

GREENSTORM ST GREENSTORM ST-B INSTALLATION MANUAL

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!

This includes (in extracts):

- Accident prevention regulations
- Construction work BGV C22
- Technical wastewater systems GUV-V C5

Safety regulations for working in enclosed spaces of technical wastewater systems GUV-R 126

Handling biological working materials in technical wastewater systems GUV-R 145

Directives for working in tanks and narrow spaces BGR 117

Standards

- Excavations and trenches - slopes, planking and strutting, breadths of working spaces DIN 4124
- Construction and testing of drains and sewers DIN EN 1610

Tool for safety and health protection in technical wastewater systems.

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 system is part of an entire network. During installation, maintenance, service and repair work on one component, always consider the entire system.

Avoid work during rain.

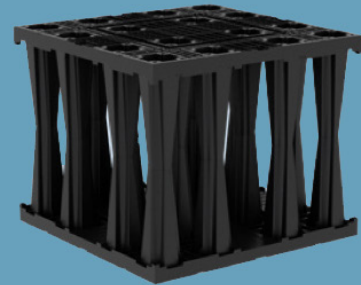
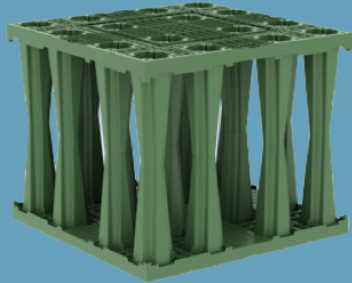
Changes or modifications to the system may only be carried out with the agreement of the manufacturer. For safety reasons, use original spare parts and accessories approved by the manufacturer. The use of other parts voids the liability for any consequences arising therefrom.

PARTH PUSHKARNAparthp@stormcon.ca**GREG DZIEWIECKI**gregd@stormcon.ca

General information on using our products and systems:

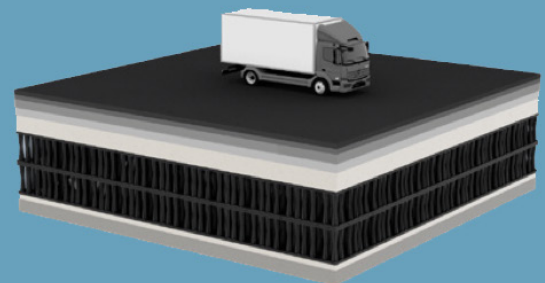
Information about or assessments of the use and installation of our products and systems is exclusively provided on the basis of the information submitted. We do not assume any liability for damage caused by incomplete information. If the actual situation deviates from the planned situation or if a new situation occurs or if different or new installation techniques are applied, these must be agreed upon with, since these situations or techniques may lead to different conclusions. Notwithstanding the above, the customer is solely responsible for verifying the suitability of our products and systems for the intended purpose. In addition, we do not assume any liability or responsibility for system characteristics and functionalities when third-party products or accessories are used in combination with systems. We only assume liability if original products are used. For use in other countries than, country-specific standards and regulations must also be observed.

All information in this publication generally reflects the state of the art at the time of printing. Furthermore, considerable care was taken when preparing this publication. Nevertheless, typesetting and translation errors cannot be entirely excluded. We also reserve the right to make changes to our products, specifications and other data. Changes may also become necessary as a result of legal, material-related or other technological requirements, which cannot or can no longer be considered in this publication. For this reason, we cannot assume any liability which is based solely on the data provided in this publication. The decisive role with regard to the data on products and services is always played by the order placed, the product actually purchased and the documentation in connection with it, or the information provided by our specialist staff in each specific individual case.

