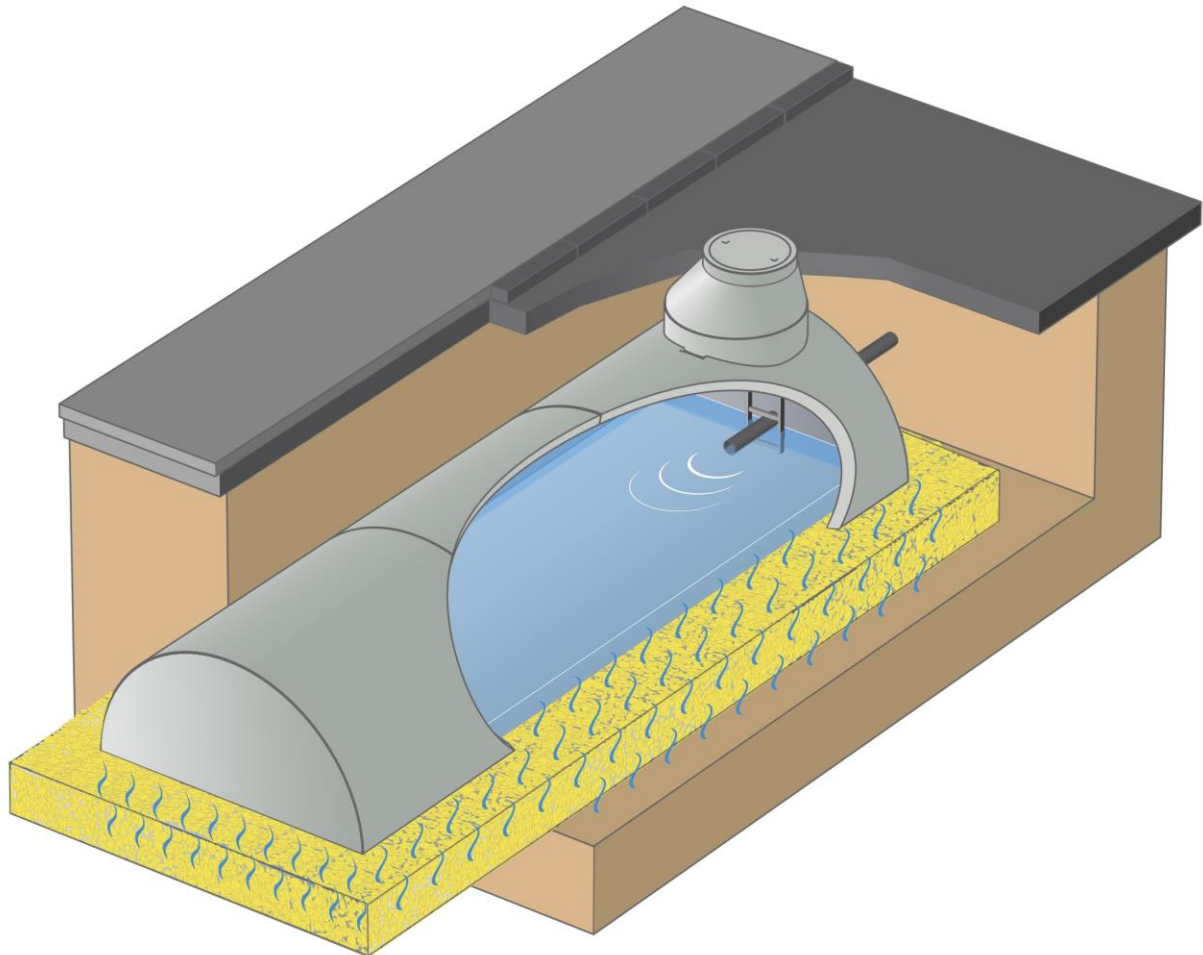


Installation instructions for the Mall CaviLine infiltration tunnel



Version	Date	Description
1.0	27/01/2020	Original version
2.0	15/07/2020	Additional pictures, graphics added

Important:
It is essential to read these instructions before installation!

