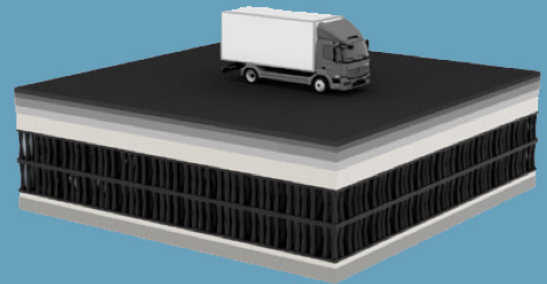
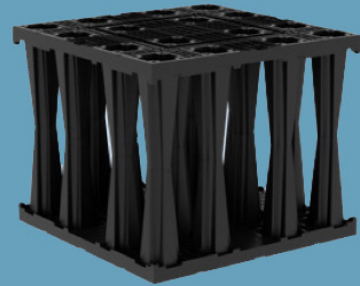
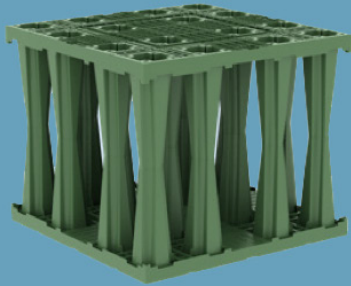


GREENSTORM ST GREENSTORM ST-B

UNDERGROUND STORAGE INFILTRATION MODULES

Certification CSTB

**EXTREMELY HIGH VOLUME VERY EASY TO INSTALL 100% INSPECTABLE****NB**

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

In the following, please be sure to pay attention to these signs:

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

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STORING STORMWATER WITH STORAGE/ INFILTRATION SYSTEMS

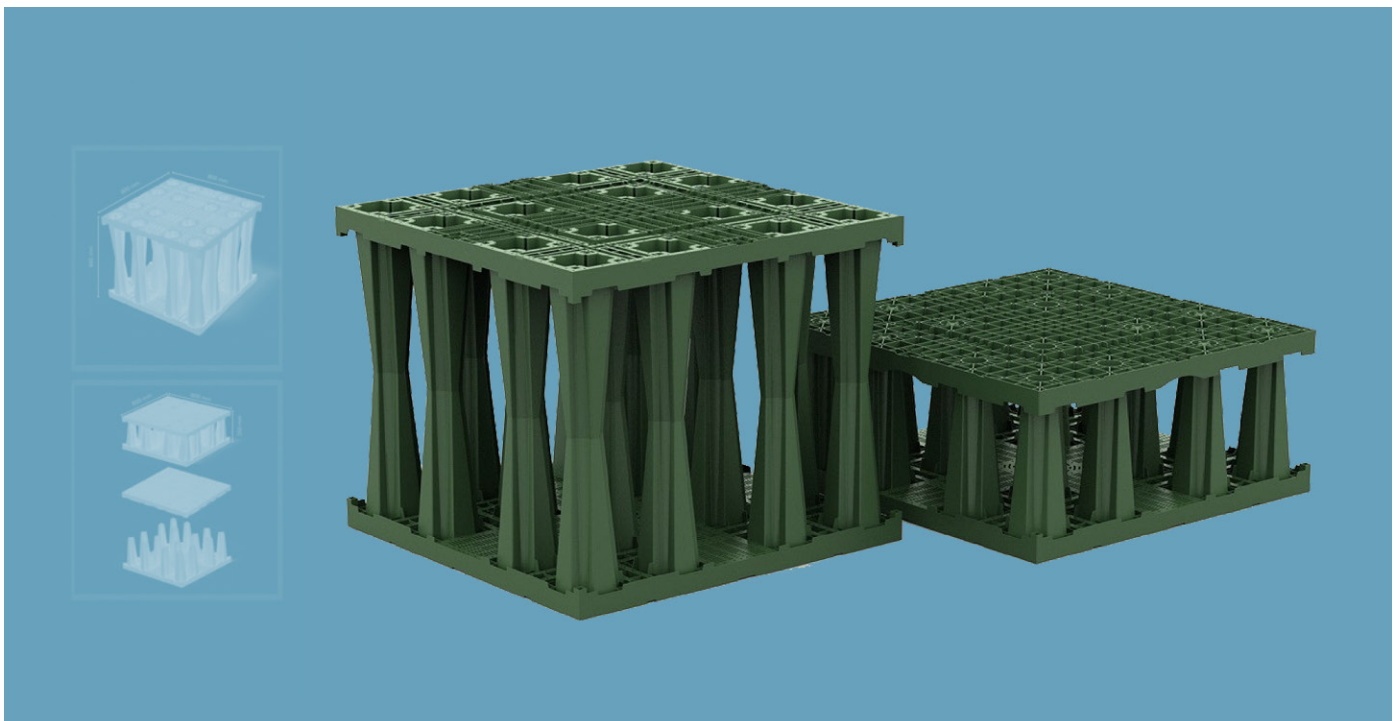
Basic element for underground water storage facilities

GreenStorm ST* are plastic tanks to be installed underground (storage/ infiltration modules) in which water is collected and stored. Storage/infiltration systems temporarily collect stormwater and discharge it later. In addition to infiltration using underdrained swale systems, pipe swales, and gravel swales common in the past, increasingly more storage/infiltration systems are being built today.

The storage space of the storage/ infiltration system consists of numerous GreenStorm ST* modules which can be combined three - dimensionally to form large systems.

The advantage of this method is that the void ratio is up to three times larger in these infiltration systems than in gravel swales which saves space and excavation work.

GreenStorm ST* is a modular system which is characterised by high flexibility, rapid installation and a high level of user-friendliness.



APPLICATION – INFILTRATION

Stormwater infiltration – giving back to nature

Large amounts of stormwater can reduce the performance of wastewater treatment systems. Infiltrating unpolluted stormwater nearby has therefore several advantages.

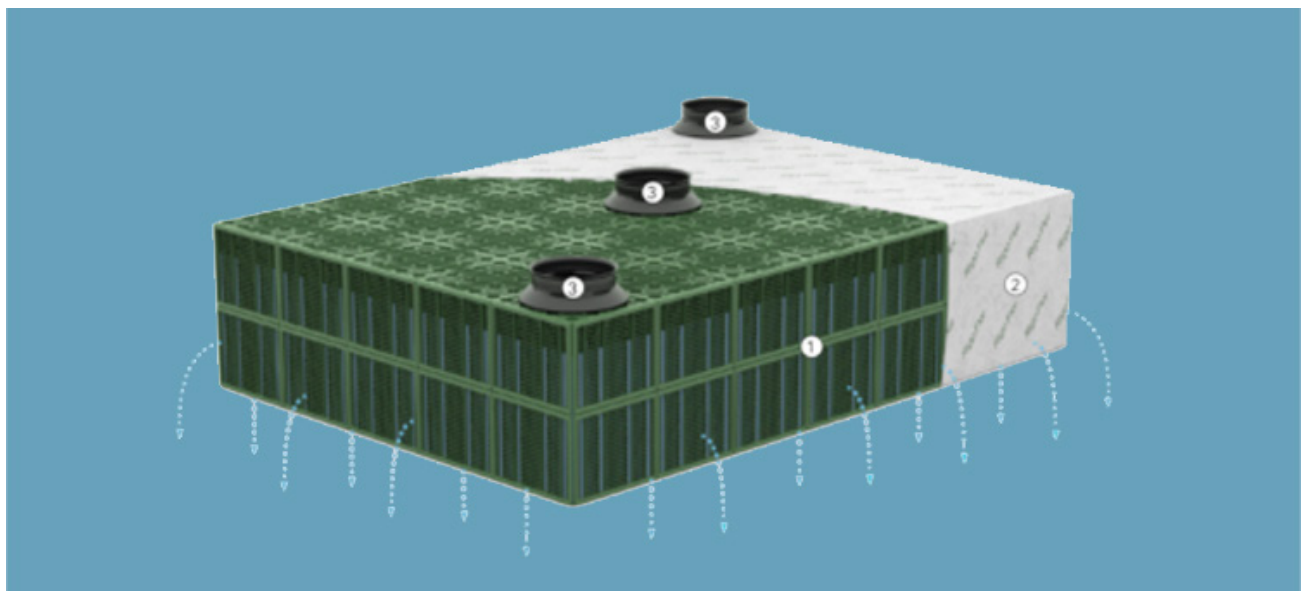
A constant growth in built-up areas and increase in impervious surfaces prevent natural infiltration of stormwater into the soil. Special infiltration systems are used in order to discharge it to the water cycle. In addition to infiltration using pipe swales, increasingly more storage/infiltration systems are being built.

The advantage of this method is that the storage volume of the infiltration system is increased, and space and excavation are saved as compared to gravel swales.

Stormwater is thus returned to the natural water cycle and can contribute to producing new groundwater. Infiltration systems are subject to very high requirements. Consequently, they have become an important component of urban drainage.

Storage/infiltration systems considerably increase the underground storage volume. High-performance storage/infiltration systems can be installed even in confined space.

