 | PAP 24 | PAP 30 | PAP 36 | PAP 42 | PAP 48 | PAP 56 |
|----------------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| <b>V<sub>Rd</sub> [kN]</b> | 7,9    | 12,7   | 18,7   | 29,8   | 43,8   | 60,5   | 80,2   | 110,8  |

Absorbable shear forces with concrete quality **C25/30**

| Type                       | PAP 16 | PAP 20 | PAP 24 | PAP 30 | PAP 36 | PAP 42 | PAP 48 | PAP 56 |
|----------------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| <b>V<sub>Rd</sub> [kN]</b> | 9,2    | 14,7   | 21,6   | 34,5   | 50,7   | 70,0   | 92,8   | 128,0  |

Absorbable shear forces with concrete quality **C30/37**

| Type                       | PAP 16 | PAP 20 | PAP 24 | PAP 30 | PAP 36 | PAP 42 | PAP 48 | PAP 56 |
|----------------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| <b>V<sub>Rd</sub> [kN]</b> | 10,4   | 16,7   | 24,0   | 38,4   | 56,6   | 77,8   | 102,4  | 141,7  |



## Connection combinations

### Foundation anchor PGS + Connecting bolt PAP + Wall shoe PWS

The size of the foundation anchor usually determines the design resistance of the wall shoe connection. If the wall shoes are not fully utilized, a smaller foundation anchor can be selected, which is more economical. Due to the dimensions, not all combinations of foundation anchors and wall shoes are practical.

The following table is intended to facilitate appropriate assignments.

| Foundation anchor type | Connecting bolt type | Wall shoe type           |                          |                          |                          |                          |                          |
|------------------------|----------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
|                        |                      | PWS 120                  | PWS 200                  | PWS 330                  | PWS 400                  | PWS 650                  | PWS 900                  |
| <b>PGS-H2 16</b>       | <b>PAP 16</b>        | N <sub>Rd</sub> = 68 kN  |                          |                          |                          |                          |                          |
| <b>PGS-H2/H4 20</b>    | <b>PAP 20</b>        | N <sub>Rd</sub> = 97 kN  |                          |                          |                          |                          |                          |
| <b>PGS-H2/H4 24</b>    | <b>PAP 24</b>        | N <sub>Rd</sub> = 120 kN | N <sub>Rd</sub> = 139 kN |                          |                          |                          |                          |
| <b>PGS-H2/H4 30</b>    | <b>PAP 30</b>        |                          | N <sub>Rd</sub> = 200 kN | N <sub>Rd</sub> = 299 kN |                          |                          |                          |
| <b>PGS-H2/H4 36</b>    | <b>PAP 36</b>        |                          |                          | N <sub>Rd</sub> = 330 kN | N <sub>Rd</sub> = 400 kN |                          |                          |
| <b>PGS-H2/H4 42</b>    | <b>PAP 42</b>        |                          |                          |                          | N <sub>Rd</sub> = 400 kN | N <sub>Rd</sub> = 570 kN |                          |
| <b>PGS-H2/H4 48</b>    | <b>PAP 48</b>        |                          |                          |                          |                          | N <sub>Rd</sub> = 650 kN | N <sub>Rd</sub> = 778 kN |
| <b>PGS-H2/H4 56</b>    | <b>PAP 56</b>        |                          |                          |                          |                          |                          | N <sub>Rd</sub> = 900 kN |

Table 9

## Socket bar PH-MU + Connecting bolt PAP + Wall shoe PWS

If the PH-MU socket bar is intended as a reinforcement connection for the transfer of static and quasi-static tensile and compressive loads according to EN 1992-1-1, Sections 8.7 and 8.8, the resistances should be used according to ETA-20/0259. In this case, the load-bearing capacity of the system will be determined based on the reinforcing bar cross-section.

