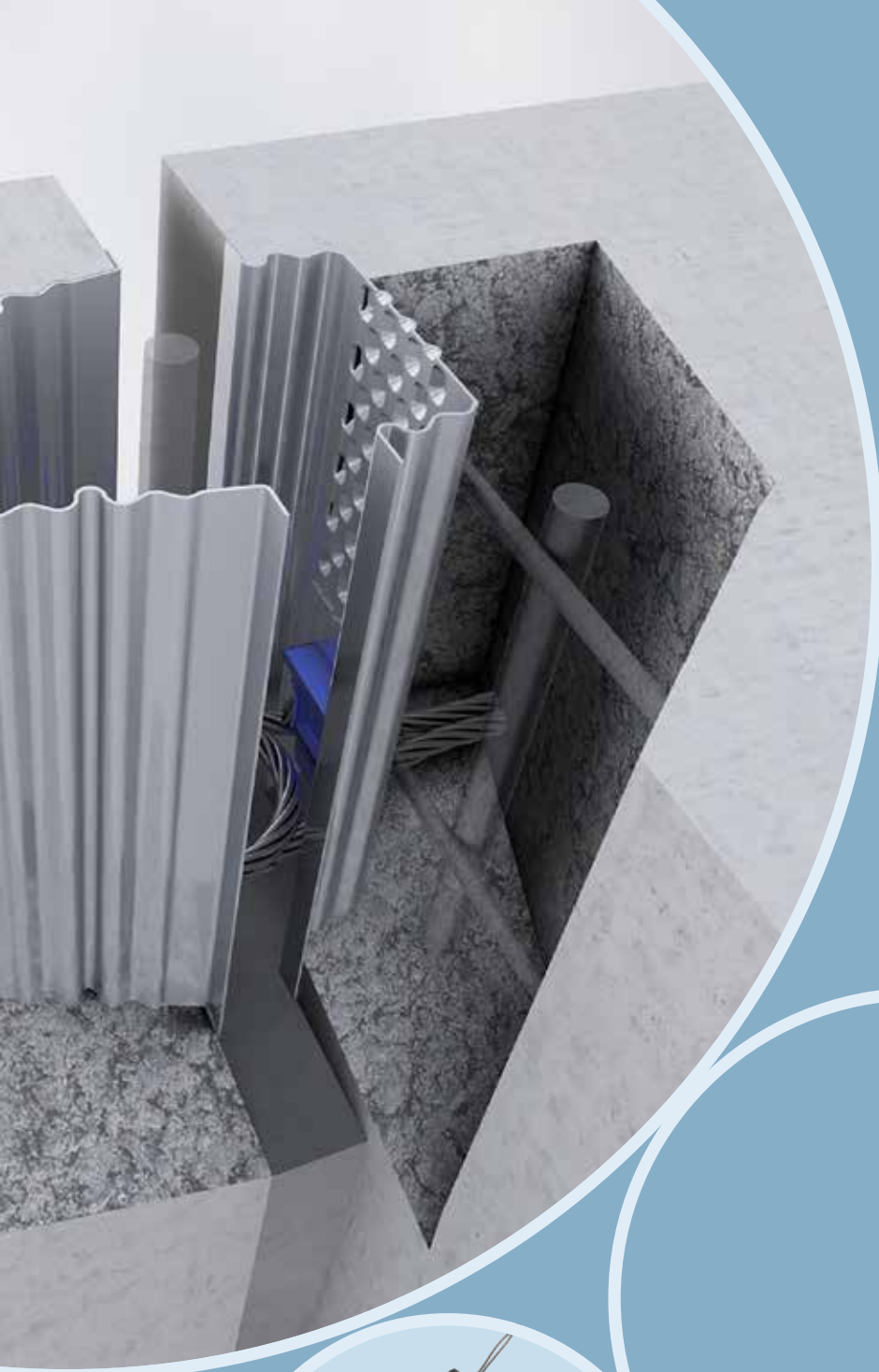
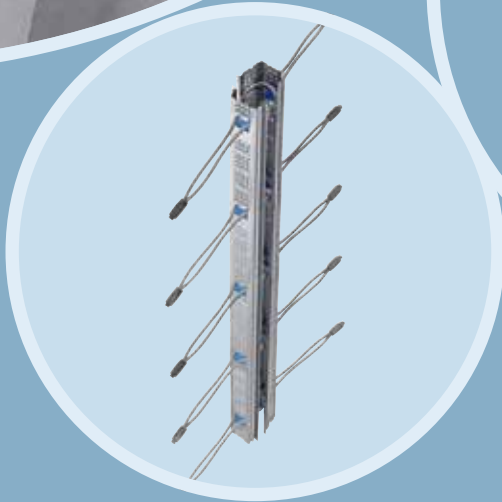




VS®-ISI-System^{3D}

Wire rope loop rails for
the connection of precast
concrete elements

PFEIFER

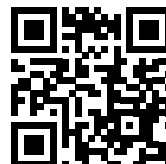


Installation and usage
instructions



Advantages

- Building authority approval with a very high safety standard in the event of fire
- One design resistance for all mortars
- Free dimensioning software
- Optimum joint geometries – less mortar consumption
- Huge variety of applications thanks to approved mortars – even in the event of fire
- Design resistances in every direction – now also in the event of fire
- Symmetrical rail profiles – NO directional installation
- Clear marking with color-coded clips
- No additional formwork measures – profiles form the complete joint profile.
- Tested and approved for wall thicknesses from 140 mm



