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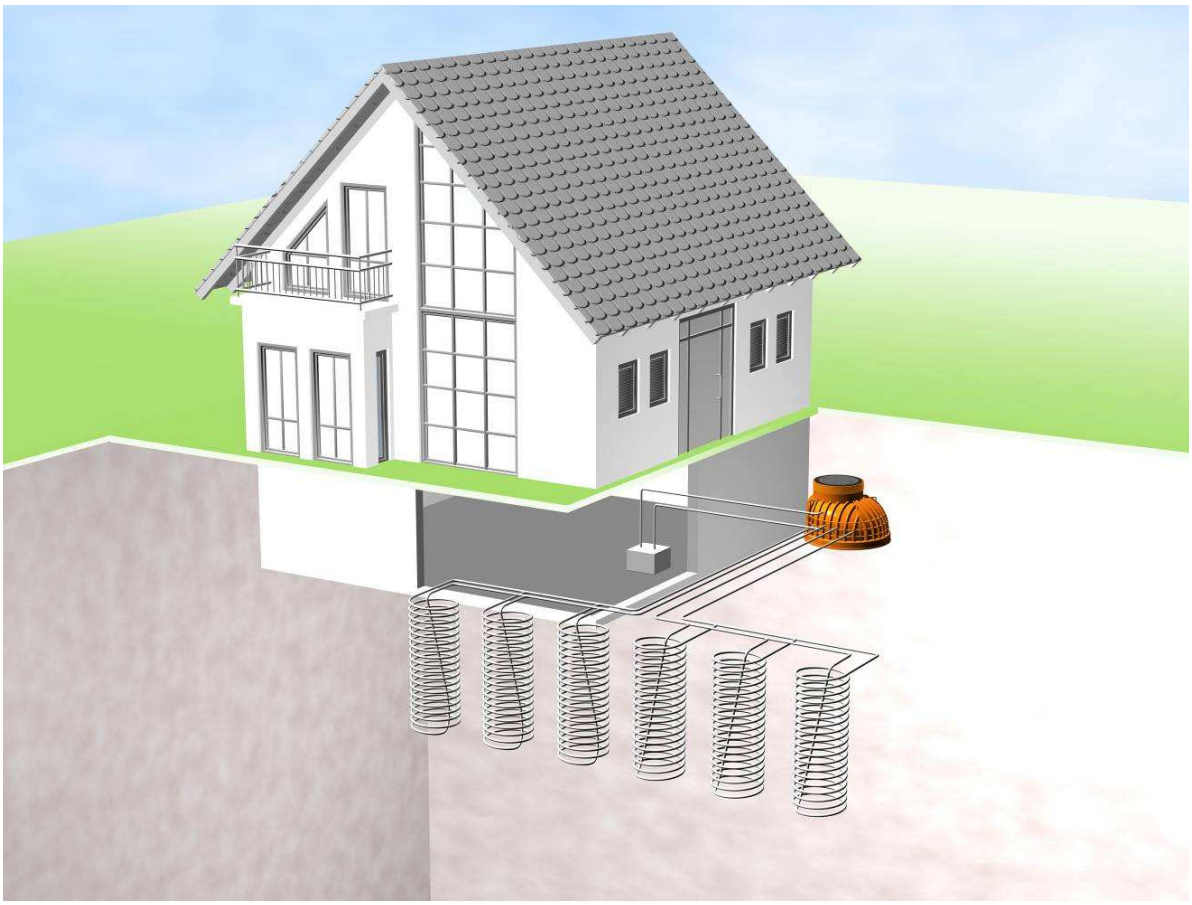

RAUGEO HELIX PROBE PE-Xa

TECHNICAL INFORMATION (draft)
Version 1: March 2009

Sizing and installing Helix Probes

The specifications detailed on VDI 4640 should be observed when installing and sizing Helix Probes.