| Socket bar type | Connecting bolt type | Wall shoes type            |                             |                             |                             |
|-----------------|----------------------|----------------------------|-----------------------------|-----------------------------|-----------------------------|
|                 |                      | PWS 120                    | PWS 200                     | PWS 330                     | PWS 400                     |
| PH-MU 12, M16   | PAP 16               | $N_{Rd} = 49,2 \text{ kN}$ |                             |                             |                             |
| PH-MU 16, M20   | PAP 20               | $N_{Rd} = 87,4 \text{ kN}$ |                             |                             |                             |
| PH-MU 20, M24   | PAP 24               | $N_{Rd} = 120 \text{ kN}$  | $N_{Rd} = 136,6 \text{ kN}$ |                             |                             |
| PH-MU 25, M30   | PAP 30               |                            | $N_{Rd} = 200 \text{ kN}$   | $N_{Rd} = 213,4 \text{ kN}$ |                             |
| PH-MU 28, M36   | PAP 36               |                            |                             | $N_{Rd} = 267,7 \text{ kN}$ | $N_{Rd} = 267,7 \text{ kN}$ |
| PH-MU 32, M42   | PAP 42               |                            |                             |                             | $N_{Rd} = 349,7 \text{ kN}$ |

Table 10

### ⚠ CAUTION

The verification of shear design resistances for the PH system is NOT covered by the approval (here: European Technical Assessment ETA). Only tensile forces can be verified.

## Tensile and shear force interaction

The design resistances for tensile and shear force can easily be read off with the help of the shear force interaction diagrams depending on the grouting concrete quality and the bolt diameter. Decisive for the interaction between normal and shear force is the stress on the threaded bolt. Here, a superposition takes place between normal stresses from the centric forces and the bending stress from shear force load. From the wall shoe itself, the shear forces are transmitted into the concrete directly or via additionally inserted reinforcement.

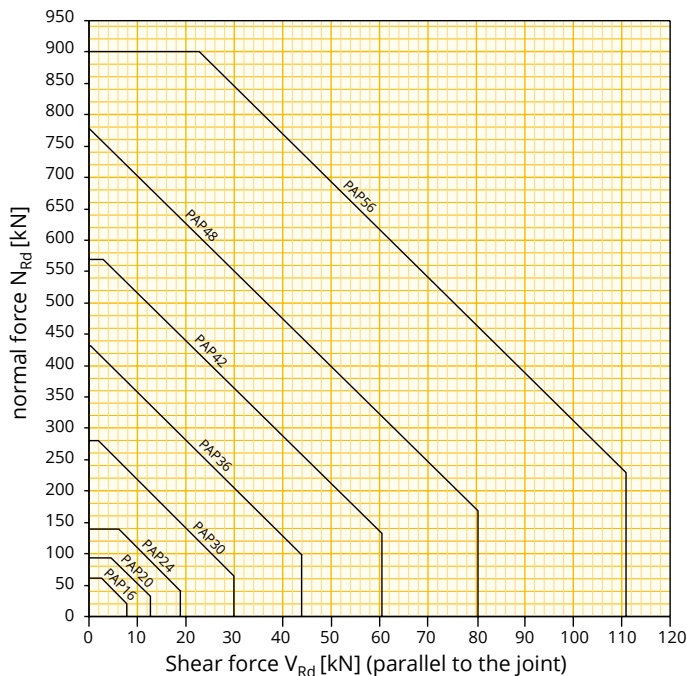
For walls with thicknesses  $\gg 160\text{mm}$ , it is possible to transfer shear forces perpendicular to the longitudinal direction of the wall if there is sufficient concrete to transfer the shear forces (separate verification via framework model or truss model).

Decisive for the use of the shear force interaction diagrams is the minimum concrete quality used in conjunction with the wall shoe or foundation anchor. This means that the poorer of the two concrete qualities of the components to be connected, such as wall above/wall below, foundation/precast column or strip foundation/wall, is decisive. Practically, this means: the precast element has the higher concrete quality compared to the in-situ concrete foundation. Thus, the resistance side is reduced to the concrete quality of the foundation.

