

PFEIFER- VS[®] Slim Box EASYFILL

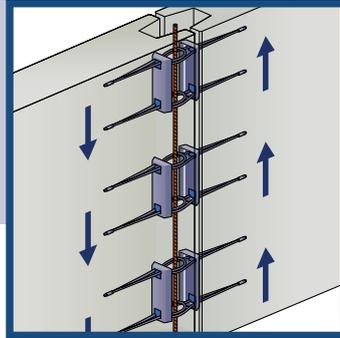
PFEIFER



planning and installation

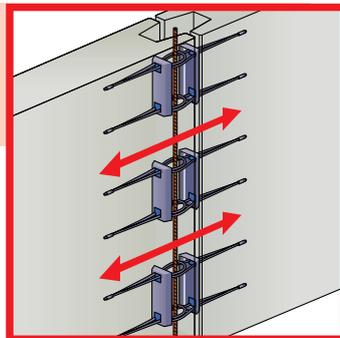
Safe and reliable application – PFEIFER-VS[®] Slim Box EASYFILL

- ⊕ Design resistance under shear load parallel $V_{Rd II}$ approved by the building authorities

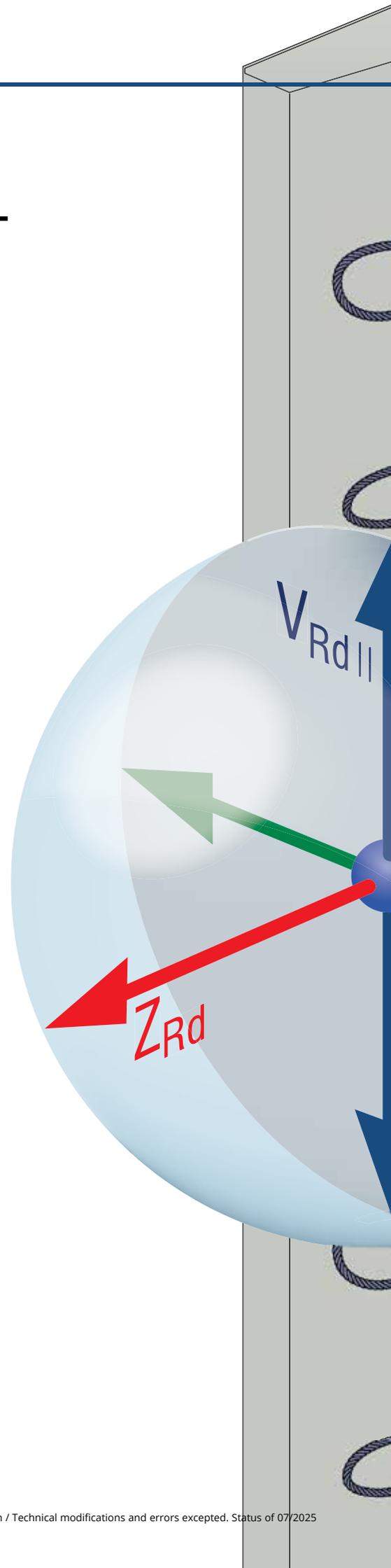


- ⊕ Solid, static shear force model due to 2 loops
- ⊕ High transmission of shear loads due to interlocking
- ⊕ Tested and approved for wall thicknesses from 100 mm

- ⊕ Design resistance under shear load Z_{Rd} is possible



- ⊕ Transmission of tensile forces approved by the building authorities
- ⊕ Omission of ring anchor, tie rod
- ⊕ Possible to absorb constraint forces





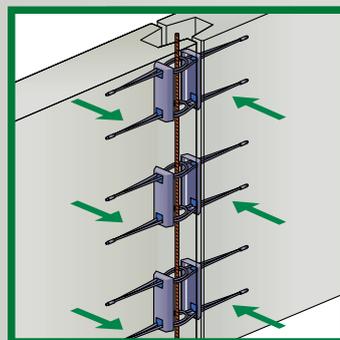
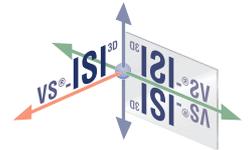
3D Forces

$V_{Rd\perp}$



Your VS® benefits at a glance

- European Technical Assessment ETA
- Symmetric boxes – installation NOT tied to one direction
- 3D interaction model permits overlapping in all load directions
- No protruding cross-sections on the backs of the boxes
- Unmistakeable blue clip mark
- No additional static measures needed
- Optimal interlocking for best connection
- Every application can be solved with just one product
- Maximum design resistances can be implemented
- Can be used for wall thickness from 100 mm
- Individually calculable spacings depending on static requirement, optimal provisioning and scheduling
- No additional reinforcement (back additional reinforcement for non-bended wire loops) necessary



Design shear load perpendicular $V_{Rd\perp}$ from wall thicknesses of 100 mm approved



Design model takes wall thicknesses and concrete strength into account



Forces transmitted even in case of fire

Ultimate efficiency and performance – The new PFEIFER-VS[®] Slim Box EASYFILL



Efficiency

- Minimum mortar use
- Minimum wall thickness
- Cost savings due to reduced additional reinforcement



Additional reinforcement

- Reduced additional reinforcement according to ETA-22/2024



Innovation

- Loop fixing
- Grouting system – grout and plastic



Quality

- High-quality sheet metal boxes with no loose plastic elements
- No fish plates cutting into the grout area
- Building authority approval



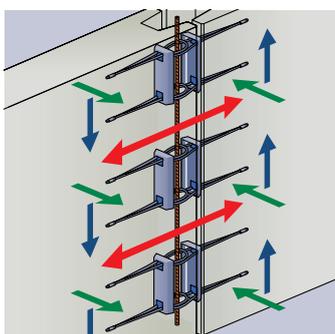
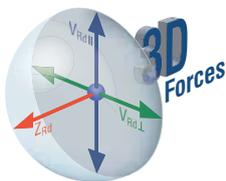
Symmetrie

- Box does not have to be installed in one particular direction



Force transmission

- Design resistances in every direction



- ▶ Color-coded sealing sliders for easy assignment
- ▶ Joint filling with grouting or plastic/thixotropic mortar possible
- ▶ Free design software
- ▶ Flexible due to case-related positioning of the boxes
- ▶ Low mortar consumption
- ▶ European Technical Assessment (ETA)

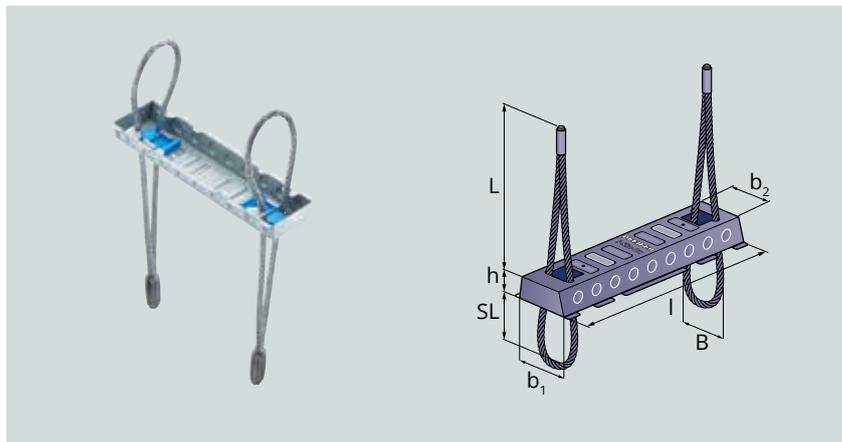
Construction recommendation

- ▶ precast-wall (load-bearing)
- ▶ precast-wall (non-load-bearing/constructive)
- ▶ Column