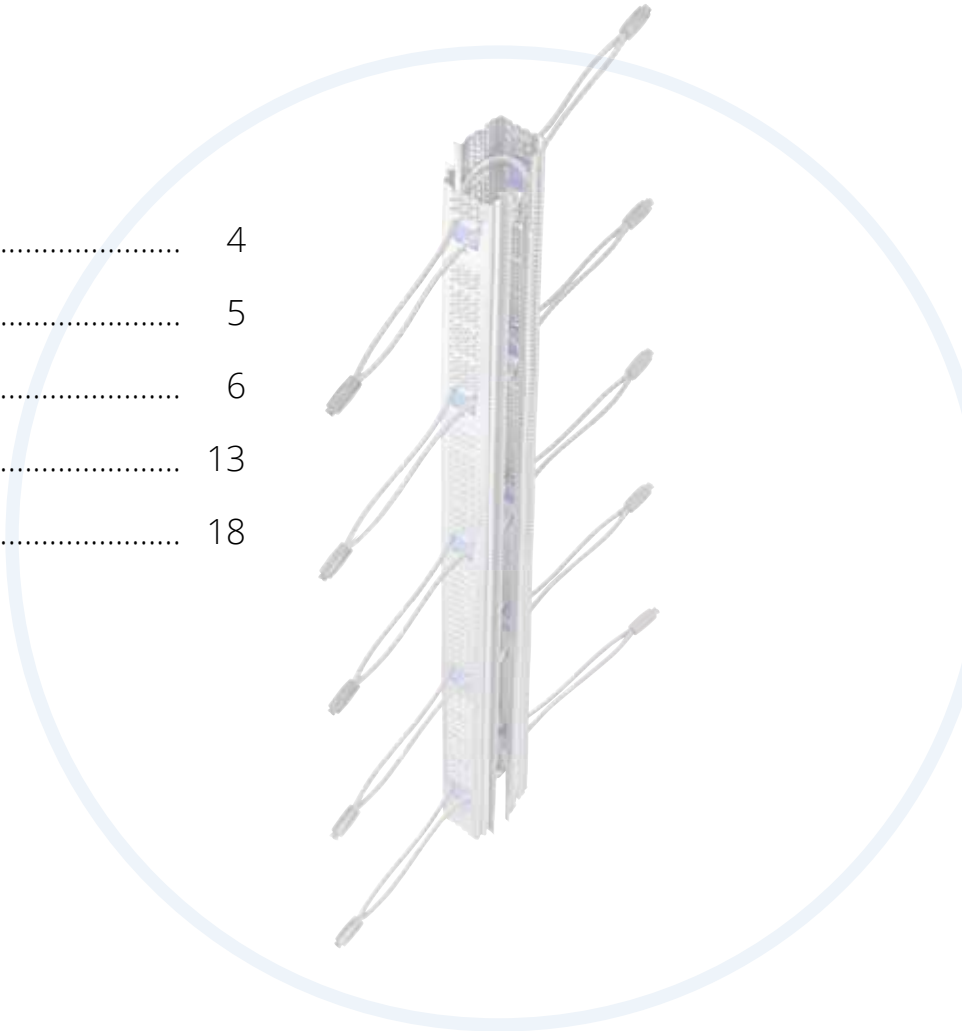
More information about
VS®-ISI-System^{3D}:

pfeifer.info/vs-isi-system

VS®-ISI-System^{3D}

Application reliability and performance that inspires

Products	4
System	5
Installation & usage	6
Dimensioning	13
Dimensioning software	18



Symbols and safety instructions used

⚠ DANGER

This symbol in conjunction with the signal word “Danger” indicates an imminent danger. Failure to observe the safety instruction will result in death or serious injury.

⚠ WARNING

This symbol in conjunction with the signal word “Warning” indicates a potentially dangerous situation. Failure to observe the safety instruction may result in death or serious injury.

⚠ 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.

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.

NOTE

Here you will find information, notes, and application tips.

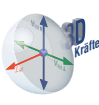
- ▶ Joint filling with grout or plastic/thixotropic mortar possible
- ▶ One design resistance for all mortars
- ▶ Free dimensioning software
- ▶ No directional installation required
- ▶ Safety through maximum tolerances with any loop position
- ▶ Low mortar consumption
- ▶ Color-coded clips for easy identification
- ▶ General building authority approval (abZ)
- ▶ Comprehensive approval also covers fire situations

Component recommendation

- ▶ FT wall (load-bearing)
- ▶ FT wall (non-load-bearing/structural)
- ▶ Column

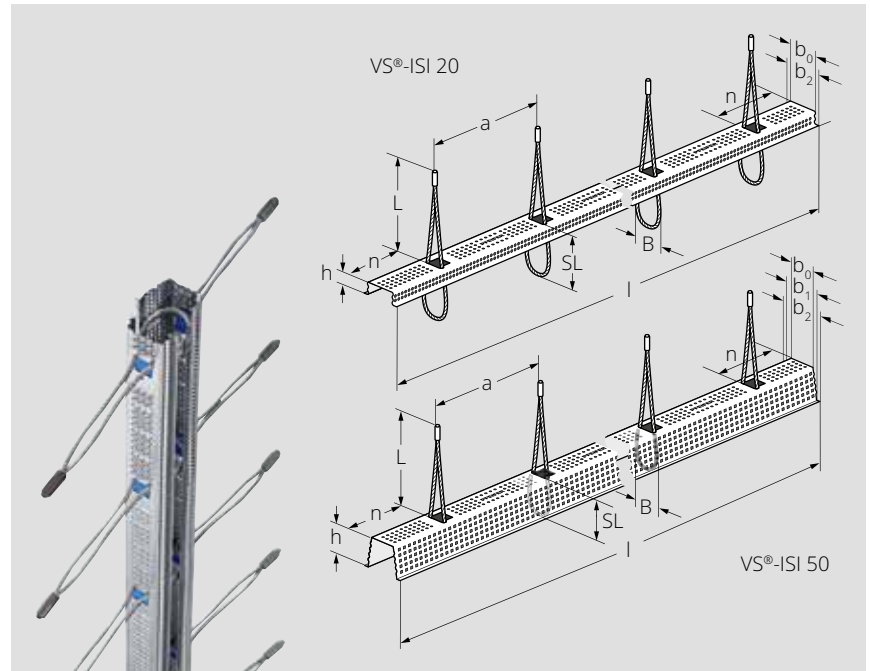
Technical data

- ▶ **Material:** galvanized steel



VS®-ISI-System^{3D}

- ▶ Rail profiles for the force-locking connection of precast elements
- ▶ The ISI strips (20 mm deep) and ISI rails (50 mm deep) are always used in combination. Their overlapping loops are connected by a threaded reinforcing bar. The joint between the components is then filled with a suitable mortar.



VS®-ISI-System^{3D}

type designation			VS®-ISI-20	VS®-T-20/0	VS®-ISI-50	VS®-T-50/0
Number of loops		St	5	0	5	0
Colour coding			Blau	-	Blau	-
Length	l	mm	1180	1180	1180	1180
Height	h	mm	20	20	50	50
Width	b	mm	-	70	-	80
Loop length	SL	mm	80	-	80	-
Loop width	B	mm	60	-	60	-
Length of rope end	L	mm	227	-	227	-
Spacing wire rope loop	a	mm	236	-	236	-
Edge distance wire rope loop	n	mm	118	-	118	-
Profile width top	b ₀	mm	50	-	50	-
Profile width below	b ₁	mm	-	-	65	-
Profile width edge	b ₂	mm	70	-	80	-
Reference no.			245321	287840	245477	287786
VS® Tape						
Reference no.			175678	175678	257382	257382

If the number of loops is 0, it is an empty rail.