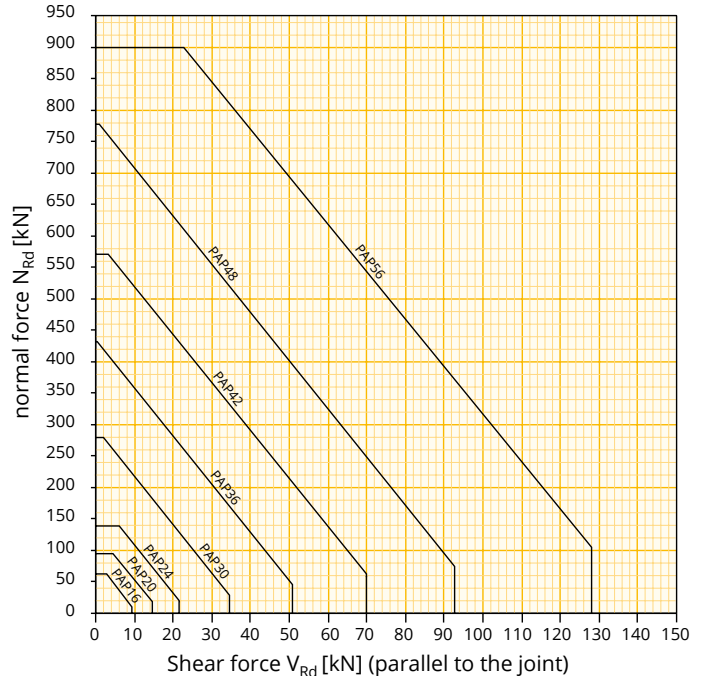
Ensure that the grouting of the assembly aperture and the recess takes place immediately after the assembly of the components to absorb the stress.

**Interaction diagrams for the design resistances of shear force and normal force for common concrete qualities:**

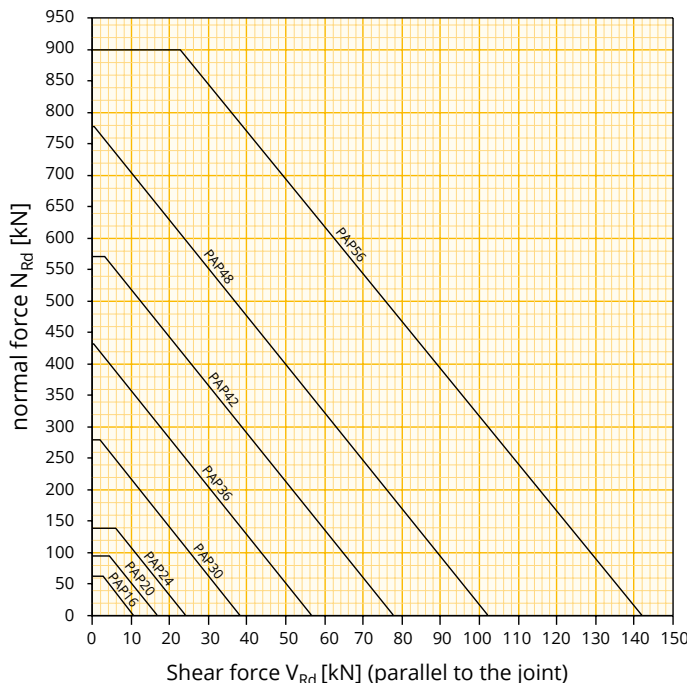
**Concrete quality C20/25**



**Concrete quality C25/30**



**Concrete quality C30/37**



### ATTENTION

The respective design resistances must be compared for each combination of wall shoe/foundation anchor. The minimum design resistance is decisive in each case.

### ATTENTION

Joint sealing; When moving the wall on a mortar joint, ensure that no mortar is applied in the area of the grouting width of the wall shoe. In order to be able to apply the design resistances from the interaction diagrams, it must be ensured that the grouting extends to the foundation or the underlying component (e.g. FT wall).

### CAUTION

The verification of shear design resistances for the PH system is NOT covered by the approval (here: European Technical Assessment ETA). Only tensile forces can be verified.