GREENSTORM ST*
GREENSTORM STB


  SLW 60/ HGV 60

  SLW 30/ HGV 30



Certification CSTB 

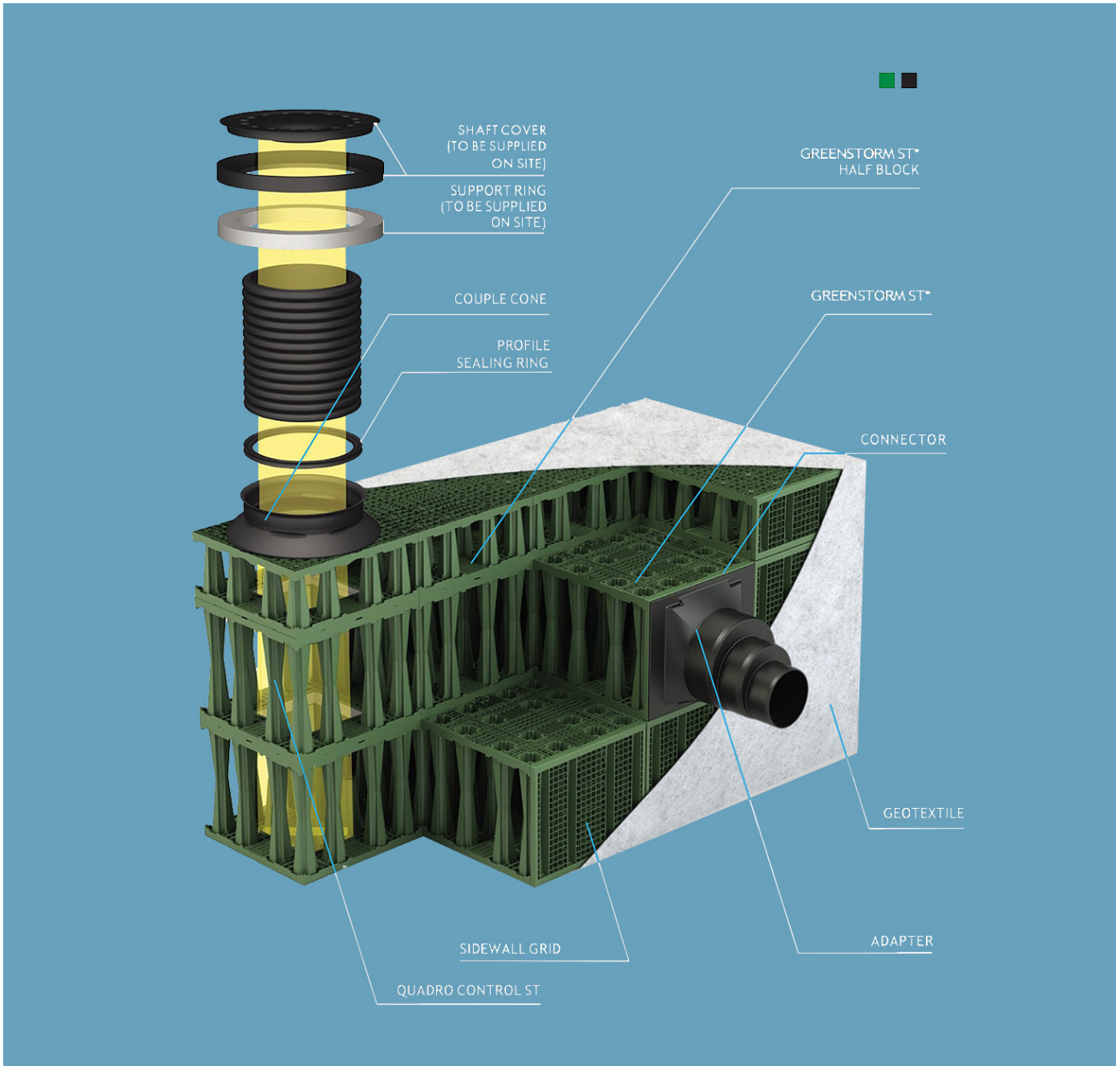
NB

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.

Safety Instructions	2
Connection	3
Greenstorm ST - System	4
Greenstorm ST - System & components	6 - 7
Greenstorm ST - Storage/infiltration module	8 - 12
Transport and storage	8
Separating pallets	8
Creating excavation pit and bearing	9
Laying geotextile	9
Installing GreenStorm ST	10 - 12
Quadro® Control ST – shaft elements	13 - 16
Delivery	13
Shaft variants	13
Installation of shaft elements	14 - 15
Temporary construction site covers	16
Shaft cover	16
Final Installation steps	17 - 22
Installing sidewall grids	17
Cutting openings in sidewall grids	18
Inserting adapters	18
Creating geotextile wrapping	19
Lateral backfilling	19
Creating cover SLW 60 / HGV 60	20
Creating cover SLW 30 / HGV 30	21
Construction vehicles during installation	22
Waterproofing systems note	23
Cold Installation	24

