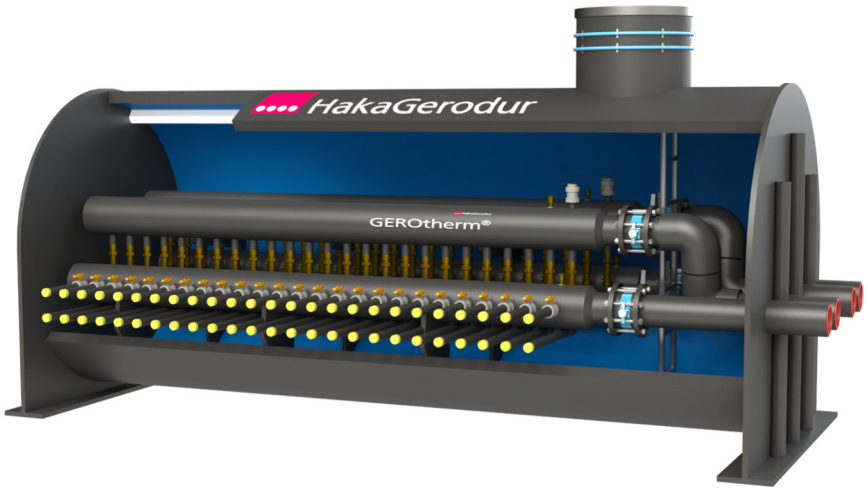
Installation instructions for manholes



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Disclaimer

The information in this document has been compiled with the greatest possible care. All references to ordinances, standards or other regulations has been intensively researched. Nevertheless, HakaGerodur AG cannot guarantee that the information is up-to-date, correct and complete. It excludes any liability claims relating to damage of both a material and immaterial nature caused by the use or non-use of the information provided.

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1 General information

1.1 Safety

The installation instructions must be read prior to unloading the manholes, creating the trench profile, installing the manhole, refilling the trench and operating the geothermal plant. This is carried out by trained specialist personnel, the master builder or the plant operator. The relevant specialist planner is responsible for planning the detailed workflows at the construction site. The generally applicable regulations, standards, guidelines and accident-prevention regulations must be complied with on site, and are not replaced by this document. This document provides additional, supplementary information about the products. HakaGerodur AG recommends that work at the construction site should only be performed by certified personnel with a valid welding permit from the Swiss Welding Association (SVS)/Plastic Pipes and Fittings Association (VKR)[1] that has been awarded on completion of a pipe-laying course, geothermal course or similar.

1.2 Purpose

HakaGerodur AG manholes have been explicitly designed for use in the geothermal sector. They are delivered fully prefabricated, including the collection and distribution system and the shut-off and control valves. HakaGerodur AG accepts no liability if these components are used for purposes other than the intended use. The main body of the manhole is made from polyethylene (PE) and is environmentally friendly and suitable for recycling. The products undergo an internal quality inspection before leaving the production factory.

1.3 Preliminary clarifications regarding planning and installation

The following issues must be clarified before installation at the latest:

- Any traffic loads in the area of the manhole.
- On-site subsoil and installation conditions.
- Any groundwater; this defines the type of manhole. See Sections 2.1 and 3.1 "Areas of application". On-site uplift protection must be provided in these cases.
- Obstructions caused by root systems or newly planted trees must be ruled out.
- Wherever possible, the bottom of the trench and the backfill material should be water-permeable, and any water-carrying layers should be drained off where possible (drainage).
- The impact of foundation loads or supporting structures during and after the construction phase must be ruled out in the area of the manhole. The appropriate distances to buildings, masonry, other buildings, heavy traffic areas and other shafts must be complied with in accordance with the relevant standards. The planner is responsible for the positioning of the manhole.
- If manholes will be driven over with heavy-duty vehicles during and after the construction phase, this must be taken into account in the structural design.
- Changes in the lengths of pipelines and the manhole as a result of thermal influences must be taken into account.
- The connected lines for the geothermal probes must be connected according to the forward/return flow and the flow arrows on the control valves.

1.4 Inspection and warranty period

The recipient is obligated to inspect the product immediately after delivery with regard to its identity and any externally visible damage (particularly transport damage) and patent defects, and to give written notice of any defects in writing within five working days of delivery at the latest. Claims by the customer arising from a defective

[1] https://vkr.ch/Kurse/Allgemeine-Informationen

delivery lapse upon expiry of one year following the delivery. Additional points are covered in the Terms and Conditions (T&C) of HakaGerodur AG.

1.5 Information regarding entering manholes

If manholes are to be entered, the following safety instructions must be observed:

- The open manhole must be **adequately identified** (signal strips, danger signs and mandatory traffic information signs) **and secured** (suitable barriers). There must be no risk of falling, and employees must be protected against the danger posed by road traffic. The cover must be kept closed at all times, apart from when work is being carried out in the manhole.
- The manhole must be adequately secured to the ground in order to protect against unwanted movements and to avoid any slipping risk.
- **There must always be one person outside of the manhole.**
- The manhole must be sufficiently ventilated before being entered for maintenance purposes. Before entering the manhole, it must always be assumed that the atmosphere is dangerous. This poses a **risk of poisoning, explosion and asphyxiation.** A suitable and powerful ventilation unit must be provided when persons are inside the manhole. This is intended to supply the tank with a continual flow of fresh air.
- Before entering the manhole, a suitable measuring device designed to measure different gas concentrations should be used.
- There is a risk of electric shock if there are electrical components inside the manhole.
- For all work carried out on the manhole (either externally or internally), it must be ensured that the plant equipment is not in operation and that it cannot be switched on by unauthorised persons.
- If there is a sealing lip or sealing surface in the manhole cover, as is the case in selected models, this must be cleaned together with the contact surfaces after every time the cover is opened. The manhole cover must be stored on a clean surface after raising the manhole. Using Vaseline or a lubricant makes it easier to raise the cover again.
- The collector/distributor (SAVE) must not be exposed to any additional load in either the internal or external area of the manhole (e.g as a result of being walked on – risk of breakage).

1.6 Pressure testing of the collector/distributor system

The applicable safety regulations at the construction site must be complied with. Suitable protective equipment must be used while the pressure test is being carried out in the manhole. Before the pressure test is carried out on the collector/distributor system, all screw connections must be checked for secure attachment. HakaGerodur AG recommends that only drinking water (possibly with anti-freeze additive) be used to test the brine circuit and not compressed air (risk of splintering). When using drinking water (possibly with anti-freeze additive), the test pressure in the system must not exceed the internal pressure of 10 bar. The rated operating temperature of the SAVE is –20°C to +40°C.

1.7 Definition of left or right variants

The design of the manhole as either a left or right variant allows for the optimal positioning of the geothermal probe connections. The allocation is defined as shown in the following figure:

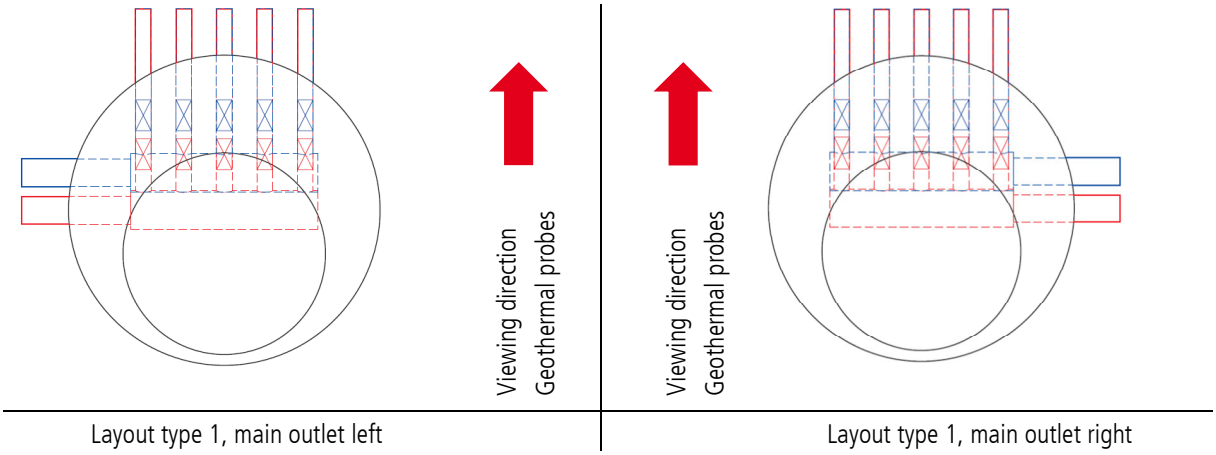


Figure 1: Definition, main outlet left/right

1.8 Classification of covers

The load classes for the covers are defined in the following table:

Load class	Description
200 kg	Areas in green area and on the pavement.
A15	Areas that are exclusively used by pedestrians and cyclists. Comparable green areas.
B125	Pedestrian zones and comparable areas, car parking areas or car parking decks.
D400	Carriageways of all types of roads and parking areas for all approved road vehicles.

Table 1: Classification of covers

Additional covers are available on request. The planner is responsible for selecting the suitable classes and the appropriate materials. If in doubt, always select the next higher class.