## Installation instruction – precast plant

### Minimum thicknesses of the wall components

The minimum wall thicknesses for wall components with Wall Shoes specified in Table 11 result from the Wall Shoe dimensions, the surface reinforcement and the concrete cover.

| Type    | Minimum thicknesses [mm] |
|---------|--------------------------|
| PWS 120 | 160                      |
| PWS 200 | 160                      |
| PWS 330 | 180                      |
| PWS 400 | 200                      |
| PWS 650 | 210                      |
| PWS 900 | 210                      |

**Table 11:** Minimum wall thicknesses

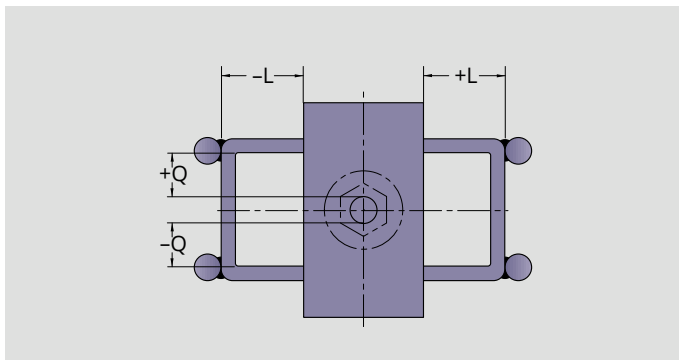
### Edge and axis distances

The edge and axis distances are to be taken into account to the extent that the required concrete cover  $c_{nom}$  according to EN 1992-1-1 is complied with. This protects the built-in parts against corrosion and serves to transmit the acting forces.

When placing the reinforcement, care must be taken that the bar spacing is selected so that the concrete can be placed and sufficiently compacted, and that a sufficient bond is ensured.

The minimum values of the clear bar spacing according to DIN EN 1992-1-1 must therefore be observed.

### Theoretical possible installation tolerances



**Figure 9**

The installation tolerances in Table 12 are based on optimal installation conditions; if necessary, the production tolerances according to Table 3 must be taken into account.

Wall shoes are fixed as fixtures to the formwork of the wall panels. The installation tolerances depend on the size of the selected wall shoe and the outer diameter of the anchor bolt.

| Connecting bolt type | Wall Shoes type            |                           |                            |                           |                            |                           |                            |                           |                            |                           |                            |                           |
|----------------------|----------------------------|---------------------------|----------------------------|---------------------------|----------------------------|---------------------------|----------------------------|---------------------------|----------------------------|---------------------------|----------------------------|---------------------------|
|                      | PWS 120                    |                           | PWS 200                    |                           | PWS 330                    |                           | PWS 400                    |                           | PWS 650                    |                           | PWS 900                    |                           |
|                      | length-wise<br>± L<br>[mm] | transverse<br>± Q<br>[mm] | length-wise<br>± L<br>[mm] | transverse<br>± Q<br>[mm] | length-wise<br>± L<br>[mm] | transverse<br>± Q<br>[mm] | length-wise<br>± L<br>[mm] | transverse<br>± Q<br>[mm] | length-wise<br>± L<br>[mm] | transverse<br>± Q<br>[mm] | length-wise<br>± L<br>[mm] | transverse<br>± Q<br>[mm] |
| PAP 16               | 35                         | 14                        |                            |                           |                            |                           |                            |                           |                            |                           |                            |                           |
| PAP 20               | 30                         | 12                        |                            |                           |                            |                           |                            |                           |                            |                           |                            |                           |
| PAP 24               | 25                         | 10                        | 25                         | 10                        |                            |                           |                            |                           |                            |                           |                            |                           |
| PAP 30               |                            |                           | 20                         | 7                         | 30                         | 10                        |                            |                           |                            |                           |                            |                           |
| PAP 36               |                            |                           |                            |                           | 20                         | 7                         | 20                         | 12                        |                            |                           |                            |                           |
| PAP 42               |                            |                           |                            |                           |                            |                           | 15                         | 9                         | 35                         | 15                        |                            |                           |
| PAP 48               |                            |                           |                            |                           |                            |                           |                            |                           | 25                         | 12                        | 25                         | 12                        |
| PAP 56               |                            |                           |                            |                           |                            |                           |                            |                           |                            |                           | 15                         | 8                         |