Quadro® Control ST – system shaft



GreenStorm® ST



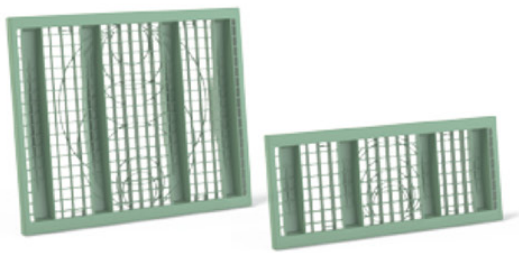
consisting of:
GreenStorm ST half

GreenStorm® ST half block



consisting of:
one GreenStorm ST half element and one roof slab

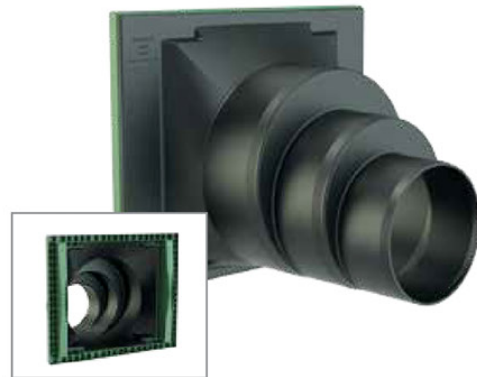
Sidewall grid



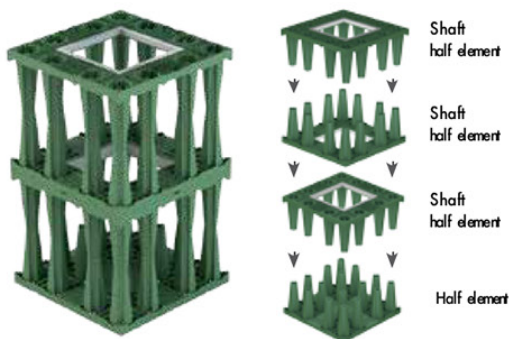
Sidewall grid for
GreenStorm ST full

Sidewall grid for
GreenStorm ST half

Adapter

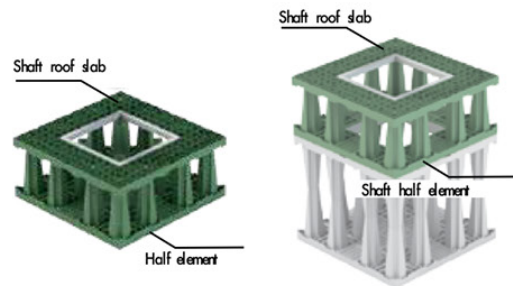


Quadro®Control ST



consisting of:
one half element and several shaft half elements

Quadro®Control ST - half shaft



consisting of:
one half element
and one shaft roof slab

consisting of:
one shaft half element and one
shaft roof slab

TRANSPORT AND STORAGE

GreenStorm ST modules are delivered stacked on pallets (63.00 in. x 31.5 in). 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 accordingly. Preferably unload the pallets using forklifts or other lifting tools. The lifting tools must have the technical equipment required for lifting gear operation.

GreenStorm ST can be stored outdoors. ■ ■ Storage time 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 stability of the material decreases in sub-zero temperatures. *Damaged modules must NOT be installed!*

The relevant safety provisions of the building industry apply.



SEPARATING PALLETS



CAUTION

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

Avoid dropping, dumping as well as hitting the GreenStormST modules against each other.

We recommend using hoisting slings to separate both stacked pallets. Separate the pallets before removing the half elements.

EXCAVATING PIT AND CREATING BEARING



The excavation pit must be made according to planning 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 downsiding masses. In addition, national regulations must be observed. Take measures to ensure that the excavation pit is free from water during the entire execution time. In order to install GreenStorm ST modules, a horizontal, level and stable bearing is essential.

To this end, create a levelling layer of approx. 3.93 in, 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 compression level D_{pr} should be $\geq 97\%$ ($E_{vd} \geq 522135.85 \text{ lbf/ft}^2$ or $CBR \geq 8\%$ 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 area is decisive for further installation and strongly affects both bearing and setting properties of the storage/infiltration modules, particularly in case of multi-layer designs



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 11.81 in. at all edges.

ATTENTION

Ensure that the geotextile surface is completely closed and no openings occur even during backfilling!



IMPORTANT CHARACTERISTICS OF GEOTEXTILE (E.G. RIGOFLOR):

Thickness: ≥ 0.07 in

Puncture resistance: 449.6 lbf

Geotextile class: 3

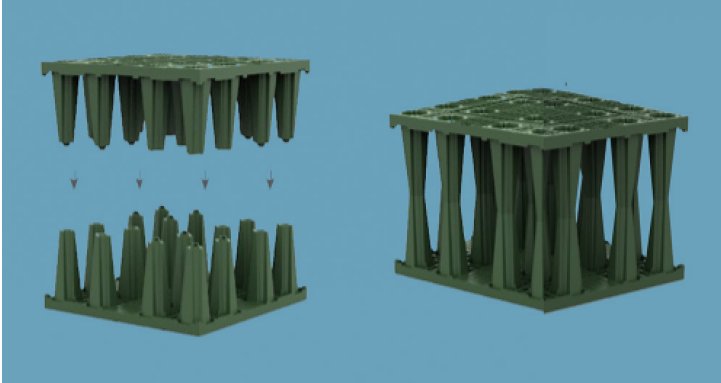
Characteristic opening width: 0.003 in

k_f value (at 20 kPa): 0.134 mph

Water permeability acc. to EN ISO 11058: 90 l/sm²

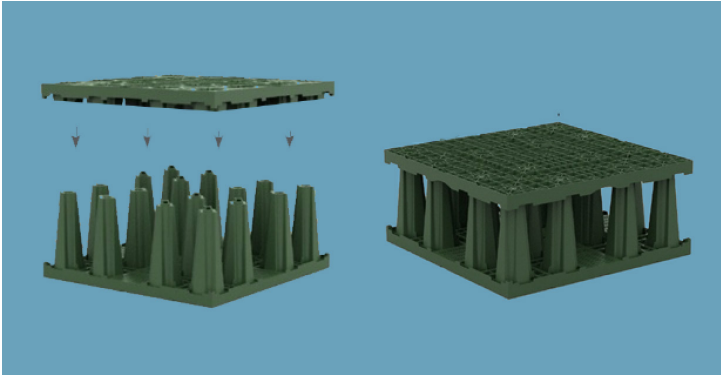
Mass per unit area: 4.74 lb/ft²

INSTALLATION



Each GreenStorm 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.



Each GreenStorm ST half block consists of one half element and one roof slab. 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 multi-layer systems, the half blocks must be arranged in the top layer.

ATTENTION

Half blocks must be installed with the roof slab located on top.