In particular in urban construction no additional space is required and precious building ground is saved.



① GreenStorm ST* storage/infiltration module ② Geotextile ③ QuadrControl ST system shaft

APPLICATION – RETENTION

Retaining stormwater – instead of flooding

If subsoil conditions are unfavourable to infiltration, the goal is to retain the stormwater and ensure a retarded, timelagged discharge. Exposure to impulsive stress can be eliminated or reduced in sewer networks, wastewater treatment systems and waterbodies.

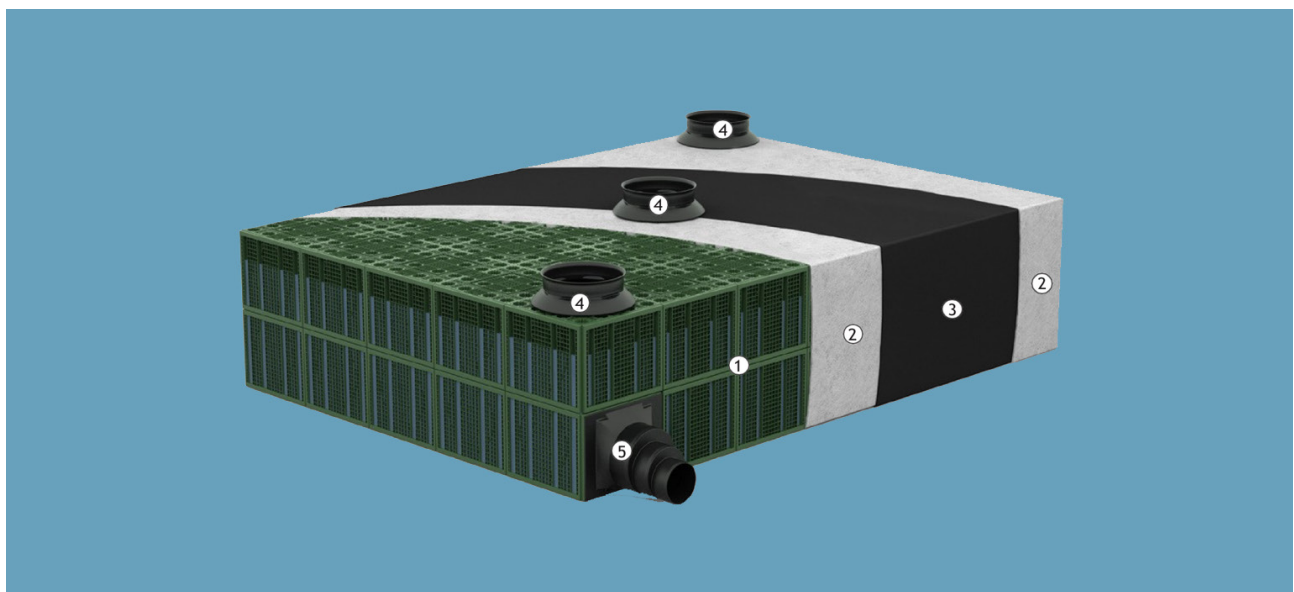
Stormwater retention systems retard the infiltration of stormwater. They are comprised of a watertight retaining element, an inlet and a vortex outlet.

The stormwater distributes evenly in the system where it can be stored and is then discharged in a controlled manner through throttle shafts. If infiltration must be avoided or to prevent unintended

discharge of groundwater or strata water (e.g., in case of contaminated soil), it is necessary to waterproof the retention system.

Stormwater runoff from impervious surfaces that cannot infiltrate naturally leads to peak loads in sewer systems.

Stormwater retention facilities collect stormwater in an underground storage tank and discharge it in a retarded manner but continuously. Their very short construction times make storage/ infiltration systems an inexpensive alternative to conventional retention facilities such as retention channels or underground concrete tanks.



- ① GreenStorm ST* storage/infiltration module
- ② Geotextile
- ③ Impermeable membrane
- ④ QuadroControl ST system shaft
- ⑤ Adapter

APPLICATION – HARVESTING / FIRE WATER STORAGE

Retaining stormwater – instead of flooding

Water – particularly drinking water – is a priceless resource which should be treated responsibly and used sparingly. It is therefore wise to collect, store and use stormwater if the water must not necessarily be suitable for drinking purposes, instead of allowing the water to infiltrate into the soil unused or diverting it into the sewer system.

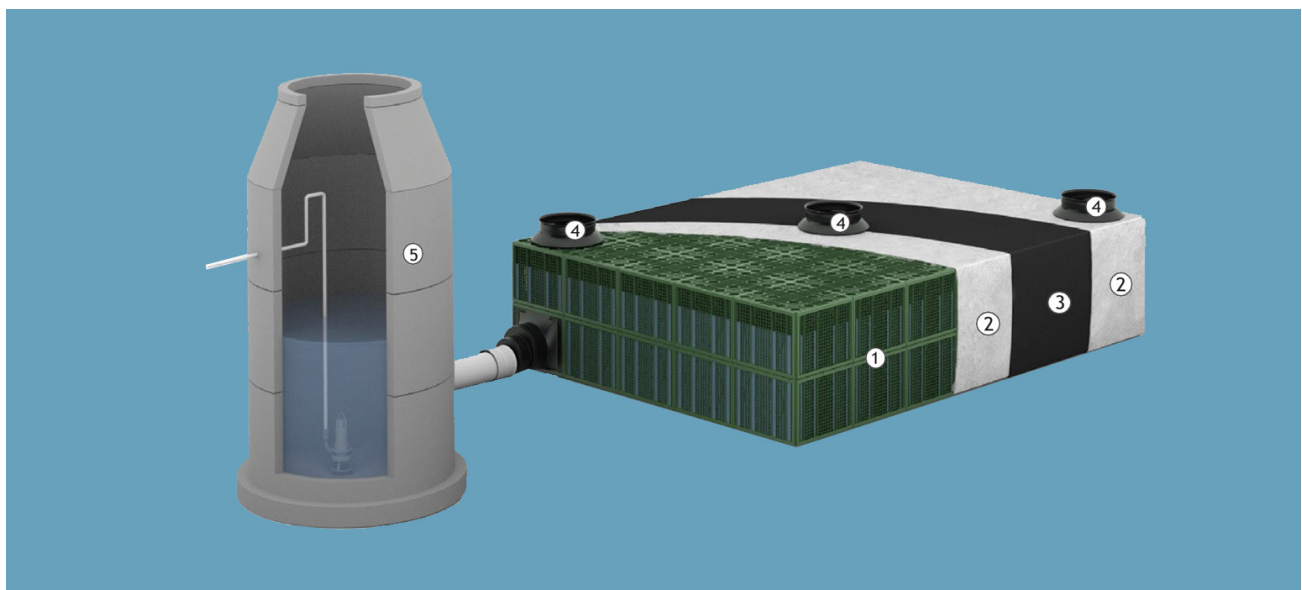
There are many examples: irrigation for greens, car wash, use in toilets, etc.

Water is diverted into a waterproof storage/ infiltration system and can be supplied for use via a pumping system

The use of the GreenStorm inspect system allows for finding solutions that fit project-specific requirements – even under the most difficult conditions such as very tight space, narrow conditions, low cover, high groundwater level, etc.

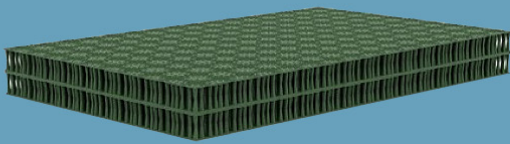
Stormwater harvesting systems provide water for different domestic and industrial water uses. They comprise a watertight retaining element, an inlet with upstream stormwater treatment system, a pump shaft and a system control.

Using GreenStorm ST* for fire water storage also saves water, since system checks can be made in a filled state and water does not have to be pumped out as is the case with conventional concrete tanks.