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1. General notes

- It should be noted that infiltration systems may require official approval and that this must be checked in each case before installation. The respective regional official and legal regulations must be observed. Furthermore, the relevant German and European standard regulations as well as the valid worksheets, in particular DWA-A 138, must be observed.
- All installation and inspection work must be carried out by an authorised and qualified specialist company that has sufficiently informed itself by studying the operating instructions in detail and has familiarised itself with the product's special features. The existing regulations for accident prevention must be observed; in particular:
 - Safety rule "Construction work" VBG37
 - Safety rule "Excavators, loaders, scrapers and special earth-moving machines" VBG40
 - DIN 4124 Excavations and trenches - Slopes, planking and strutting breadths of working spaces.
- Dimensioning should be done in accordance with the currently valid worksheet DWA-A 138, taking into account the intensity of rainfall derived from the KOSTRA Atlas published by the German Meteorological Service (DWD). In order to prevent system malfunctions, the permeability coefficient (K_f value) of the existing soil must be determined by means of a soil investigation report and/or appraisal by a technical expert.
- The thickness of the infiltration space below the lower edge of the infiltration tunnel must be at least 1 m, based on the average highest groundwater level.
- The distance between the infiltration system and trees must at least correspond to the expected, not current, crown diameter.
- Before starting construction, it must also be ensured that any locally specific regulations are complied with in conjunction with the competent authority (usually the district administration).

2. Product information

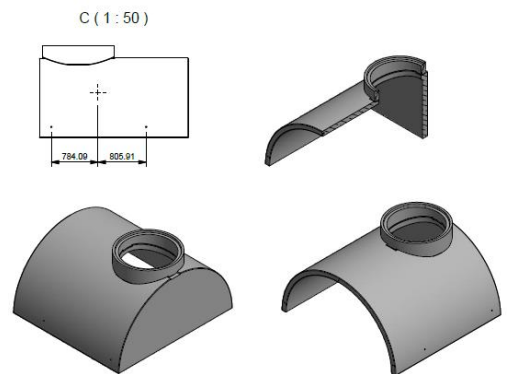
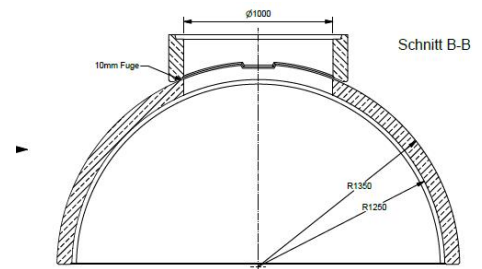
a. Geometry

The infiltration system consists of an underground cavity that is open at the bottom. It is formed by semi-circular reinforced concrete tunnel vaults, the end parts of which each have a vertical end wall.

The outer length is generally 2.50 m,
 The external width is 2.70 m,
 The external height without a saddle piece is 1.35 m,
 The external height with a saddle piece (entrance dome) is 1.54 m.

In the end sections, a DN 1000 access dome with rebate connection can be installed above a saddle piece in accordance with DIN 4034-2.

As the prefabricated parts are manufactured in steel formwork, very low tolerances of less than 10 mm can be expected for all relevant component parameters.



CaviLine – Einzelbauteile

Bauteile	Volumen m ³	Länge l mm	Breite b mm	Höhe h mm	Sickerfläche m ²	Gewicht kg
Tunnelement	6,10	2500	2500	1250	9,25	2.500
Tunnelendelement	5,90	2400	2500	1250	11,10	3.230
Tunnelendelement mit Einstieg	5,90	2400	2500	1250	11,40	3.250
Sattelstück für Schachtaufbau	–	–	–	–	–	210

b. Configuration of the infiltration trench

The exact geometry of the entire infiltration tunnel trench must be available as a confirmed working drawing at the start of the work.

Infiltration tunnels can be constructed as a single string or in multiple strings. Usually, a maximum of 3 strings are provided.

During installation, care must be taken to ensure that the connecting pipes are arranged in accordance with the plan so that the inflowing water can spread evenly and unhindered.



c. Component joints

The end faces of the tunnel elements are butt-jointed in the vertical plane.
It is not necessary to glue or brace the sections.

The horizontal component joints for the access dome should be formed with mortar (MG III) in accordance with DIN 4034-3.

Non-cohesive gravel-free material shall be used as backfill material.

Installing a geotextile strip or full-surface covering with geotextile can effectively prevent the earth cover from creeping in.

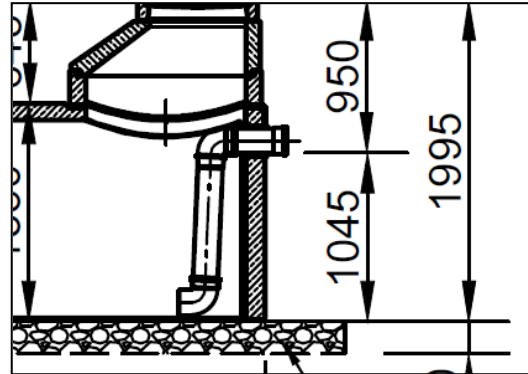


NOTE !