VS[®] Slim Box EASYFILL approved

- ▶ Wire loop profiles for the friction-locked connection of precast elements
- ▶ The VS[®] Slim Box EASYFILL are used in pairs and installed opposite each other. Their overlapping loops are connected via a threaded reinforcement bar. The joint between the components is then filled with suitable mortar



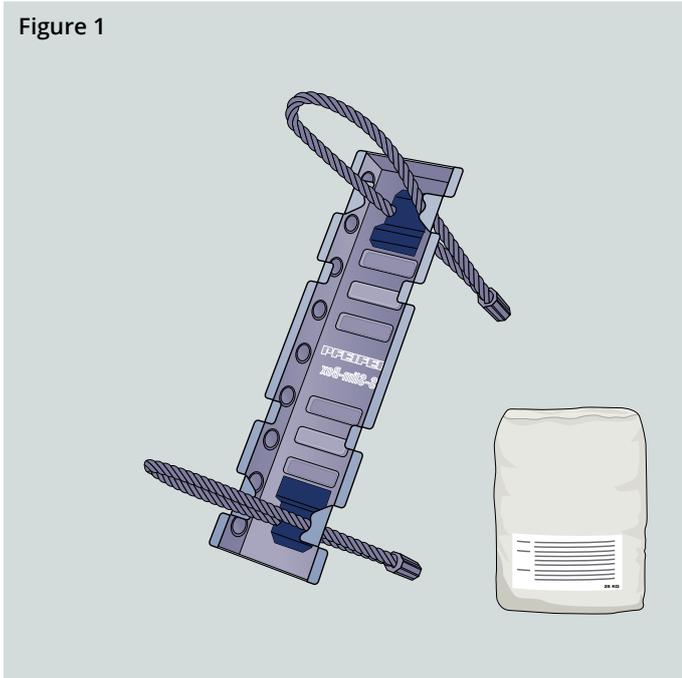
VS[®] Slim-Box EASYFILL

Type			VS [®] -SB-80
Number of loops		St	2
Color coding			blue
Box length	l	mm	200
Height box	h	mm	20
Wide box	b ₁	mm	50
Width box	b ₂	mm	44
Loop length	SL	mm	80
Loop width	B	mm	55
Length rope end	L	mm	204
Packaging unit		St	400
Order number			309578

System

System description

Figure 1



A PFEIFER-VS® system, when using VS® Slim Boxes, always consists of at least two pairs of boxes opposite each other and a suitable joint filling material. As suitable material, grout or plastic mortar is available to the user. The system is suitable for connecting precast reinforced concrete walls of concrete quality C30/37 and higher. The connection is approved from a wall thickness of $d = 100\text{mm}$ and for static and quasi static loads in all three directions (3D). Please also take note of the additional information about approval in this regard.

Table 1: Possible joint materials

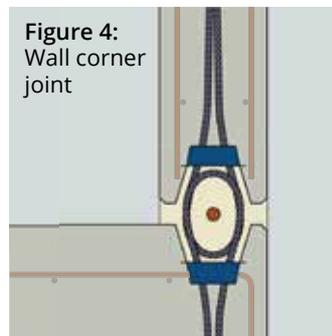
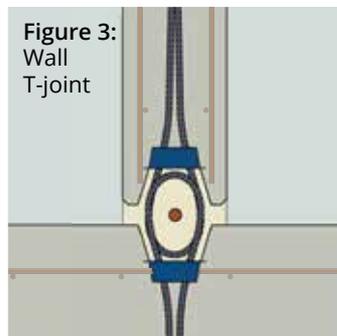
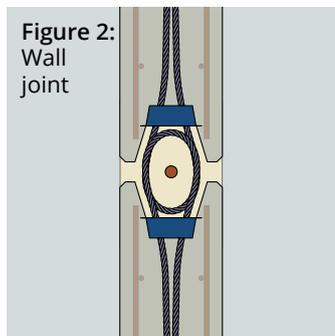
Material type	Description
Grout	EuroGrout® Varix grout BETEC® grout
Plastic/thixotropic mortar*	EuroGrout® universal filler BETEC® thixo

* only permitted with the "recessed" installation version

Intended use

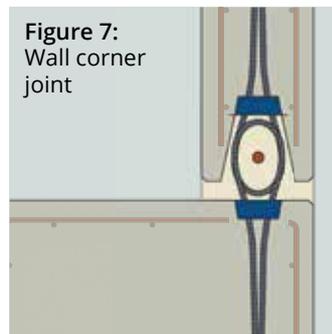
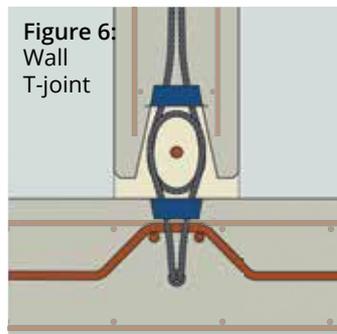
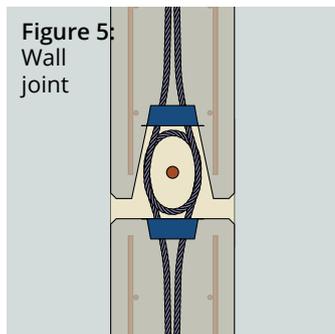
Two usage types are generally differentiated: "recessed" and "flat". The flat installation is used in cases where the component reinforcement leaves no room for reproducing recessed joint (e. g. columns) or on structural elements with a small thickness (see T-joint). If these restrictions do not exist due to the existing reinforcement, the standard "recessed" version can be allowed for.

Recessed installation



For current information on planning and installation with reinforcement reduction and corresponding performances, please refer to the currently valid approval

Flat installation



Dimensioning

The precast concrete elements being connected must be constructed by a responsible planner in a minimum concrete grade of C 30/37 in accordance with DIN EN 1992-1-1. The connection with the aid of VS® Slim Boxes is seen as a reinforced joint with design resistances for tensile and shear forces.

Corresponding design resistances are listed in Table 2 and 3. When dimensioning the connection, the evidence for each load direction must be kept individually. It must be noted in this respect that, in addition to the tensile forcing acting from outside, the tensile forces resulting from the acting shear forces must be taken into account. If no external tensile force should be applied, a simplified analysis via an interaction diagram (Figure 12) in accordance with the approval can be used. Evidence of the acting expanding forces must then be provided, however. Crack widths as a result of constraining forces must be limited in accordance with DIN EN 1992-1-1.