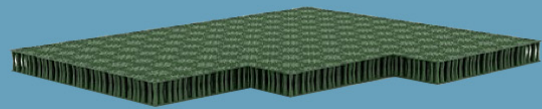


- ① GreenStorm ST* storage/infiltration module
- ② Geotextile
- ③ Impermeable membrane
- ④ QuadroControl ST system shaft
- ⑤ Adapter

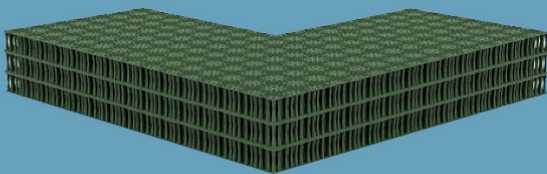
POSSIBLE SYSTEM GEOMETRIES



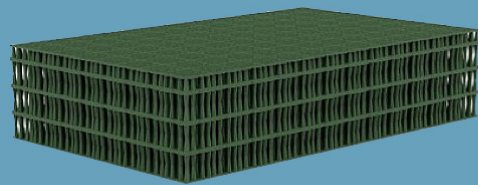
GreenStorm ST*
2 Layer



GreenStorm ST*
1 Layer



GreenStorm ST*
3 Layer



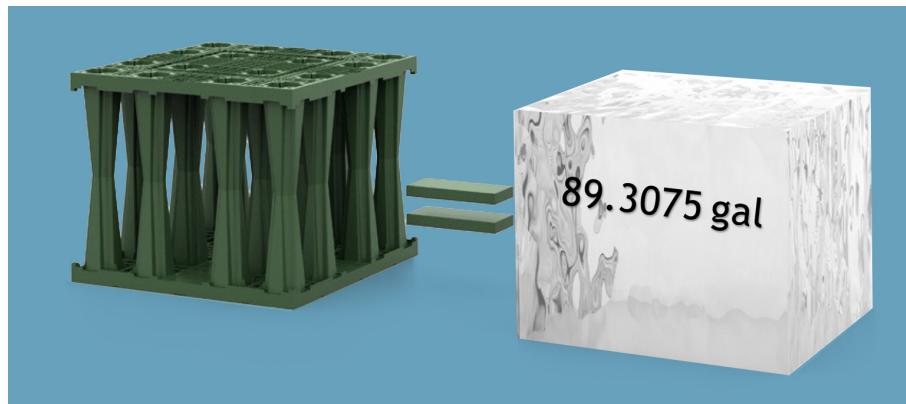
GreenStorm ST*
3 1/2 Layer

STORAGE VOLUME

Extremely high volume

The GreenStorm ST* full block provides a storage volume of 89.3075 gallons with a gross volume of 92.827 gallons. With a storage volume of more than 96 %, it stores three times as much water as gravel swales.

The half block has a height of 13.7795 in and is used if shallow systems are required, e.g, in case of high groundwater levels. With a gross volume of 49.2731 gallons, it offers a storage volume of 46.6335 gallons.

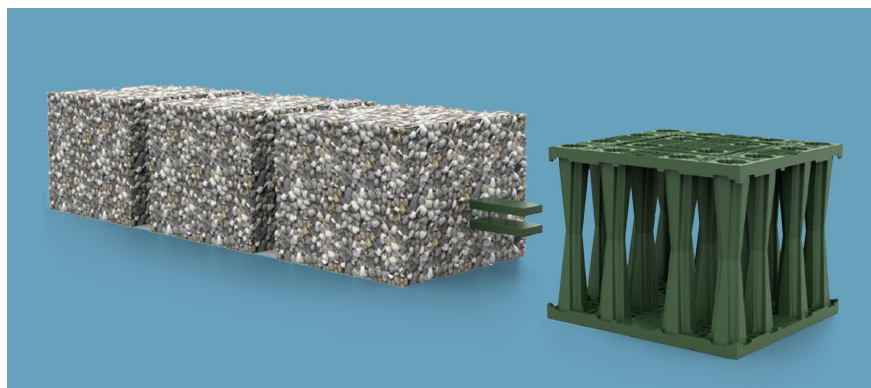


Pipe and gravel swales only use approx. 30 % of their volume to store water. Therefore, three times the required water storage volume must be provided by excavation.

Thus, subsoil storage spaces for stormwater can be built in a very efficient and cost-saving way.

This requires lots of space which is frequently not available in urban areas. GreenStorm ST* storage/infiltration systems save an enormous amount of space and excavation work.

Storage/infiltration systems considerably increase the storage space. High- performance storage/infiltration systems can be installed even in confined space.



INSTALLATION

Easy construction site handling

REQUIRES LITTLE SPACE FOR STORAGE.

The storage/infiltration modules are delivered in compact, stacked units with 17 modules per pallet. The easy stackability of the GreenStorm ST* and ST-B modules allows them to be stored even in confined construction space, even outside the excavation pit. This facilitates installation, since no additional storage space must be provided in the excavation pit. Installation is neither impeded nor constrained.



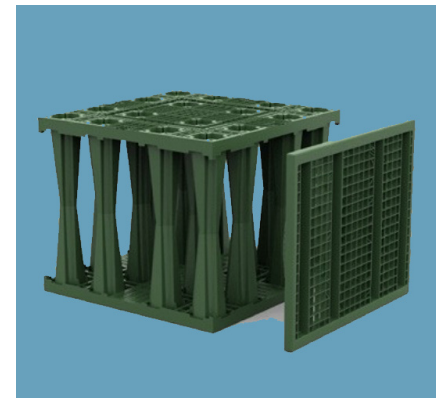
PRE-ASSEMBLY

Depending on the requirements, GreenStorm ST and GreenStorm ST*-B modules can be pre-assembled in no time at all, both outside and inside the excavation pit with just one easy move. Easy high tensile strength snap connections allow for combining two half elements to create a reliable unit in only a short period of time. This can easily be done by one person alone without requiring any additional tools. The moveable parts of the snap connection are recessed and thus protected from damage.



EASY ASSEMBLY

There is no need to adhere to any complex installation pattern – the pre-assembled modules or half blocks can just as well be connected to create a single unit. The low weight allows this to be done by one person only. Connectors establish firm connections between the individual modules. The surface can be accessed immediately without any risk of accidents, since the hole size of the columns is dimensioned respectively (< 3.93701 in). Thus, no additional covers of column holes are required.



UP TO 88%
The storage/infiltration modstorage space saved as compared to unstackable storage/infiltration modules

INSPECTION

CCTV inspection even when filled ■ ■

Storage/infiltration systems are durable structures for urban drainage; they must work reliably for decades. Durability and reliability are essential requirements. The best way to inspect the state of a system using state-of-the-art technology

is CCTV inspection. Thus, a storage/infiltration system can be inspected excellently – for final acceptance or later. This provides safety for authorities, engineers, construction companies, customers, and operators.

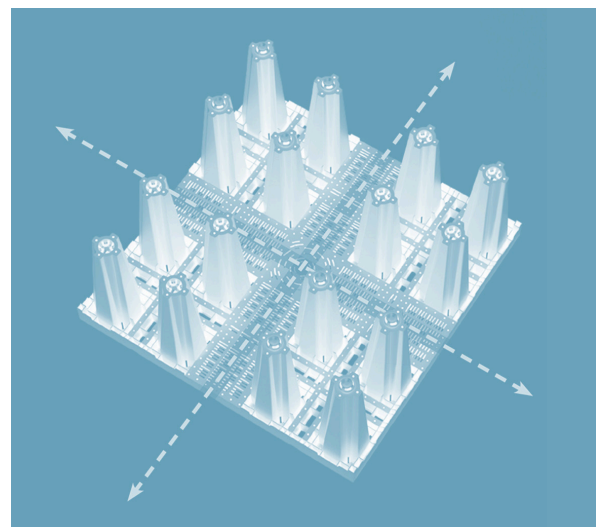
Cross-shaped inspection tunnel

GreenStorm ST* modules have a cross-shaped tunnel which makes the storage/infiltration system camera-accessible and flushable in two axes and thus in four dimensions. The special and open design of the inspection tunnel allows for an unobstructed view of the entire interior and not only the inspection tunnel.

The ideal, level and vibration-free running surface and the slim column structure allow for an unobstructed view of the entire module volume. The Quadro Control ST shaft for GreenStorm ST*, which can be integrated, allows for easy access of the automotive dolly for both professional final acceptance inspection and flushing technology.

For example, the statically relevant load-bearing elements, the condition of the geotextile and the entire soil area can be viewed. GreenStorm ST* and GreenStorm ST*-B thus provide excellent options to control the “inner life” of a storage/ infiltration system at any time.

100%
INSPECTABLE



INSPECTION

Recommended camera equipment

A standard sewer camera is sufficient for camera inspection. A rotatable and height-adjustable camera head allows for an optimal view of the lateral soil area,

a controllable carriage ensures a centred positioning, and high-performance optics together with lighting allow for a perfect picture.



Recommended: tender invitation for final acceptance inspection

Final acceptance of sewers using camera inspection has long since become a matter of course in sewer construction. Also in the construction of storage/ infiltration systems, the final acceptance inspection is important! Planning engineers should absolutely include this in their tender documents.



Certified CCTV accessibility

GreenStorm ST* has been designed for the use of modern CCTV inspection technology. The inspectability of the GreenStorm ST* and QuadroControl ST system unit has been tested and confirmed by leading manufacturers of pipe CCTV inspection technology.



LOADING

Heavy traffic

Storage/infiltration systems are subsoil structures and must have sufficient load-carrying capacity against impacting soil and traffic loads.

GreenStorm ST* storage/ infiltration systems are extremely strong and have been designed with various applications in mind: While GreenStorm ST* has been designed in particular for traffic loads of up to 13 tons axle load.



High resistance

When installed under traffic areas, relevant national guidelines must be observed. To build the planum for the road construction, an upper levelling layer must be provided.