1.9 Available load classes

Manholes from HakaGerodur AG have the following load classes:

Load class	Type S/M/L	SMART	Type 1–4
200 kg	✓		
A15	(✓)		✓
B125	(✓)	✓	(✓)
D400	(✓)	(✓)	(✓)

Table 2: Available load classes

Legend for table 2:

✓ Cover provided as standard

(✓) Optionally available

The above load classes only apply to the installation situation following underground installation in accordance with the installation instructions. Small manholes of type S/M/L are only designed for load class A15. HakaGerodur AG accepts no liability for damage caused by higher loads.

1.10 Covers in higher load classes

If the permissible traffic loads exceed the load class of the manhole, it is essential that the forces be dissipated into the road sub-bed. The structural design of the construction must be defined by a specialist planner. In the structural design, a higher cover height between the cast iron cover and the pipe crown or manhole plate must be defined in accordance with the load class. It is essential to avoid any exchange of load between the cast iron cover (or concrete support ring) and the manhole. The support surface on the concrete support ring of the cast iron cover must be level and free of point loads. The concrete support ring of the cast iron cover must be positioned centrally over the dome of the plastic shaft and must be supported with a steel plate or reinforcing rods until installation or the backfilling of the subsoil. It is essential to check that the installation has been performed correctly. Long-term load actions can damage the manhole. The following figures show examples of how the installation can be performed.

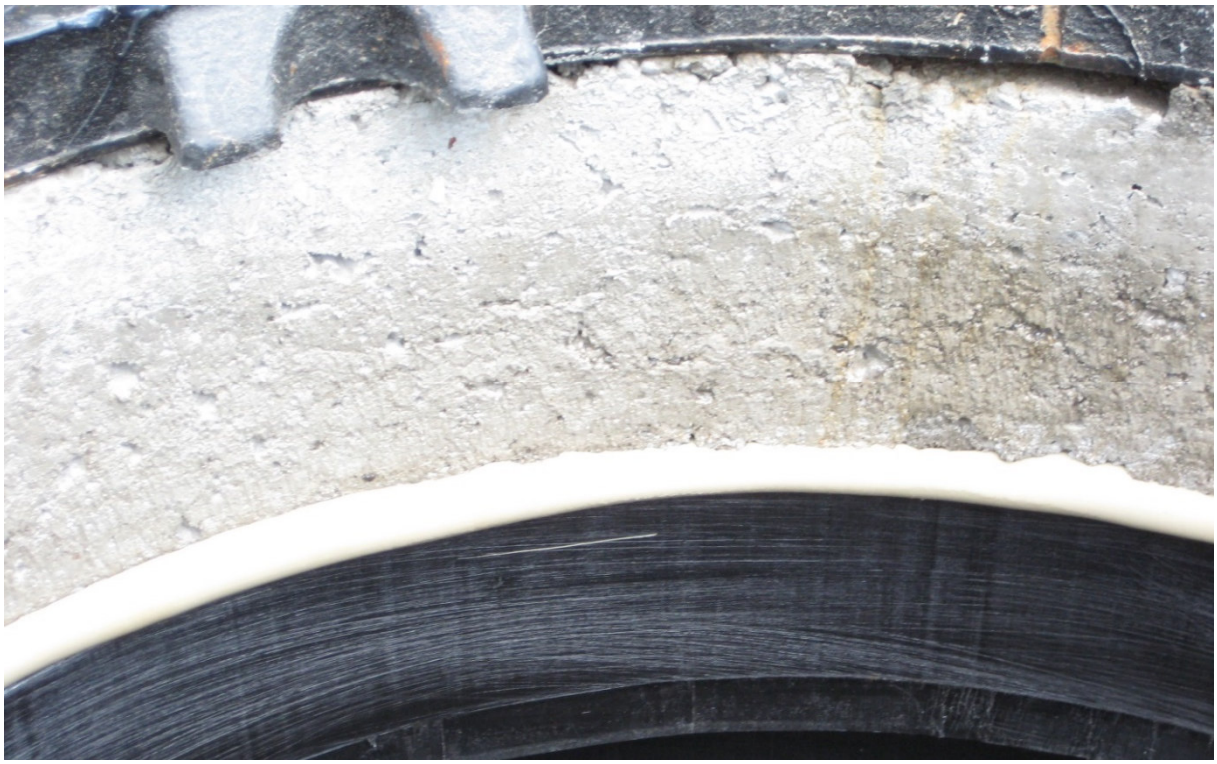


Figure 2: Layer principle with concrete support ring

From top to bottom: Connection between the cast iron cover ring, concrete support ring for the cast iron cover, expanding tape to create a seal between the shaft and the cover, pipe of plastic manhole entry.

Figure 3: Support of the concrete support ring

The concrete support ring of the cast iron cover is positioned centrally over the dome of the plastic shaft and is supported with a steel plate or reinforcing rods until installation of the backfilling.

Figure 4: Support of the concrete support ring

Using concrete as backfill between the reinforcing rods and the concrete support ring. The material is compacted with a needle vibrator. The needle vibrator must not touch the manhole. The vibrations could cause screw connections on the fittings to come loose.

Figure 5: Completed concrete support ring

The compaction of the concrete is complete. The load from the road traffic is distributed across the roadbed via the cast iron cover and the concrete support ring. The manhole does not experience any direct loading, giving it lasting protection. As an alternative to this principle, a sufficiently large support plate can be concreted between the manhole and the concrete support ring of the cast iron cover. When using this method, no direct force transmission can occur between the support plate and the dome of the manhole or cast iron cover.

1.11 Trench profile for manholes

The planner is responsible for defining the burying profile. Construction management is responsible for the trench and the securing of the trench. For vertical and horizontal manholes, it is recommended that trench profiles be selected in accordance with common standards. Detailed documents on the design of the trench profiles can be found in the VKR document "Erdverlegte, drucklos betriebene Rohrleitungen aus Polyethylen (PE), Polypropylen (PP) und Polyvinylchlorid (PVC-U)"[2] ["Buried, pressureless pipelines made from polyethylene (PE), polypropylene (PP) and polyvinyl chloride (PVC-U)"]. The information can be found in Sections 2.7.1 "Normal profiles" and 4.3 "Burying technique in open pipe trenches". As a general rule, unbound building materials should be used in the area of the manholes in accordance with normal profile U1/V1. The building materials suggested for this purpose are described in this document in Sections 2.3, 3.3 and 3.4 depending on the particular manhole being used.

1.12 Installation of manholes on slopes

Manholes can be installed in areas containing slopes. This may be the case, for example, on driveways, parking areas or sloping terrain. HakaGerodur AG recommends creating a foundation that runs parallel to the upper edge of the slope. This is shown in the following figure.

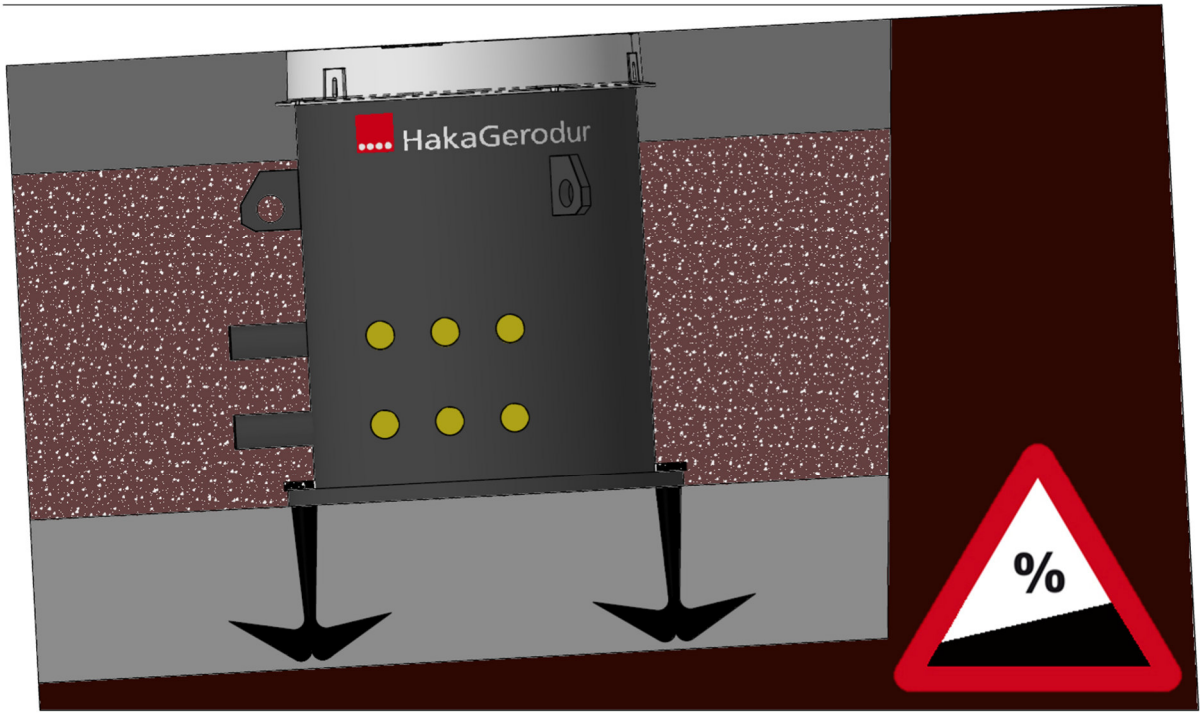


Figure 6: Manhole on a slope

The following must be taken into account when designing the foundation and assembling the manhole:

- The foundation must have the same gradient as the upper edge of the slope.
- If the foundation is on a slope, the on-site situation will need to be assessed with regard to slipping risk and slope stabilisation. Additional stabilising and supporting structures must be used in critical cases. This is the responsibility of the planner or the on-site specialist.
- The manhole must be adequately secured to the sloping foundation. Measures must be taken to avoid any change in the manhole position.
- The horizontal connecting lines must be connected to the manhole using electrofusion fittings with no pretension.