**Table 12:** Longitudinal and transverse installation tolerances

### Recessing block PWS – dimensioning

The necessary assembly recess in the wall can be manufactured with the aid of a foam polystyrene recessing block (fig. 14). Select the dimensions of the block so that, on the one hand, the concrete cover of at least 1.5 cm according to EN 1992-1-1 is ensured and, on the other, the anchor plate has sufficient clearance to the rear.

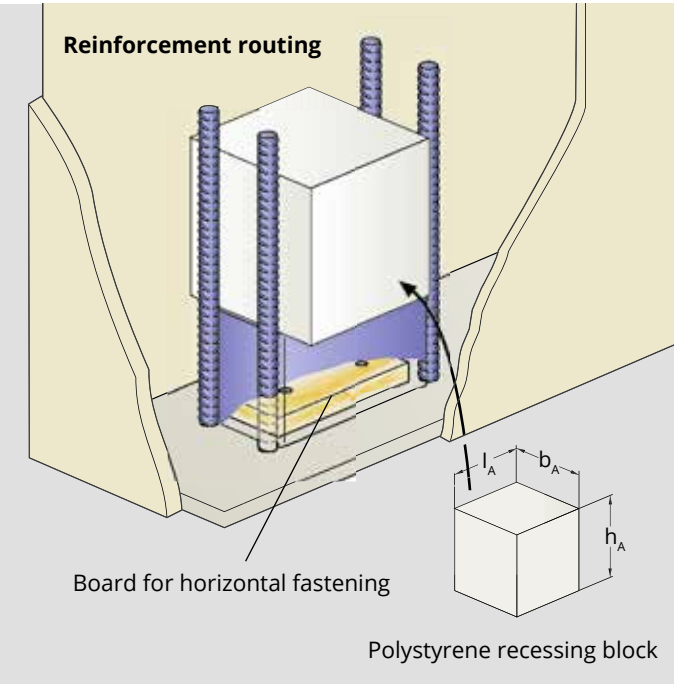


Figure 10

The recessing block is not included in the scope of delivery.

Table 13 shows the optimal styrofoam recess former dimensions for the axial installation of a wall shoe in a 20 cm thick wall:

| Type    | $b_A$<br>[mm] | $h_A$<br>[mm] | $l_A$<br>[mm] |
|---------|---------------|---------------|---------------|
| PWS 120 | 170           | 110           | 120           |
| PWS 200 | 170           | 130           | 120           |
| PWS 330 | 170           | 150           | 140           |
| PWS 400 | 170           | 180           | 140           |
| PWS 650 | 170           | 180           | 180           |
| PWS 900 | 170           | 180           | 180           |

Table 13: Recessing block dimensions

## Installation instruction – precast plant

### Reinforcement layout

The transverse reinforcement (stirring) required to absorb the splitting tensile forces occurring in the anchorage area must be verified and installed in accordance with the type test according to DIN EN 1992-1-1. Tables 14 and 15 (Figures 11 and 12) below show the additional reinforcement, taking into account the connection at maximum load. Furthermore, the reinforcement guidelines and the information on the minimum concrete cover according to DIN EN 1992-1-1 must be observed.

| Wall Shoe type | Additional lap reinforcement   |                                                         |
|----------------|--------------------------------|---------------------------------------------------------|
|                | Longitudinal reinforcement [-] | Length of the welded-on longitudinal reinforcement [cm] |
| <b>PWS 120</b> | 4 Ø 14                         | 69,0                                                    |
| <b>PWS 200</b> | 4 Ø 16                         | 113,5                                                   |
| <b>PWS 330</b> | 4 Ø 20                         | 148,0                                                   |
| <b>PWS 400</b> | 4 Ø 25                         | 142,0                                                   |
| <b>PWS 650</b> | 4 Ø 28                         | 198,5                                                   |
| <b>PWS 900</b> | 4 Ø 32                         | 217,0                                                   |

**Table 14:** Lap reinforcement (pos. 1)

The acting tensile forces must be relayed into the components and guided into the foundation by additional reinforcements and corresponding overlapping joints. The required longitudinal reinforcement (laps) is illustrated in table 6.