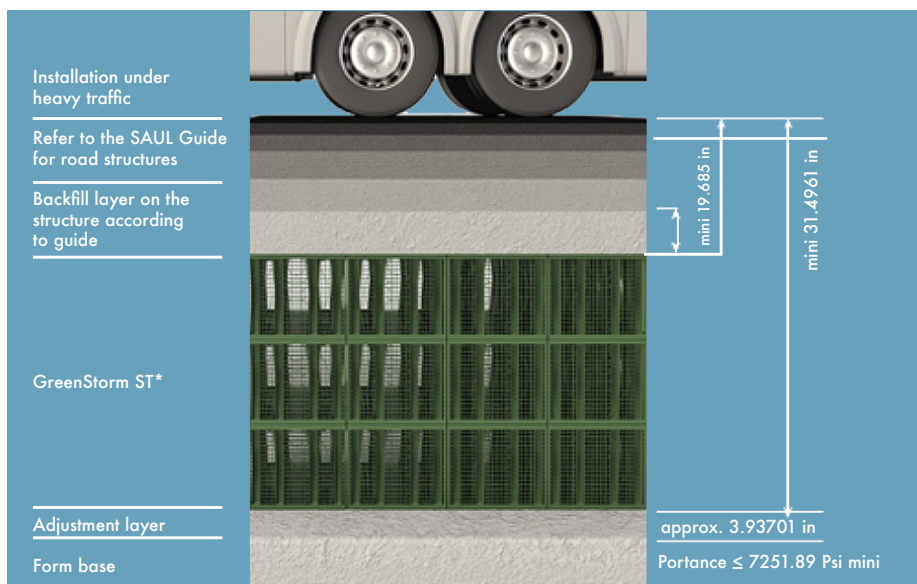
It should preferably be built as a gravel sub-base with a thickness of at least 13.7795 in, other materials usually result in larger covers.

Generally, a uniform modulus of deformation $EV2 \geq 45 \text{ MN/m}^2$ must be proven on the planum.

Installation under traffic area

The subsoil structures must have sufficient load-carrying capacity against impacting soil and traffic loads to ensure reliable stability.

This is why GreenStorm ST* is suitable for traffic loads of up to 15 tons axle load (20 tons possible, please refer to our technical department).



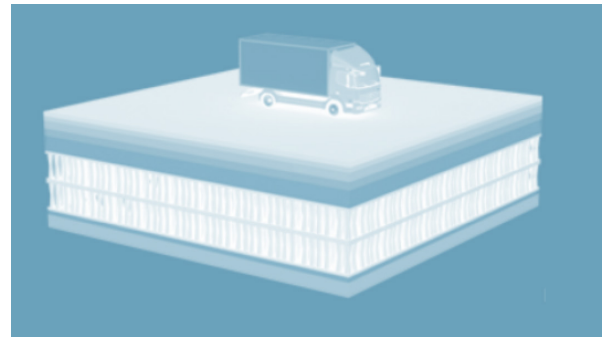
With conventional installation parameters*, depths of cover of DC 157.48 in and soil depths DSof 236.22 in are possible for infiltration systems. A project-specific stability analysis can be prepared by STORMCON.

*specific weight of soil 18 kN/m³ Mean soil temperature max. 73.4°F, 236.22 in. soil depth, = 0.3, 4-layer

LOADING

Light traffic, green spaces

The special material composition of GreenStorm ST-B* makes it ideal for surfaces with less traffic such as sports fields or green spaces. STORMCON storage/ infiltration systems have been designed for a minimum lifetime of 50 years.



Installation under traffic areas

When installed under traffic areas, relevant national guidelines must be observed. To build the planum for the road construction, an upper levelling layer must be provided.

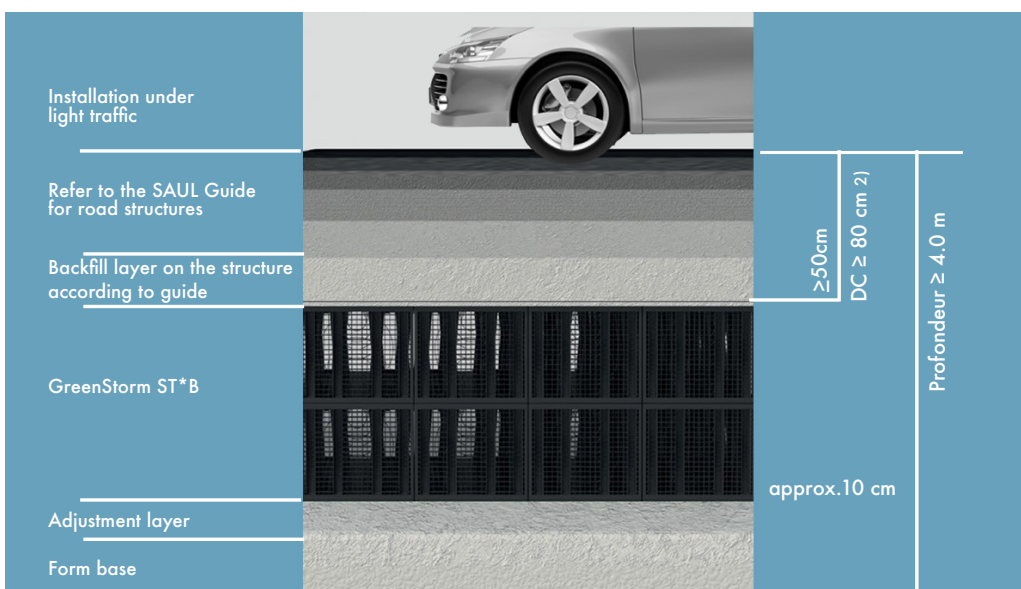
It should preferably be built as a gravel sub-base with a thickness of at least 13.7795 in, other materials usually result in larger covers.

Generally, a uniform modulus of deformation EV2 $\geq 45 \text{ MN/m}^2$ must be proven on the planum.

Standard installation under a traffic area

The GreenStorm ST-B* storage/infiltration module is suitable for traffic loads of up to 10 tons axle load and therefore also

suitable for the construction of systems under parks, greens and car parks.

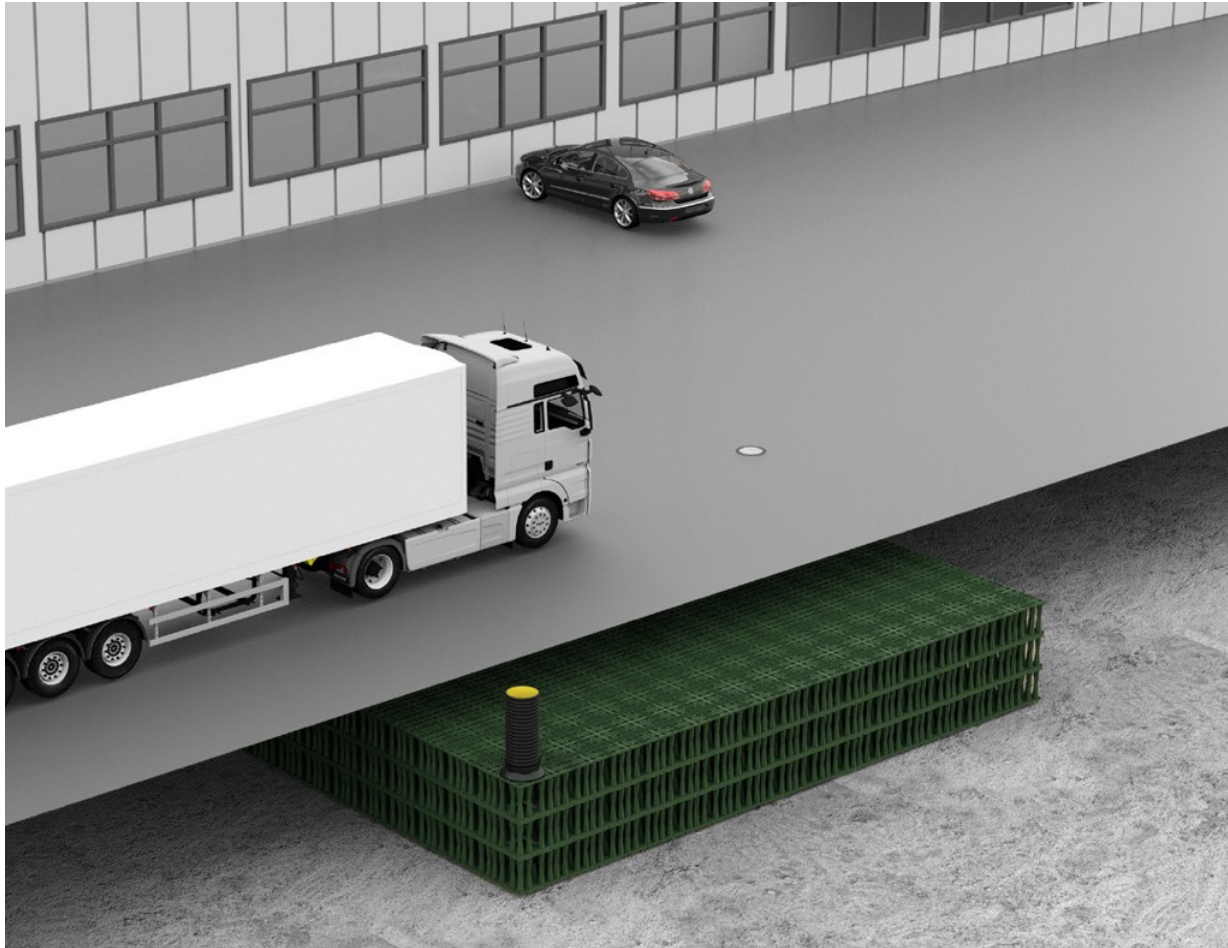


With conventional installation parameters*, depths of cover up to 2.5 m and soil depths up to 4m are possible for infiltration systems. A project-specific stability analysis can be prepared by STORMCON.