- **The use of geotextiles is not required to achieve filter stability between the structure and backfill material. We recommend covering the structure to prevent the ingress of fine particles!**
- **It is essential to fill horizontal joints between the rising shaft rings and cones for the access dome with mortar or joint sealing tape (see photo) - risk of cracking!**

d. Accessories

- Inlet**
Dimension DN 150 PP (KG 2000) is provided as standard. Connection via a multi-lip seal in the ridge area of the tunnel vault. A vertical pipe should be installed in the infiltration tunnel to calm the inlet.
If required, concrete slabs can be placed as scour protection in the base area.
- Geotextile**
We recommend covering the vertical end wall joints to provide protection against trickling:
Separation and filter fleece
Weight per unit area: approx. 200 g/m²
Robustness class: GRC 3
- Connecting pipes**
In systems with several strings aligned alongside one another, a connecting pipe is installed as standard for every second centre section if there are more than 2 centre sections.
As with the inlet pipe, DN 150 PP pipes with multi-lip seals are provided for this purpose.
Alternatively, drainage pipes can be used, which are inserted into the bell socket of the inserted KG sewer pipes.
- It may be necessary for design reasons to install an emergency overflow for the trench body.
- In the case of small chamber geometries (e.g. only 2 end sections) and low-permeability soils, a vent pipe should be routed to the surface. (bend out of the chamber with a vertical riser)
- Ladders**
With low system levels, it may be advisable to install a permanently fixed shaft ladder (with fall protection if necessary). Variants with variable lengths and equipment can be supplied by the manufacturer.
- Joint sealing tape**
Mall joint sealing tape as a substitute for mortar for the access dome's shaft rings



The accessory components only form part of the scope of delivery if they have been ordered.

3. Excavation pit / subgrade layer

The excavation pit must be constructed in accordance with the safety regulations of the respectively applicable liability insurance association for the construction industry (e.g. BG BAU in Germany) or DIN 4124 and DIN 4123, taking into account the depth of the inlet and the tunnel dimensions.

Even after the system has been constructed, sufficient working space must remain and the backfill must be carried out professionally (min. 50 cm distance from the elements to the edge of the excavation pit). This must be properly secured.

The use of CaviLine concrete vaults enables installation depths of up to 5 m to be realised. In these cases, it may be necessary to shore the excavation pit or construct berms.

A distance of at least 1 m must be maintained from the upper edge of the slope for stored materials. The excavation base must be prepared so that it is level and horizontal. It must be ensured that the subsoil is able to support loads.

The installation site for the crane vehicle or suitable lifting equipment must be designed in accordance with the vehicle's requirements under the direction of the responsible driver. Special requirements for the distance of the supports from the edge of the excavation pit must be observed.

Subject to deviating values from any soil investigation reports, the following soil parameters are given as guideline values:

- Soil group: Fine gravel/sand grain fraction 2 to 8 mm with a minimum thickness of 25 cm
- Permissible soil pressure of 300 kN/m²
- Compaction work $E_{v2} = 80 \text{ MN/m}^3$ according to load plate compression test pursuant to DIN 18134.

After excavation, the ground must be compacted using large compaction tools, e.g. vibratory plates.

Excessive compaction should be avoided as this reduces the infiltration capacity of the base. If there are reasonable doubts about the stability of the excavation over a wide area, the use of a "geogrid" as a reinforcement layer should be considered in conjunction with a technical expert. As a rule, it is not necessary to lay geotextiles as filter fleece in the base area.



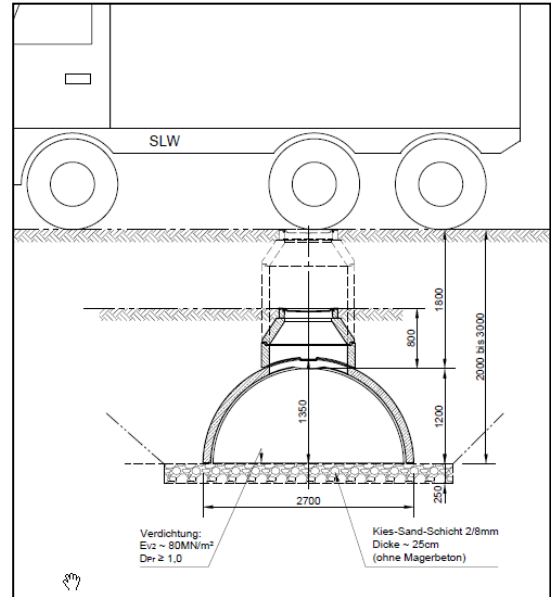
NOTE !

