HakaGerodur

GEROtherm® geothermal system

Geostructures / energy piles

Overview

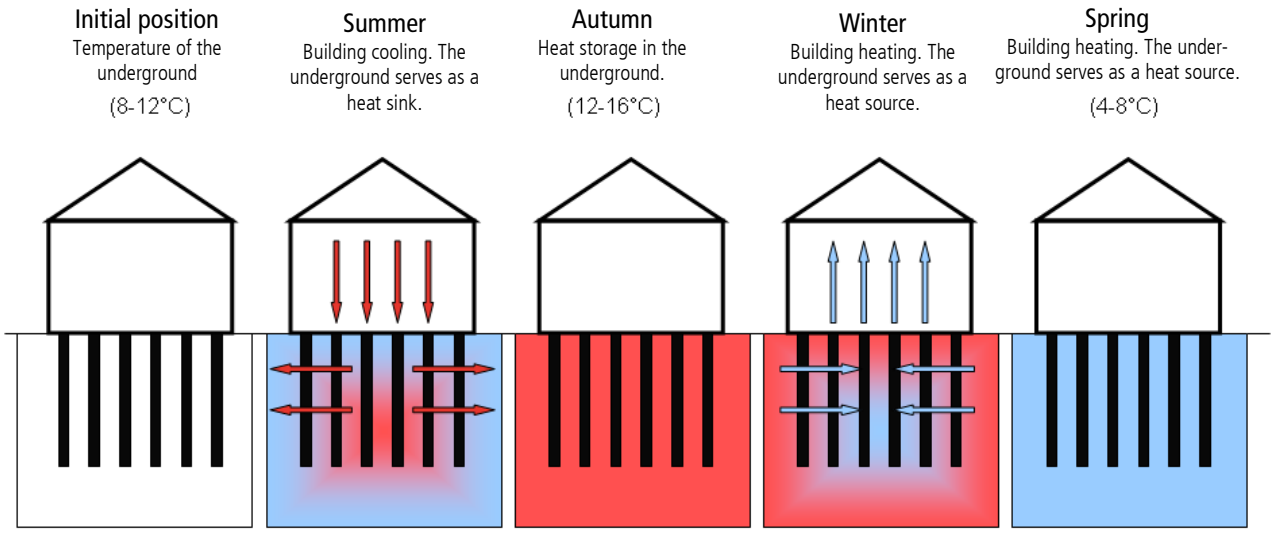
Foundation piles that are required in buildings due to static requirements can be fitted with geothermal heat exchangers. This turns the piles into energy geostructures, enabling the supply of heat in winter and cooling in summer.

Heat and cooling from beneath the building

Geostructures are structures that are either in the ground or in contact with it. These are usually piles, walls and base plates. They help give the substrate the required stability and load-bearing capacity. Geostructures are usually made of concrete, with or without reinforcement. The concrete's ability to store and convey heat make it the ideal material for absorbing thermal energy. In addition, the ground temperature at a depth of several metres (15-20 m) is constant (9-11°C in the Swiss climate). This temperature level can be used to provide direct cooling in summer and deliver heat in winter via a heat pump.

Geostructures of all sizes that are required for support and building foundations can be fitted with heat exchangers. The concrete piles and walls in contact with the substrate are fitted with plastic heat exchanger pipes that exchange heat or cold with the substrate. These pipes are brought together via collectors/distributors and connected to one or more heat pumps.

This system is based on an annual cycle that draws heat from the substrate during the heating period (and introduces cold into the substrate) and draws cold from the substrate during the cooling period (and introduces heat into the substrate). The installed amount of heating energy ranges from a few kW to around 1,000 kW, depending on the size of the building. A system of this type can deliver lower operating costs due to the reduction of fossil fuel use, while also reducing CO_2 emissions by between 45% and 100%.