*Light traffic, specific weight of soil 18 kN/m^3
Mean soil temperature max. $23 \text{ }^\circ\text{C}$, $= 0.3$

LOADING

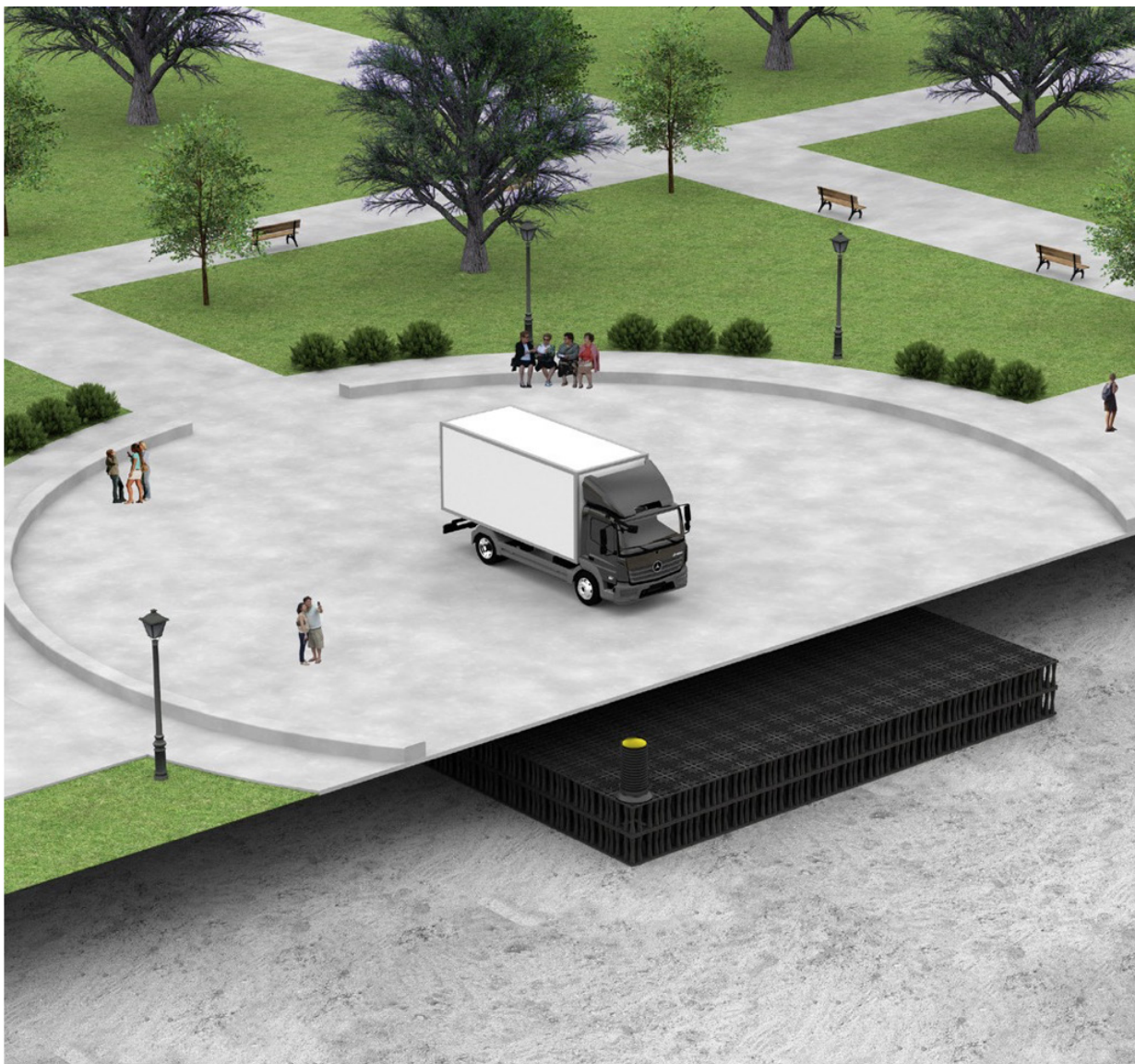
Heavy traffic example GreenStorm ST*



*GreenStorm ST/STB underground infiltration/storage modules *Rigofill ST RigofillST-B

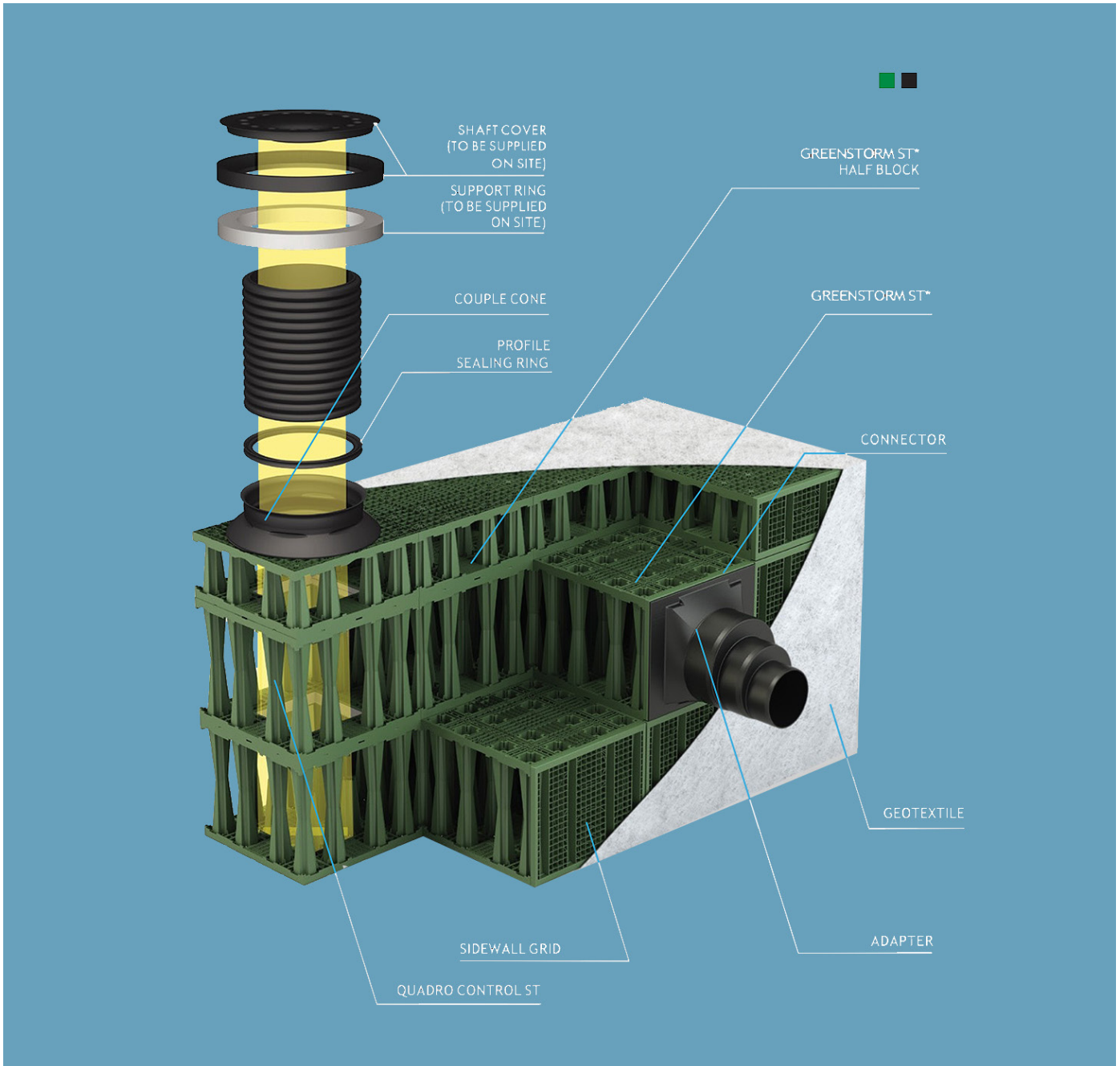
LOADING

Light traffic example GreenStorm ST*



*GreenStorm ST/STB underground infiltration/storage modules *Rigofill ST RigofillST-B

Quadro® Control ST – system shaft



INTEGRATED INSPECTION SHAFTS

Quadro® Control ST is a polypropylene inspection shaft which can be integrated in the storage/infiltration system.