[2] https://vkr.ch/Fachinformationen/Kanalisation

- It must be ensured that the brine circuit is kept ventilated despite the slope. The SAVEs must be ventilated at the highest point of the plant.

2 Small manholes type S/M/L

2.1 Areas of application

Small manholes of type S/M/L are defined for the following areas of application:

Manhole	Number of geothermal probes	$\dot{V}$ max. [m³/h] @1 m/s in SAVE	Product version	Pavement and green areas	Floor slabs (buildings)	Groundwater	Suitability for car traffic	Main barrier
Type S	2–4	7.9	Standard	✓				
Type M	2–8	19.6	Standard	✓				(✓)
Type L	9–16	19.6	Standard	✓				(✓)

Table 3: Areas of application for small manholes

Legend for table 3:
✓ Suitable area of application
(✓) Optionally available

2.2 Transport, storage and unloading

Transportation must be carried out in a way that ensures that no damage is sustained by the manhole or the distributor connections. The tanks must be adequately secured during transportation. The unloading of the products onto the ground or into the trench must be performed as described on the following pages. Loading and unloading should be performed using smooth, jerk-free movements. The protruding pipelines must not be used as handles, attachment points or climbing aids, and must not be damaged.

If the manhole is to be stored at the construction site or in the yard, it must be ensured that the manhole cannot be damaged by vehicles or other equipment.

2.2.1 Small manhole type S

For the loading and unloading of manhole type S, the two designated crane lugs must all be used simultaneously. Failing to use the lugs at the same time can cause them to be torn off. Any loose parts, such as covers, must be secured. The fittings in the manhole cause an imbalance and destabilise the tank in the air. Before loading or unloading a manhole, it is essential to check the product weight, which is stated on the delivery note or on the manhole, and to adjust the crane and the hoisting cables accordingly. For loading and unloading, it is important to use suitable hoisting cables that are not hard and that do not have any hard edges. The plastic must not be damaged.

Figure 7: Suspension of small manhole type S

2.2.2 Small manhole type M

For the loading and unloading of manhole type M, the three designated crane lugs must all be used simultaneously. Failing to use the lugs at the same time can cause them to be torn off. Any loose parts, such as covers, must be secured. The fittings in the manhole cause an imbalance and destabilise the tank in the air. Before loading or unloading a manhole, it is essential to check the product weight, which is stated on the delivery note or on the manhole, and to adjust the crane and the hoisting cables accordingly. For loading and unloading, it is important to use suitable hoisting cables that are not hard and that do not have any hard edges. The plastic must not be damaged.

Figure 8: Suspension of small manhole type M

2.2.3 Small manhole type L

For the loading and unloading of manhole type L, the four designated crane lugs must all be used simultaneously. Failing to use the lugs at the same time can cause them to be torn off. Any loose parts, such as covers, must be secured. The fittings in the manhole cause an imbalance and destabilise the tank in the air. Before loading or unloading a manhole, it is essential to check the product weight, which is stated on the delivery note or on the manhole, and to adjust the crane and the hoisting cables accordingly. For loading and unloading, it is important to use suitable hoisting cables that are not hard and that do not have any hard edges. The plastic must not be damaged.

Figure 9: Suspension of small manhole type L

2.3 Foundation, backfilling, uplift protection

The following section describes the suitable foundation, the backfilling and possible uplift protection. The list is non-exhaustive.

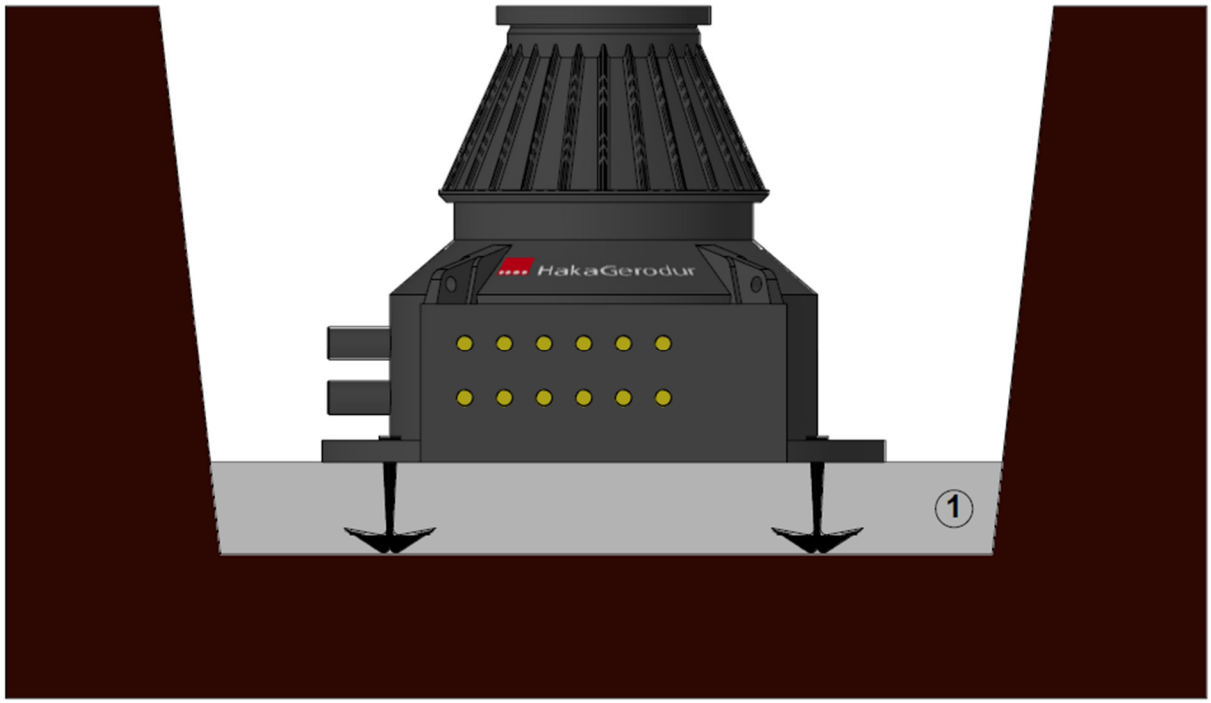


Figure 10: Small manhole installation situation (1/3)

Description ①

A level, stable and load-bearing foundation must be created for the foundation or stabilisation layer of the small manhole. Depending on the on-site situation, the foundation can be created using **lean concrete or a compacted gravel-sand mixture with particle size 0 to 16 mm**. The layer thickness of the foundation should be at least 30 cm. The foundation must always be at least 50 cm larger than the ground area of the manhole including pipes and plates. Adequate working space must be included between the manhole and the trench wall in order to guarantee that the pipelines can be connected tension-free. A minimum working space depth of 1 m is recommended. Designated through holes or protruding plastic plates on the small manholes can be used for concrete anchors or similar if required. The manhole must be aligned so that it is level on the foundation.

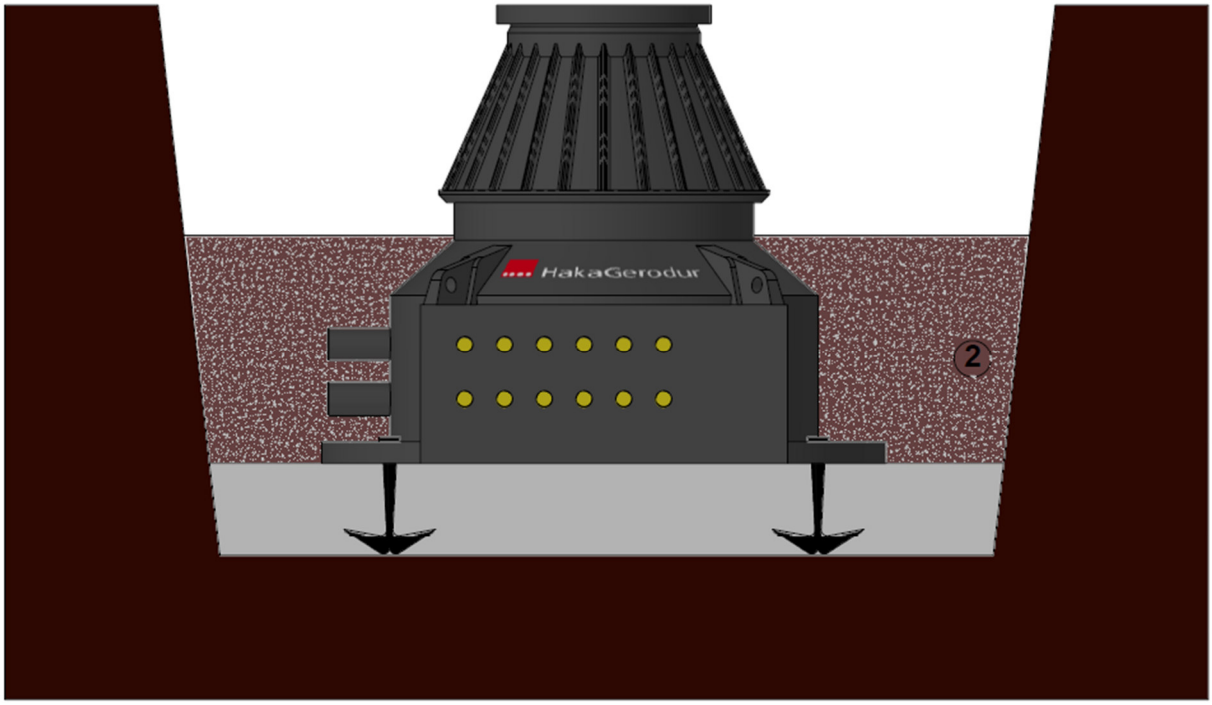


Figure 11: Small manhole installation situation (2/3)