At maximum utilisation, the lap reinforcement is to be led up to the upper edge of the wall shoe box and butted with the welded-on reinforcement of the wall shoe. The length of the welded-on bars is selected so that the lap length is maintained at maximum utilisation.

The lap lengths are calculated with concrete quality C30/37 and assuming a good bond. In case of lower utilisation or higher concrete quality, the lap length can be reduced linearly from the specified lengths by the planning engineer.

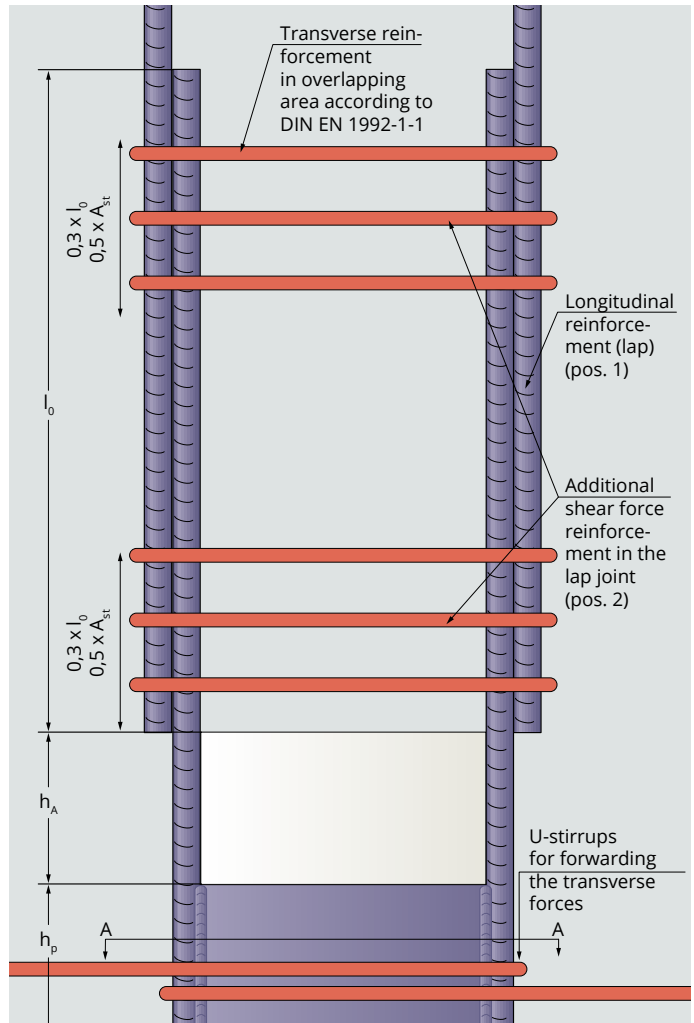
| Wall Shoe type | Additional shear reinforcement – closed stirrup     |                                        |
|----------------|-----------------------------------------------------|----------------------------------------|
|                | Quantity and diameter <sup>1)</sup><br>$A_{st}$ [-] | Joint area<br>$0,3 \times l_0$<br>[cm] |
| <b>PWS 120</b> | 6 Ø 6                                               | 20,7                                   |
| <b>PWS 200</b> | 6 Ø 8                                               | 34,0                                   |
| <b>PWS 330</b> | 8 Ø 8                                               | 44,5                                   |
| <b>PWS 400</b> | 8 Ø 8                                               | 42,5                                   |
| <b>PWS 650</b> | 8 Ø 10                                              | 59,5                                   |
| <b>PWS 900</b> | 10 Ø 10                                             | 65,0                                   |

<sup>1)</sup> Total number of stirrups per overlapping joint; to be divided in half into joint start and end.