System description



Figure 1: VS®-ISI System^{3D}

The VS®-ISI System^{3D} (Fig. 1) is designed for the connection of steel reinforced concrete precast wall elements or steel reinforced concrete walls and columns. According to building authority approvals, the user has a choice of different materials with appropriate properties for filling the joints. The connections are approved from component thicknesses of 140 mm for predominantly stationary **forces from all three directions (3D)** (Figs. 2 and 3). In the case of a right-angled joint (T-joints) (Figs. 5 and 6), the thickness of the joined wall can be reduced to 100 mm. The VS®-ISI System^{3D} can be used according to Figs. 4 to 7.

Permissible stress directions: Tensile forces, shear forces parallel and perpendicular to the joint.

Material type	Designation
grout	VS®-PAGEL® grouting EuroGrout® Varix potting BETEC® potting
Plastic/Thixotropic mortar	EuroGrout® Universal Filler BETEC® Thixo

Table 1: Possible joint materials

Intended use – Rule details

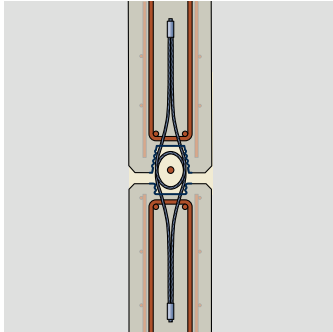


Figure 2: Wall butt joint

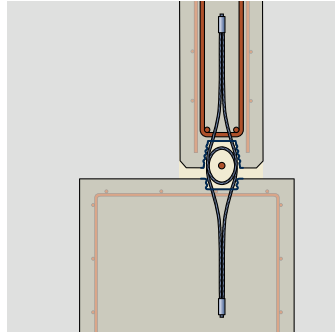


Figure 3: T-joint

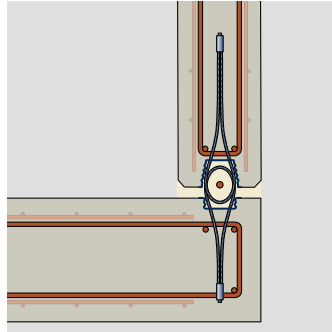


Figure 4: Corner joint

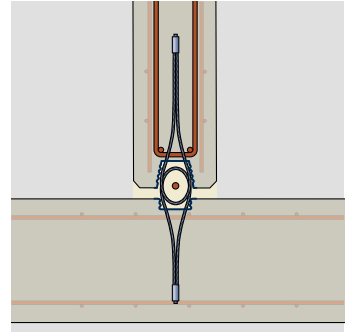


Figure 5: Column-wall connection

Dimensions and reinforcement

For the VS®-ISI-System^{3D}, the rail and strip should be installed as shown in Figures 6 and 7. Tolerances and joint dimensions are shown in Figures 16 to 19.

Minimum surface reinforcement

For the VS®-ISI-System^{3D}, a minimum surface reinforcement of 1.88 cm²/m must be installed. If appropriate reinforcement is already provided for other structural reasons, this can be taken into account.

Standard reinforcement

The standard reinforcement for the wall-to-wall connection should be installed in the precast reinforced concrete elements as shown in Figures 6 and 7. 8 mm diameter stirrups should be provided every 236 mm as insert stirrups (Figures 6 and 7).

The required anchorage lengths and the required concrete covers must be determined by the responsible designer depending on the concrete grade used.

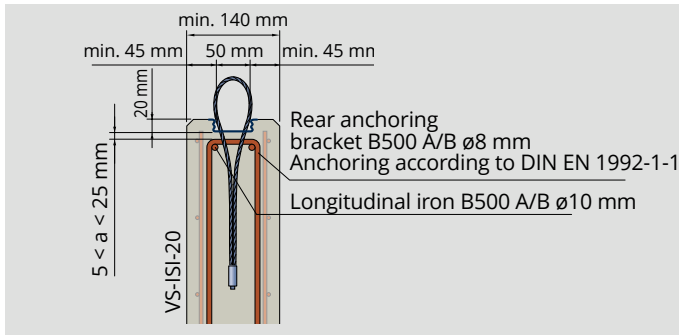


Figure 6

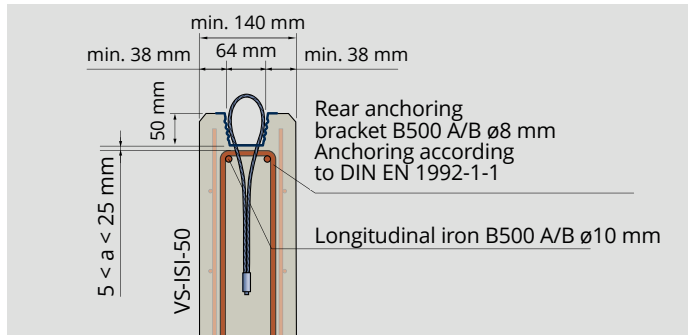


Figure 7

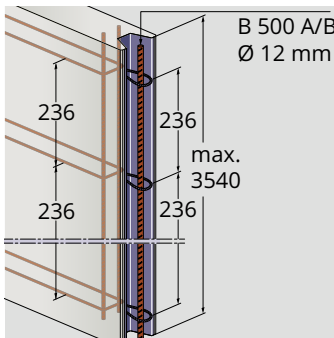


Figure 8: Force introduction reinforcement

NOTE

As an alternative to these plug-in brackets, a mat cap Q257A can also be provided.

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

Joint reinforcement

Before filling the joint, a 12 mm diameter reinforcing bar must be inserted in the loop overlap area (Figures 8 and 9) over the entire height of the joint. This reinforcing bar is structurally essential, as it serves as splitting tensile reinforcement in the joint.

T-connection and corner joint for thin wall components

For small element dimensions, the anchoring loop of the VS®-ISI System^{3D} can be bent. The bending dimensions shown as examples in Figures 9, 10, and 11 are decisive. The drawings show the additional reinforcement required for local load transfer. This additional reinforcement serves to anchor back the loads resulting from the connecting elements.

All component reinforcement required for load transfer is not shown. This must be determined by the responsible designer.