1. Reference data for the Helix Probe

Height (for transport)	approx.1.1 m
Height (for installation)	approx. 3.0 m
Diameter (external)	approx. 0.38 m
Pipe length	40 m
Pipe dimension	25 x 2.3
Pipe material	PE-Xa
Weight (unfilled)	approx. 7.5kg
Pipe volume	approx. 13 litres

Table 1: Reference data for the Helix Probe

2. Sizing

The basis for sizing Helix Probes is the calculated heat required by the building.
On one hand this depends on the number of full-load operation hours required and on the other the soil and groundwater conditions.
The estimated heat extraction of the Helix Probe (based on 1800h operating hours / annum) for different soil conditions is shown in the table below.

Underground	Specific heat extraction in W / Helix Probe
Sand (dry)	200 – 300 W
Sand (wet GW)	400 – 700 W
Silt (dry)	250 – 350 W
Silt (wet GW)	400 – 650 W
Clay	250 – 350 W
Sandy clay (dry)	300 – 400 W
Sandy clay (wet GW)	450 – 700 W

Table 2: specific heat extraction of Helix Probes

The soil types which influence the heat extraction of the Helix Probe significantly can be requested from either the British Geological Survey or determined during trial drilling. Data about the existing groundwater conditions can also be requested from this provider. The groundwater depth and (in particular) the groundwater gradient influence the heat extraction of the Helix Probe.

Therefore determining the soil type and the groundwater conditions are both recommended to calculate the number of Helix Probes required accurately.
If no data about the soil type and groundwater conditions is available an average estimated heat extraction of 400 W / Helix Probe can be assumed. In order to guarantee a problem-free and stable operation it is necessary to determine the soil conditions during further planning.
If the Helix Probes are used for passive or active cooling, the ground will regenerate more quickly. This additional "recharging" of the ground leads to increase in the heat extraction, depending on the time, type and duration of the recharging.

Calculation example:

Step 1:
Building heat load: 10 kW

$$\textit{Evaporator output*t} = \frac{\textit{Heat output x (COP-1)}}{\textit{COP}}$$

* Evaporator output is equal to the heat extraction from the soil. This Coefficient of Performance (COP) depends on the heat pump and its operating temperature.

Assuming GSHP COP is 4 (B0ºC / W35ºC)

$$\text{Evaporator output} = \frac{10 \times (4-1))}{4}$$

Evaporator output = 7.5 kW (7,500 W)

Step 2:
Operation hours 1800 h/a
Soil: Sandy clay (groundwater from 3 m)
Estimated heat extraction 550 W/Probe

This results in the following

$$\textit{Number of probes (units)} = \frac{\textit{Evaporator output (W)}}{\textit{Heat extraction (W/Probe)}}$$

Therefore 14 Helix Probes

The following table can be used for the initial estimation of Helix Probe requirement.
Calculating the number of Helix Probes required based on a heat pump COP of 4 (B0ºC / W35ºC) and a heat extraction of 400 W/Helix Probe:

Required heat output	Evaporator output	Number of RAUGEO Helix Probes
kW	kW	Units
4	3	8
6	4,5	12
8	6	15
10	7,5	19
12	9	23
14	10,5	27
16	12	30
18	13,5	34
20	15	38

Table 3: Estimating probe requirement

2.1 Sizing larger installations (>30kW)

An exact calculation and sizing of the installation should always be carried out for large heating installations with a heating / cooling capacity of > 30 kW. The heating-cooling requirement of the building is to be determined as a basis for the calculation.
The findings about geology and water geology conditions are required for the dimensioning of every installation over 30 kW.

3. Installation

Note: The foil on the probe is not packaging material and should not be removed. This serves to fix the distance between the spiral coils.

The installation of the Helix Probes can be carried out using standard site equipment which can be fitted with a spiral or auger drill bit. The drill bit must have a min. diameter of 450 mm.