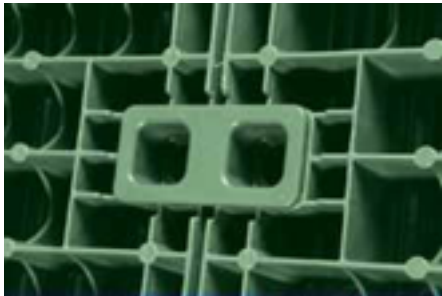
PRE-ASSEMBLY OUTSIDE THE EXCAVATION PIT



PRE-ASSEMBLY INSIDE THE EXCAVATION PIT



INSTALLATION





CONNECTOR, FULL BLOCK/HALF BLOCK:

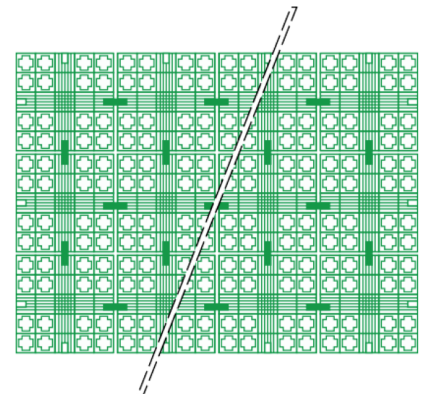
Connectors help secure the modules in place.

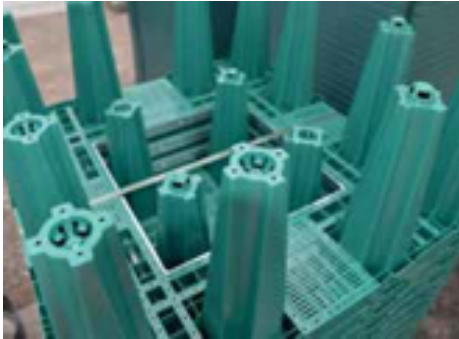
Secure modules using connectors on the top surface of the module in the centre of each edge that neighbours another module.

Single-layer connector using the example of GreenStorm ST Multiple-layer connector using the example of GreenStorm ST-B

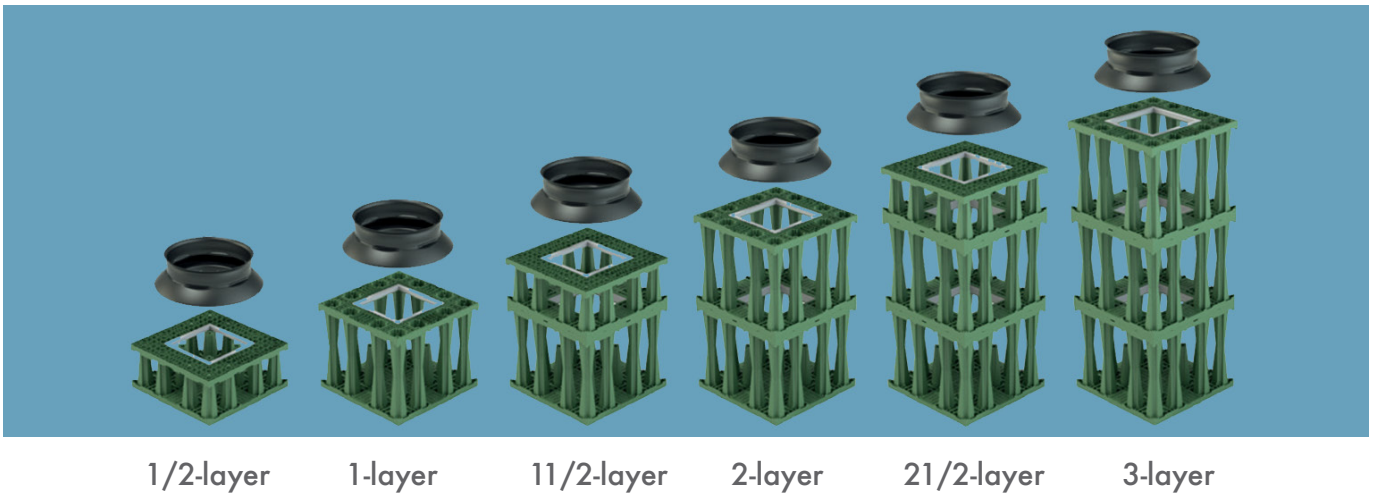
Determination of requirements:

Connector	Application	Requirement	
single-layer 	for single-layer installation	requirement for single-layer installation	1 pc. per module
		requirement for multiple layer installation	2 pcs. per module
multiple layer 	for multiple layer installation	requirement for 2-layer installation	1 pc. per module
		requirement for 3-layer installation	1.3 pcs. per module



DELIVERY


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

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	515.04.005	1	1		1	1
Quadro Control ST 1	515.04.010	1	1	1		1
Quadro Control ST 1.5	515.04.015	1	1	2	1	1
Quadro Control ST 2	515.04.020	1	1	3		1
Quadro Control ST 2.5	515.04.025	1	1	4	1	1
Quadro Control ST 3	515.04.030	1	1	5		1
QuadroControl ST-B 0.5	515.04.205	1	1		1	1
QuadroControl ST-B 1	515.04.210	1	1	1		1
QuadroControl ST-B 1.5	515.04.215	1	1	2	1	1
QuadroControl ST-B 2	515.04.220	1	1	3		1
QuadroControl ST-B 2.5	515.04.225	1	1	4	1	1
QuadroControl ST-B 3	515.04.230	1	1	5		1

INSTALLATION OF SHAFT ELEMENTS



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

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



Install the shaft bottom in the intended position in the layout.

Please ensure that the opening with the metal frame faces upwards. Use block connectors to connect to the adjacent GreenStorm ST modules.