T-connection – standard

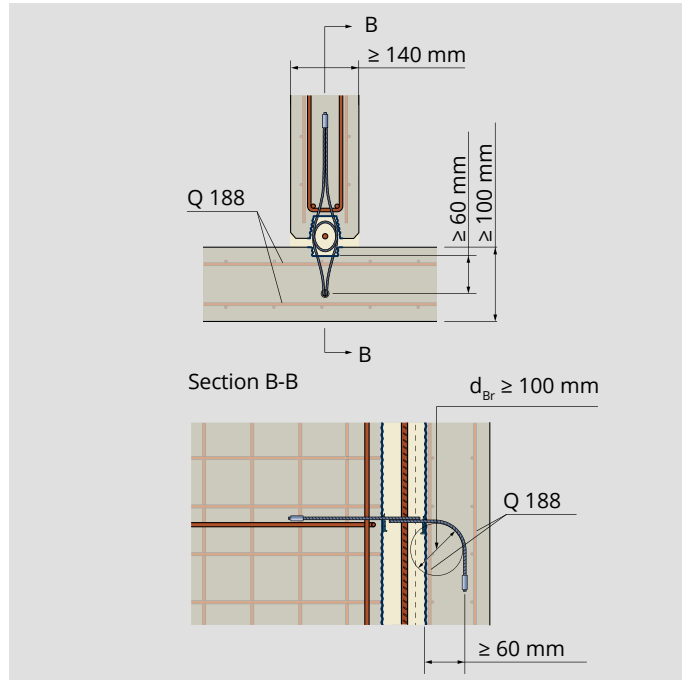


Figure 9

Corner joint – standard

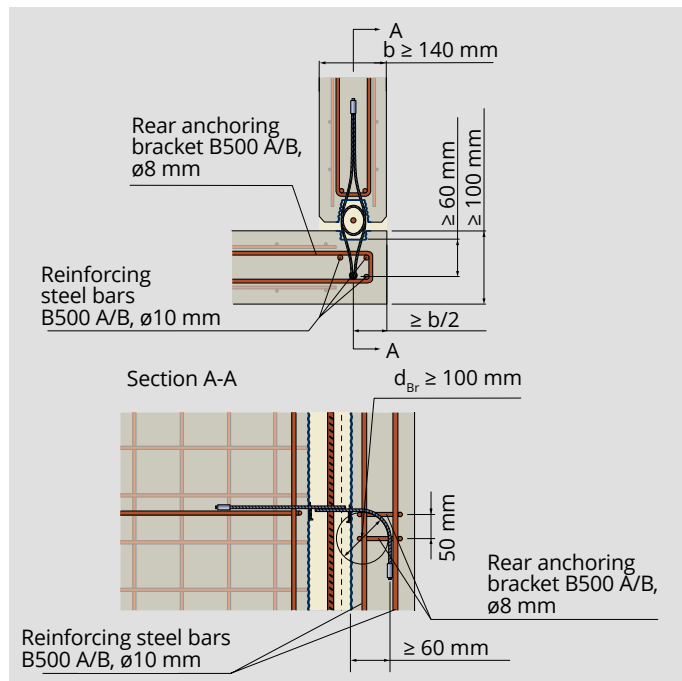


Figure 10

When using angled wire loops in the reinforced concrete element of the T-joint, additional anchoring reinforcement can be omitted. However, a minimum surface reinforcement of 1.88 cm²/m must be ensured.

For T-joints as shown in Figure 9, the design resistances specified in Table 3 apply.

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

Corner joint with reduced additional reinforcement

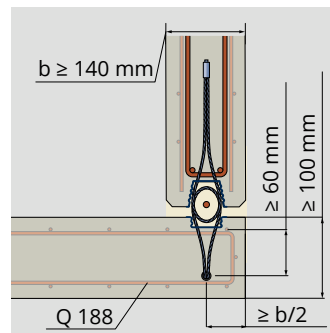


Figure 11

When using angled wire loops in the reinforced concrete element of the corner joint, additional anchoring reinforcement can be omitted (Figure 11). However, a minimum surface reinforcement of 1.88 cm²/m must be ensured.

For corner joints with reduced additional reinforcement, as shown in Figure 11, the design resistances specified in Table 3 must be reduced to 70%.

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

For corner joints as shown in Figure 10, the design resistances specified in Table 3 apply.

Manufacture of the precast elements

When a precast element connection is established using the VS®-ISI System^{3D}, the casting channel is automatically formed by rail profiles. This means that it is not necessary to provide any additional recessing blocks, depressions or the like. When inserting the VS®-ISI System^{3D} into the formwork, it is necessary to ensure that the wire rope ends are threaded as straight as possible between the reinforcements. Starting from the lowest point of the element, the profiles are then simply nailed into place with the loops at the same height for both elements (Fig. 20), or attached with hot-melt adhesive in the case of steel formwork. Fixing the loops to the mesh reinforcement with wire prevents the rails and loops from slipping out of place. The anchorages for the wire rope ends are to be arranged at 90° to the joint.



Figure 12: ISI identification with blue clip

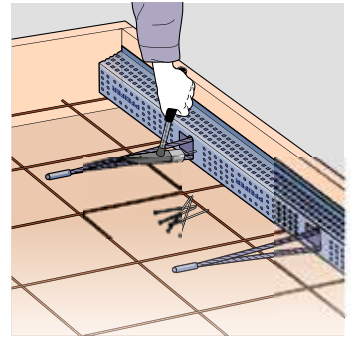


Figure 13: Nailing the profile into the formwork

NOTE

In case of installation variants deviating from Fig. 20, PFEIFER Application Consulting must be contacted if **increased formwork pressure** is to be expected as a result. This is the case, for example with upright or battery formwork!

After demoulding

The flexible covering tape is simply pulled off after demoulding (Fig. 21). The inside of the VS® profiles is then exposed, and the wire rope loops are visible. The wire rope loop can easily be folded out (Fig. 22). The wire rope loop should protrude perpendicularly from the element, and should spring back to this position again even after having been pushed aside when assembling the elements. The wall components are now ready for final installation on site.

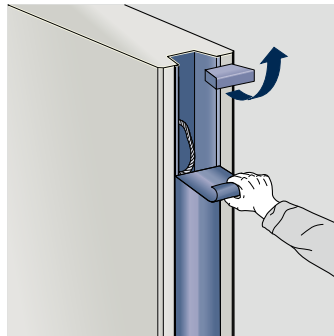


Figure 14: Opening the VS® Rail

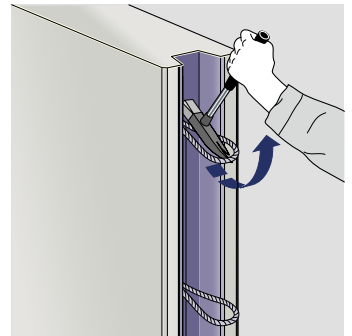


Figure 15: Folding out the loops

Assembly

Wall joint

The joints, rail profiles and loops must be free of dirt or separating wetting. The wall components are placed either on a mortar bed or on leveling plates. The components must be leveled to ensure their position and heights are correct. The joint spacing is possible from 15 mm to 40 mm, within the scope of the approval.