The borehole should be drilled to a depth of approx. 5 m. It may be necessary to use a protective casing in very sandy soil or harsh groundwater conditions. The protective casing would prevent the borehole collapsing or filling with water.
If it is expected that groundwater will be encountered when drilling the relevant authorities should be contacted before drilling is carried out. If groundwater is encountered when drilling is carried out the responsible water authority should be informed and the further action agreed with the authorities.

The minimum distance of 2 m from the building should be observed, to prevent jeopardising the building's stability.
The installation of Helix Probes under the building in particular should always be carefully designed.
The distance of the Helix Probes between one another should be a minimum of 3-4 m. In very good groundwater conditions the distance between the Helix Probes can also be reduced.
The distance of the Helix pipes from other pipes must be a minimum of 1 m.
If the distance is less than this the supply lines must be protected with sufficient heat insulation.

As the first step of installation, the transit support must be undone so that the Helix Probe can now be extended to the installation length of 3 m. The Helix Probe will be fixed into the connecting loops provided as shown in Fig. 1 using an approx. 4-5 m long insertion tool or wooden batten.

Fig. 1: Fixing the connecting loops

After drilling the probe will need to be positioned in the borehole. When doing this ensure that the Helix Probe has extended across the full length and is sitting directly on the bottom of the borehole. This is necessary to ensure that no hollow areas occur at the foot of the Helix Probe which can lead to a deterioration in the heat transfer. To weigh down and fix the Helix Probe in the borehole, a bucket of sand can be poured in the middle of the Helix Probe.
Once the Helix Probe is bedded into the borehole sufficiently, slowly start to fill the Helix Probe by hand. When filling ensure that there aren't any hollow areas between the Helix Probe pipe and the wall of the borehole.
It is recommended that water is added to the excavated soil during backfilling, to ensure good contact between the Helix probe and the soil.

The excavated soil can normally be used as the filler material. If the fine grain percentage of the soil material is too high it should be mixed with medium grain sand. From an energy point of view a sandy to very sandy clay is the optimum filler material. The objective being to prevent air pockets which reduce heat transfer.

Once the probe has been installed properly a pressure test should be carried out.
The pressure test will be carried out at 1.5 times the operating pressure (min. 6 bar) and max. 10 bar. The test duration is 60 minutes with a permissible pressure drop of 0.2 bar.

If there is a danger of frost during installation, the probe should be emptied to less than 2 m below the top ground surface. The probe pipes ends must be sealed tightly until they are connected.

3.1 Installation variations

The installation of the Helix Probes can be carried out differently depending on the soil conditions or the space available. In order to guarantee the lowest possible pressure loss the Helix Probes should be installed in parallel to the circuits connected to the manifold.
Up to 3 probes can also be connected in series. The Helix Probes can be installed next to or on top of other.

The Helix Probes or groups of probes connected in series should be installed parallel to the manifold. The manifold should be installed at the highest point, with a suitable air vent provided. The manifold can be fitted with flow meters to adjust the flow rates.

Before commissioning the complete system a pressure test is to be carried out at 1.5 times the operating pressure. Check to ensure that all probes have a balanced flow rate.

3.2 Assembling the Helix Probe

Fig. 2: Preparing the probe

Assembly step 1

- Check the Helix Probe for damage before installation
- Undo the transit support and extend
- Use an insertion aid or wooden batten to fix the probe at the installation length (3.0 m)

Fig. 3: Inserting the probe

Assembly step 2

- Insert the Helix Probe into the borehole
- If groundwater is present fill the probe with water when inserting

Fig. 4: Filling the borehole

Assembly step 3

- Wash sand or other suitable excavated material into the probe
- Carry out pressure tests on the probe filled with water
- Pressure test at 1.5x operating pressure (min. 6 bar)

Fig. 5: Connecting the connecting lines

Assembly step 4

- Connect the probe with the connecting pipework and to the manifold
- Fill the system with water / glycol mixture (to pre-determined ratios)
- Flush the pipes using an open vessel until all the air is removed
- Before commissioning, the complete system should be pressure tested at 1.5 times operating pressure.