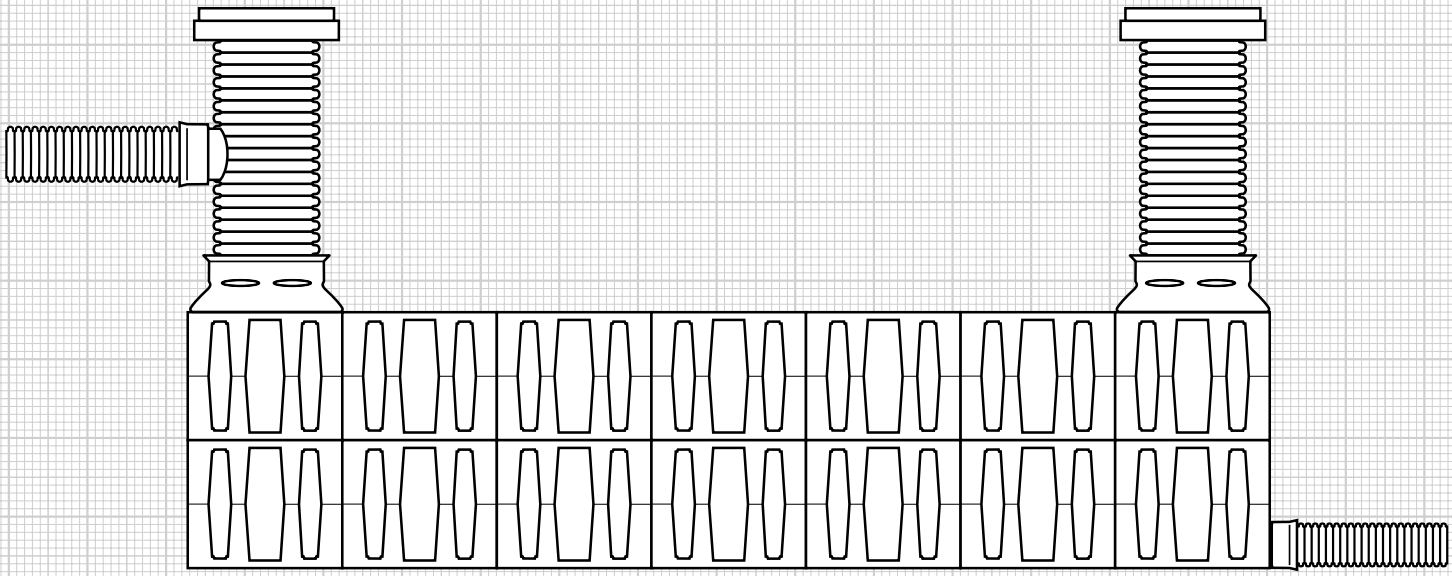
FRÄNKISCHE

Installation manual

Rigofill® ST / Rigofill® ST-B



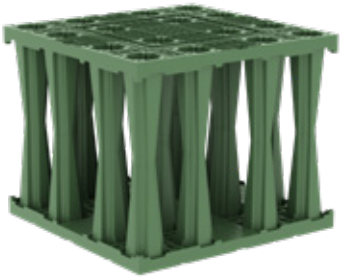
Underground storage/infiltration modules

Drainage Systems
www.fraenkische.com

1. Rigofill® ST – system

Rigofill® ST – system

Rigofill® ST



SLW 60/HGV 60

Rigofill® ST-B

SLW 30/HGV 30

NB

In what follows, an illustrative explanation of the Rigofill system will be given by means of the green module. All properties and advantages also apply to the Rigofill ST-B system. The systems have been optimised for different installation situations.

In the following, please be sure to pay attention to this sign.

Statements marked with this sign apply to both Rigofill ST and Rigofill ST-B.

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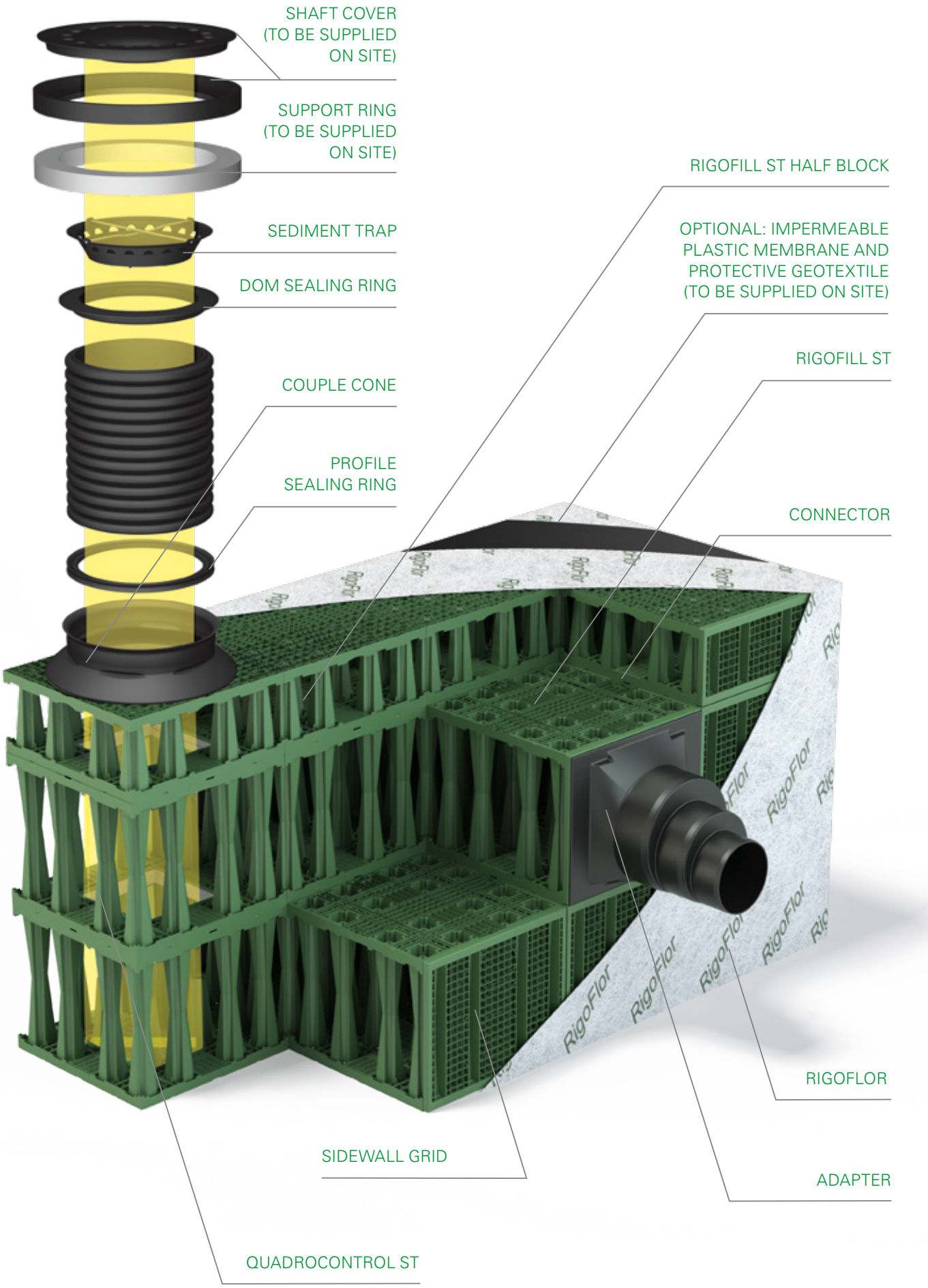
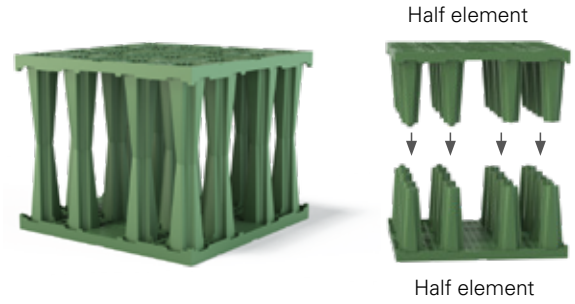
2. Rigofill® ST – system