- **The stated guideline values should not serve as a substitute for a geotechnical report!**
- **Do not install in areas impacted by building loads!**

- **The maximum base depth below ground level is 5 m.**

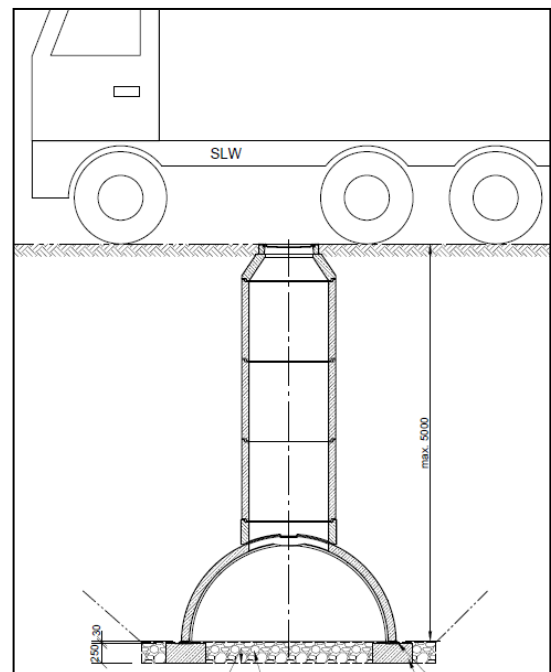
With regard to the foundation, a distinction must be made between two cases:

1. Foundation level up to 3 m below ground level
- overrun by heavy goods vehicles:
Foundation on compacted gravel-sand (see below) - no further measures



2. Foundation level up to 5 m below ground level
- overrun by heavy goods vehicles:
Foundation on a lean concrete strip foundation W/H = 25/50 cm, grade C12/15 plus a load-damping layer (3 cm mortar or elastomer strip)

A load-distributing layer in the form of screed mortar or elastomer strips must be applied between the lean concrete strip and the tunnel elements.



4. Installing the infiltration tunnel

a. Tools

- Mobile crane (excavator if necessary) for placing the tunnel elements
- Controlled lifting chains, setting claws
- Spirit level, trowel and bucket for mortar
- Plum line, setting lath, chisel
- Lubricant for pipe installation
- Installation aids (squared timber, wooden wedges)



Caution !

- Do not stand under the load!
- Use only factory-supplied load-bearing equipment!
- Observe the “Shaft construction” installation and relocation instructions (www.mall.info)

b. Installation

The system may settle between several millimetres and a few centimetres during installation.

In order to ensure that the installation position is correct in terms of the height and alignment, we recommend anticipating this settlement by inserting squared timbers and applying gentle pressure with the excavator shovel (does not apply to lean concrete strips - see above).

On the upper sides of the joints (outer face), we recommend providing protection against trickling by using geotextile strips or by covering the entire surface of the system.

Install PP piping or drainage pipes (see “Accessories”) between the elements.

To prevent scouring within the chamber, guide the pipe horizontally or upwards through a bend (“swell pot”) or lay scour slabs (30x30 cm pavement slabs) on the base.



5. Backfilling the excavation pit

- Before backfilling, all inlets and outlets must be properly installed and closed. The backfilling must be based on the intended usage requirements above the system (traffic, surface design).
- Under no circumstances may the backfilling be carried out just on one side (asymmetrically). The difference in height between backfill areas must not exceed 80 cm.
The individual phases are shown in the following diagram. Systems with 2 or 3 strings must be backfilled with special care.
- The backfilling and compaction should be based on the current regulations, in particular FGSV bulletin "M HiFü Bau".
- Only vibratory plates and earth-moving equipment with individual (wheel) loads of 1 tonne may be used up to a backfill height of approx. 1.60 m from the base of the excavation pit. Above this level, vibratory rollers and equipment with a 5 tonne wheel load may be used.
- Note information on infiltration capacity in accordance with Section 6