Additional complete layers:

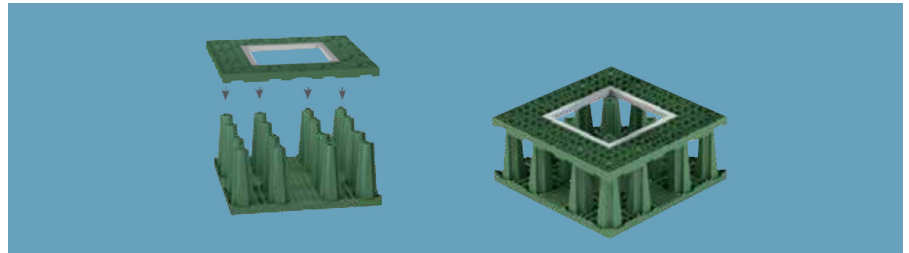
Each of these layers is made of two shaft half elements. Place the shaft components onto the already existing shaft bottom using multi-layer connectors

INSTALLATION OF SHAFT ELEMENTS

Half-layer shaft:

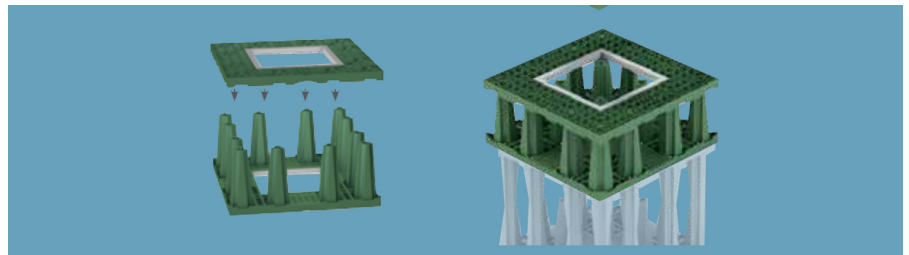
Always start by putting the half element and the shaft roof slab together.

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



Upper half layer:

This layer consists of a shaft half element and a shaft roof slab. Place the half layer onto the subjacent shaft part using multi-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. Preferably put the couple cones on the shaft openings only after the upper system layer has been completed.

Before installing the couple cones, wrap the entire storage/infiltration system including shafts in geotextile. At the square openings, cut out the geotextile.

Installation of extension pipes:

Insert the extension pipes into the cone coupling using the sealing rings included in the delivery (please use lubricant). Before, mount profile sealing rings onto the first corrugation trough of the extension pipes.

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



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 temporary 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

SHAFT COVERS

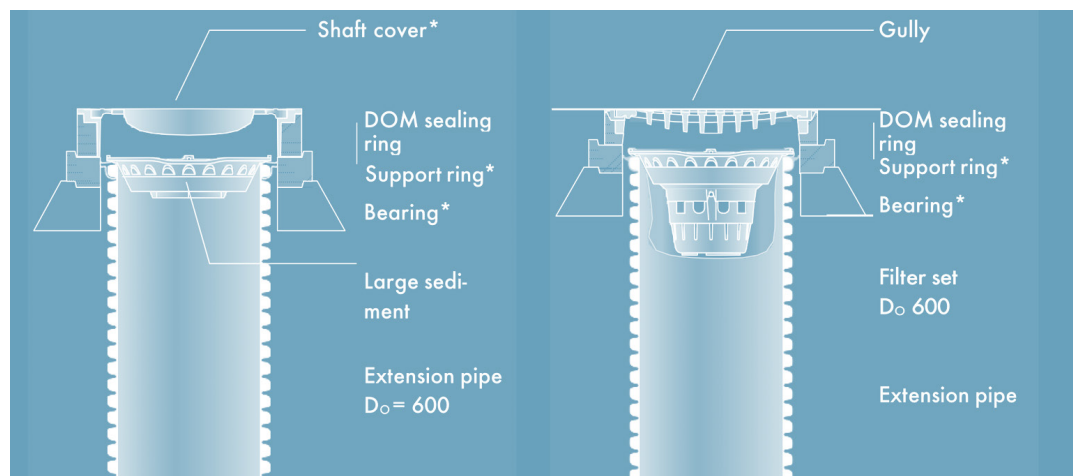
After installing the covering (see next chapter), mount shaft covers. Cut the extension pipe DO 600 such that it reaches the support ring. Seal the gap between the support ring and the shaft cover using a DOM sealing ring.

Mount the sealing ring onto the last corrugation of the extension pipe. Place a sediment trap DO 600 on the extension pipe. If according to planning specifications, the shaft must feature a gully gutter, place the filter set DO 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. Carry out and install shaft covers according to planning specifications.

The inside diameter must be at least 24.0 in. 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 $h = 3.93$ in. 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.



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

CAUTION

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



DOM sealing ring

INSTALLING SIDEWALL GRIDS

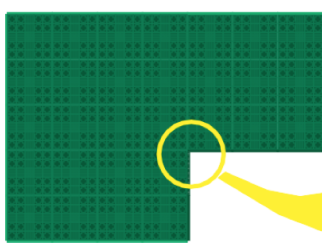
Use sidewall grids to cover tunnel ends of the storage/infiltration system. Place the sidewall grid in the centre. Pressing the sidewall grid is enough to connect the module tight using four locking pins.