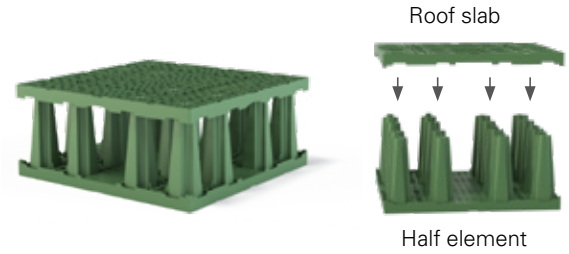
2. Rigofill® ST – system components

Rigofill ST



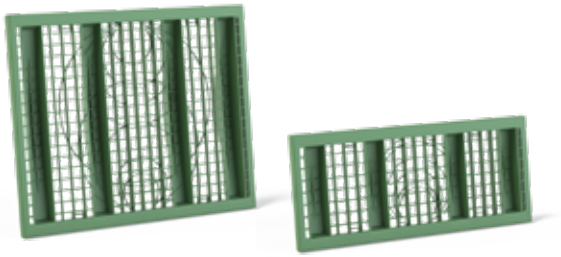
comprising:
Rigofill ST half elements

Rigofill ST® half block



comprising:
Rigofill ST half element and roof slab

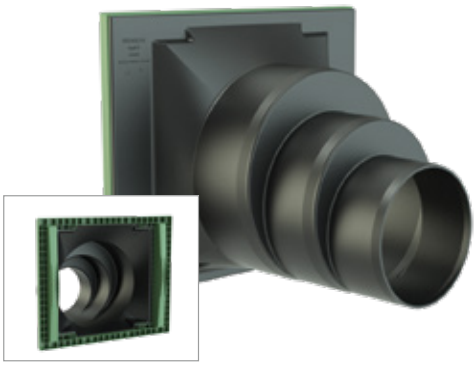
Sidewall grid



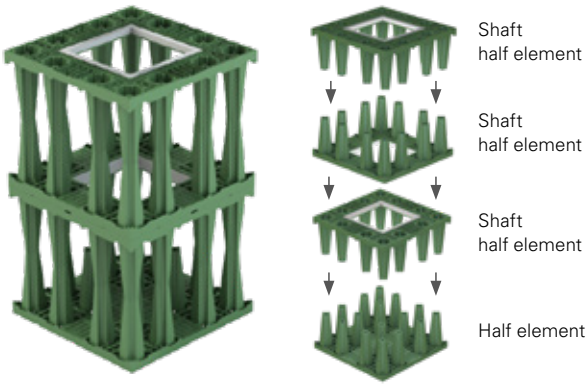
Sidewall grid for
Rigofill ST full block

Sidewall grid for
Rigofill ST half block

Adapter

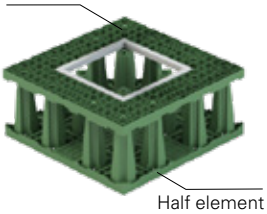


Quadro®Control ST

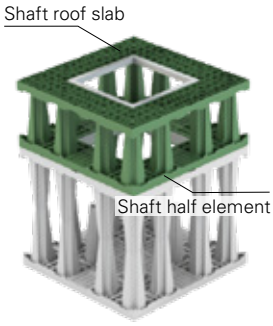


comprising:
Half element and shaft half elements

Quadro®Control ST – half shaft



comprising:
Half element
and shaft roof slab



comprising:
Shaft half element
and shaft roof slab

3. Rigofill® ST – storage/infiltration module

3.1 Transport and storage

Rigofill ST modules are delivered stacked on pallets (1.60 m x 0.80 m). A pallet contains 34 half elements for 17 modules. When leaving the factory, two pallets are typically stacked on top of each other. Sidewall grids and roof slabs (required for half blocks only) are packed on separate pallets.

The components of the QuadroControl ST shaft are delivered pre-assembled on separate pallets. These pallets are marked correspondingly. Preferably unload the pallets using forklifts or other lifting tools. The lifting tools must have the technical equipment required for lifting gear operation.

Rigofill ST can be stored outdoors. Storage time outside should, however, not exceed **one year**. Protect the material from direct sunlight (e.g., store in the shade or cover with bright-coloured, light-tight foil).

Check the components for defects before installation. The impact strength of the material decreases in sub-zero temperatures. The relevant safety provisions of the building industry apply. **Damaged modules must NOT be installed!**

⚠ CAUTION

Solid and level ground is required for storage at the construction site.

Avoid dropping, dumping and hitting the Rigofill ST modules against each other!

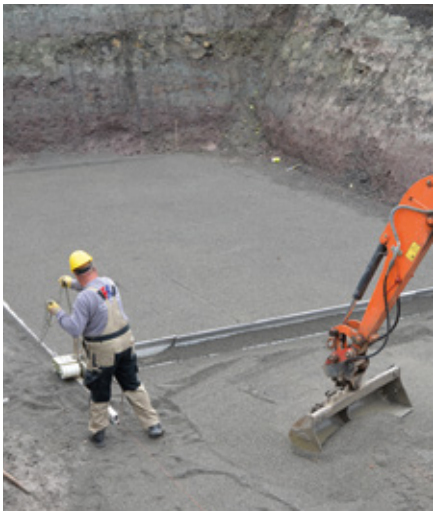
3.2 Separating pallets

We recommend using hoisting slings to separate both stacked pallets.

Separate the pallets before removing the half elements.

3. Rigofill® ST – storage/infiltration module

3.3 Excavating pit and creating bearing



Excavate the pit according to design specifications. During excavation work, the walls of the pit must be sloped or constructed such that they pose no danger to the workers due to downsliding masses. Additionally, national regulations must be observed. Measures must be taken to ensure that the excavation pit is free from water during the entire execution time.

In order to install Rigofill ST modules, a horizontal, level and stable bearing is essential. To this end, create a levelling layer of approx. 10 cm, preferably made of crushed stones or gravel (without fine fractions), above the bottom of the excavation pit. The layer must be compacted carefully and smoothed to achieve a level surface. The degree of compaction D_{pr} should be larger than or equal to 97 % (E_{vd} larger than or equal to 25 MN/m² or CBR larger than or equal to 8 % top edge of the bearing). If the soil has been included in the infiltration calculation, the permeability of the compacted layer must at least correspond to the permeability (k_f value) of the backfill soil (soil groups GE, GW, SE, SW, SI).

The quality of the bedding is decisive for further installation and strongly affects both bearing and setting properties of the storage/infiltration systems, particularly in case of multiple-layer designs and higher loads (soil and traffic loads).