Design resistances

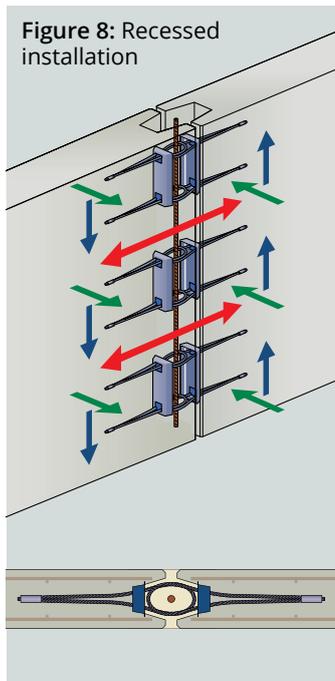
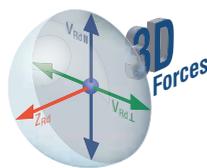


Table 2: Design resistance VS® Slim Box EASYFILL – recessed installation

Wall thickness [cm]	Shear load perpendicular $V_{Rd,\perp}$ [kN/m]				Shear load parallel $V_{Rd,\parallel}$ [kN/Box]		Tension load Z_{Rd} [kN/Box]
	C 30/37	C 35/45	C 40/50	C 45/55	All concrete grades		All concrete grades
10 ¹⁾	4,5	5,2	5,5	5,9	25	30	18
12 ¹⁾	7,0	8,0	8,5	9,1	25	30	18
14	9,7	11,1	11,9	12,6	25	30	18
16	12,7	14,4	15,5	16,5	25	30	18
18	15,9	18,1	19,4	20,7	25	30	18
20	19,3	21,9	23,5	25,1	25	30	18
22	22,8	26,0	27,9	29,7	25	30	18
24	26,6	30,3	32,5	34,6	25	30	18
26	30,5	34,8	37,3	37,5	25	30	18
28	34,6	37,5	37,5	37,5	25	30	18
30	37,5	37,5	37,5	37,5	25	30	18

¹⁾ Design resistance under shear load perpendicular $V_{Rd,\perp}$ valid only for joint/elements with length ≥ 1 m
red: Resistance for Thixotropic-plastic joint casting grout



For current information on planning and installation with reinforcement reduction and corresponding performances, please refer to the currently valid approval

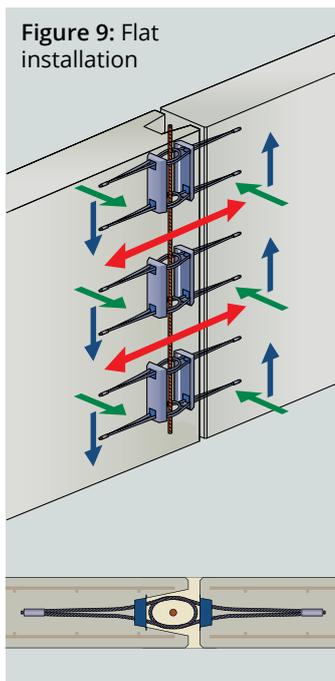


Table 3: Design resistance VS® Slim Box EASYFILL – flat installation

Wall thickness [cm]	Shear load perpendicular $V_{Rd,\perp}$ [kN/m]				Shear load parallel $V_{Rd,\parallel}$ [kN/Box]		Tension load Z_{Rd} [kN/Box]
	C 30/37	C 35/45	C 40/50	C 45/55	All concrete grades		All concrete grades
10 ¹⁾	-	-	-	-	-	-	-
12 ¹⁾	2,1	2,4	2,6	2,7	30	30	18
14	2,9	3,3	3,6	3,8	30	30	18
16	3,8	4,3	4,7	5,0	30	30	18
18	4,8	5,4	5,8	6,2	30	30	18
20	5,8	6,6	7,1	7,5	30	30	18
22	6,9	7,5	7,5	7,5	30	30	18
24	7,5	7,5	7,5	7,5	30	30	18
26	7,5	7,5	7,5	7,5	30	30	18
28	7,5	7,5	7,5	7,5	30	30	18
30	7,5	7,5	7,5	7,5	30	30	18

¹⁾ Design resistance under shear load perpendicular $V_{Rd,\perp}$ valid only for joint/elements with length ≥ 1 m



Note: "Installation Flat"

At least 2 pairs of boxes with a minimum spacing of 1.5 m are to be arranged per joint. Only Flowable casting grout is permitted for filling the joint here.



Notice:

For the unusual design situation (accident, explosion etc.), a characteristic tensile force resistance of 27 kN/Box may be estimated. An angular deflection of the rope loops is not possible in this case!

Dimensioning

Detection method

Shear load parallel to the joint

For a shear load parallel to the joint reinforced with the VS[®] Slim Box, in the limit state of the load capacity a corresponding design resistance (shear force parallel $V_{Rd,II}$) may be estimated according to Table 2/3.

Shear load vertical to the joint

For a shear load vertical to the joint reinforced with the VS[®] Slim Box, in the limit state of the load capacity a corresponding design resistance (shear force vertical $v_{Rd,\perp} / V_{Rd,\perp}$), depending on the component thickness and concrete strength, may be estimated according to Table 2/3.

Expansion forces (tensile) result from stresses vertical to the joint. These tensile forces can be absorbed either by the VS[®] wire rope loops or by appropriately arranged additional reinforcement or other structural measures and verified.

Verification of shear load

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

$V_{Ed,II}$ [kN/Box]: Acting shear load parallel per box
 $V_{Rd,II}$ [kN/Box]: Design resistance under shear load parallel per box

$$\frac{v_{Ed,\perp}}{v_{Rd,\perp}} \leq 1,0$$

$v_{Ed,\perp}$ [kN/m]: Acting shear load vertical per metre of joint length
 $v_{Rd,\perp}$ [kN/m]: Design resistance under shear load perpendicular to the joint per metre



Notice:

With the "flat" installation version $v_{Rd,\perp} = n \cdot V_{Rd,\perp}$ is used for the verification

Verification of tension load

Table 4: Determination of tension loads

Stress from	Shear load parallel $V_{Ed,II}$	Shear load vertical $V_{Ed,\perp}$	"Outer" tension load
Tension load components	$Z_{Ed,VII} = 0,75 \cdot V_{Ed,II}$	$Z_{Ed,V\perp} = 0,25 \cdot V_{Ed,\perp}$	$Z_{Ed,N}$

Verification of the total tension load:

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

n [Box/m] : number of VS[®] Slim Boxes per metre of joint

Z_{Rd} [kN/Box] : design resistance under tension load VS[®] Slim Box according to Table 2/3

$Z_{Ed,N}$ [kN/m] : acting "outer" tensile load per metre of joint

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

$Z_{Ed,V\perp}$ [kN/m] : expansion force from shear load perpendicular per metre of joint

$V_{Ed,II}$ [kN/Box] : acting shear load parallel per box

$v_{Ed,II}$ [kN/m] : acting shear load parallel per meter of joint

$$v_{Rd,II} = n \cdot V_{Rd,II}$$

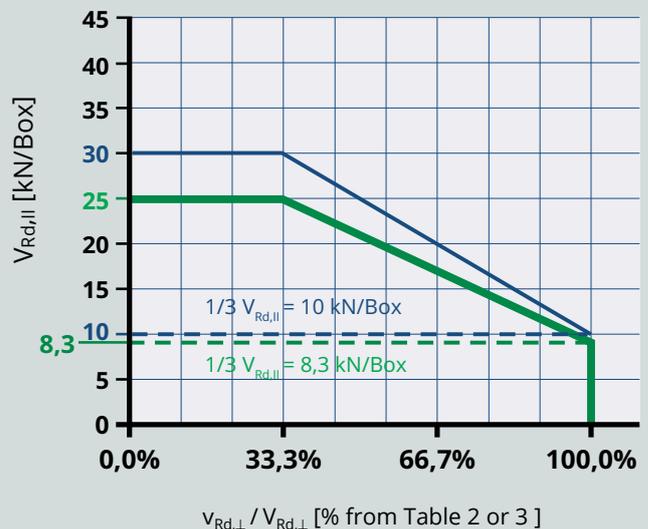
Combined shear load parallel and vertical to the joint

When shear loads vertical and parallel to the joint act simultaneously, the interaction of the shear loads is to be verified by means of the interaction relationship shown in the diagram (figure 12).