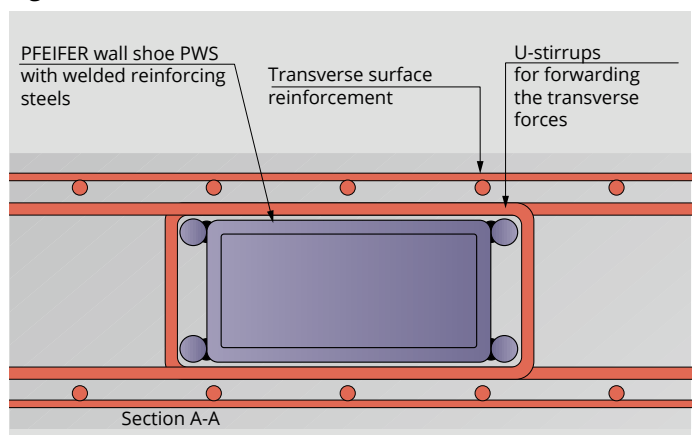
<sup>2)</sup> If the conditions of subsection (2), section 8.7.4.1 of DIN EN 1992-1-1 + NA are met, the transverse reinforcement or stirrups provided for other reasons may be considered sufficient to absorb the transverse tensile forces without any further verification.

**Table 15:** Transverse reinforcement at lap joint (pos. 2)

According to EN 1992-1-1, paragraph 8.7.4, shear reinforcement is to be provided in the lap area in order to absorb shear forces. This shear reinforcement is to be installed in the form of closed stirrups and concentrated in the start and end area of the lap length.



**Figure 11**



**Figure 12**

$l_0$ : the lap length corresponds to the bar length from the top edge of the installation recess for concrete grade C30/37, good bond

## Installation instructions – building site

The Wall Shoe PWS are provided with a marking band on the welded rebar. This provides information about the size or type of the wall shoe, the parts or reference number and the address of the manufacturer with all relevant data.

|                           |            |                                                                                   |                                                                                                                                    |
|---------------------------|------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| <b>PWS 120</b>            |            |  | <b>PFEIFER</b><br>Seil- und Hebetchnik GmbH<br>Dr.-Karl-Lenz-Straße 66<br>D-87700 Memmingen<br>www.pfeifer.info<br>Art.-Nr. 199442 |
| WA-Nr./Factory order no.: | Q12868     |                                                                                   |                                                                                                                                    |
| Datum/Date:               | 09.10.2024 |                                                                                   |                                                                                                                                    |