3.4 Laying geotextile

Wrap the entire storage/infiltration system in geotextile. Before starting to lay the modules, spread out the geotextile on the planum. The geotextile must have sufficient lateral excess length in order to eventually wrap up the entire system. It must overlap at least 30 cm at all edges.

ATTENTION

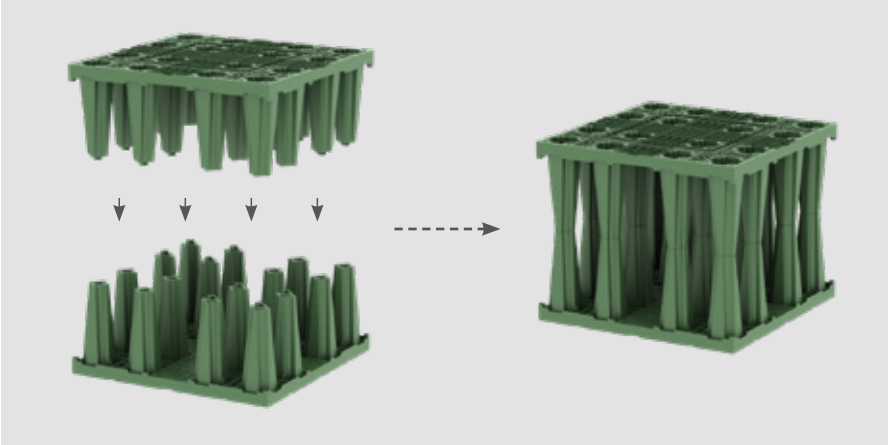
Ensure that the geotextile surface is completely closed leaving no gaps even during backfilling!

Important characteristics of the geotextile (e.g., RigoFlor):

Thickness:	**≥ 2 mm**
Puncture resistance:	**2.0 kN**
Geotextile class:	**3**
Characteristic opening width:	**0.08 mm**
k_f value (at 20 kPa):	**6 x 10^{-2} m/s**
Water permeability according to EN ISO 11058:	**90 l/sm²**
Mass per unit area:	**200 g/m²**

3. Rigofill® ST – storage/infiltration module

3.5 Installation

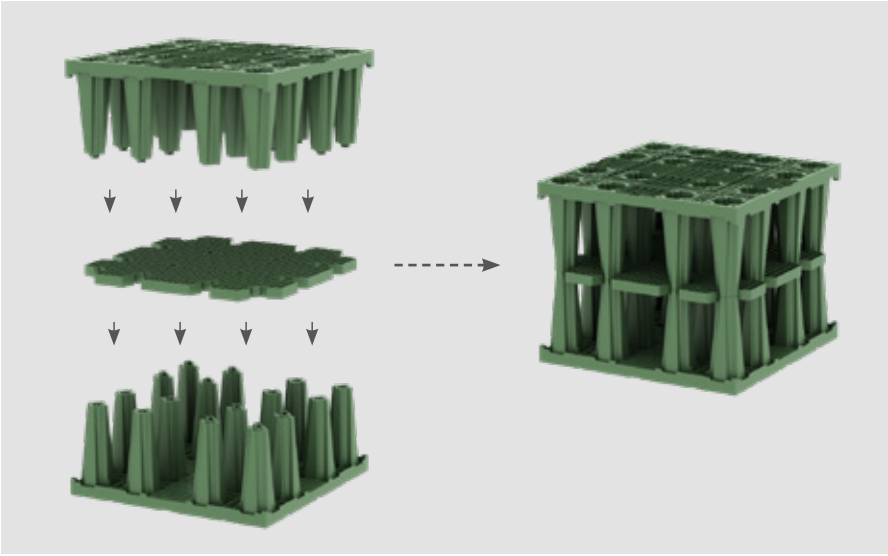


Full block installation

Each Rigofill ST module consists of two half elements. Slight hand pressure is enough to create a connection of high tensile strength.

The modules can be pre-assembled both inside and outside the excavation pit.

The pre-assembled modules must be arranged according to planning specifications.

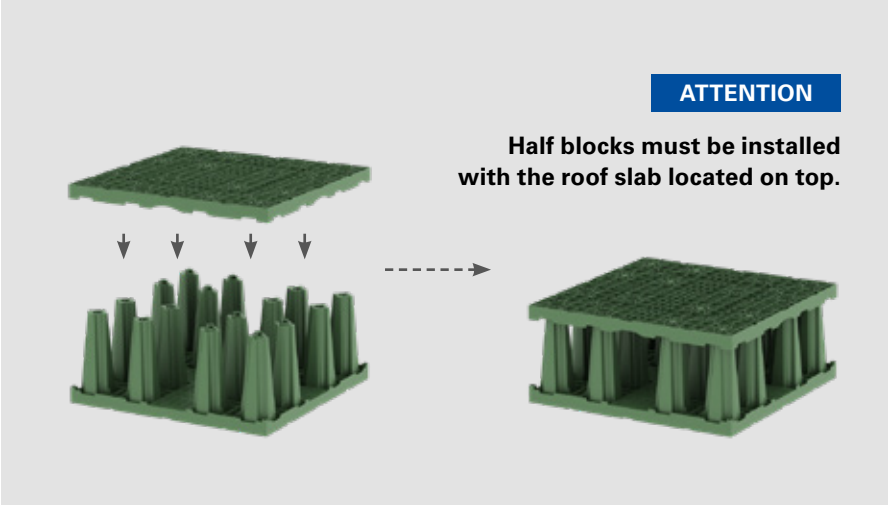


Full block installation with integrated supporting grid

If the full block has an integrated supporting grid, this must be placed between the two half elements beforehand.

The modules can be pre-assembled both inside and outside the excavation pit.

The pre-assembled modules must be arranged according to planning specifications.



Half block installation

Each Rigofill ST half block consists of one half element and one roof slab put together. Slight hand pressure is enough to create a connection of high tensile strength. The modules can be pre-assembled both inside and outside the excavation pit.

For a 0.5-layer system, the pre-assembled modules must be arranged on the planum according to planning specifications. For multiple-layer systems, the half blocks must be arranged in the top layer.

3. Rigofill® ST – storage/infiltration module

3.5.1 Pre-assembly outside the excavation pit



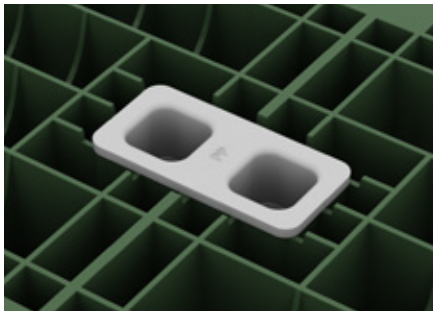
3.5.2 Pre-assembly inside the excavation pit