General points to consider for the entire backfilling:

- Backfilling material must be applied in layers. The thickness of individual layers should not exceed 30 cm. This ensures sufficient compaction.
- Cohesive soils are not suitable for backfilling.
- The entire backfilling must be performed without gaps (Proctor density 97%).
- Measures must be taken to prevent the sudden filling of large filling masses.
- The backfill must be exposed around pipeline joints. This allows for permanently tension-free pipe connections.
- It is not permitted to use drop weights or to hit or press down the backfill material using excavator buckets.
- The pipelines and the manhole must not come into contact with the compaction machinery. Vibrations can cause screw connections to come loose.
- Backfilling with concrete is not recommended. Doing so would mean that it would no longer be possible to access the tank from the outside for repair work.

Description ②

A gravel-sand mixture 0 to 16 mm or sand 0 to 5 mm are approved as materials for bedding, sealing and covering. In order to prevent damage to the manhole or the connecting pipes, compaction in this area must only be performed manually using a manual compactor. Any mechanical compaction of the main backfill above the pressure pipes must only be carried out once a minimum thickness of 300 mm above the pipe crown of the main outlet pipes has been covered. Permanent leachate drainage is recommended in the case of water-impermeable soils.

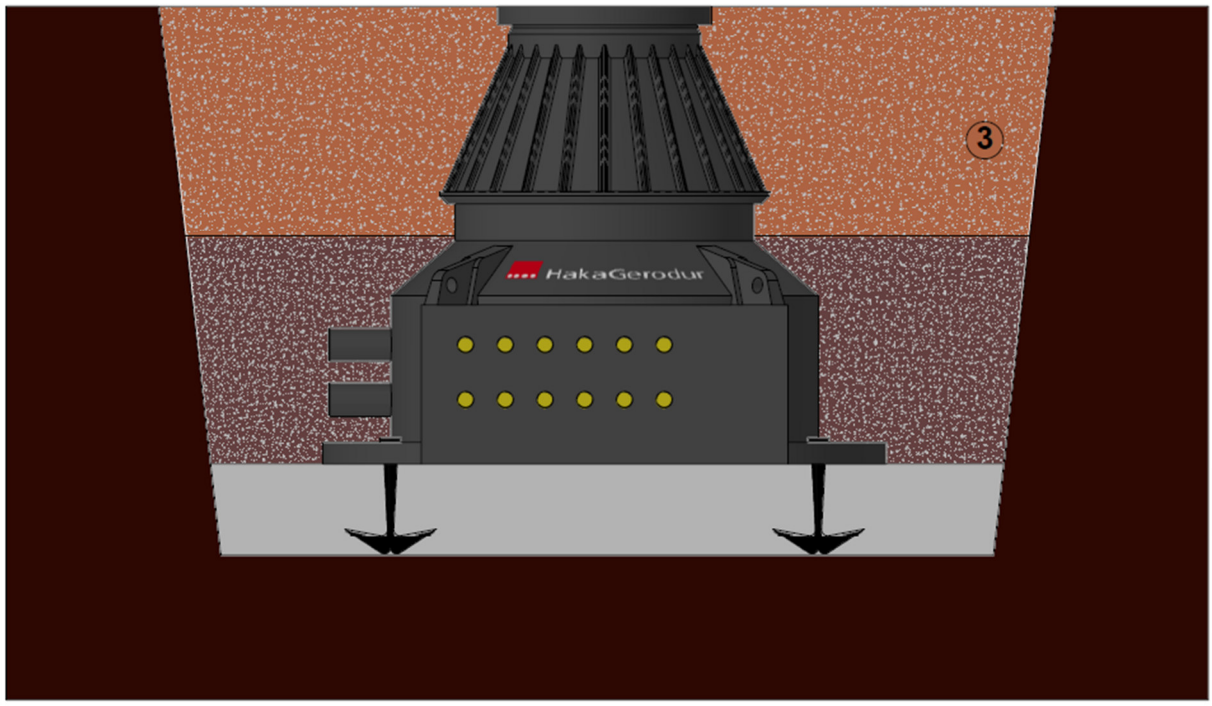


Figure 12: Small manhole installation situation (3/3)

Description ③

For the main backfill above the pipe zones (at least 300 mm coverage), **finely sorted excavated material 0 to 60 mm or concrete gravel 0 to 16 mm** can be used.

3 SMART manholes and manholes type 1/2/3/4

3.1 Areas of application

SMART manholes and manholes type 1/2/3/4 are defined for the following areas of application:

Manhole	Number of geothermal probes	$\dot{V}$ max. [m³/h] @1 m/s in SAVE	Product version	Pavement and green areas	Floor slabs (buildings)	Groundwater	Suitability for car traffic	Main barrier
SMART	2–6	7.9	Standard	✓	✓	✓	✓	(✓)
Type 1	2–5	19.6	Individ.	✓	✓	✓	✓	(✓)
Type 2	6–11	118.4	Individ.	✓	✓	✓	✓	(✓)
Type 3	12–36	118.4	Individ.	✓	✓	✓	✓	(✓)
Type 4	≥37	≥118.4	Individ.	✓	✓	✓	✓	(✓)

Table 4: Areas of application for manholes

Legend for table 4:
✓ Suitable area of application
(✓) Optionally available

3.2 Transport, storage and unloading

Transportation must be carried out in a way that ensures that no damage is sustained by the manhole or the distributor connections and that the tanks are adequately secured during transportation. The unloading of the products onto the ground or into the trench must be performed as described on the following pages. Loading and unloading should be performed using smooth, jerk-free movements. The protruding pipelines must not be used as handles, attachment points or climbing aids, and must not be damaged.

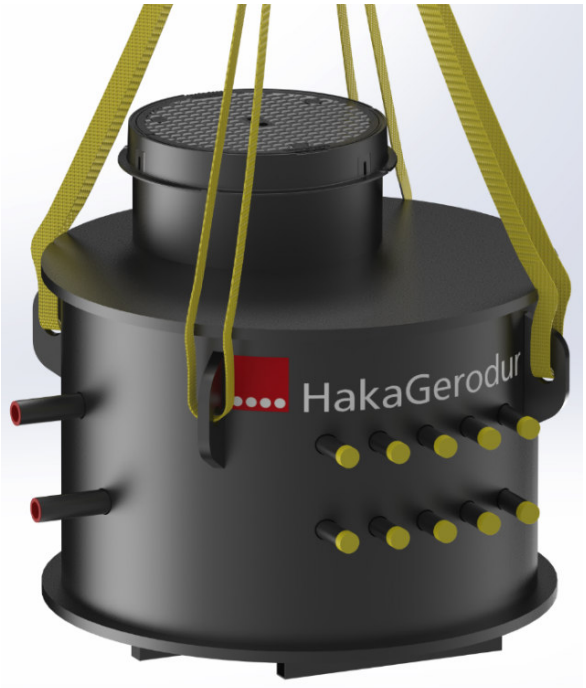
To store the manhole at the construction site or in the yard, it must be ensured that the manhole cannot be damaged by vehicles or other equipment.

3.2.1 SMART manhole

For the loading and unloading of the SMART manhole, the three designated crane lugs must all be used simultaneously. Any loose parts, such as covers, must be secured. Failing to use the lugs at the same time can cause them to be torn off. The fittings and the cast iron cover cause an imbalance and destabilise the tank in the air. Before loading or unloading a manhole, it is essential to check the product weight, which is stated on the delivery note or on the manhole, and to adjust the crane and the hoisting cables accordingly. For loading and unloading, it is important to use suitable hoisting cables that are not hard and that do not have any hard edges. The plastic must not be damaged.

Figure 13: Suspension of SMART manhole

3.2.2 Manhole type 1



For the loading and unloading of manhole type 1, the four designated crane lugs must all be used simultaneously. Failing to use the lugs at the same time can cause them to be torn off. Any loose parts, such as covers, must be secured. The fittings and the cast iron cover cause an imbalance and destabilise the tank in the air. Before loading or unloading a manhole, it is essential to check the product weight, which is stated on the delivery note or on the manhole, and to adjust the crane and the hoisting cables accordingly. For loading and unloading, it is important to use suitable hoisting cables that are not hard and that do not have any hard edges. The plastic must not be damaged.

Figure 14: Suspension of manhole type 1

3.2.3 Manhole type 2

For the loading and unloading of manhole type 2, the two designated crane lugs in the side plates must all be used simultaneously. Any loose parts, such as covers, must be secured. The fittings and the cast iron cover cause an imbalance and destabilise the tank in the air. Before loading or unloading a manhole, it is essential to check the product weight, which is stated on the delivery note or on the manhole, and to adjust the crane and the hoisting cables accordingly. For loading and unloading, it is important to use suitable hoisting cables that are not hard and that do not have any hard edges. The plastic must not be damaged.