Tensile forces across the VS[®] loops

The different load directions result in individual tensile force components that act in the direction of the wire rope loop. The sum of these individual components and any acting "outer" tension load (total tension load) is verified on the basis of the design tension load resistance Z_{Rd} of the VS[®] Slim Boxes according to Table 2/3.

Figure 10: Shear load interaction diagram



Captions:

— EuroGrout[®] universal filler / BETEC[®] Thixo

— EuroGrout[®] Varix / BETEC[®] Verguss



For simplified design purposes, the PFEIFER Suite is available to you to download free of charge.

Dimension and reinforcement

Notes about fire protection

If, when using VS® Slim Boxes EASYFILL or the overall design, requirements are placed on the fire resistance time, the regulations according to DIN EN 1992-1-2:2010-12 in conjunction with DIN EN 1992-1-2/NA:2010-12 apply. For the version as a fire wall, DIN EN 1992-1-2:2010-12 applies in conjunction with DIN EN 1992-1-2/NA:2010-12 and DIN 4102-4:1994-03 for non-supporting walls. The precast reinforced concrete connections using VS® Slim Boxes can be seen as equivalent to the connections governed in DIN 4102-4:1994-03, Section 4.8.5 to 4.8.8 in this respect.

For the verification of supporting connections exposed to fire, the working load limits according to Table 5/Diagram figure 11 may be applied. According to the temperature acting on the wire rope loop, the design resistances are to be reduced with α_{fi} (see temperature profile DIN EN 1992-1-2:2010-12, figure A.2 or figure 39 on the right). Loads vertical to the joint cannot be verified in the event of a fire.

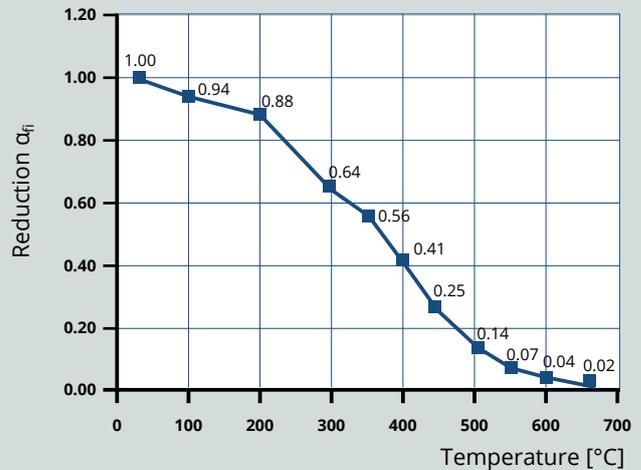
Table 5: Working load limit when exposed to fire

	Tension [kN/Box] $Z_{Rd,fi}$	Shear force parallel to the joint [kN/Box] $V_{Rd,fi,II}$
Dimensioning value of the working load limit	$Z_{Rd,fi} = \alpha_{fi} \cdot Z_{Rd}^{1)}$	$V_{Rd,fi,II} = \alpha_{fi} \cdot V_{Rd,II}^{2)}$

¹⁾ Z_{Rd} see values in table 2 and 3

²⁾ $V_{Rd,II}$ see values in table 2 and 3

Figure 11:
Reduction factor α_{fi} depending on rope temperature



Verification of the working load limit when exposed to fire

Verification of the total tension load:

$$n \cdot Z_{Rd,fi} \geq Z_{Ed,fi,VII} + Z_{Ed,fi,N}$$

- n [Box/m] : Number of VS® Slim Boxes per metre of joint
- $Z_{Rd,fi}$ [kN/Box] : Design resistance under tension load in the event of fire per VS® Slim Box according to Table 5
- $Z_{Ed,fi,VII}$ [kN/m] : Expansion force from shear load parallel in the event of fire per metre of joint
- $Z_{Ed,fi,N}$ [kN/m] : Acting "outer" tension load in the event of fire per metre of joint

Verification of the shear load parallel:

$$V_{Rd,fi,II} \geq V_{Ed,fi,II}$$

- $V_{Rd,fi,II}$ [kN/Box] : Design resistance under shear load parallel in the event of fire per VS® Slim Box according to Table 5
- $V_{Ed,fi,II}$ [kN/Box] : Acting shear load parallel in the event of fire per VS® Slim Box

PFEIFER Suite dimensioning software

The PFEIFER-VS® Slim Boxes EASYFILL can be easily planned on precast wall joints with the aid of the free dimensioning software. The latest version of the software is available to download from the Internet at www.pfeifer.info. Your additional benefits when using the software are:

- Permanently storable processor data and one-off project data
- Automatic quantity calculation for a complete project – mortar (litres and dry quantity) and VS® product
- Automatic verification of the connection
- Generation of a complete mathematical verification
- Calculations for the widest range of applications:
 - Wall-wall joint
 - Wall-column joint
 - Wall-corner
 - Wall panel complete
 - with constant and changing loads
 - with shear force parallel and vertical
 - with tensile forces
- Integrated fire protection verification