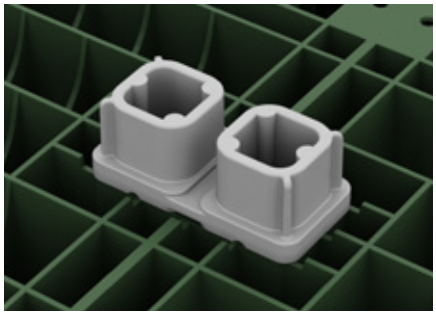
Assembly inside the excavation pit

3. Rigofill® ST – storage/infiltration module

3.5.3 Connectors



Single-layer connector using the example of Rigofill ST



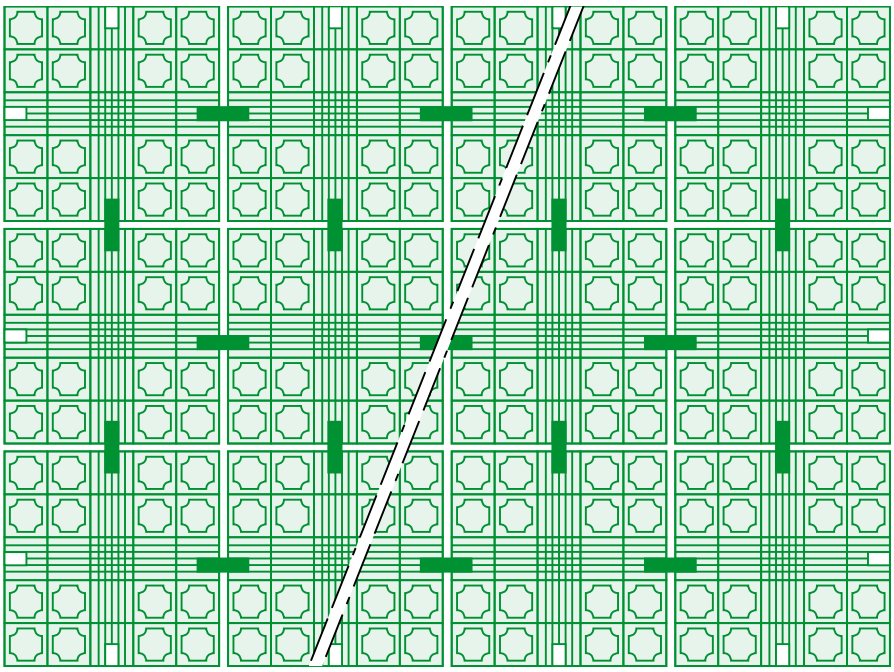
Multiple-layer connector using the example of Rigofill ST

Connector, full block/half block:

Connectors help secure the modules in place. Secure modules using connectors on the top surface of the module in the centre of each edge that is adjacent to another module.

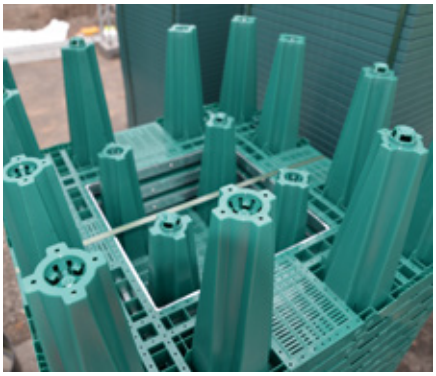
Determination of requirements:

Connector		Application	Requirement	
Single-layer		for single-layer installation	requirement for **single-layer** installation	1 pc(s). per module
			requirement for **multiple-layer** installation	2 pc(s). per module
Multiple-layer		for multiple-layer installation	requirement for **2-layer** installation	1 pc(s). per module
			requirement for **3-layer** installation	1.3 pc(s). per module



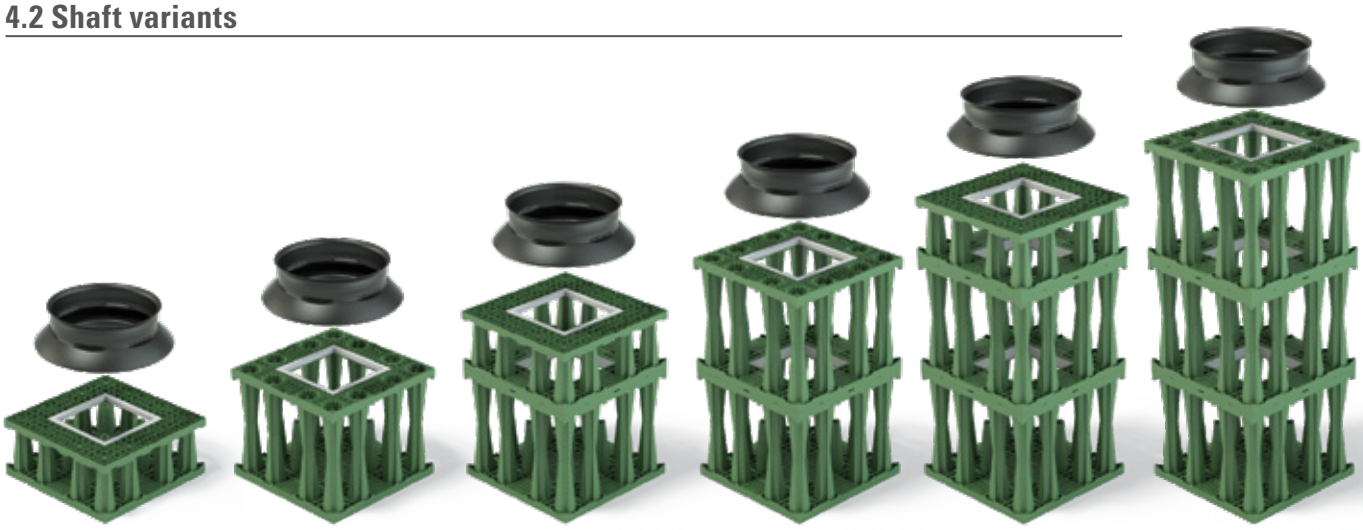
4. Quadro®Control ST – shaft elements

4.1 Delivery



The components of the QuadroControl ST shaft are delivered to the site preassembled and packed on a pallet.

4.2 Shaft variants



1/2-layer 1-layer 1 1/2-layer 2-layer 2 1/2-layer 3-layer

Product	Cat. no.	Cone	Profile sealing ring for extension pipe	Shaft half element	Shaft roof slab with frame	Half element
						
		pc(s).	pc(s).	pc(s).	pc(s).	pc(s).
Quadro Control ST 0.5	51504005	1	1		1	1
Quadro Control ST 1	51504010	1	1	1		1
Quadro Control ST 1.5	51504015	1	1	2	1	1
Quadro Control ST 2	51504020	1	1	3		1
Quadro Control ST 2.5	51504025	1	1	4	1	1
Quadro Control ST 3	51504030	1	1	5		1
QuadroControl ST-B 0.5	51504205	1	1		1	1
QuadroControl ST-B 1	51504210	1	1	1		1
QuadroControl ST-B 1.5	51504215	1	1	2	1	1
QuadroControl ST-B 2	51504220	1	1	3		1
QuadroControl ST-B 2.5	51504225	1	1	4	1	1
QuadroControl ST-B 3	51504230	1	1	5		1

4. Quadro®Control ST – shaft elements

4.3 Installation of shaft elements

The shaft is constructed layer by layer and it grows as construction of the unit progresses.

The installation of the bottom layer of the QuadroControl ST shaft always starts with connecting the half element and the shaft half element.

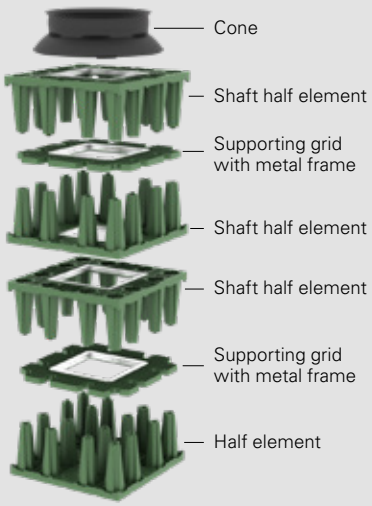
NB

For systems with supporting grid (see below)

Install the shaft bottom in the intended position in the layout. Please ensure that the opening with the metal frame faces upwards. Use connectors to connect to the adjacent Rigofill ST modules.