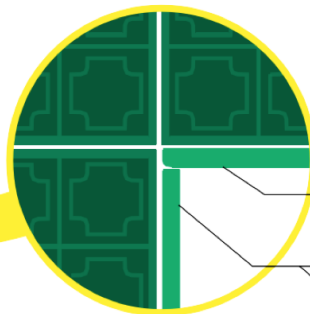
ATTENTION

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

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.



Special quality: Inside corner



NB


Use sidewall grids shortened at one side for storage/infiltration designs with inside corners.

GreenStorm ST sidewall grid




Cat. no. 519.94.000

GreenStorm ST sidewall grid, short




Cat. no. 519.94.010

GreenStorm ST half block sidewall grid, short




Cat. no. 519.94.011

GreenStorm ST-B sidewall grid




Cat. no. 519.94.200

GreenStorm ST-B sidewall grid, short



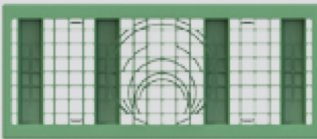
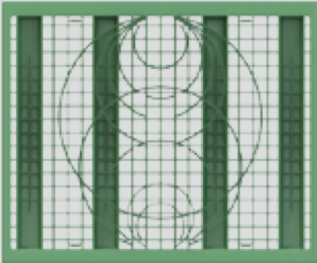
Cat. no. 519.94.210

GreenStorm ST-B sidewall grid, short



Cat. no. 519.94.211

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).

Module layers	Connection height
1/2-layer	1.57 in.
1-layer	1.57 in.
1 1/2-layer	27.55 in.
2-layer	27.55 in.
2 1/2-layer	53.54 in.
3-layer	53.54 in.

Connection heights (independent of nominal diameter) from the trench soil

NB

We recommend using a jigsaw.

INSERTING ADAPTERS (DN 315/DN 400/DN500)

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.



NB

An angular grinder is best suited for cutting. Please cut approx. 0.40 in. 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.

Securing with an adapter fastener



CREATING GEOTEXTILE WRAPPING



GreenStorm systems must be wrapped completely in geotextile (e.g. RigoFlor). At the edges, provide sufficient overlapping (at least 11.81 in.) 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 and no openings occur even during backfilling!

LATERAL BACKFILLING

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

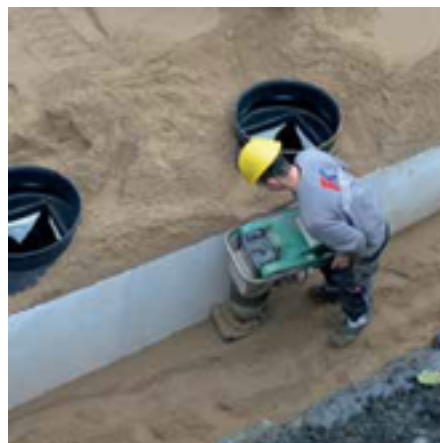
Use non-cohesive, non-frozen earthwork material with a maximum grain size of 12.60 in. for backfilling.

Distribute the backfill material evenly and compact it in layers of max. 11.81 in. using a light or machine (area vibrator or vibratory rammer). In doing so, a compaction level Dpr of > 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 GreenStorm ST modules are not damaged!

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



CREATING COVER

The storage/infiltration module must be covered according to planning specifications. Non-cohesive, compactable graded earthwork material with a maximum grain size of 12.60 in. should be used for cover, which is a mandatory requirement under trafficked areas!

Frozen soil is not permissible! Additionally, national guidelines for earthworks (such as ZTV E-StB) apply.

Stability analysis

Storage/infiltration systems are subsoil structures and must have sufficient load-carrying capacity against permanently 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 DC 157.48 in. and soil depths of Ds 236.22 in are possible for infiltration systems. A project-specific stability analysis can be prepared by. Under trafficked areas, a minimum cover Dc of 31.5 in. must be observed.

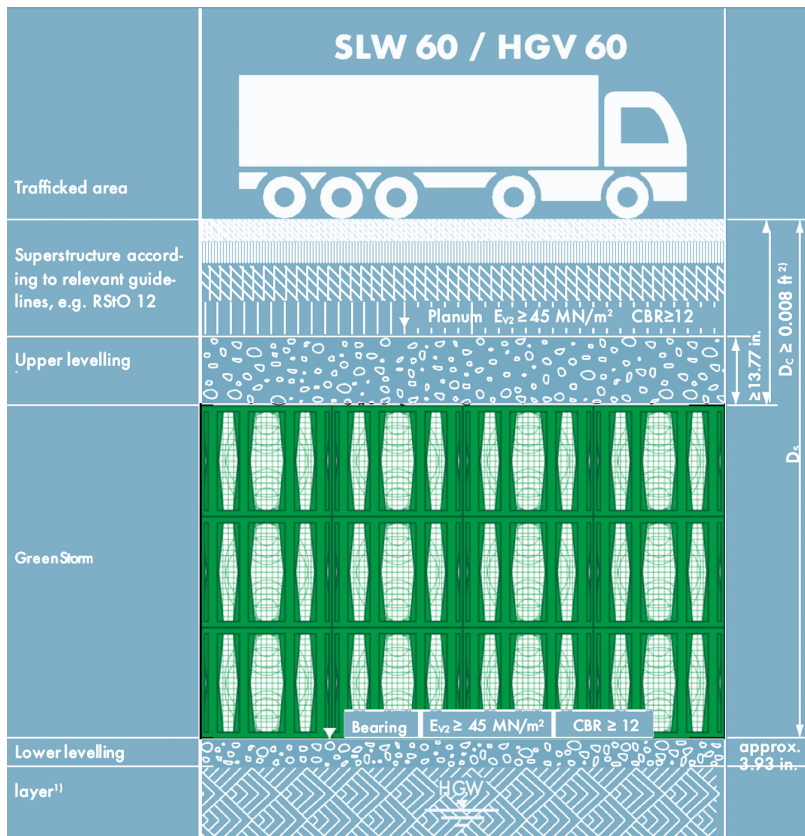
* HGV 60, specific weight of soil 115.61 lb/ft³; Mean soil temperature max. 73.4 °F; Soil depth 236.22 in; $k=0,3$; 4-layer