Figure 12



Instructions for installation and use

Dimension and reinforcement – Recessed installation

Figure 13

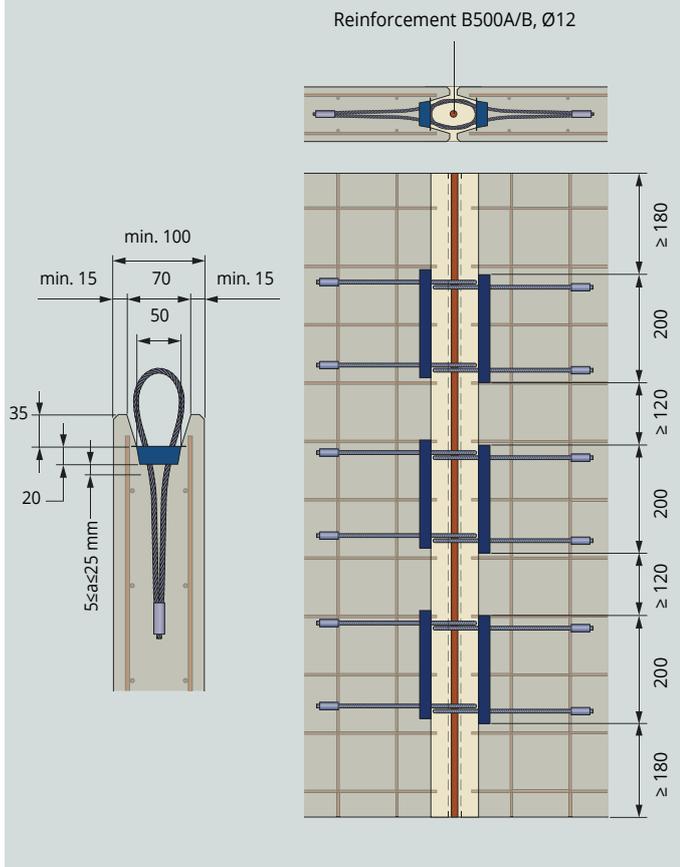


Figure 14

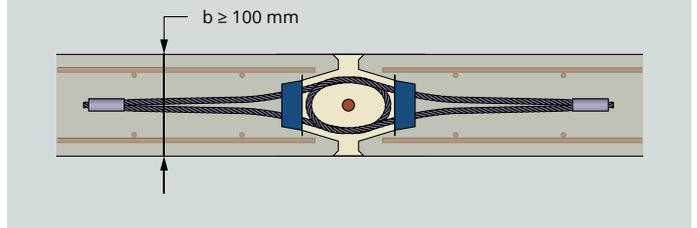


Figure 15

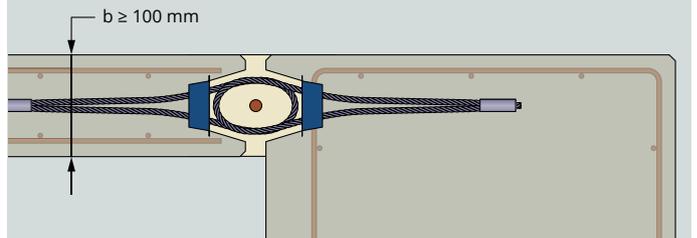
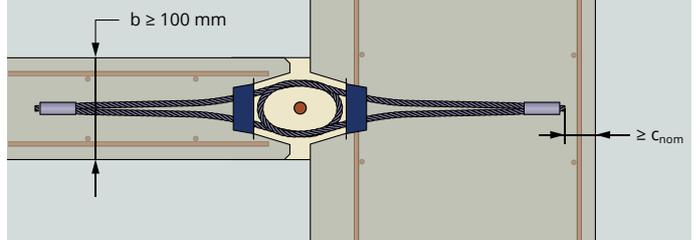


Figure 16



T-joint and corner joint for thin components – bended loops

Figure 17

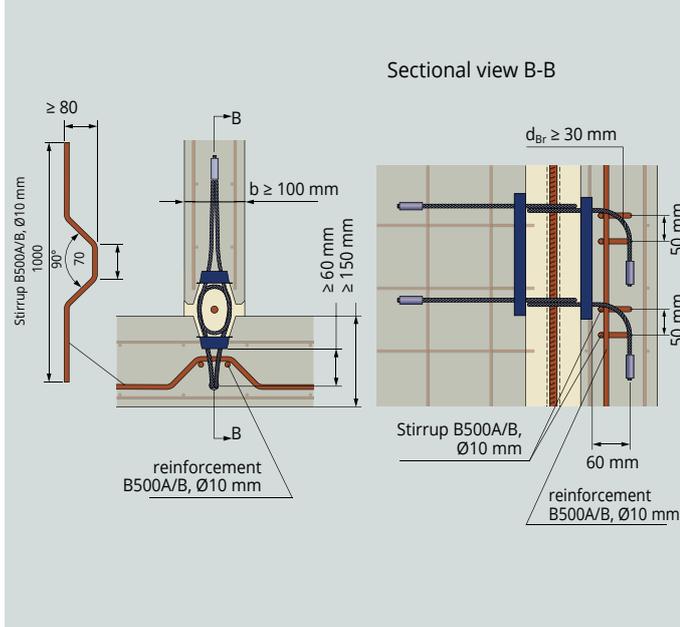
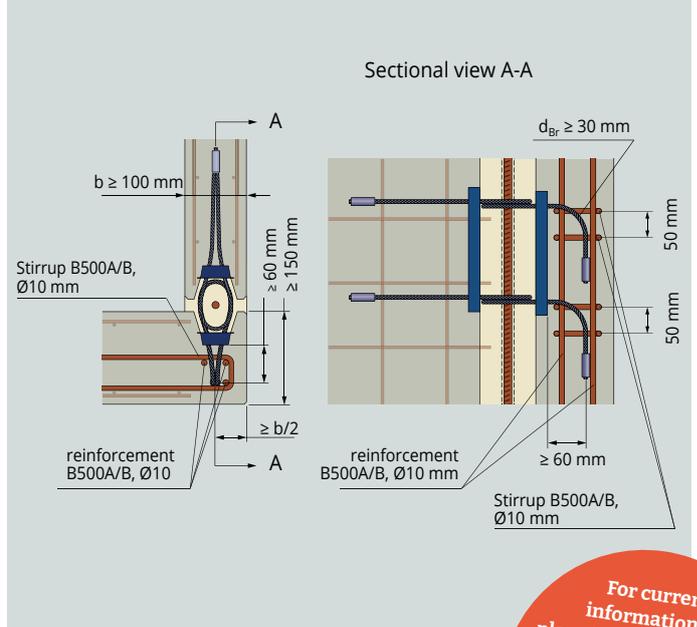


Figure 18



Note about bending anchoring loops:

The anchoring loop of the VS[®] Slim Boxes can be bent for small element dimensions. In the case of T-joints and corner joints, the wall thickness of the joined wall (Fig. 17 and 18) can thus be reduced. For wall or support thicknesses from 280 mm, the anchoring can be guided straight into the component, which means that the loop no longer needs to be bent.

For current information on planning and installation with reinforcement reduction and corresponding performances, please refer to the currently valid approval