Additional complete layers

Each of these layers is made of two shaft half elements combined. Place the shaft components onto the already existing shaft bottom using multiple-layer connectors.

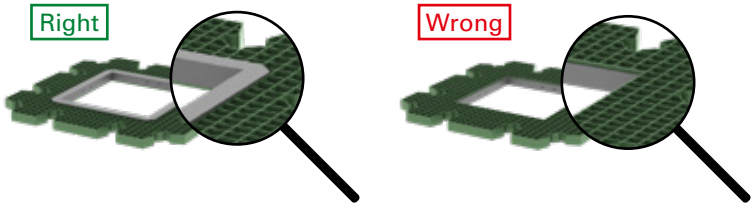


Installation with integrated supporting grid

Proper installation is mandatory for systems with supporting grids due to reasons of stability. For QuadroControl ST shafts with an integrated supporting grid, this must be placed between the half elements beforehand.

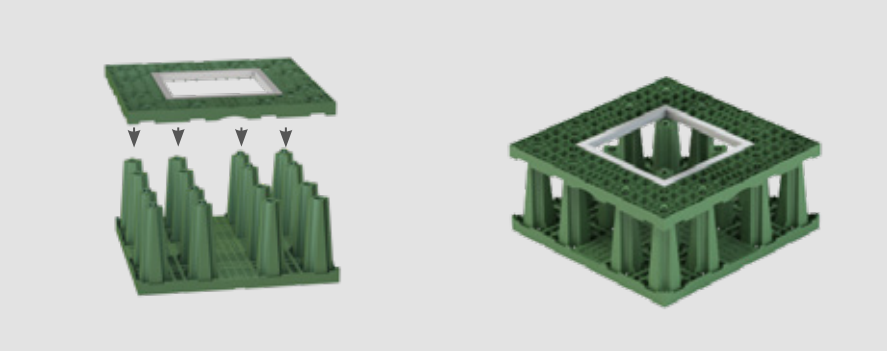
NB

During installation, make sure that the metal frame integrated in the supporting grid faces upwards.



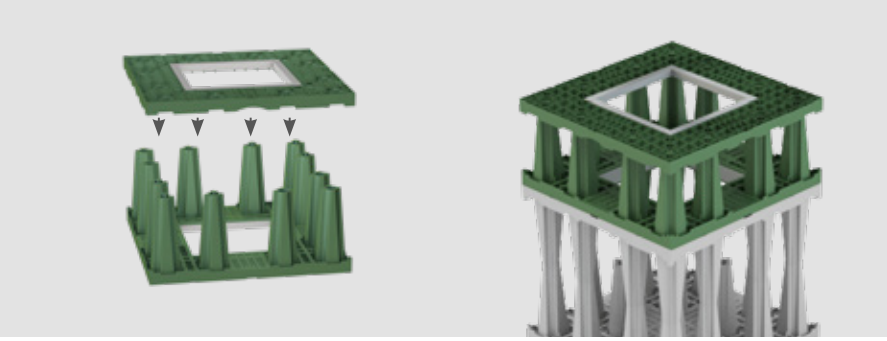
4. Quadro®Control ST – shaft elements

4.3 Installation of shaft elements (continued)



Half-layer shaft

Always start with putting the half element and the shaft roof slab together. Install the shaft in the intended position in the layout. Please ensure that the opening with the metal frame faces upwards. Use connectors to connect to the adjacent Rigofill ST modules.



Upper half layer

This layer consists of a shaft half element and a shaft roof slab put together. This half layer is placed onto the subjacent shaft part using multiple-layer connectors; the roof slab must face upwards.

How to place cones

Regardless of the number of layers, the couple cones provide the transition to the extension pipes. The couple cones are preferably to be put on the shaft openings only after the upper system layer has been completed.

Before installing the couple cones, the entire storage/infiltration system incl. shafts must be covered with the wrapping geotextile. The geotextile must be cut out at the square openings.

Installation of extension pipes

The extension pipes are inserted into the cone coupling by means of sealing rings included in the delivery (please use lubricant). Prior to that, profile sealing rings must be placed into the **first** corrugation trough of the extension pipes.

Make sure that the extension pipes are installed upright and do not shift during compaction.

4. Quadro®Control ST – shaft elements

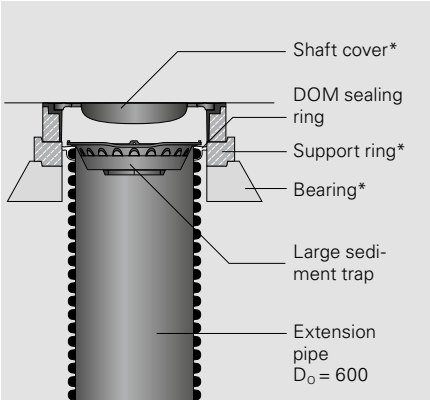
4.4 Temporary construction site covers

Extension pipes are delivered with temporary construction site covers. They are used to prevent backfill or other dirt from entering the shafts during installation. The construction site cover is not accessible and may not be trafficked! Do not remove temporary construction site covers before installing permanent shaft covers.

Purpose of temporary construction site covers when backfilling

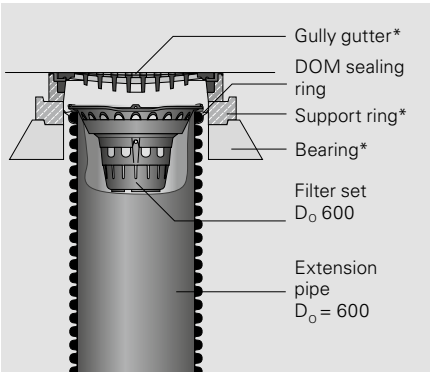
Temporary construction site cover for extension pipes

4.5 Shaft covers



Shaft cover on the shaft (e.g., inspection shaft)

* to be supplied on site



Gully gutter on the shaft (e.g., swale emergency overflow)

* to be supplied on site

DOM sealing ring

After installing the cover (see next Section), shaft covers can be placed. Cut the extension pipe D_O 600 such that it reaches the support ring. The gap between the support ring and the shaft cover must be sealed using a DOM sealing ring. Mount the sealing ring onto the last corrugation trough of the extension pipe. Place a sediment trap D_O 600 on the extension pipe. If, according to the design specifications, the shaft must feature a gully gutter, place the filter set D_O 600 on the extension pipe.

Shaft covers or gully gutters and concrete support rings are not included in the scope of delivery and must be supplied on site. Shaft covers must be carried out and installed according to planning specifications. The inside diameter must be at least 610 mm. Shaft covers must be suitable for the expected traffic loads. If national guidelines such as EN 124 are applicable, they must be observed.

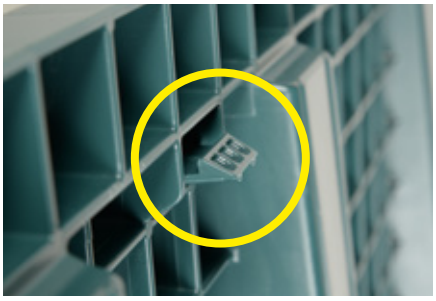
Put a support ring h = 100 mm on an appropriate bearing under the shaft cover/gully gutter. Create the bearing from compacted bearing layer material or in-situ concrete C 16/20. Avoid interlocking of the bearing with the corrugations of the extension pipe (use casing aid!). Vertical loads may only be transferred to the load-bearing underground.