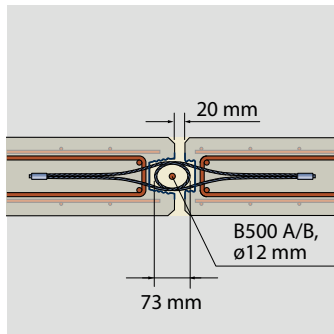


Figure 16

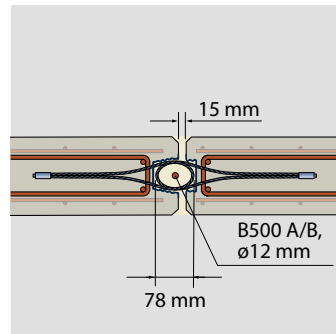


Figure 17

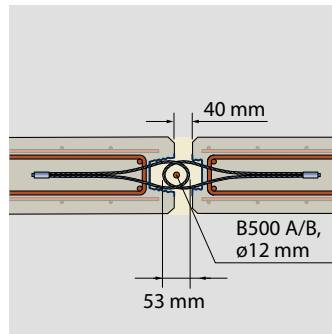


Figure 18

Standard joint = 20 mm (Fig. 13)
Minimum joint = 15 mm (Fig. 14)
Maximum joint = 40 mm (Fig. 15)

Tolerance

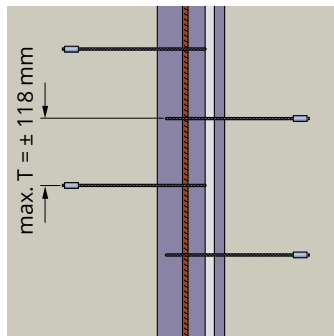


Figure 19: VS®-ISI-System

In the normal case the joint must be planned in the vertical direction without offsetting the loops (Fig. 16). If the joints extend over a number of floors, it may in some circumstances be useful to set regular zero points for orientation of the rail sections.

NOTE

Maximum vertical tolerance (Fig. 16):
VS®-ISI System: max. T = ± 118 mm

Permissible joint material combinations

		VS®-ISI-System ^{3D} cold case	VS®-ISI-System ^{3D} hot case
PAGEL® Spezialbeton GmbH & Co. KG Wolfsbankring 9 D-45355 Essen Telefon +49 (0) 201 685 040 Telefax +49 (0) 201 685 0431 E-Mail info@PAGEL.com Internet www.PAGEL.com	VS®-PAGEL® grout	✓	✗
P & T Technische Mörtel GmbH & Co. KG Bataverstraße 84 41462 Neuss Telefon +49 (0) 2131 5669-0 Telefax +49 (0) 2131 5669-22 E-Mail info@eurogrout.de Internet www.eurogrout.de	EuroGrout®Varix	✓	✓
	EuroGrout® universal filler	✓	✓
BETEC® GCP Germany GmbH Alte Bottroper Str. 64 45356 Essen Telefon +49 (0) 201 86147-0 Telefax +49 (0) 201 86147-43 E-Mail info.betec@gcpat.com Internet www.gcpat.de	Betec® VS® grout	✓	✓
	Betec® VS® ThixoTop	✓	✓

ATTENTION

The manufacturer's information must be observed for processing! You will also find detailed information there regarding processing, and an extensive list of recommended devices. Technical data can also be found in the technical documentation issued by the respective company.

Grout



- Highly penetrating
- Simple handling
- High design resistance
- No feed pump required
- Even relatively few joints can be filled economically

This high strength and extremely free flowing grout flows perfectly into the recesses of the VSS® Systems. As a result there are no strength-limiting faults.

Joint filling mortar



- Plastic and stable in the joint without formwork
- Less preparatory work is required
- Mixing and conveying can be done in one step
- Pump conveying to the joint

The VS®-ISI System^{3D} has an optimised profile without unfavourable recesses. It is therefore possible to use a mortar that is plastic/thixotropic and that stands in the joint independently. The big advantage of this is that only very little formwork is needed here. This technology offers significant savings, particularly on large building sites with many metres of joint.

VS® system joint with grout

The properties of the grout in the joint play an important role in a load-bearing connection of precast concrete elements with the VS® system elements. The specially developed grouting materials have proven their suitability in combination with the VS® rails system in elaborate tests. These grouting materials are approved within the framework of the building authority approvals.

Grout properties

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

The PFEIFER Suite dimensioning software works out the grout volume for the selected grouting joint with the real quantities and masses of the project entered, displays the number of sacks for this.

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.

	Wall thickness [cm]					
	14	16	18	20	22	24
VS®-ISI-System ^{3D}	6,68	7,08	7,48	7,88	8,28	8,68

Consumption in l/m;
about 2 kg material are required per litre

Table 2: Grout volumes for standard joint (2 mm)

Mixing

The material is delivered as a ready-to-pour mixture and only needs to be mixed with water according to the instructions printed on the packaging. 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. Nevertheless, air removal by poking with the reinforcing steel or the application of an internal vibrator is recommended. 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.

Joint formwork variants

1. Board formwork (Fig. 20)

In order to fill a precast joint with grout, a shuttering board needs to be attached from both sides. It is recommended that foam rubber is applied to the shuttering boards in order to compensate for unevenness. When the shuttering boards are properly fastened and it has been ensured that grout material cannot escape anywhere, the joint can be filled as described in the "Joint filling" section. The formwork can be removed, cleaned and reused after the material has hardened.

2. Mortar seal (Fig. 21)

Another variant makes it possible to close the joint flanks with a mortar. After this mortar has hardened, the core of the joint can be filled with grouting material and the higher performance of the systems can be achieved.

3. Sealed off compriband (Fig. 22)

Another way to cast the joints with a grout is the variant sketched in Fig. 25. In this case, prior to grouting, 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 grouting must, however, be borne in mind. This should be determined by the processing company, allowing suitable grouting sections to be chosen to avoid the jointing from being pushed out.