Instructions for installation and use

Dimension and reinforcement - Installation Flat

Figure 19

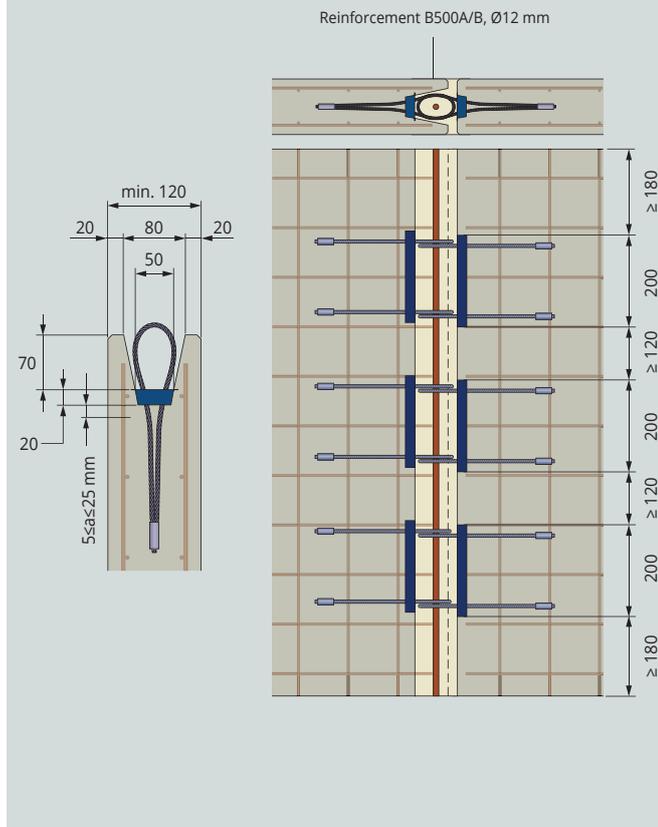


Figure 20

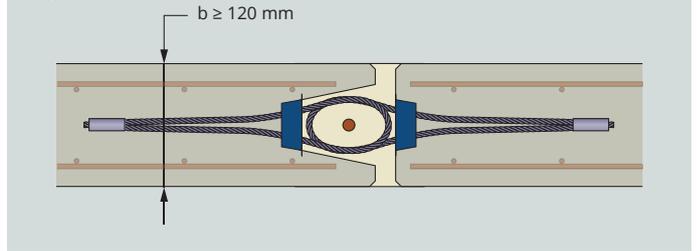


Figure 21

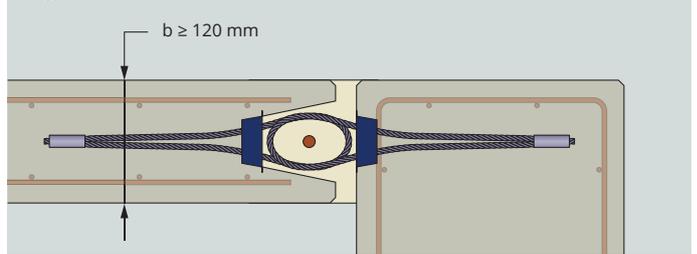
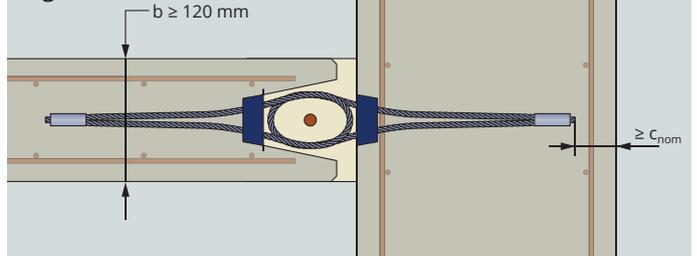


Figure 22



T-joint and corner joint for thin components - bended loops

Figure 23

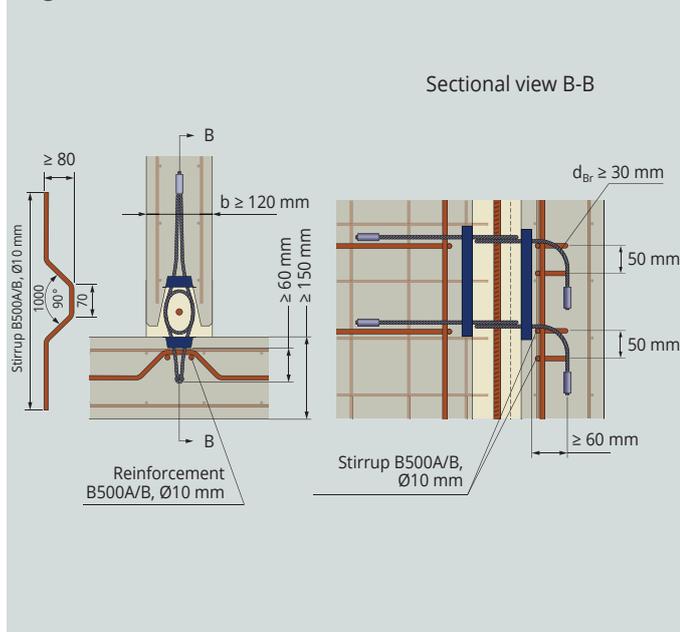
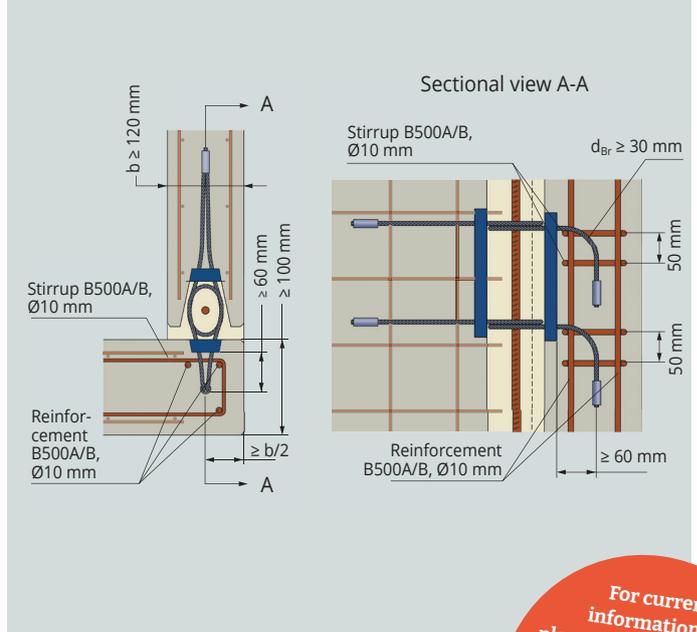


Figure 24



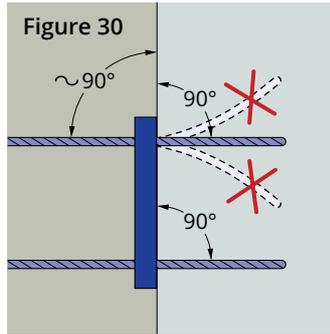
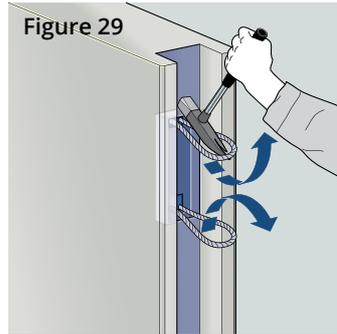
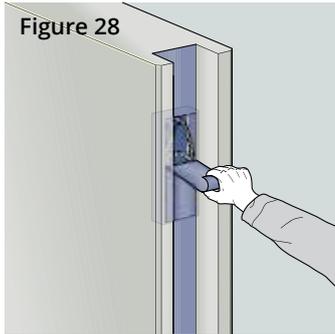
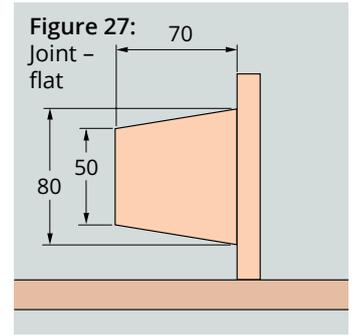
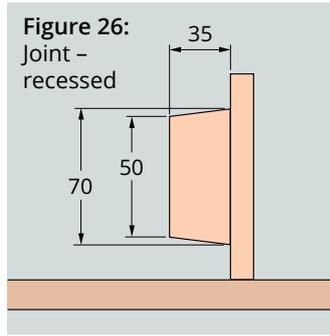
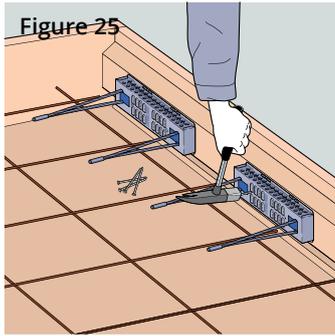
Note about bending anchoring loops:

The anchoring loop of the VS® Slim Boxes can be bent for small element dimensions. In the case of T-joints and corner joints, the wall thickness of the joined wall (Fig. 23 and 24) can thus be reduced. For wall or support thicknesses from 250 mm, the anchoring can be guided straight into the component, which means that it is no longer necessary to bend the loop.