⚠ CAUTION

Installation in sub-zero temperatures requires greater care (impact stability, please refer to the section on transport and storage).
The modules are slippery when wet or frosty!

5. Final installation steps

5.1 Installing sidewall grids



Use sidewall grids to cover tunnel ends of the storage/infiltration system. Place the sidewall grid in the centre. Pressing the sidewall grid is enough to connect the module tight using four locking pins.

Depending on on-site requirements, the installation of the sidewall grids can already take place outside the excavation pit.

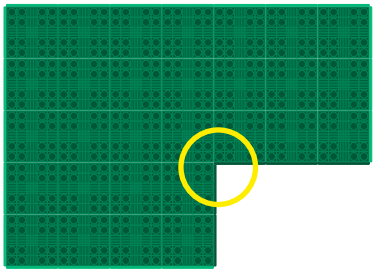
ATTENTION

If there is enough space, the installation of all sidewall grids can alternatively be carried out after the installation of modules has been completed.

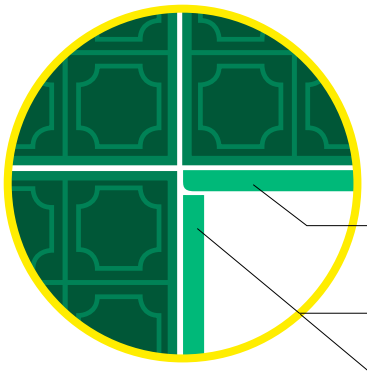
Similar application with sidewall grid/half block.

NB

In storage/infiltration designs with inside corners, shortened sidewall grids are used at one side.



Special quality: Inside corner



Rigofill ST-B sidewall grid
Cat. no. **51994200**

Rigofill ST-B sidewall grid, short
Cat. no. **51994210**

Rigofill ST-B half block sidewall grid, short
Cat. no. **51994211**

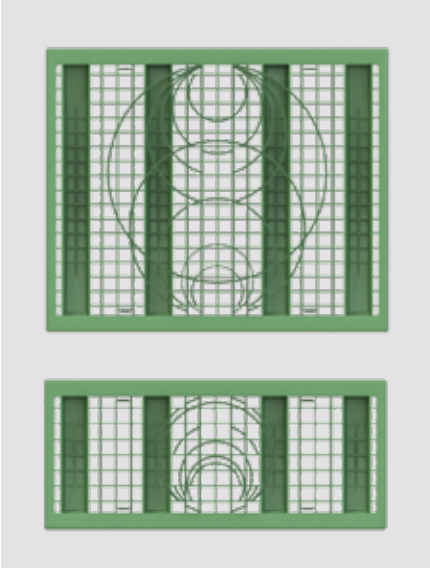
Rigofill ST sidewall grid
Cat. no. **51994000**

Rigofill ST sidewall grid, short
Cat. no. **51994010**

Rigofill ST half block sidewall grid, short
Cat. no. **51994011**

5. Final installation steps

5.2 Cutting openings in sidewall grids



To directly connect supply pipe and drain pipe, the sidewall grids have pre-marked circles for solid wall pipes with nominal diameters of DN 110 to 500 (DN 110 to DN 250 for sidewall grid/half block).

NB

We recommend using a jigsaw.

Module layers	Connection height
1/2-layer	40 mm
1-layer	40 mm
1 1/2-layer	700 mm
2-layer	700 mm
2 1/2-layer	1,360 mm
3-layer	1,360 mm

Connection heights (independent of nominal diameter) from the swale bottom

5.3 Inserting adapters (DN 315/DN 400/DN 500)

The adapter must be cut to the nominal diameter according to planning specifications. The pipe DN 315 can be connected directly. The adapter can be installed at soil level or turned by 180° at crown level.

Securing with an adapter fastener

NB

An angular grinder is best suited for cutting. Please cut approx. 1 cm from the edge to maintain the insertion chamfer. Mount the prepared adapter to the module just like a sidewall grid and secure it using an adapter fastener.

5. Final installation steps

5.4 Creating geotextile wrapping

Rigofill systems must be wrapped completely in geotextile (e.g., RigoFlor). At the edges, sufficient overlapping shall be provided (at least 30 cm) to make sure no backfill material enters the system. Produce sand-tight pipe inlets by cross-shaped cutting of the geotextile.

ATTENTION

Ensure that the geotextile surface is completely closed leaving no gaps even during backfilling!

5.5 Lateral backfilling

Connectors secure the individual Rigofill ST modules and prevent the storage/infiltration system from shifting during backfilling.

Use non-cohesive, non-frozen earthwork material with a maximum grain size of 32 mm for backfilling.

Distribute the backfill material evenly and compact it in layers of max. 30 cm using a light or medium compacting machine (area vibrator or vibratory rammer). In doing so, a compaction level D_{pr} of larger than or equal to 97 % should be achieved. The modules must NOT be damaged. National guidelines for earthworks (such as ZTV E-StB) must be adhered to.

Make sure that the geotextile overlapping is not pulled apart during backfilling and compacting and that the Rigofill ST modules are not damaged!

The permeability of the backfill must at least correspond to the permeability of the backfill soil.

5. Final installation steps

Rigofill® ST
SLW 60/HGV 60

5.6 Creating cover SLW 60/HGV 60

The storage/infiltration system must be covered according to design specifications. Non-cohesive, compactable graded earthwork material with a maximum grain size of 32 mm should be used for the cover, which is a mandatory requirement under traffic areas! **Frozen soil is not permissible!** Additionally, national guidelines for earthworks (such as ZTV E-StB) apply here as well.

Stability analysis

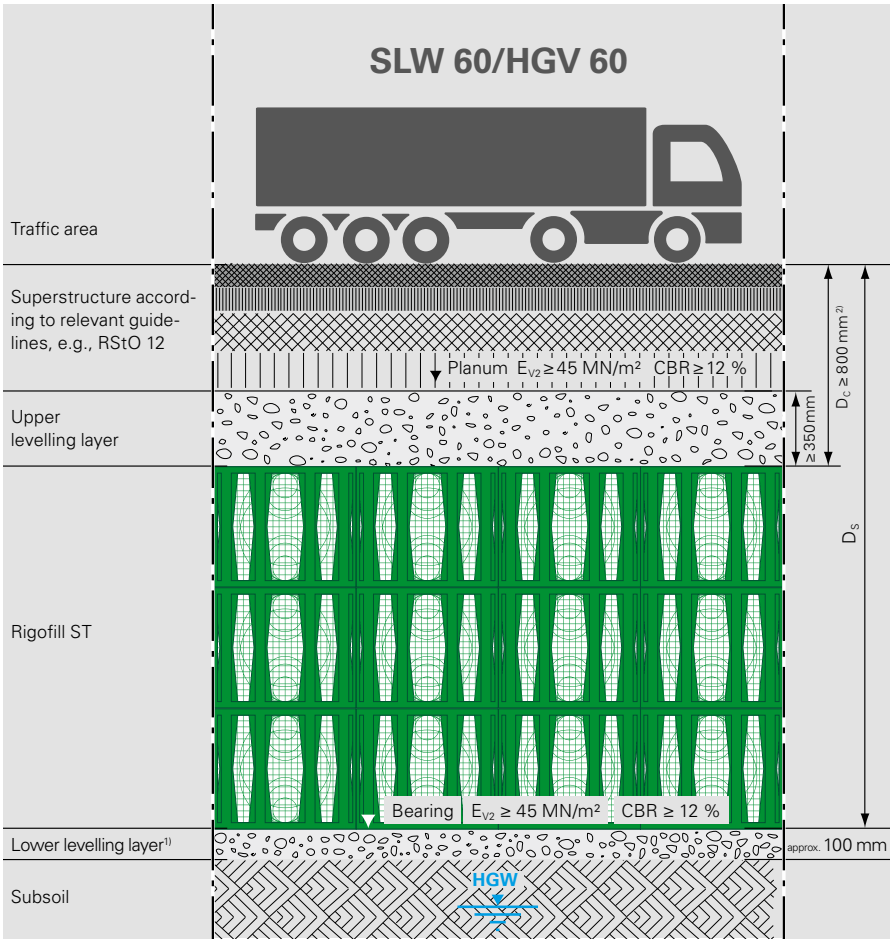
Storage/infiltration systems are subsoil structures and must have sufficient load-carrying capacity against impacting soil and traffic loads. The stability must be proven according to Eurocode, taking into account partial safety factors and/or limiting factors. With conventional installation parameters*, depths of cover of D_C 4 m and soil depths of D_S 6 m are possible for infiltration systems. A project-specific stability analysis can be prepared by FRÄNKISCHE. Under traffic areas, a minimum cover D_C of 80 cm must be observed.