ATTENTION

Note for HGW over structure soil: GreenStorm 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. Please contact us!

STANDARD INSTALLATION UNDER A TRAFFICKED AREA



National guidelines, e.g. RStO 12, must always be observed for installation under trafficked 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 13.77 in. Other construction materials normally lead to greater depths of cover.

Generally, at the surface of the cover (= planum), a uniform modulus of deformation $E_{V2} \geq 939844.54 \text{ lbf/ft}^2$ or $\text{CBR} \geq 12\%$ must be achieved.

Soil layers must always be provided and compacted in layers of max. 311.81 in. The compaction level D_{pr} should be $\geq 97\%$.

Carry out compacting using light or medium area vibrators only!

1) At least the same permeability (kf) as the subsoil for infiltration systems
2) Lower cover upon request!

CAUTION

Compacting using vibratory rollers and explosion rammers is not permissible!
Carry out compacting using light or medium area vibrators only!

CREATING COVER



The storage/infiltration module must be covered according to planning specifications. Non-cohesive, compactable graded earthwork material with a maximum grain size of 1.26 in. should be used for cover, which is a mandatory requirement under trafficked areas!

Frozen soil is not permissible! Additionally, national guidelines for earthworks (such as ZTV E-StB) apply.

Stability analysis

Storage/infiltration systems are subsoil structures and must have sufficient load-carrying capacity against permanently 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 DC 98.42 in. and soil depths of DS 157.48 in. are possible for infiltration systems. A project-specific stability analysis can be prepared by. Under trafficked areas, a minimum cover DC of 80 cm must be observed.

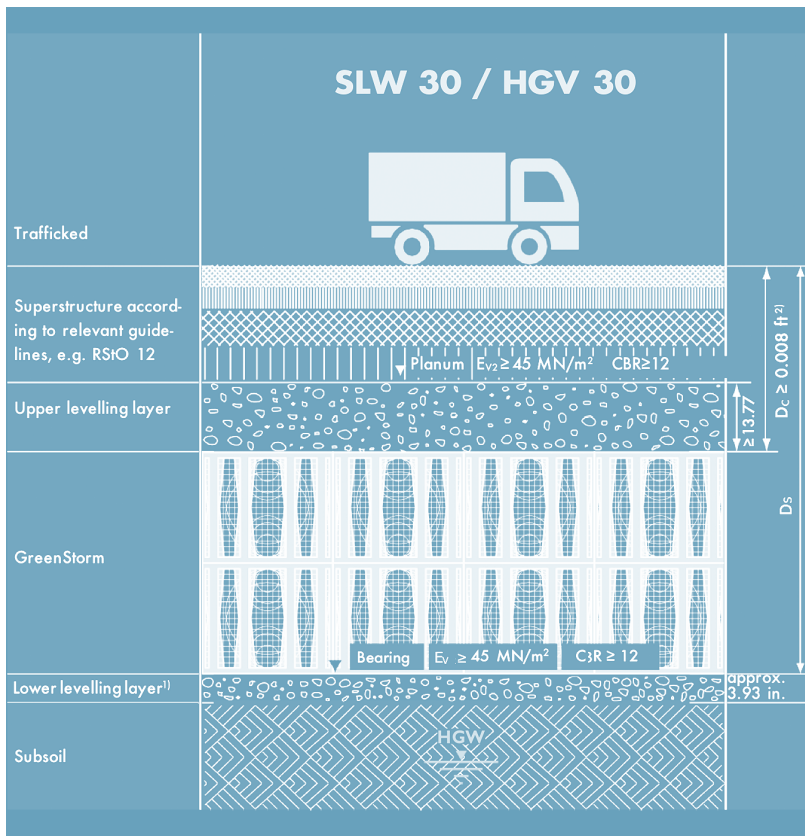
* HGV 30, specific weight of soil 115.61 lb/ft³ Mean soil temperature max. 73.4 °F, $K=0.3$

ATTENTION

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2) Lower cover upon request!

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Compacting using vibratory rollers and explosion rammers is not permissible!

USE OF CONSTRUCTION VEHICLES DURING INSTALLATION**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 30000 lbs (chain, 4 wheels, twin-tyres), a compacted cover of at least 11.81 in. 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 11240.45 lbf (e.g. HGV 30) is possible if the thickness of the compacted cover is not less than 23.62 in. Possible formation of ruts must be taken into account!

When dumping the earthwork material, the wheel load of 11240.45 lbf must not be exceeded; if necessary, load distribution plates must be used.