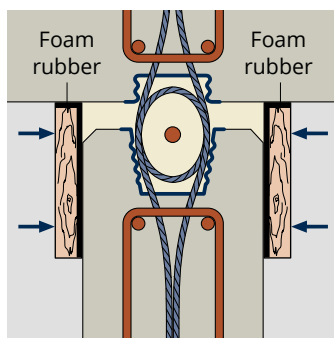


Figure 20

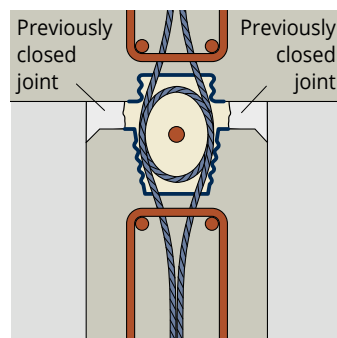


Figure 21

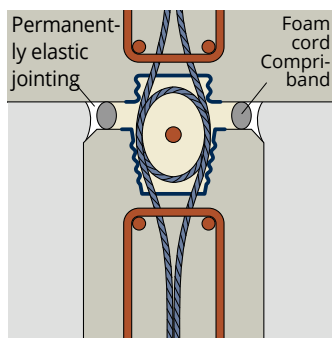


Figure 22

⚠ CAUTION

The remaining cross section must be at least 14 cm.

If joint pressure formwork or 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.

VS® system joint with plastic/thixotropic joint filling mortar

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 worm 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.

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 (Figs. 26 and 27).

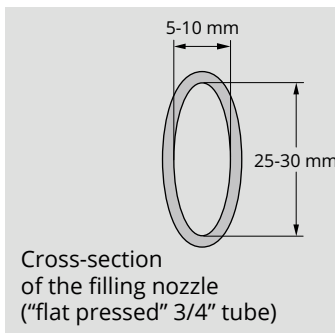


Figure 23



Figure 24

NOTE

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 necessary, instructions can be requested at any time from the mortar manufacturers.

Storage

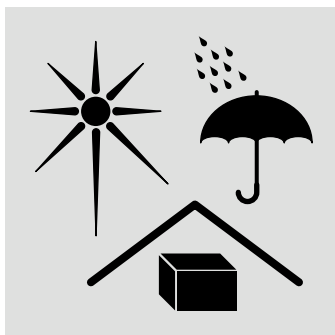


Figure 25

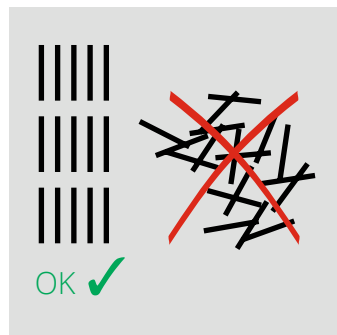


Figure 26

Dimensioning values

The precast concrete elements being connected must be construed by a responsible planner in a minimum concrete grade of C 30/37 in accordance with EN 1992-1-1. Connections made with the VS®-ISI System^{3D} are seen as reinforced joints with design resistances for tensile and transversal shear forces. Corresponding design resistances are listed in Table 1. When dimensioning the connection, the evidence for each load direction must be kept individually. Note here 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 in accordance with the approval can be used. The acting expansion forces then need to be validated. Crack widths as a result of constraining forces must be limited in accordance with EN 1992-1-1. The approval Z-21.8-1929 applies.

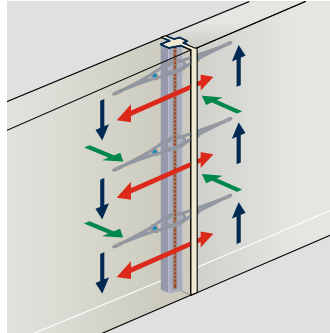


Figure 27

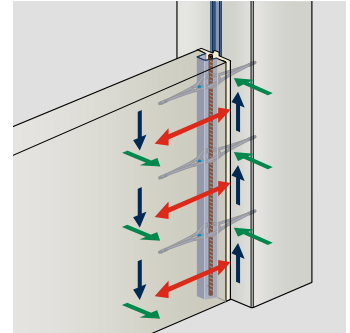


Figure 28

Wall thickness [cm]	Design resistance – shear force, perpendicular $V_{Rd, I}$ [kN/m]				Design resistance – shear force, parallel $V_{Rd, II}$ [kN/m]	Design resistance tensile force Z_{Rd} [kN/m]
	C 30/37	C 35/45	C 40/50	C 45/55		
14	9,7	11,1	11,9	12,6	60 ¹⁾	36 28
16	12,7	14,4	15,5	16,5	60 ¹⁾	36 28
18	15,9	18,1	19,4	20,7	60 ¹⁾	36 28
20	19,3	21,9	23,5	25,1	60 ¹⁾	36 28
22	22,8	26,0	27,9	29,7	60 ¹⁾	36 28
24	26,6	30,3	32,5	34,6	60 ¹⁾	36 28
26	30,5	34,8	37,3	37,5	60 ¹⁾	36 28
28	34,6	37,5	37,5	37,5	60 ¹⁾	36 28
≥ 30	37,5	37,5	37,5	37,5	60 ¹⁾	36 28

¹⁾ When using the VS®-ISI Rail System^{3D} for corner joints with reduced additional reinforcement as shown in Figure 11, the design resistances specified in Table 3 must be reduced to 70%.

blue dimensioning values when using grouting material

red dimensioning values when using plastic/thixotropic material (possible materials according to p. 10)

Table 3: Dimensioning values for VS®-ISISystem^{3D}

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

Verification method

Shear force parallel to the joint

The design resistance of the shear force parallel to the joint $v_{Rd,II}$ according to Table 1 can be used in the limit state of the carrying capacity for the shear force parallel to the joint reinforced with the VS®-ISI^{3D}

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

$v_{Ed,II}$ [kN/m]: Parallel shear force per metre of joint
 $v_{Rd,II}$ [kN/m]: Design resistance of the parallel shear force per metre of joint

Shear force perpendicular to the joint

The design resistance $v_{Rd,\perp}$ according to Table 1, depending on the component thickness and concrete strength class, can be used in the limit state of the carrying capacity for the shear force perpendicular to the joint reinforced with the VS®-ISI^{3D}.

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

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

Expansion forces result from stresses perpendicular 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. The possibilities to verify the tensile forces are outlined below.

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 (Table 2). The sum of these individual components and any acting "external" tensile force (total tensile force) is verified on the basis of the tensile force resistance Z_{Rd} of the VS®-ISI System^{3D} according to Table 1.