For current information on planning and installation with reinforcement reduction and corresponding performances, please refer to the currently valid approval

Instructions for installation and use

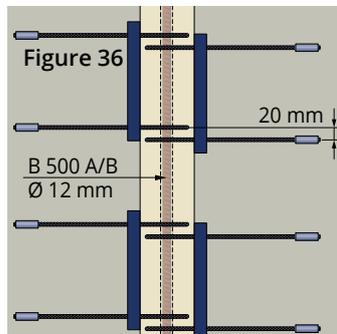
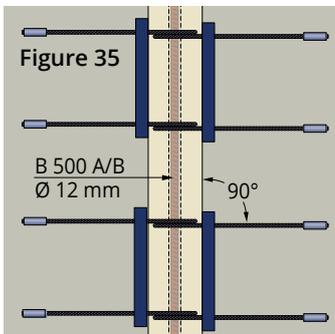
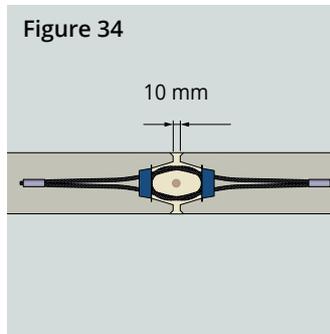
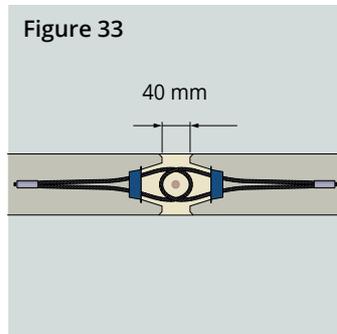
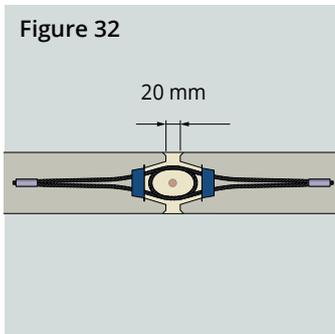
Installation



Assembly

Tolerances

The VS® Slim-Box connection acts as an overlapping joint. For that reason, the loops must each lie above one another within certain vertical and horizontal tolerances. Fit vertically into the loops normally with no offset so that they touch each other and lie directly on top of each other.



Instructions for installation and use

VS® SYSTEM JOINT WITH GROUT

Information and notes

The properties of the grout in the joint play an important role in a load-bearing connection of precast concrete elements with the PFEIFER-VS® system elements. This grout is approved as part of the approval by the building authorities.

Mortar properties

- ✓ Highly free flowing
- ✓ Shrinkage-compensated
- ✓ Resistant to frost and de-icing salt
- ✓ Can be pumped with mixing and conveying pumps
- ✓ Corrosion inhibiting
- ✓ Production certified according to DIN ISO 9001
- ✓ Delivered as bagged goods (25kg bags)

Mixing

The grout materials are delivered as a ready-to-pour mixture and only have to be mixed with water according to the printed mixing instructions. The material is then immediately ready to use.

Joint filling

The grout is added continuously until the planned height (max. 3.54 m) is reached. The formwork must be able to withstand the pressure created in this way.

Compaction is not necessary. Venting by poking with the reinforced concrete bar or placing an internal vibrator on top is recommended, however. The grout sets very quickly, and allows work to continue promptly. The joint can be subjected to the approved load after the appropriate setting time.

Grout material consumption

The PFEIFER Suite dimensioning software works out the grout volume for the selected grouting joint with the real quantities

Table 6: Grout volumes for standard joint (20 mm)

	Wall thickness [cm]							
	10	12	14	16	18	20	22	24
VS® Slim Box EASYFILL	7,3	7,7	8,1	8,5	8,9	9,3	9,7	10,1

Consumption in l/m; approx. 2 kg of material are needed per litre; The grout volume is significantly influenced by the number of boxes. The maximum possible number of boxes per m is applied here.

and masses of the project entered, displays the number of sacks for this and generates an enquiry email on request.

The table below makes it possible to calculate an estimate of the fully-filled joints; an average grout consumption per metre of joint, based on walls that are 3.5 m high, is given.

Joint formwork variants

1. Board formwork (figure 37)

In order to fill a precast joint with grout, a shuttering board needs to be attached from both sides. Here it is useful to add foam rubber to the shuttering boards to compensate for any unevenness. Once the shuttering boards are correctly fastened and it is ensured that the grout material cannot leak anywhere, it is permitted to fill the joint as described in the section "Joint filling". The formwork can be removed, cleaned and reused after the material has hardened.

2. Mortar seal (figure 38)

An additional version enables the joint edges to be sealed with the plastic joint filling mortar. Once this mortar has hardened, the core area of the joint can be filled with a suitable grout to thereby implement the higher performance of the systems.

3. Sealed off compriband (figure 39)

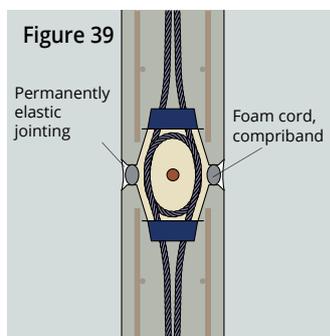
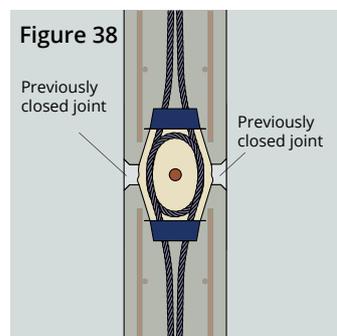
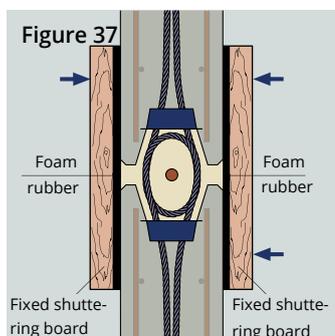
Another way to cast the joints with a grout is the variant sketched in Figure 43. In this case, prior to casting, a foam cord/compriband is inserted into the joint in a defined manner, after which a permanently elastic jointing is applied.

When this jointing has completely hardened, the grouting can be carried out without any additional formwork measures. The pressure that arises during casting must, however, be borne in mind. This should be determined by the processing company, allowing suitable casting sections to be chosen to avoid the jointing from being pushed out.



Caution:

If joint pre-compressed strips are to be pressed into the side joints without affecting the casting space, the effective lateral concrete coverage of the rail and the wire rope loop is reduced. The remaining cross section must be at least 10 cm².



Instructions for installation and use

VS[®] system joint with plastic/thixotropic joint filling mortar

Information and notes

The advantage of the joint filling mortar is the filling of joints between precast elements, where formwork can mostly be dispensed with. The optimised, plastic/thixotropic properties of this mortar means that it is stable after being poured in the joint, without the need for further measures. The associated approval governs tensile and shear forces parallel and vertical to the joint.

Mortar properties

- ✓ Non-shrinking, with a gel-like consistency
- ✓ Easy preparation
- ✓ Can be pumped with conventional screw pumps
- ✓ High early and final strengths
- ✓ Resistant to frost and de-icing agents
- ✓ Impermeable to water
- ✓ Low water/cement ratio
- ✓ Production certified according to DIN ISO 9001
- ✓ Monitored externally and in-house
- ✓ Delivered as bagged goods (25 kg bags)

Mixing

The mortar is supplied ready to use, and only has to be mixed with water before use. It is essential that the mixing instructions on the bags are observed.