Figure 15: Suspension of manhole type 2

3.2.4 Manhole type 3 and 4

Figure 16: Suspension of manhole type 3 and type 4

For the loading and unloading of manhole type 3 and 4, the designated crane lugs must all be used simultaneously. The manhole must not be lifted directly from the crane lugs. In manhole type 3 and 4, the crane lugs are only intended for the guiding of the hoisting cables. It is essential that the hoisting cables be guided through the lugs underneath the manhole. Any loose parts, such as covers, must be secured. The fittings and the cast iron cover cause an imbalance and destabilise the tank in the air. Before loading or unloading a manhole, it is essential to check the product weight, which is stated on the delivery note or on the manhole, and to adjust the crane and the hoisting cables accordingly. For loading and unloading, it is important to use suitable hoisting cables that are not hard and that do not have any hard edges. The plastic must not be damaged.

3.3 Foundation, backfilling, uplift protection (vertical)

The following section describes the suitable foundation, backfilling and possible uplift protection for **SMART and type 1 vertical plastic manholes**. The list is non-exhaustive.

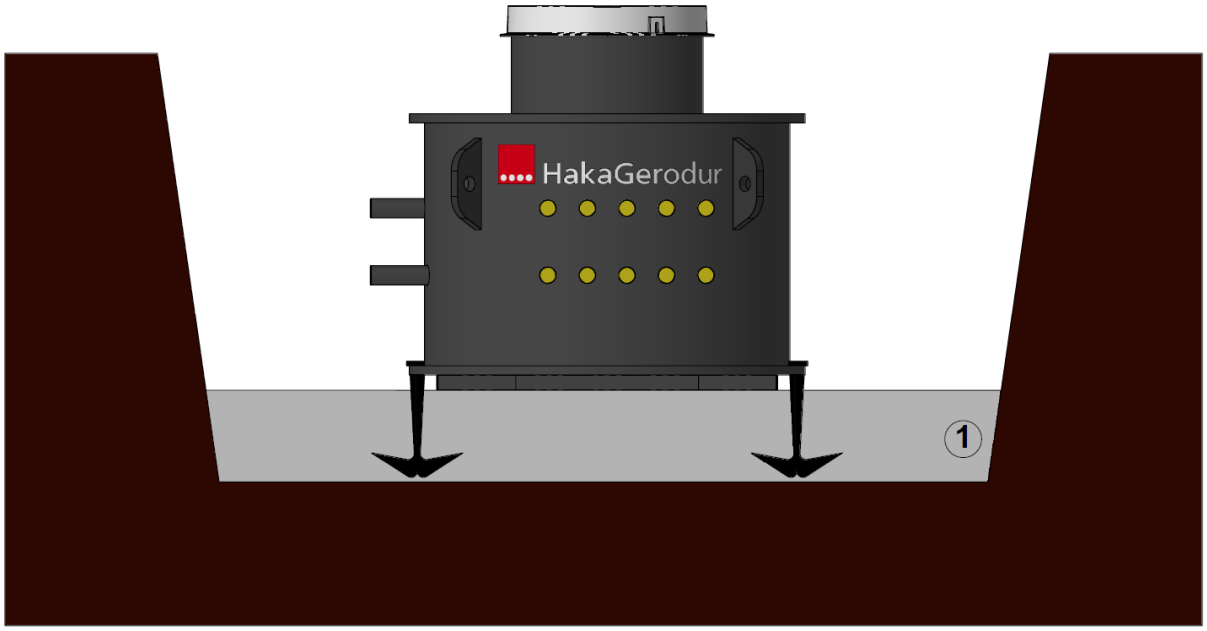


Figure 17: Installation situation of SMART and type 1 manhole (1/6)

Description ①

A level, stable and load-bearing foundation must be created for the foundation or stabilisation layer of SMART and type 1 manholes. Depending on the on-site situation, the foundation can be created using **lean concrete or a compacted gravel-sand mixture with particle size 0 to 16 mm**. The layer thickness of the foundation should be at least 30 cm. Reinforcement must be provided in the case of special structural requirements. The foundation must always be at least 50 cm larger than the ground area of the manhole including pipes and plates. Adequate working space must be included between the manhole and the trench wall in order to guarantee that the pipelines can be connected tension-free. A minimum working space depth of 1 m is recommended. Protruding plastic plates on the manholes can be used for concrete anchors or similar if required. The manhole must be aligned so that it is level on the foundation.

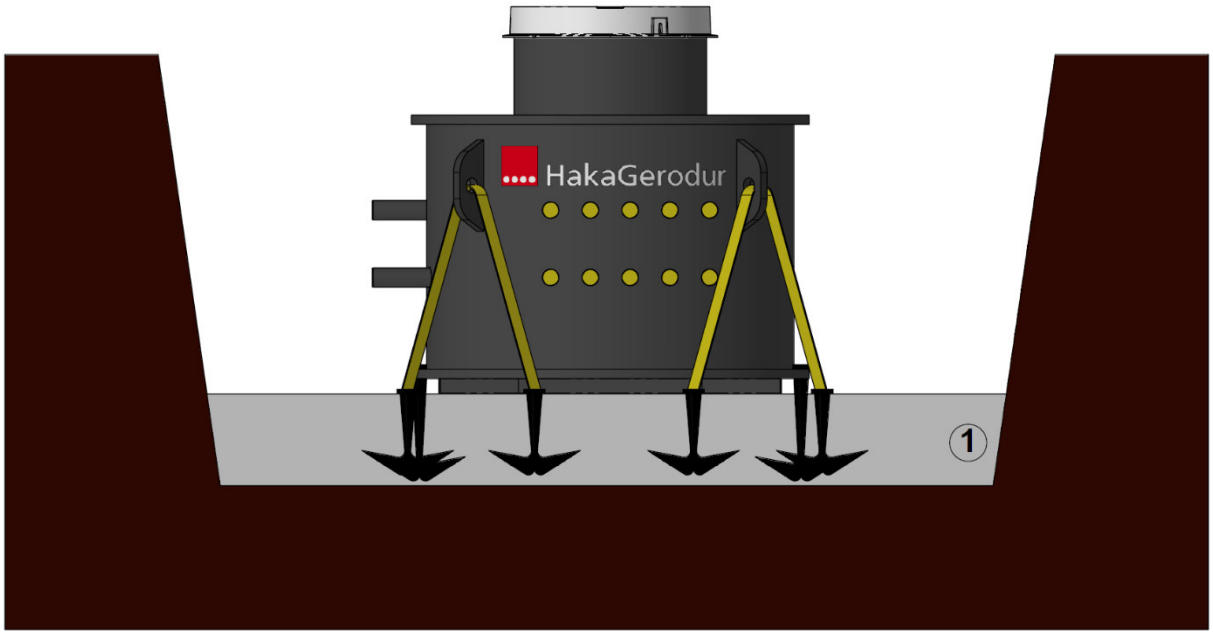


Figure 18: Installation situation of SMART and type 1 manhole (2/6)

If groundwater emergence or local flooding is expected (storm/heavy rain), additional uplift protection is recommended in the form of retaining straps and concrete anchors. The retaining straps are guided through the designated openings on the manhole and anchored into the foundation using concrete anchors. Once the retaining straps have been fixed in place, the protruding base plate on the vertical manhole can also be used for additional ballasting in the form of lean concrete. Another option is to install a concrete plate above the manhole. With this option, the traffic loads cannot be transferred to the manhole structure.

The expected uplift is calculated by a specialist planner, taking into account the soil properties and the groundwater table. The structural design of the products is discussed with the manufacturer prior to the production of the manhole as required. Permanent leachate drainage is recommended in the case of water-impermeable soils. This protects the manholes against external and non-definable forces and therefore against damage. If the manholes are not completely covered during the construction phases, they must be protected against any groundwater or meteoric water.

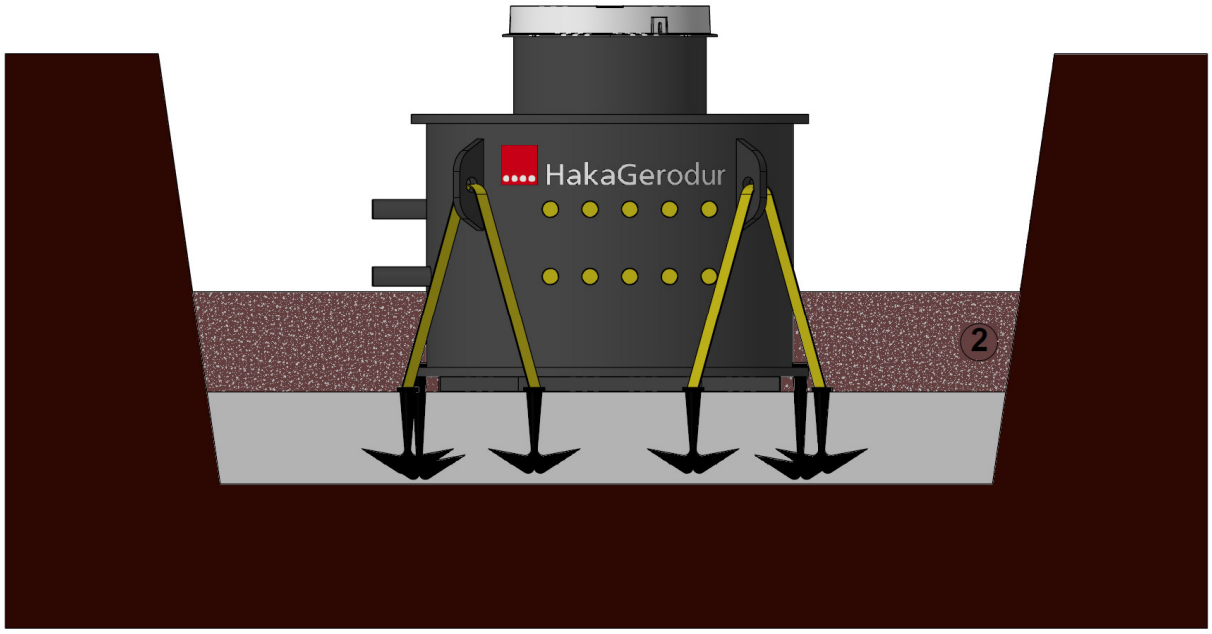


Figure 19: Installation situation of SMART and type 1 manhole (3/6)