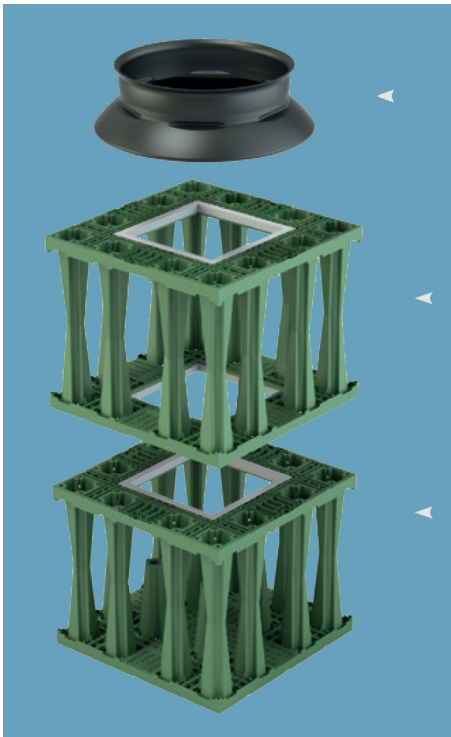
It is square with a base of 800 x 800 mm and can be used in any position of the layout.

Its height results from the number of layers of the connected storage/infiltration system. The shaft allows for comfortable access to the inspection tunnel from aboveground. High-performance inspection and flushing equipment can easily be inserted into the inspection

tunnel. The shaft is integrated in the storage/infiltration system and grows layer by layer as construction progresses. QuadroControl ST is delivered with all required components and will be assembled on site.



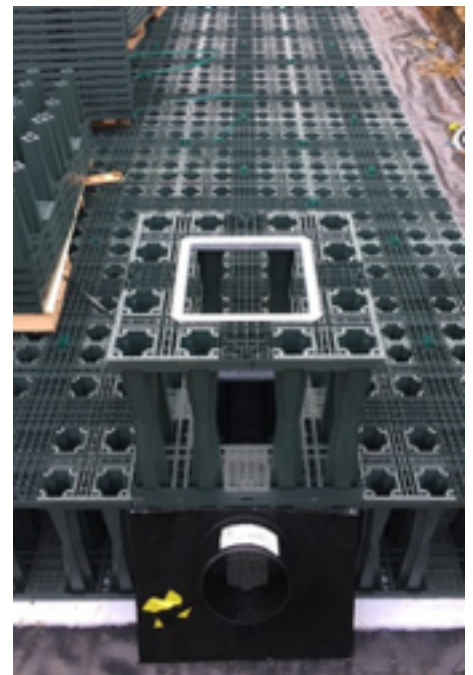
Structure



The shaft cone is the transition to the extension pipe. The length of the extension pipe is chosen depending on the installation depth.

The shaft is integrated in the storage/infiltration system and grows layer by layer as construction progresses.

The shaft components are stackable and delivery includes the cone with all required components as shaft package.



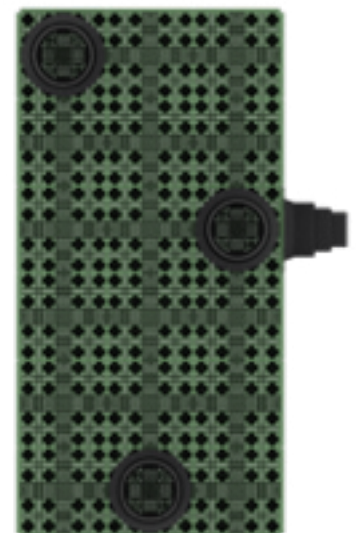
Arrangement of inspection shafts

Number of and position in the system are above all determined by the size of the system, access, pipe connections and design of the outdoor facilities.

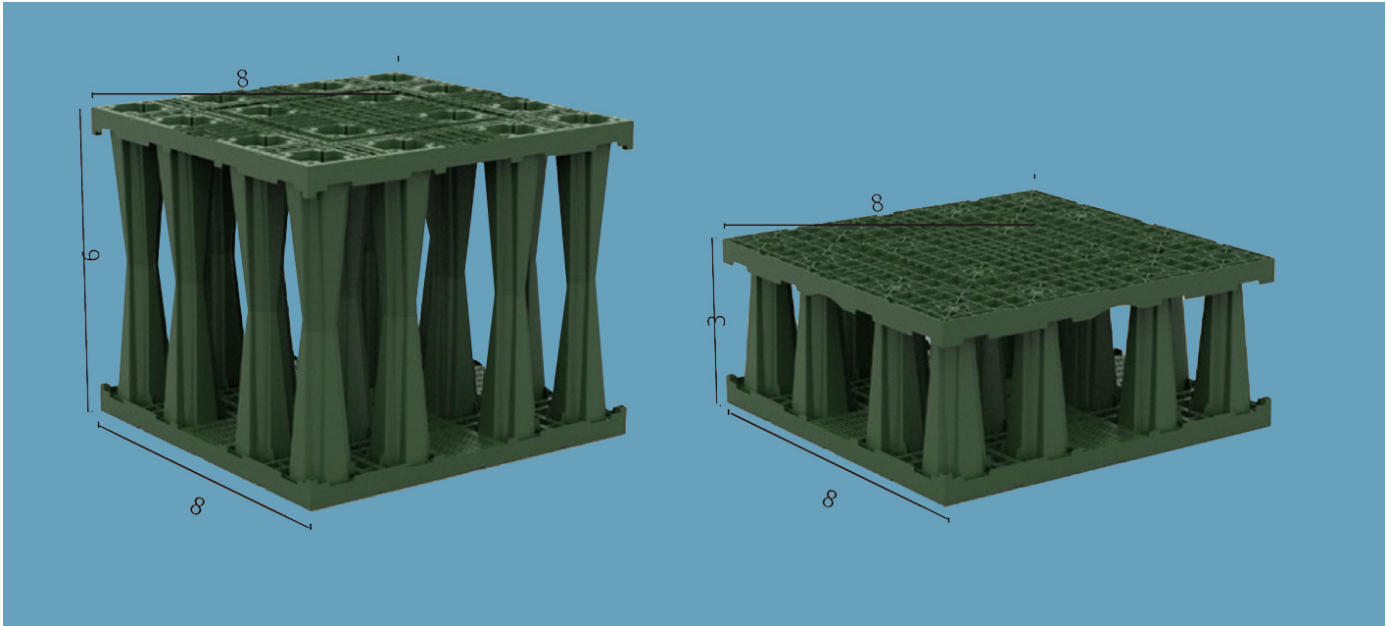
not interfere with the design of the outdoor facilities, but can easily be accessed by vehicles for maintenance purposes.

In order to ensure that flushing of the complete system is possible, each module should comprise at least one inspection shaft. In addition, the shafts should be positioned such that the shaft covers do

Adjacent shafts should be staggered in the layout.

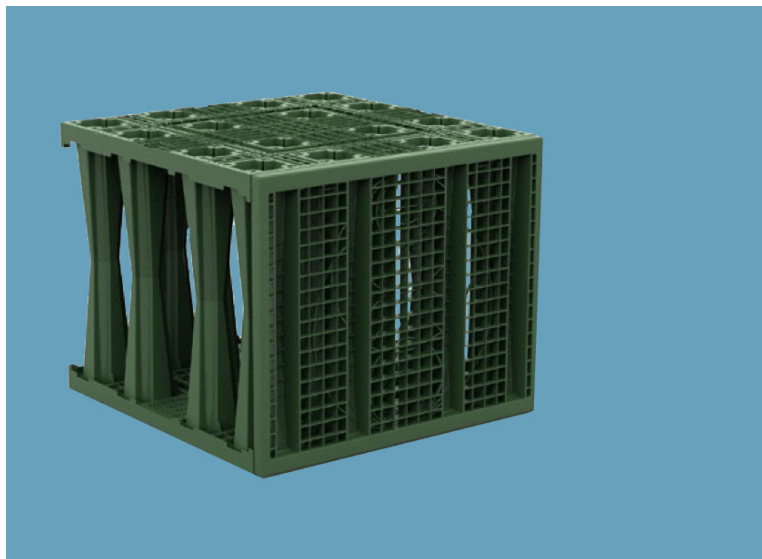


DESIGN-RELEVANT DIMENSIONS



Sidewall grid connection options

Full block connection options
 Dia 100 mm, 135 mm, 150 mm, 200 mm,
 250 mm, 300 mm, 375 mm et 450 mm



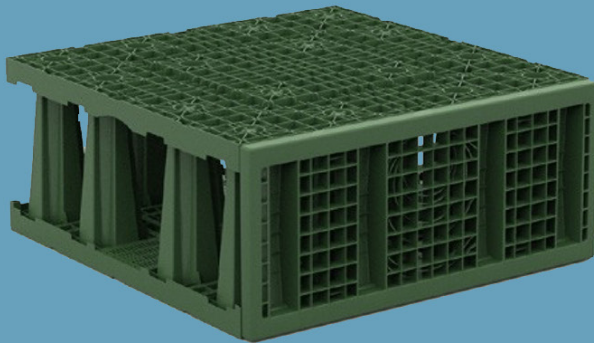
This allows all available nominal diameters to be realised both at the top and the bottom of the module.