**Figure 13:** Identification of the Wall Shoe PWS

### Installation of the wall elements

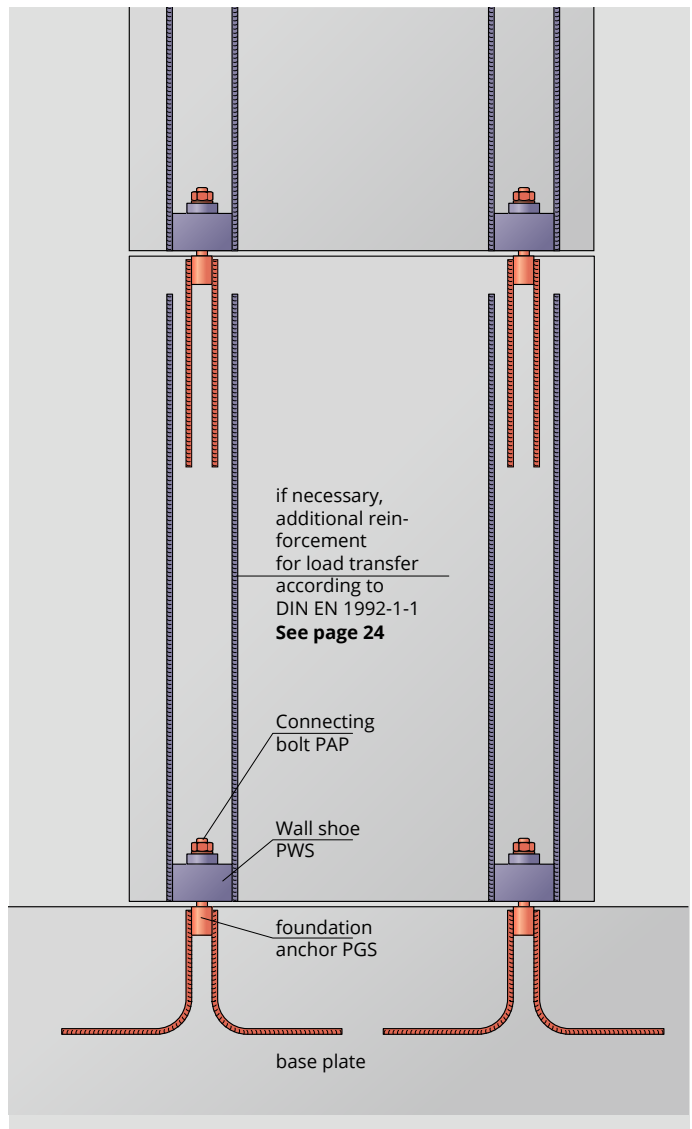
Shortly before the installation of the wall elements, the plastic caps or bolts inserted for protection are removed from the foundation anchor sleeve. The Connecting Bolt PAP is then screwed in. The screw-in depth in the foundation anchor is 2 x the thread diameter. With the help of shims, the precast wall elements are then positioned and aligned in their final position. After inserting the anchor plate, the nut can be tightened.

To reduce the deformations, the screwed connections should generally be pre-tensioned with 50% of the tightening values according to DIN 18800, Part 7. If necessary, lower or higher pre-tensioning forces can be planned by the engineer for individual applications.

### Assembly of wall elements with wall shoes and foundation anchors

Care must be taken to ensure that the resulting forces are transferred to the wall shoes through overlap joints or appropriate reinforcement placement. The required reinforcement must be verified for each individual application and installed on site.

Additional information can be found on page 21.



**Figure 14**

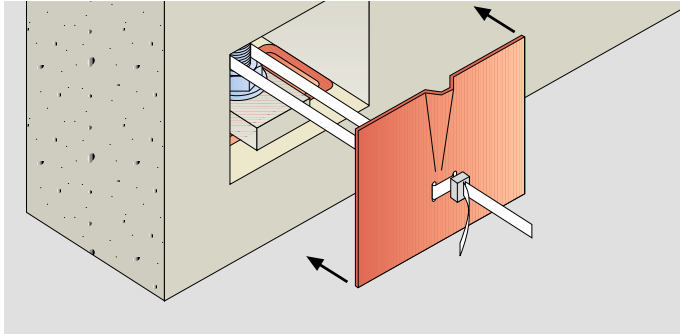
## Grouting

### Grouting the recess

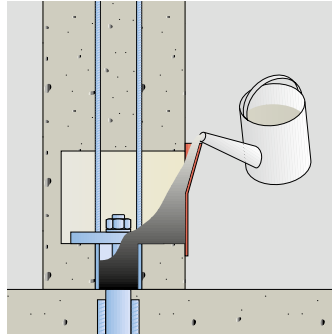
The additional grouting of the cavity in the wall shoe body with a free-flowing and low-shrinkage grouting concrete ensures the transmission of shear forces longitudinally to the joint. The high-strength, very free-flowing, self-compacting grouting mortar is to be used.

The grouting process must be carried out via the filling funnel as far as possible without interruption.

A reusable cover plate with filling funnel is available for the simple, fast and clean filling of the assembly recess. Lash the cover plate to the threaded bolt using a cable tie. After the hardening of the grout, simply cut the cable tie and re-use the sheet. (figs. 15 & 16).



**Figure 15**



**Figure 16**

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