General points to consider for the entire backfilling:

- Backfilling material must be applied in layers. The thickness of individual layers should not exceed 30 cm. This ensures sufficient compaction.
- Cohesive soils are not suitable for backfilling.
- The entire backfilling must be performed without gaps (Proctor density 97%).
- Measures must be taken to prevent the sudden filling of large filling masses.
- The backfill must be exposed around pipeline joints. This allows for permanently tension-free pipe connections.
- It is not permitted to use drop weights or to hit or press down the backfill material using excavator buckets.
- The pipelines and the manhole must not come into contact with the compaction machinery. Vibrations can cause screw connections to come loose.
- Backfilling with concrete is not recommended. Doing so would mean that it would no longer be possible to access the tank from the outside for repair work.

Description ②

The bedding should be created up to below the connecting pipes for the geothermal probes and the main outlet pipe. It must be ensured that a layer height is selected that guarantees the proper connection of electrofusion coupler sockets. A **gravel-sand mixture 0 to 16 mm, sand 0 to 5 mm or free sand** should be used as the material. In order to prevent damage to the manhole or the connecting pipes, compaction in this area must only be performed manually using a manual compactor.

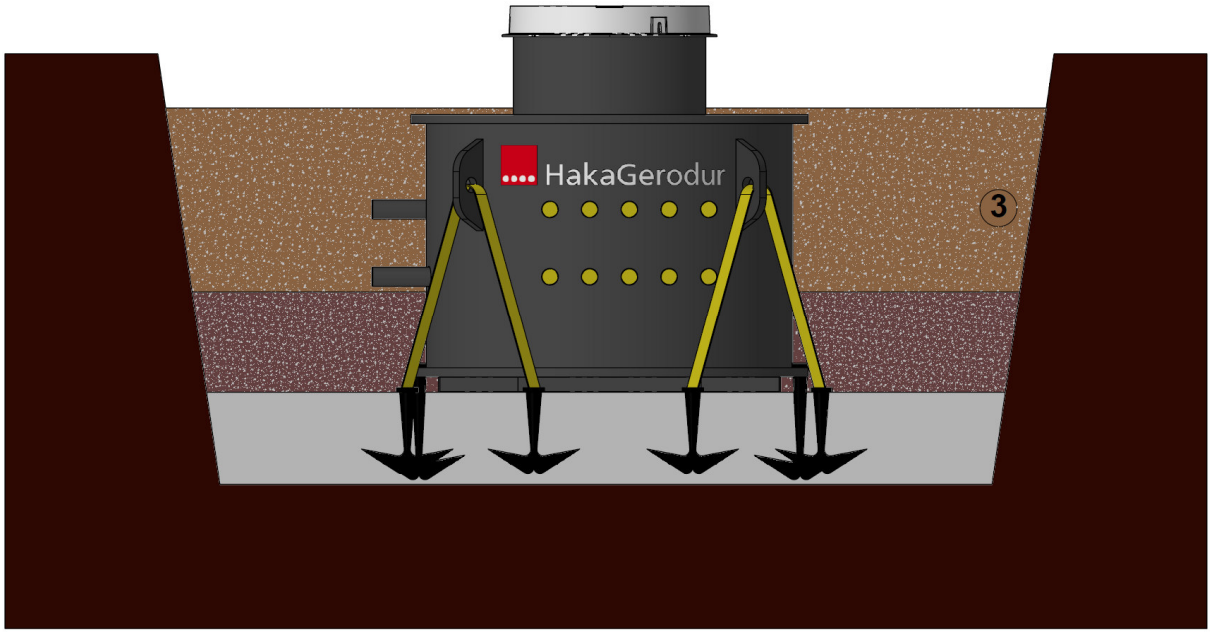


Figure 20: Installation situation of SMART and type 1 manhole (4/6)

Description ③

Sealing and covering should be performed once the connecting lines from the geothermal probes and the main outlet pipes have been connected to the manhole. The layer consists of **concrete gravel 0 to 16 mm, sand 0 to 5 mm or free sand**. Any mechanical compaction of the main backfill above the pressure pipes must only be carried out once a minimum thickness of 300 mm above the pipe crown of the main outlet pipes has been covered.

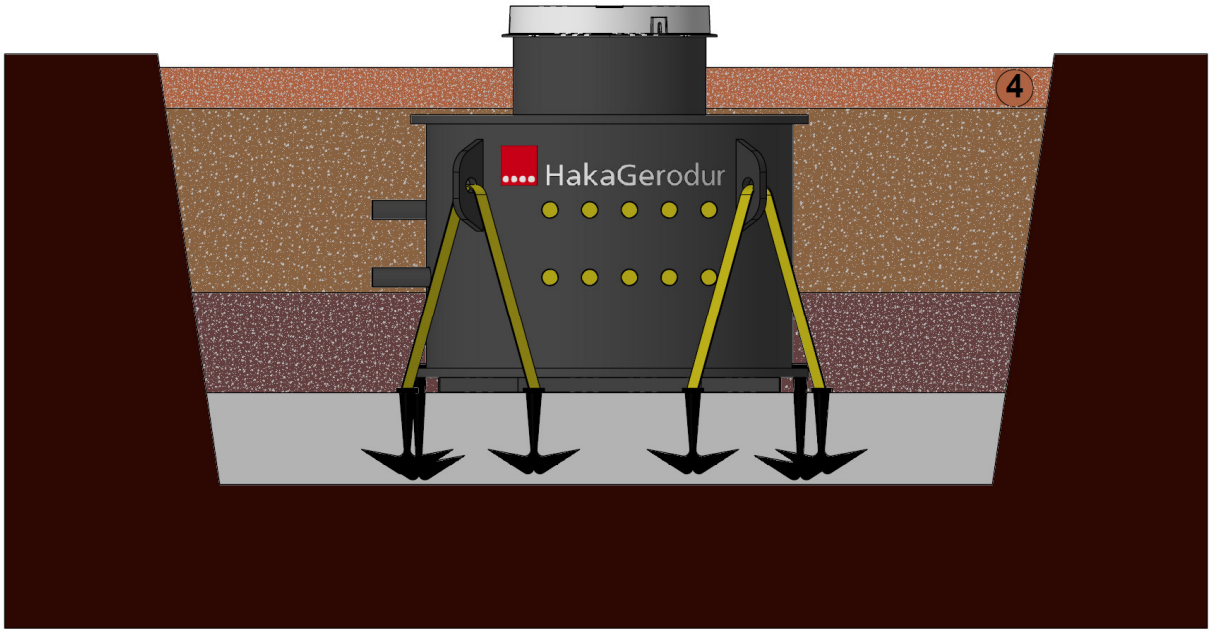


Figure 21: Installation situation of SMART and type 1 manhole (5/6)

Description ④

The main backfill can be created using **finely sorted excavated material 0 to 60 mm, concrete gravel 0 to 16 mm or free sand**. If there is a minimum covering height of 300 mm above the pipe crowns, mechanical compaction machinery may be used here. Lightweight vibratory rammers (up to 30 kg) are recommended on account of the operating weight. Heavier machinery such as explosion rammers, area vibrators or vibration rollers are not recommended.