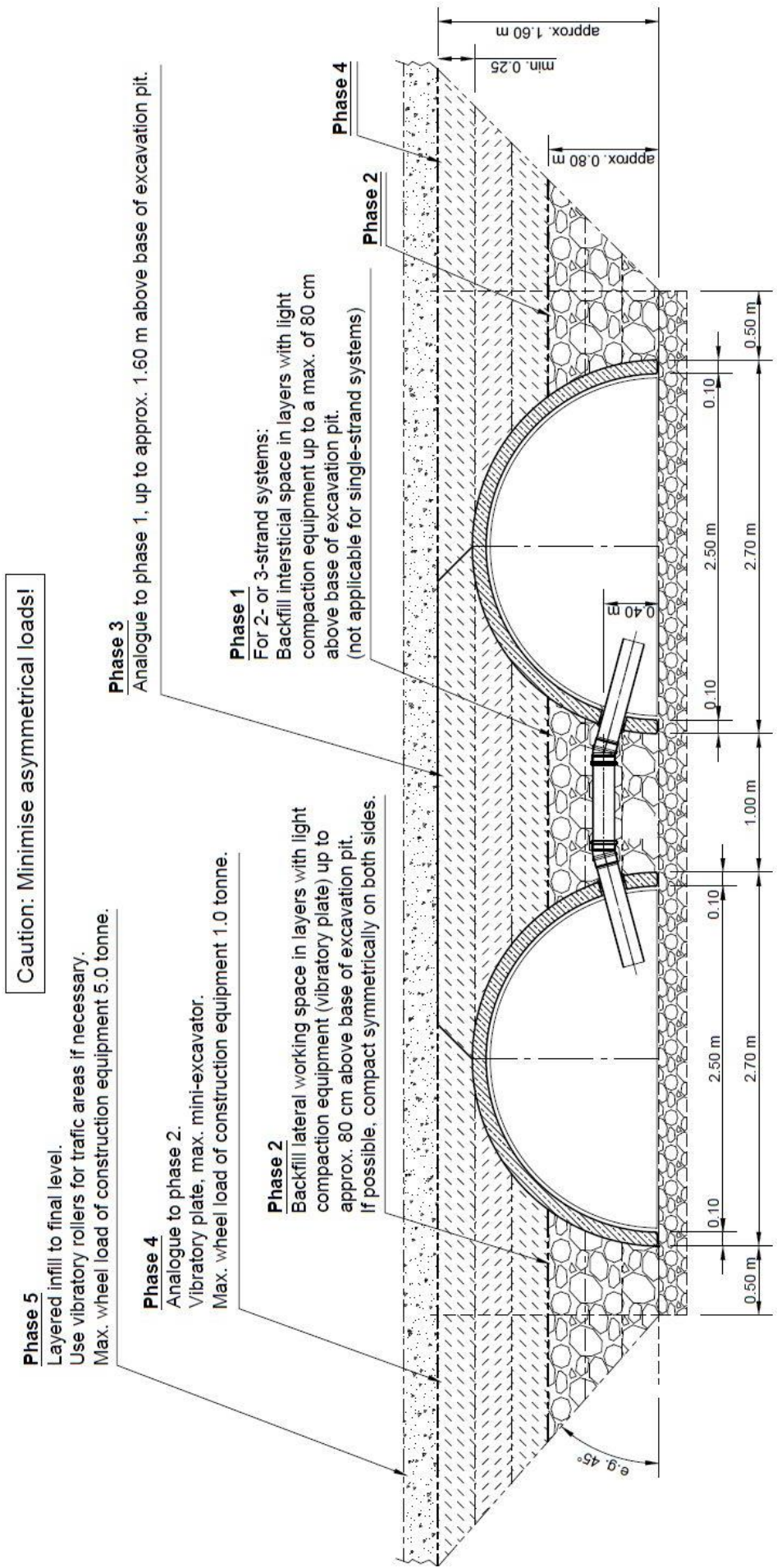


Caution !

- **Minimise asymmetrical / one-sided backfilling!**
- **Even during backfilling, the elements may only be driven over with heavy equipment (wheel load up to 5 tonnes) when the backfill is approx. 25 cm thick!**
- **Observe the factory specifications (construction phases) for backfilling in sections (graphic)!**



Construction phases for backfilling CaviLine



Caution: Minimise asymmetrical loads!

6. Installation parameters for the final state / Design notes:

The tunnel elements can be used close to the surface with a cover of 50 cm or more. A load-bearing capacity of HGV 60 is given. Lower covers result in limited heavy-load traffic ability.

The discharged stormwater can only infiltrate through the base of the shaft. A permeable, non-cohesive layer structure, including in the lateral working areas up to at least 100 cm above the foundation level, is decisive if the system is to function correctly. If necessary, a geotextile should be used to ensure filter stability between the layers.

7. Addresses

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