SIDEWALL GRID CONNECTION OPTIONS

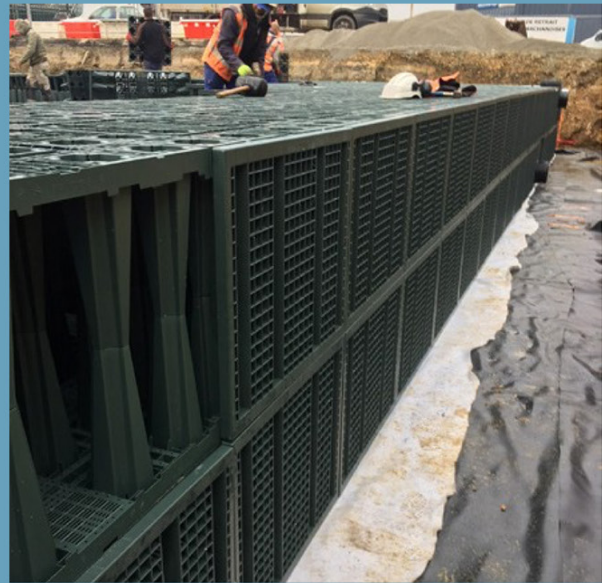


Sidewall grid connection options

Half block connection options
 Dia 100 mm, 135 mm, 150 mm,
 200 mm et 250 mm



The side plates can be drilled to the height and desired position within the frame.

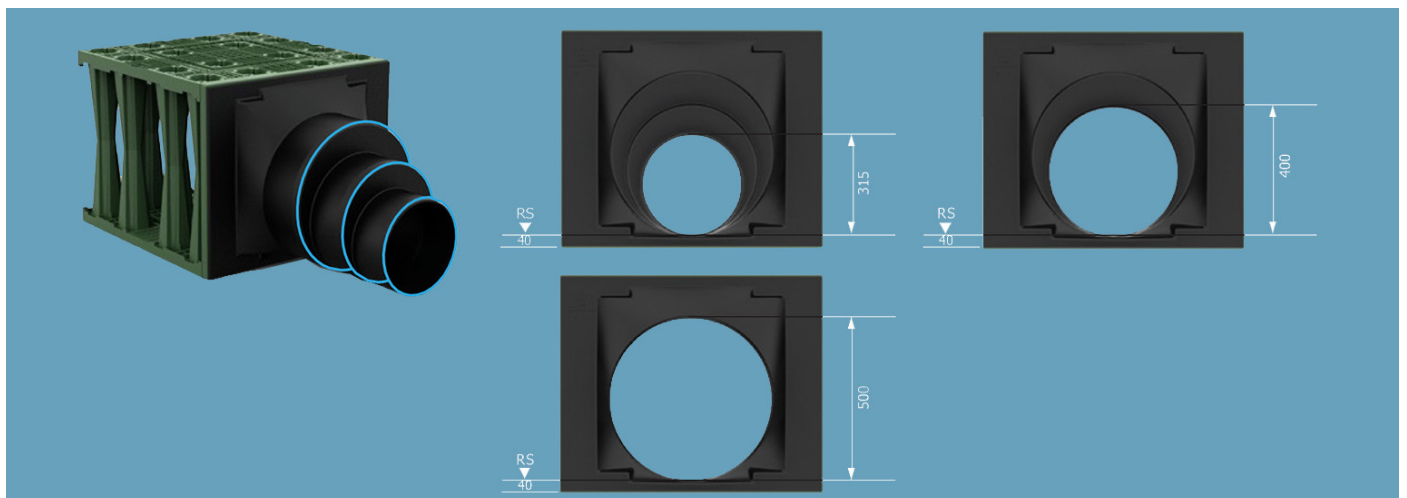


ADAPTER CONNECTION OPTIONS

Connections:
 Dia 300 mm, 450 mm
 et 525 mm

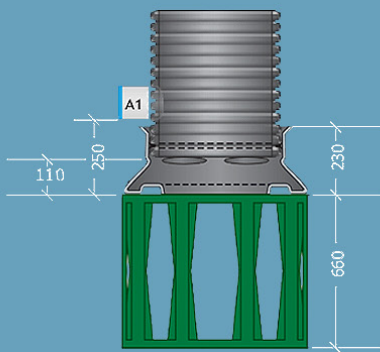
Outside diameter 315 mm for
 a pipe diameter 300 mm PVC

Outside diameter 400 mm for a pipe
 diameter 450 mm PVC. A flexible
 sleeve off center is required.

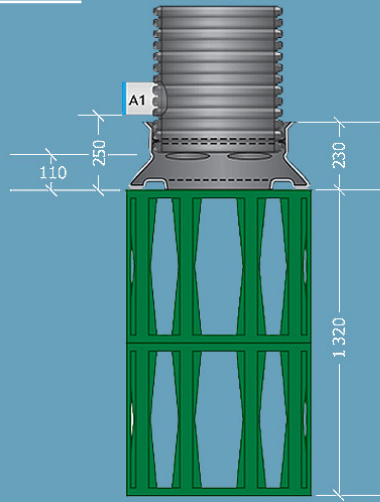


Outside diameter 500 mm for a pipe
 of diameter 525 mm.
 A flexible sleeve off center is required

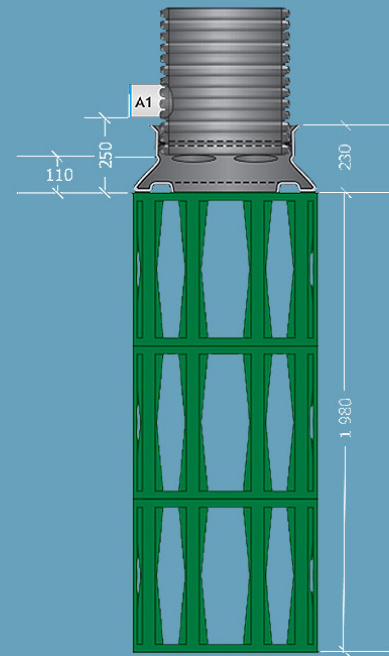
DIMENSIONS OF QUADRO® CONTROL ST
CONNECTION OPTION
A1

 DN/OD 200 OR DN/OD 315
CONNECTION POSSIBLE


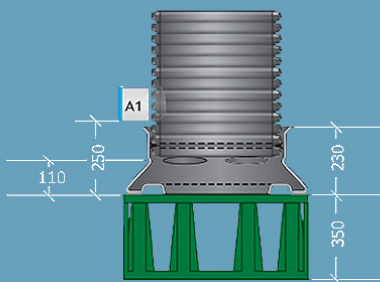
1-layer



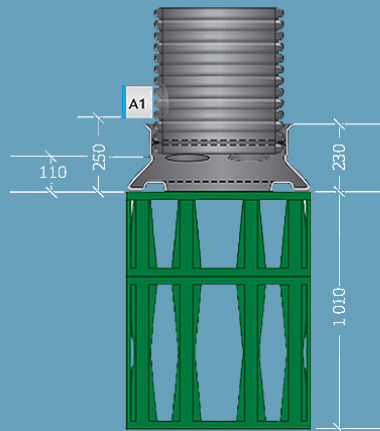
2-layer



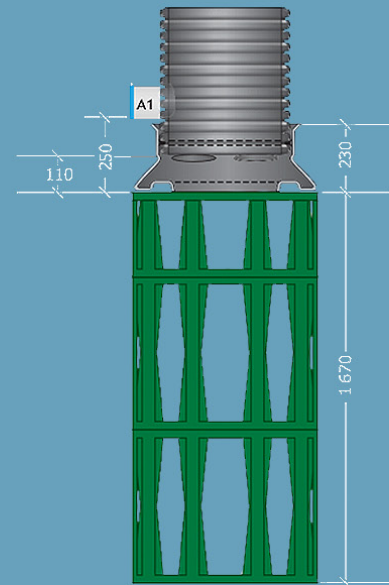
3-layer



1/2-layer



1 1/2-layer



2 1/2-layer

SHAFT DESIGN OF QUADRO® CONTROL ST

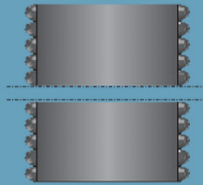
Structure of inspection shaft



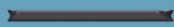
Class B or D
shaft cover acc. to DIN EN 124,
CW 610