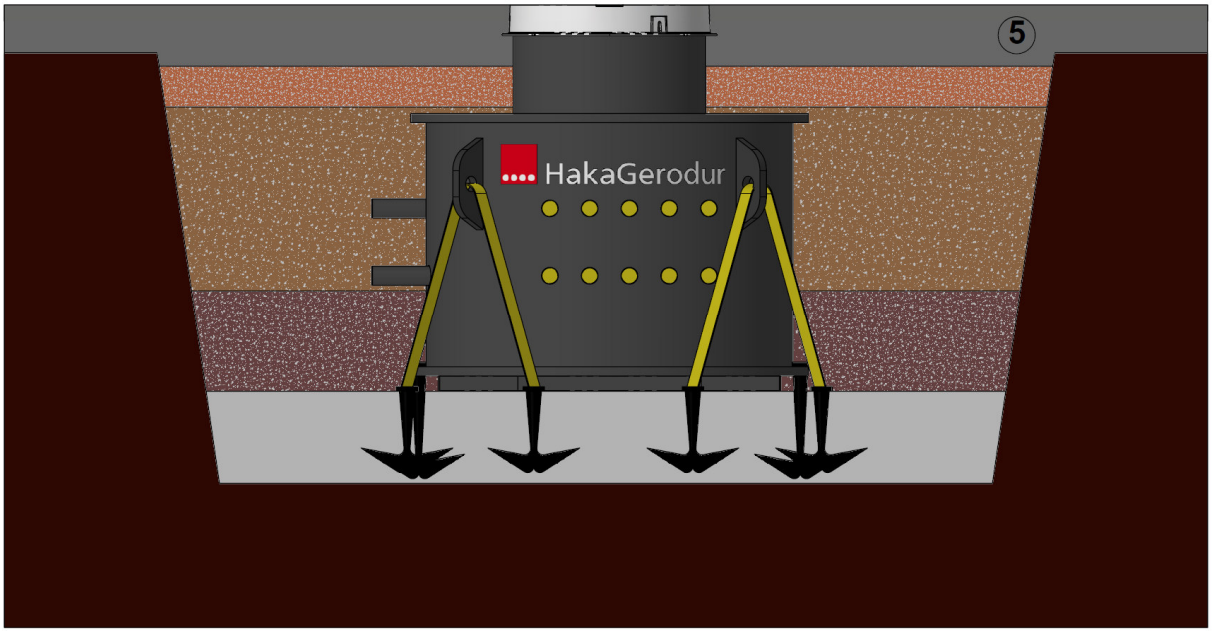


Figure 22: Installation situation of SMART and type 1 manhole (6/6)

Description ⑤

Creation of the roadbed or base plate by the civil engineering or road construction specialist in accordance with standards and guidelines.

3.4 Foundation, backfilling, uplift protection (horizontal)

The following section describes the suitable foundation, backfilling and possible uplift protection for **horizontal plastic manholes of type 2-4**. The list is non-exhaustive.

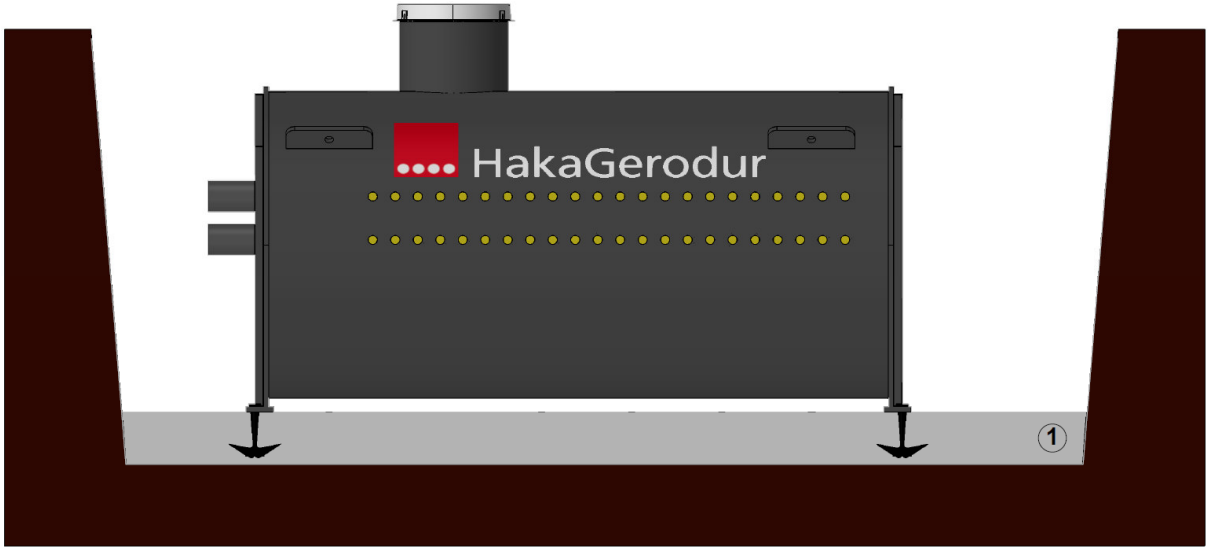


Figure 23: Installation situation of manhole type 2-4 (1/6)

Description ①

A level, stable and load-bearing foundation must be created for the foundation or stabilisation layer of manholes of type 2-4. This can take the form of **lean concrete or a compacted gravel sand mixture with particle size 0 to 16 mm**. The layer thickness of the foundation should be at least 30 cm. Reinforcement must be provided in the case of special structural requirements. The foundation must always be at least 50 cm larger than the ground area of the manhole including pipes and plates. Adequate working space must be included between the manhole and the trench wall in order to guarantee that the pipelines can be connected tension-free. A minimum working space depth of 1 m is recommended. Protruding plastic plates on the manholes can be used for concrete anchors or similar if required. The manhole must be aligned so that it is level on the foundation.

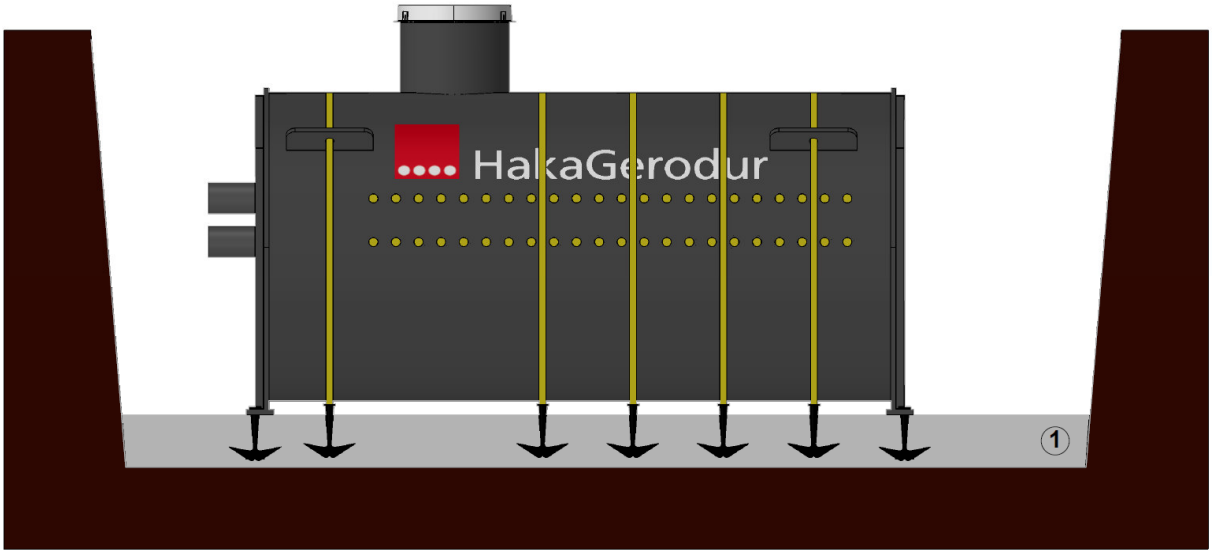


Figure 24: Installation situation of manhole type 2-4 (2/6)

If groundwater emergence or local flooding is expected (storm/heavy rain), additional uplift protection is recommended in the form of retaining straps and concrete anchors. The retaining straps are guided through the designated transport openings and between the geothermal probe connections around the entire circumference of the pipe. The retaining straps must not cause any damage to the geothermal probe connections. The retaining straps are then anchored into the foundation using concrete anchors. Once the retaining straps have been fixed in place, the two protruding base plates on the horizontal manhole can also be used for additional ballasting in the form of lean concrete. Another option is to install a concrete plate above the manhole. With this option, the traffic loads cannot be transferred to the manhole structure.

The expected uplift is calculated by a specialist planner, taking into account the soil properties and the groundwater table. The structural design of the products is discussed with the manufacturer prior to the production of the manhole as required. Permanent leachate drainage is recommended in the case of water-impermeable soils. This protects the manholes against external and non-definable forces and therefore against damage. If the manholes are not completely covered during the construction phases, they must be protected against any groundwater or meteoric water.

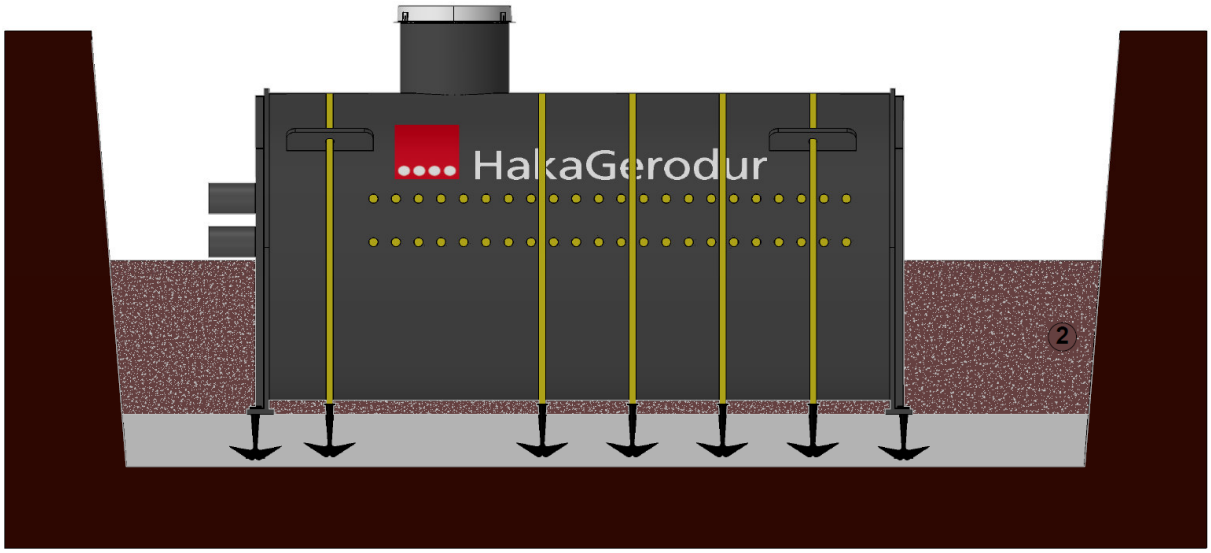


Figure 25: Installation situation of manhole type 2-4 (3/6)

General points to consider for the entire backfilling:

- Backfilling material must be applied in layers. The thickness of individual layers should not exceed 30 cm. This ensures sufficient compaction.
- Cohesive soils are not suitable for backfilling.
- The entire backfilling must be performed without gaps (Proctor density 97%).
- Measures must be taken to prevent the sudden filling of large filling masses.
- The backfill must be exposed around pipeline joints. This allows for permanently tension-free pipe connections.
- It is not permitted to use drop weights or to hit or press down the backfill material using excavator buckets.
- The pipelines and the manhole must not come into contact with the compaction machinery. Vibrations can cause screw connections to come loose.
- Backfilling with concrete is not recommended. Doing so would mean that it would no longer be possible to access the tank from the outside for repair work.