Stress from parallel shear force	Perpendicular shear force $v_{Ed,II}$	Perpendicular shear force $v_{Ed,\perp}$	"Outer" tensile force
ISI tensile force components	$Z_{Ed,VII} = 0,5 \cdot v_{Ed,II}$	$Z_{Ed,V\perp} = 0,25 \cdot v_{Ed,\perp}$	$Z_{Ed,N}$

Table 4: Tensile force components ISI

Verification of the total tensile force:

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

Z_{Rd} [kN/loop] : Design resistance of a loop
 Z_{Rd} [kN/m] : Design resistance of the tensile force per metre of joint according to Table 1/2, where $n = 4$ wire rope loops per metre
 $Z_{Ed,N}$ [kN/m] : Acting "outer" tensile force per metre of joint
 $Z_{Ed,VII}$ [kN/m] : Expansion force from shear force parallel per metre of joint
 $Z_{Ed,V\perp}$ [kN/m] : Expansion force from shear force perpendicular per metre of joint

Simplified proof: Parallel and perpendicular shear forces combined

When shear forces perpendicular and parallel to the joint act simultaneously, the interaction of the shear forces is to be verified by means of the interaction relationship shown in the diagram (Fig. 17).

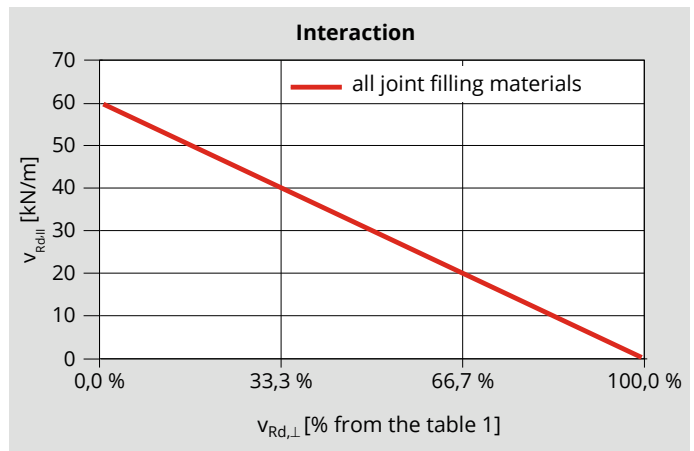


Figure 29: Interaction diagram VS®-ISI System^{3D}

Special case: tensile forces without consideration of the wire rope loops

Only in special cases the VS® wire rope loops not used for the transmission and forwarding of tensile forces; instead, the sum of the tensile forces z_{Ed} is assigned to suitable tensile elements or other structural measures. This can be tensile elements (e. g. ring anchors) or other structural measures (clamped supports, frictional forces in the case of fully erect wall elements, or similar). The tensile forces resulting from the individual load directions are shown in Table 3.

Stress from	Perpendicular shear force $V_{Ed,⊥}$	"Outer" tensile force
Tensile force component	$z_{Ed,V,⊥} = 0,25 \cdot V_{Ed,⊥}$	$z_{Ed,N}$

Table 5: Tensile components for special case

Resulting total tensile force:

$z_{Ed} = z_{Ed,V,⊥} + z_{Ed,N}$	z_{Ed} [kN/m] : Total tensile force per metre of joint
	$z_{Ed,N}$ [kN/m] : Acting "outer" tensile force per metre of joint
	$z_{Ed,V,⊥}$ [kN/m] : Expansion force from shear force perpendicular per metre of joint

Dimensioning under the effects of fire

The VS®-ISI System may be used in components for the following fire protection requirements:

Building authority requirement	DIN 4102	DIN EN 13501
fire-retardant	F30	REI 30
highly fire-retardant	F60	REI 60
fire-resistant	F90	REI 90
Fire wall	Fire wall	REI 90-M

Table 6: Fire resistance class



REI 30 to REI 90-M – proof of limitation of the stress

If $Z_{Ed,fi}$ and $v_{Ed,fi,\perp} \leq 2,5$ kN/m extraordinary stress combination due to fire, according to approval text) and $v_{Ed,cold}$ case < 60 kN/m (decisive load case in cold case) then the proof for REI-30 to REI-90M (fire wall) is deemed to have been provided.

REI 30 to REI 90 – proof of the calculation of the resistance in case of fire

If $Z_{Ed,fi} \leq 2,5$ kN/m and $v_{Ed,fi,\perp} \leq 2,5$ kN/m (extraordinary stress combination), then the dimensioning takes place in accordance with Appendix 15 of the approval. For the specified fire duration, the temperature at the wire rope loops must be known for the fire situation under consideration (numerical specified simulation or e. g. EN 1992-1-2:2010-12, Fig. A. 2). The temperature is used to determine the reduction factor for the wire rope loop carrying capacity:

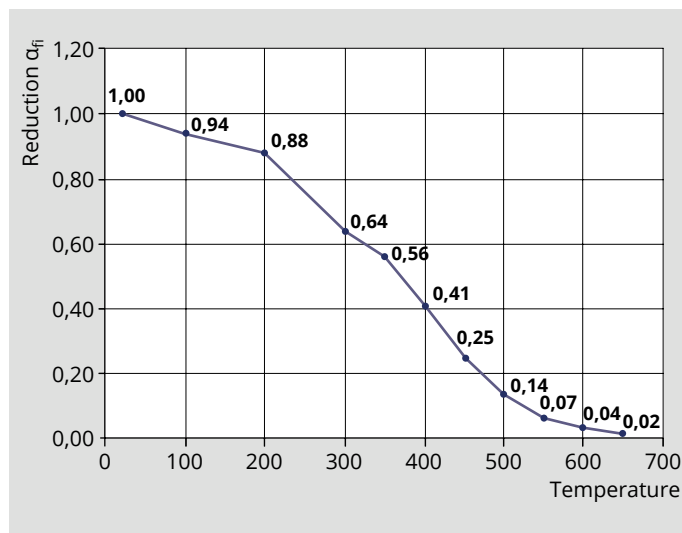


Figure 30

	Tension [kN/ wire rope loop] $Z_{Rd,fi}$	Transversal shear force parallel to the joint [kN] $v_{Rd,fi,II}$
Dimensioning value of the carrying capacity	$Z_{Rd,fi} = \alpha_{fi} \cdot Z_{Rd}^{1)}$	$v_{Rd,fi,II} = \alpha_{fi} \cdot v_{Rd,II}^{2)}$

¹⁾ Z_{Rd} according to Appendix 11, Table 1

²⁾ $v_{Rd,II}$ according to Appendix 11, Table 2

Table 7: This results in the residual carrying capacity of the wire rope loop:

Verification of the carrying capacity when exposed to fire

For the verification of supporting connections exposed to fire, the carrying capacities according to Table 5 may be applied. According to the temperature acting on the wire rope loop (e. g. temperature profile EN 1992-1-2:2010-12, Fig. A. 2), the design resistances are to be reduced with α_{fi} .