CAUTION

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

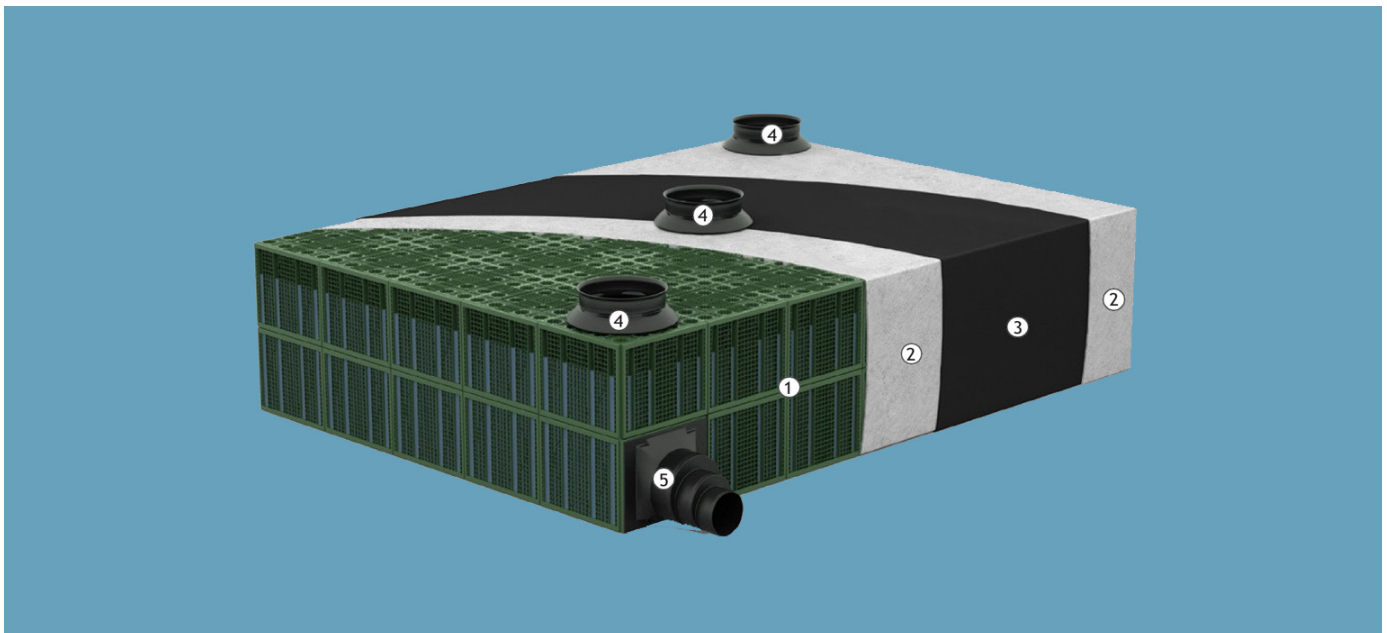
MODULAR RESERVOIR CONSTRUCTION FOR MANY APPLICATIONS**Use of vehicles when applying the first cover layer:**

When using GreenStorm 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



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

INSTALLATION OF GREENSTORM STORAGE/INFILTRATION MODULES UNDER THE EFFECTS OF FROST I IN FROST ZONES

When using GreenStorm modules for the realization of underground infiltration or storage tanks, the general climatic conditions at the location must be taken into account. In zones exposed to frost, the effects of temperature on the product properties and the entire underground building during installation and operation have to be considered.

The construction work must always be carried out professionally in accordance with the relevant national guidelines and additionally in accordance with our installation guideline.

PRODUCT CHARACTERISTICS OF GREENSTORM:

GreenStorm modules are made of the thermoplastic Polypropylene (PP). The term "thermoplastic" already says that this plastic has temperature-dependent properties. At lower ambient temperatures, the material generally becomes stiffer and the strength of the modules also increases. This leads to improved static properties.

However, the impact sensitivity increases at lower temperatures.

In particular during installing the modules, backfilling and closing the construction pit, punctual impact stresses can occur and should therefore be minimized by appropriate care. This is particularly important when selecting and using compaction equipment and compaction processes.

Due to the robustness of GreenStorm, the installation does not lead to a problem, even if it is exposed to frost. This has been practiced for many years in Central and Northern Europe.

PROPERTIES OF THE ENTIRE UNDERGROUND BUILDING

According to the state of the art, the corresponding regulations and our installation guideline, the following requirements have to be considered:

1. Soil investigation to evaluate the soil situation on site and as a basis for the realization of the building project; the soil quality and the load-bearing capacity of the subsoil are decisive for the planned use and the installation of the underground building
2. Manufacturing of a suitable lower bedding zone
3. Manufacturing of the lateral bedding zone and backfill
4. Manufacturing of the cover and remaining backfilling

For points 2 - 4, suitable soil material has to be used in the required composition to achieve the desired load capacities. This is usually non-cohesive, compressible material. Frozen Materials are not allowed!

A stable subsoil is important for the buried structure in order to ensure the permanent function and lifetime. Usually it can be assumed that frozen ground does not guarantee sufficient load bearing capacity; especially if a frost-thaw change can take place. This can lead to softening and destabilization of the subsoil and, under certain circumstances, to a complete loss of the loadbearing capacity. In order to prevent this, the installation on frozen ground must be avoided or constructive protective measures must be taken.