* HGV 60, specific weight of soil 18 kN/m³; mean soil temperature max. 23 °C; soil depth 6 m; κ=0.3; 4-layers

ATTENTION

Note for HGW over structure soil: Rigofill ST systems, which are used as watertight storage systems with impermeable membranes, have been designed for application above the highest groundwater level (HGW). Use in groundwater is possible under corresponding technical conditions after consultation with FRÄNKISCHE. Please contact us!

Standard installation under a traffic area



National guidelines, e.g., RStO 12, must always be observed for installation under traffic areas. To build the planum for the subsequent road construction, a cover must be provided, preferably a gravel sub-base with a thickness of at least 35 cm. Other construction materials normally lead to greater depths of cover.

Generally, at the surface of the cover (= planum), a uniform modulus of deformation E_{V2} larger than or equal to 45 MN/m² or CBR larger than or equal to 12 % must be achieved.

Soil layers must always be provided and compacted in layers of no more than 30 cm. The compaction level D_{pr} should be larger than or equal to 97 %.

Carry out compacting using light or medium area vibrators only!

⚠ CAUTION

Compacting using vibratory rollers and explosion rammers is not permissible!

[1] At least the same permeability (k_f) as the subsoil for infiltration systems

[2] Lower cover upon request

5. Final installation steps

Rigofill® ST-B

SLW 30/HGV 30

5.7 Creating cover SLW 30/HGV 30

The storage/infiltration system must be covered according to design specifications. Non-cohesive, compactable graded earthwork material with a maximum grain size of 32 mm should be used for cover, which is a mandatory requirement under traffic areas! **Frozen soil is not permissible!** Additionally, national guidelines for earthworks (such as ZTV E-StB) apply here as well.

Stability analysis

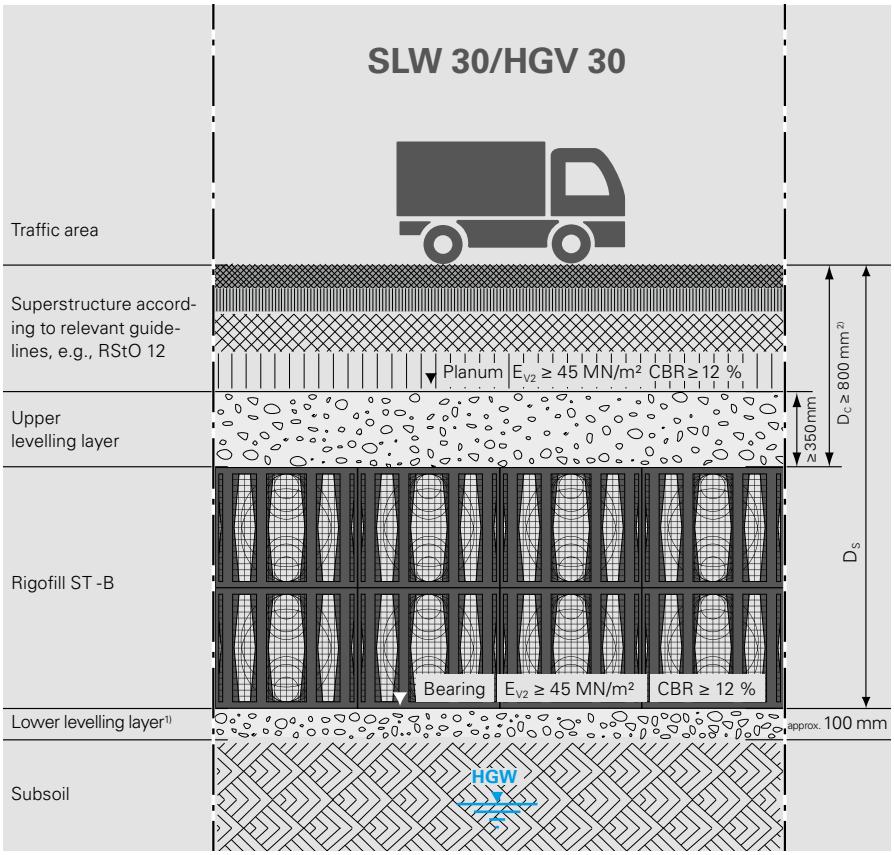
Storage/infiltration systems are subsoil structures and must have sufficient load-carrying capacity against impacting soil and traffic loads. The stability must be proven according to Eurocode, taking into account partial safety factors and/or limiting factors. With conventional installation parameters*, depths of cover of D_C 2.5 m and soil depths of D_S 4 m are possible for infiltration systems. A project-specific stability analysis can be prepared by FRÄNKISCHE. Under traffic areas, a minimum cover D_C of 80 cm must be observed.

* HGV 30, specific weight of soil 18 kN/m³, mean soil temperature max. 23 °C, κ = 0.3

ATTENTION

Note for HGW over structure soil: Rigofill ST-B systems, which are used as watertight storage systems with impermeable membranes, have been designed for application above the highest groundwater level (HGW). Use in groundwater is possible under corresponding technical conditions after consultation with FRÄNKISCHE. Please contact us!

Standard installation under a traffic area



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Carry out compacting using light or medium area vibrators only!

⚠ CAUTION

Compacting using vibratory rollers and explosion rammers is not permissible!

1) At least the same permeability (k_f) as the subsoil for infiltration systems

2) Lower cover upon request

5. Final installation steps

5.8 Use of construction vehicles during installation

⚠ CAUTION

It is not permissible to drive construction vehicles directly on the modules!