Verification of the total
tensile force:

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

Verification of the shear
force parallel:

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

Proof as a regulated detail 4102-4

In addition to the aforementioned application area, the precast concrete element connections using the VS®-ISI System^{3D} can be regarded as equivalent to the connections regulated by DIN 4102-4:2016-05, sections 5.12.5 to 5.12.7.

Building authority fire protection requirements 	Fire resistance classes		Resistances of fire-exposed components						
			Proof of limitation of the stress			Proof of the calculation of the resistance in case of fire (Appendix 15)			
	as per DIN 4102	as per DIN EN 13501	Z_{Rd}	$v_{Rd,II}$	$v_{Rd,\perp}$	Z_{Rd}	$v_{Rd,II}$	$v_{Rd,\perp}$	$Z_{Rd} + v_{Rd,II}$
fire-retardant	F30	REI 30	2,5 kN/m	$v_{Rd,II}^{1)}$	2,5 kN/m				
highly fire-retardant	F60	REI 60				$Z_{Rd}^{2)}$	$v_{Rd,II}^{2)}$	2,5 kN/m	$Z_{Rd}^{2)} + v_{Rd,II}^{2)}$
fire-resistant	F90	REI 90							
Fire wall	Fire wall	REI 90-M				–	–	–	–

¹⁾ fulfilled with the proof in the cold case

²⁾ reduced resistances according to approval no. Z-21.8-1929 Appendix 15

Table 6: Transferable resistances in case of fire

PFEIFER Suite dimensioning software

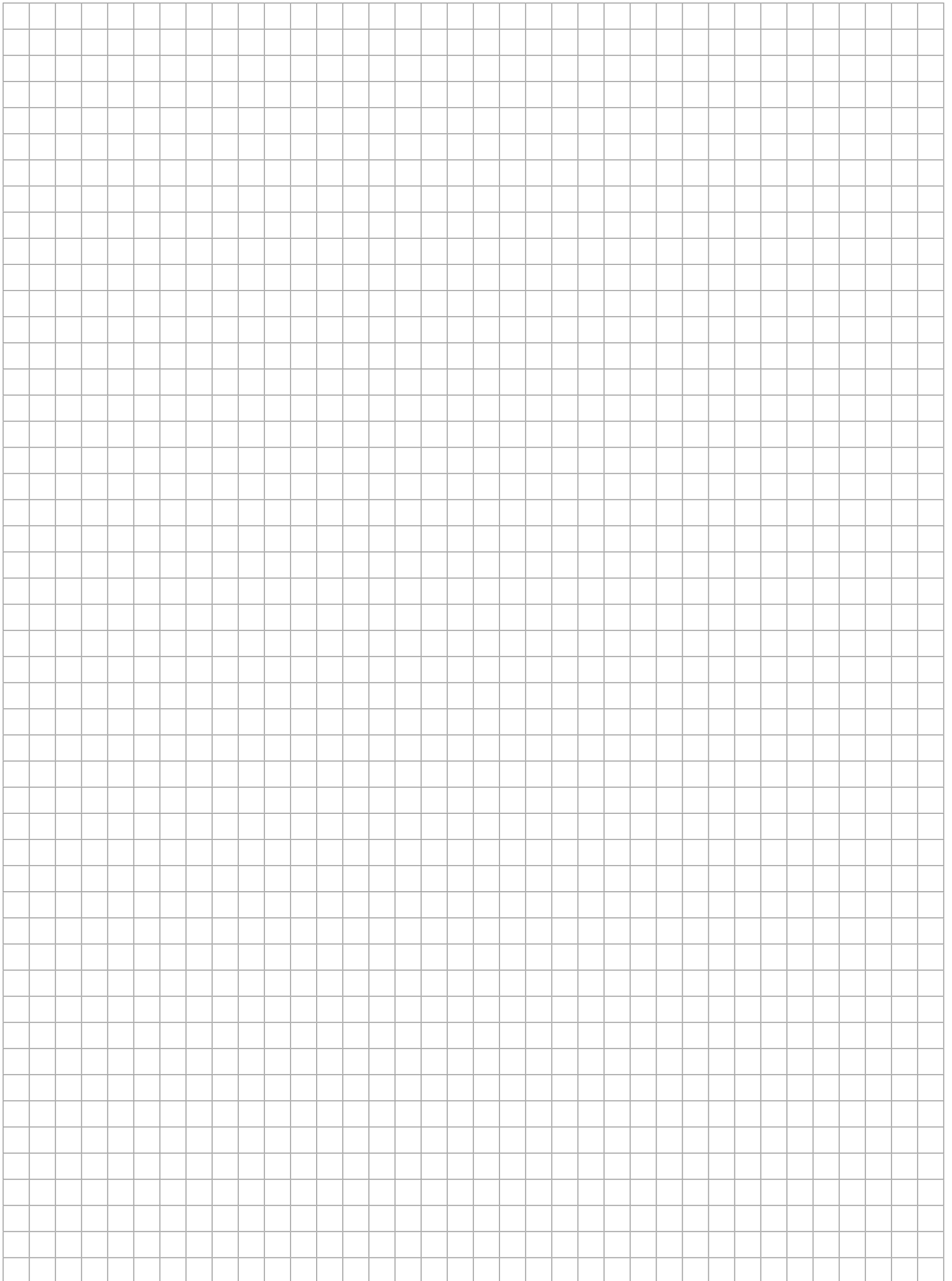
The approved VS® rail systems can be easily planned on precast wall joints with the aid of the free dimensioning software. The latest version of the software is available to download from the Internet at www.pfeifer.info. Your additional benefits when using the software are:

- 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 perpendicular
 - with tensile forces
- Integrated fire protection verification



The latest version of the software is available to download at pfeifer-suite.info







Connect with us:



PFEIFER

International

Sales

+49 83 31 937 231

Technical Support

+49 83 31 937 345

@ export-bt@pfeifer.de

 pfeifer.info/concrete-inserts

PFEIFER, VS®, HIT, MoFi®, Hybridbeam® are registered trademarks of PFEIFER Holding GmbH & Co. KG in the European Union.