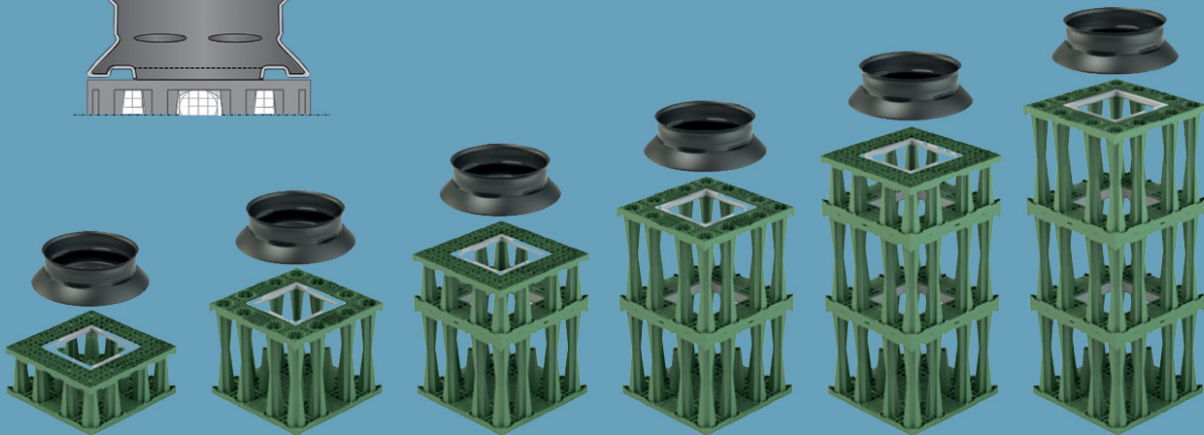
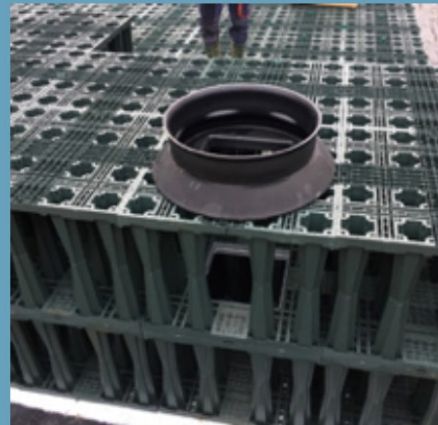
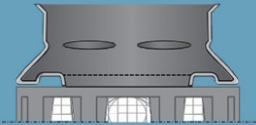
Support ring acc. to DIN 4034,
 $D_1 = 625 \text{ mm}$



Extension pipe
 $D_o 600$



Sealing ring



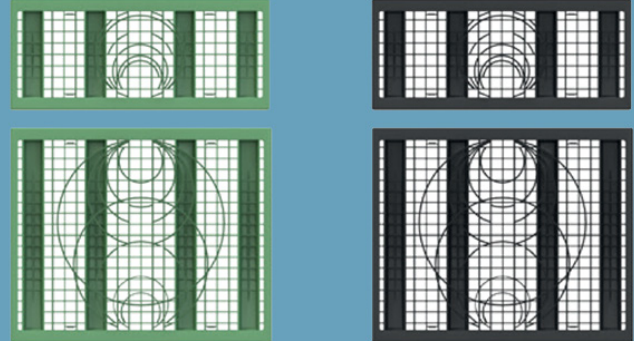
Sidewall grid

The sidewall grids serve as external boundary.

They can be assembled easily using snap connections. The predefined position of the connections at the sidewall grids guarantees that the connections of inlet pipe and outlet pipe and the tunnel are same level. The sidewall grids can be assembled easily also outside the excavation pit.

The sidewall grid for the full block and Quadro® Control ST and Quadro® Control ST-B has a size of $W \times D \times H = 800 \times 30 \times 660$ mm and is suited for connecting lateral solid wall pipes DN 110, 125, 160, 200, 225, 250, 315, 400 and 500.

The sidewall grid for the half block or the half-layer shaft has a size of $W \times D \times H = 800 \times 30 \times 350$ mm and is suited for connecting lateral solid wall pipes DN 110, 125, 160, 200, 225 and 250. In storage/infiltration designs with inside corners, shortened sidewall grids are used at one side.



Different connection heights (regardless of the nominal diameter) are required above the bottom depending on the number of floors:

ST	ST-B	Number of floors	Connection height
●	●	0.5-layer	40 mm
●	●	1-layer	40 mm
●	●	1.5-layer	700 mm
●	●	2-layer	700 mm
●	●	2.5-layer	1 360 mm
●	●	3-layer	1 360 mm

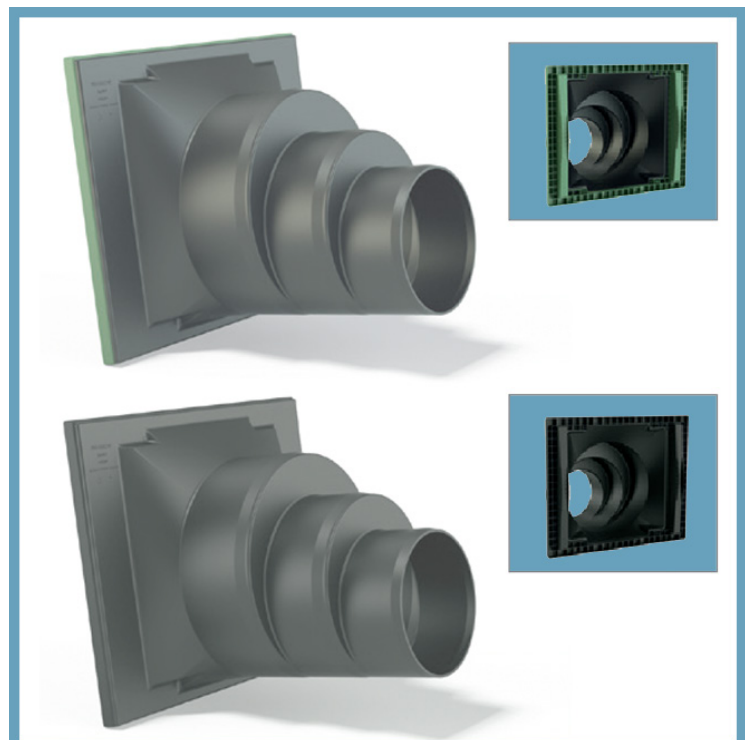
Adapter

The adapter for GreenStorm ST* and GreenStorm ST-B* has a length of 800 mm and a height of 660 mm and serves as an inlet and outlet connection.

It provides an inlet connection with an optimised flow design with diffusor effect for solid wall pipes DN 315, 400 and 500. It can be connected to GreenStorm ST* and GreenStorm ST-B* easily and quickly thanks to the snap connection.

The predefined position of the snap connection at the module guarantees that inlet pipe and outlet pipe and tunnel connect same level.

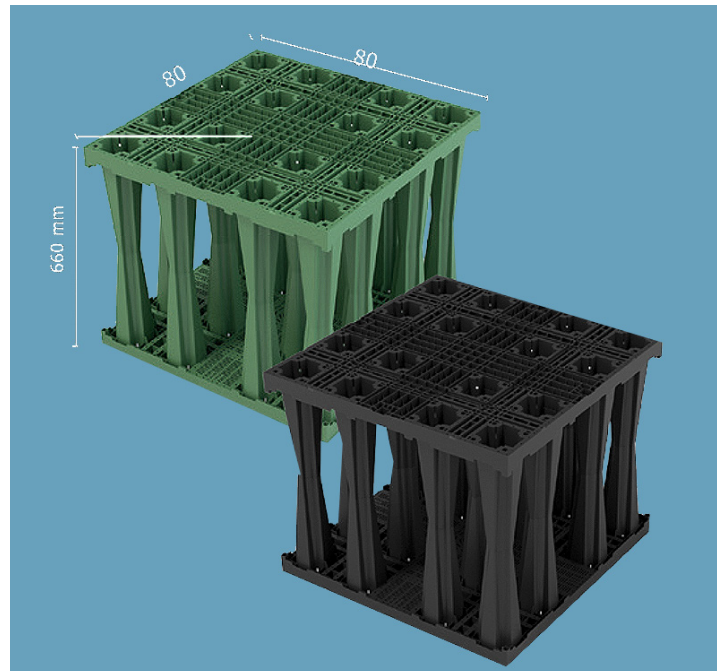
The adapter ensures a connection with the same crown, as it is installed turned by 180°.



GreenStorm ST* and GreenStorm ST-B* are highly durable and hard-wearing storage/infiltration module with a base of 800 x 800 mm and a height of 660 mm full blocks.

The polypropylene full block consists of two half elements to be installed on site and has a void ratio of more than 96 %. Water can flow through the module three-dimensionally almost without any obstacles. GreenStorm ST* and GreenStorm ST-B* allows for virtually any size and geometry of the systems.

The cross-shaped inspection tunnel in the storage/infiltration modules has been designed for the use of automotive dollies. This allows the effective drainage surface and the entire system volume with all statically relevant bearing-type fixtures to be inspected.



The GreenStorm ST* and GreenStorm ST-B* half block have a base of 800 x 800 mm and a height of 350 mm

It consists of only one half element which must be assembled with a roof slab on site. This roof slab is only required for the half block. The GreenStorm ST* and GreenStorm ST-B* half block are used in particular for systems with shallow installation depths, e.g. in case of high groundwater levels.

Systems in various heights can be realised in 35cm steps and adjusted to almost any layout in combination with the full block.