Joint filling

First completely close off one joint flank using foam cord, profiled rubber (Figure 40) or alternatively using joint filling mortar (Figure 41). After sealing with a joint filling mortar, wait for the mortar to stiffen. After this, working from the other side, the remaining joint, which is now closed on one side, should be filled from the bottom to the top evenly and continuously. Gently poking the joint with the filling nozzle or the filling pipe ensures a proper result. The joint can easily be drawn flat after having been filled.

Nozzle making

The user can make the filling nozzle from commercially available 22 mm (3/4") copper heating pipe. It can be attached to the pump hose with the aid of a solder fitting (Figures 42 and 43).

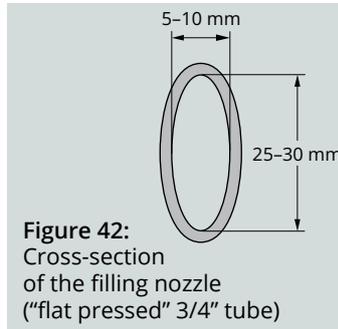


Figure 42:
Cross-section
of the filling nozzle
("flat pressed" 3/4" tube)



Figure 43



Notice:

This information only concerns the introduction of the material into the joint!



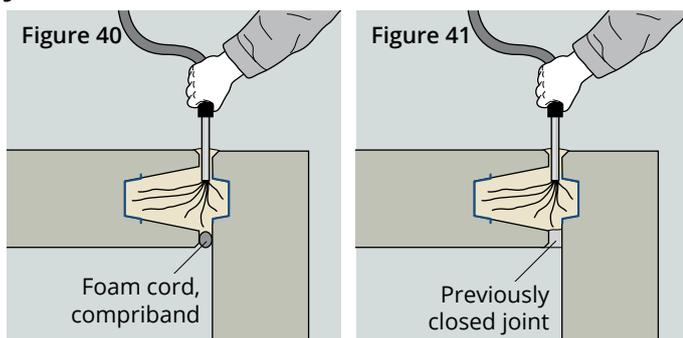
Caution:

Do not constrict the filling space. If pre-compressed strips are to be pressed into the side joints without affecting the casting space, the effective lateral concrete coverage of the rail and the wire rope loop is reduced. This must also be taken into account by the planners in the dimensioning.

Qualification

Suitable machinery and instructed personnel are important for the quality and efficiency of the mortar system. If required, instruction can be requested at any time from the respective mortar manufacturer.

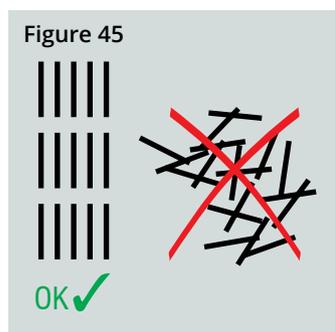
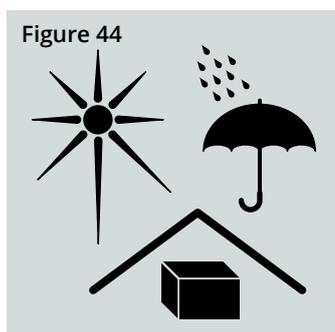
Joint formwork variants

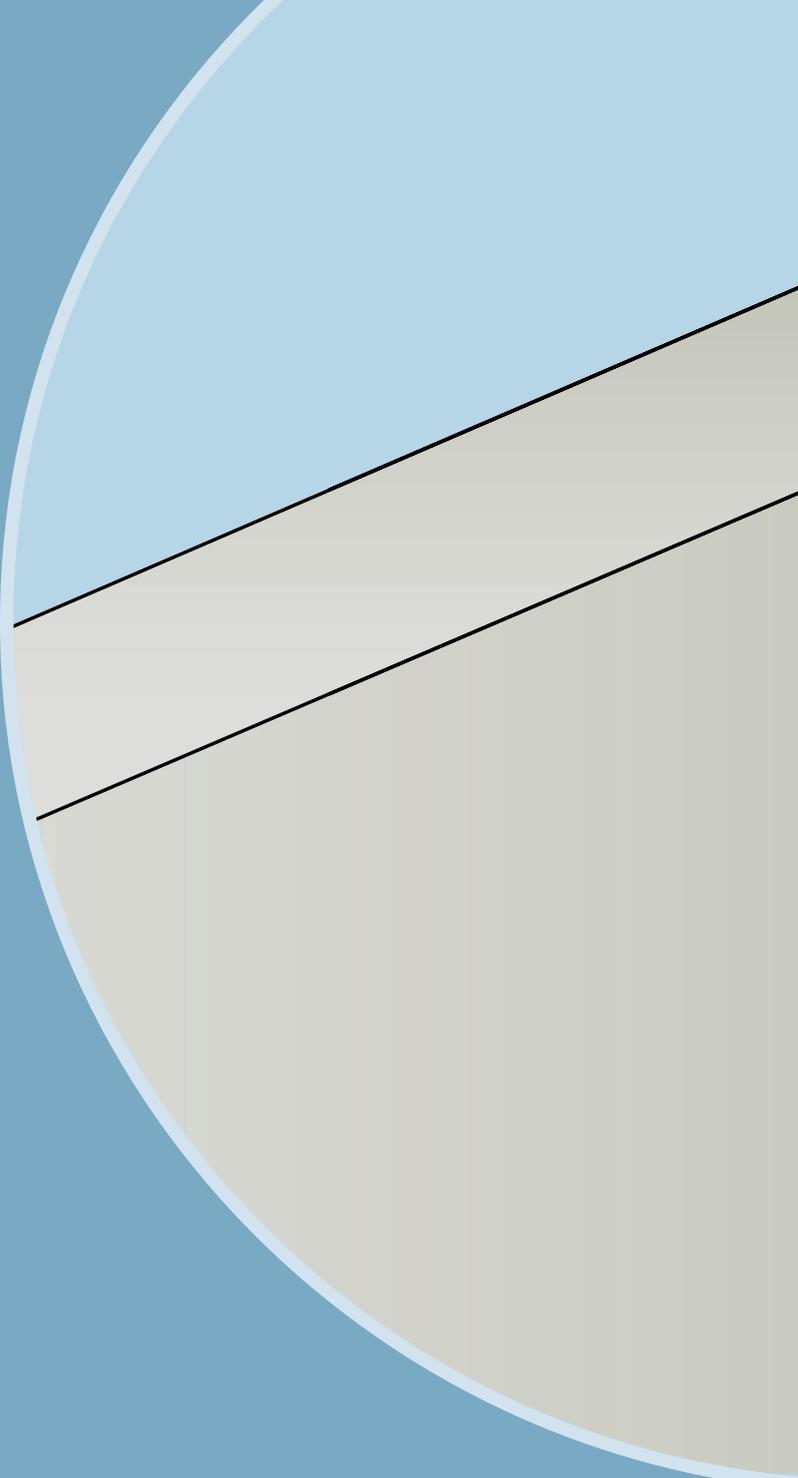


Notice:

The mortars qualified for use with PFEIFER-VS[®] Slim Boxes EASYFILL are governed in the currently valid approval by the building authorities.

Storage





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