Use of vehicles when applying the first cover layer:

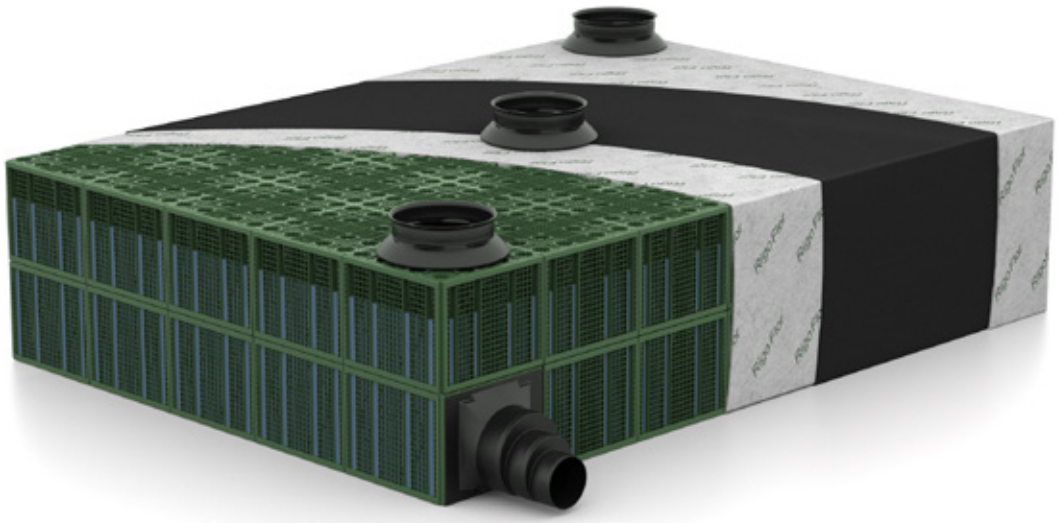
The first cover layer can be applied, for example, using a wheel loader or a front-type mobile excavator. For a wheel loader or mobile excavator with a maximum total weight of 15 tons (chain, 4 wheels, twin-tyres), a compacted cover of at least 30 cm must be placed over the storage/infiltration system. Possible formation of ruts must be taken into account! Avoid steering manoeuvres at this construction stage.

Use of construction vehicles

Driving over the cover with heavy construction vehicles with a wheel load of up to 50 kN (e.g., HGV 30) is possible if the thickness of the compacted cover is not less than 60 cm. Possible formation of ruts must be taken into account! When dumping the earthwork material, the wheel load of 50 kN must not be exceeded; if necessary, load distribution plates must be used.

6. Waterproof systems

Modular reservoir construction for many applications



When using Rigofill ST for stormwater storage, the system can be wrapped in impermeable plastic foil (KDB). Please observe the manufacturer's specifications when installing the KDB impermeable membrane.

Applications

- Stormwater retention
- Stormwater harvesting
- Fire water storage
- Combined applications

7. Professional advice from FRÄNKISCHE

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8. Safety instructions

ATTENTION

Staff responsible for installation, assembly, operation, maintenance and repair must have appropriate qualifications required for this kind of work. The builder is responsible for organising in detail authority, responsibility and supervision of staff.

The operational safety of the system components supplied is only guaranteed in case of proper installation and correct use. Technical threshold values must not be exceeded.

Observe the accident prevention regulations and relevant standards and directives for installation, fitting, operation, maintenance, and repair of systems, pipes, and shafts!

These are inter alia (in extracts):

- Accident prevention regulations
  - Construction work BGV C22 *(Bauarbeiten BGV C22)*
  - Technical wastewater systems GUV-V C5 *(Abwassertechnische Anlagen GUV-V C5)*
- Safety regulations for working in enclosed spaces of technical wastewater systems GUV-R 126 *(Sicherheitsregeln für Arbeiten in umschlossenen Räumen von abwassertechnischen Anlagen GUV-R 126)*
- Handling biological working materials in technical wastewater systems GUV-R 145 *(Umgang mit biologischen Arbeitsstoffen in abwassertechnischen Anlagen GUV-R 145)*
- Directives for working in tanks and narrow spaces BGR 117 *(Richtlinien für Arbeiten in Behältern und engen Räumen BGR 117)*
- Standards
  - Excavations and trenches - Slopes, planking and strutting, breadths of working spaces DIN 4124 *(Baugruben und Gräben-Böschungen, Verbau, Arbeitsraumbreiten)*
  - Construction and testing of drains and sewers DIN EN 1610 *(Verlegung und Prüfung von Abwasserleitungen und -kanälen)*
- Tool for safety and health protection in technical wastewater systems

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⚠ WARNING

- Hazards from gases and vapours such as risk of suffocation, risk of poisoning and risk of explosion
- Risk of falling
- Risk of drowning
- Germ pollution and wastewater with sewage
- High physical and psychic strain during work in deep, narrow and dark spaces
- And others

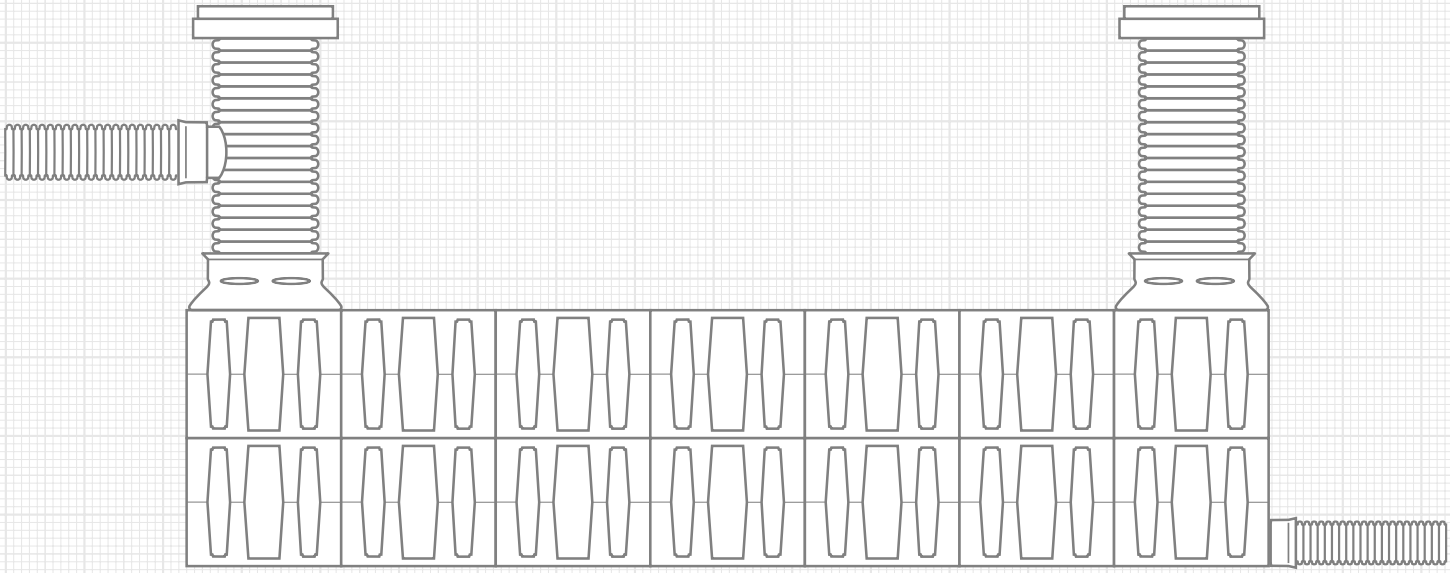
⚠ DANGER

Non-compliance with the operating manual may result in considerable property damage, injury or death.

⚠ CAUTION

The systems, pipes, and shafts are part of an entire network.
During installation, maintenance, service and repair work, always consider the entire system.
Avoid work during rain.

Changes or modifications may only be carried out with the agreement of the manufacturer.
For safety reasons, use original spare parts and accessories approved by the manufacturer.
The use of other parts voids the liability for any consequences arising therefrom.



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