Description ②

The bedding should be created up to below the connecting pipes for the geothermal probes and the main outlet pipe. It must be ensured that a layer height is selected that guarantees the proper connection of electrofusion coupler sockets. A **gravel-sand mixture 0 to 16 mm, sand 0 to 5 mm or free sand** should be used as the material. In order to prevent damage to the manhole or the connecting pipes, compaction in this area must only be performed manually using a manual compactor.

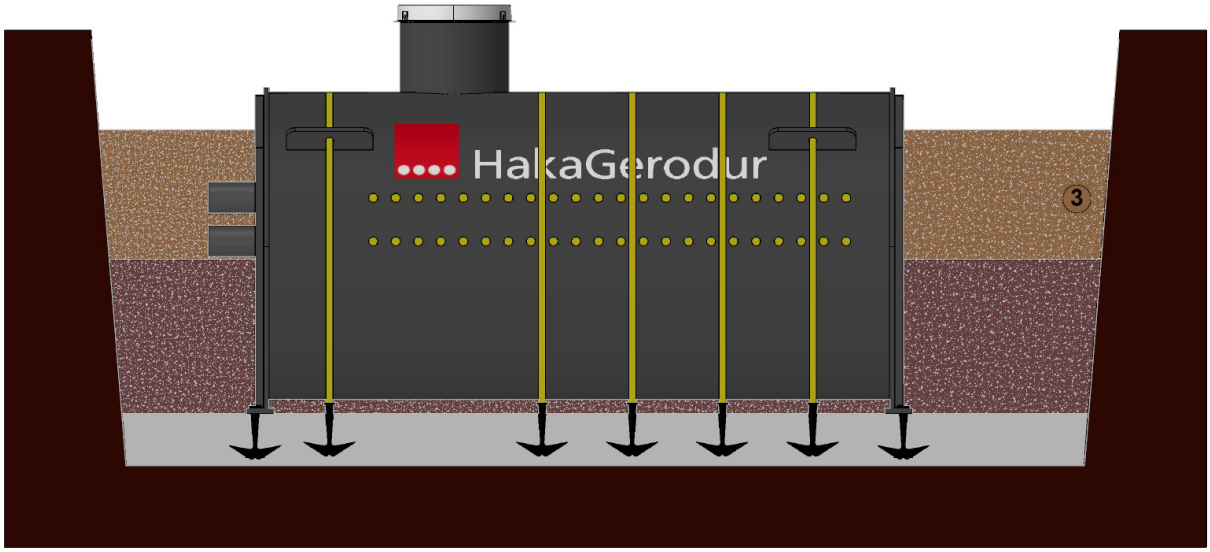


Figure 26: Installation situation of manhole type 2-4 (4/6)

Description ③

Sealing and covering should be performed once the connecting lines from the geothermal probes and the main outlet pipes have been connected to the manhole. The layer consists of **concrete gravel 0 to 16 mm, sand 0 to 5 mm or free sand**. Any mechanical compaction of the main backfill above the pressure pipes must only be carried out once a minimum thickness of 300 mm above the pipe crown of the main outlet pipes has been covered.

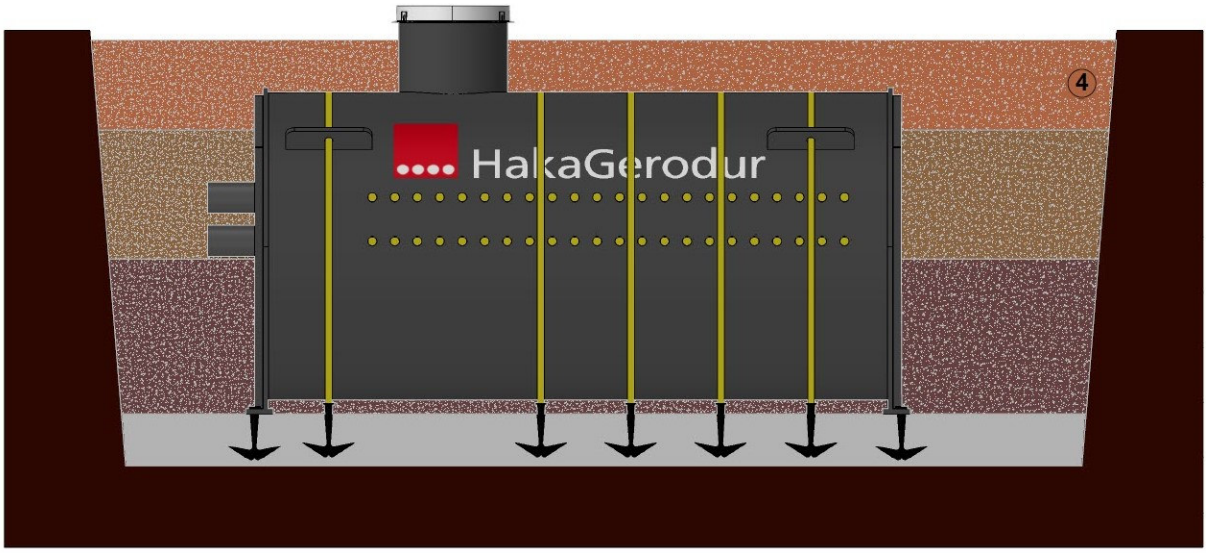


Figure 27: Installation situation of manhole type 2-4 (5/6)

Description ④

The main backfill can be created using **finely sorted excavated material 0 to 60 mm, concrete gravel 0 to 16 mm or free sand**. If there is a minimum covering height of 300 mm above the main pipe, mechanical compaction machinery may be used here. Lightweight vibratory rammers (up to 30 kg) are recommended on account of the operating weight. Heavier machinery such as explosion rammers, area vibrators or vibration rollers are not recommended.

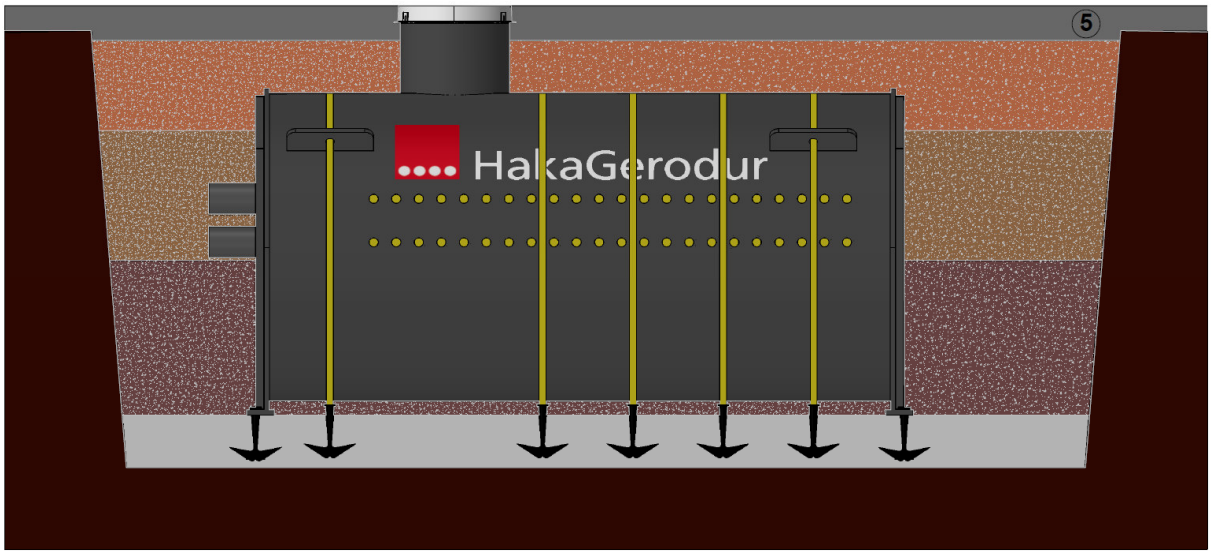


Figure 28: Installation situation of manhole type 2-4 (6/6)

Description ⑤

Creation of the roadbed or base plate by the civil engineering or road construction specialist in accordance with standards and guidelines.

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