GEROtherm® energy piles

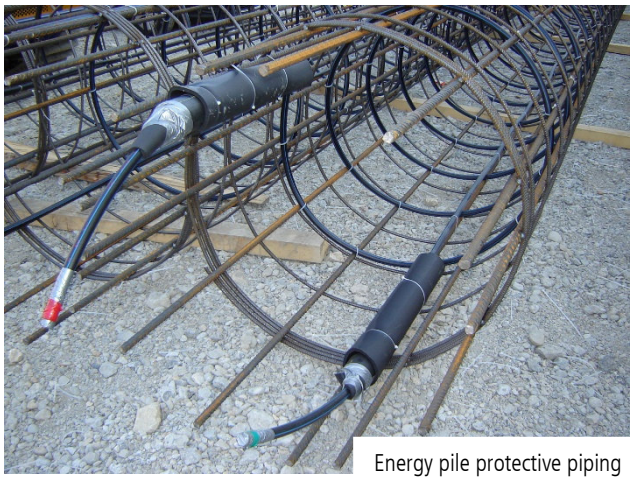
An energy pile essentially has two functions. Its main function is to transfer load to the substrate, while also acting as a geothermal heat exchanger. This secondary function must not jeopardise the load-bearing capacity. Above all, energy piles are designed as base load systems, with other systems covering peak demand periods. These systems should be operated as an alternating energy store, aiming to achieve an even distribution of cooling and heating energy. This makes it possible to achieve the best specific extraction capacity and a stable system temperature regime over the long term. The system should never be run down to below zero, in order to prevent damage to the piles.

GEROtherm® geostructures / energy piles

Reinforced concrete piles usually have a diameter of 0.4 to 1.5 m and measure between a few metres to over 30 m in length. Depending on their diameter, the insides of the piles are usually fitted with several simple U-probes made from PE 100-RC with a U-bend made in production, or a network of pipes made from polyethylene (PE 100-RC), inserted in a meandering loop pattern. These heat exchanger pipes are completely encased in concrete, in order to ensure good thermal contact with the substrate. A heat transfer fluid circulates within the closed circuit between the heat exchangers in the piles and the heat pump, extracting the heat or cold from the substrate. This energy system can be fitted into either all or merely some of the foundation piles.

Energy pile with meandering pipes

Simple U-probes in an energy pile



Energy pile protective piping

Energy piles installed with protective piping

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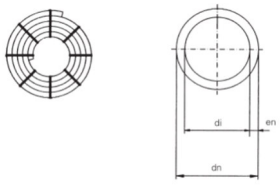
GEROtherm® energy piles – product characteristics

The material quality of PE100-RC is highly suitable for energy pile applications due to its excellent stress cracking and point load resistance properties.

	Energy pile PE 100-RC	Energy pile with short probes PE 100-RC
Delivery form	Rolls	Rods
		
Lengths	50 m / 100 m / 200 m	10–20 m
Dimension	dn 25 / dn 32 mm	dn 25 / dn 32 mm
UV stabilisation	Yes	Yes
Physical properties		
Density	0.96 g/cm^3	0.96 g/cm^3
Min. bending radius at 0° C	50 × dn	In factory
Min. bending radius at 10° C	35 × dn	In factory
Min. bending radius at 20° C	20 × dn	In factory
Mechanical properties		
FNCT (4.0 MPa, 2% Arkopal N 100, 80° C)	>/= 8,760 h	>/= 8,760 h
Connections	HS, HW, HM	HS, HW, HM
Thermal properties (for piles with min. op. temp. +3° C)		
Max. operating temp.	+40° C	+40° C
Min. operating temp.	-20° C	-20° C
Thermal conductivity	0.4 W/mK	0.4 W/mK

Prices, special lengths and minimum purchase quantities for pipes for energy piles (U-probes, pipes, etc.) are available on request; transport options to the construction site must be taken into account.

GEROtherm® energy piles – installation and planning information

Planning

- Every building must be planned separately. The design/sizing must be based on the geology present
- For energy pile systems, the number of energy piles planned should be 10% higher than necessary
- There should be at least 15 cm of space between the pipes in the energy pile. Observe the static calculations
- Planning should consider the potential interference between energy piles, as well as the influence of any groundwater flows present (system simulation)
- The extraction capacity per linear metre is between 20-75 W/m, depending on the pile diameter and the geology/hydro-geology
- Do not connect in the Tichelmann system (problems with venting, etc.)

Installation

- When using existing concrete piles, the heat exchanger pipes must be fitted on the inside of the reinforcement cages
- Secure the pipes to the reinforcement every 1-2 m with cable ties
- Connect the pipeline to the reinforcement cages with plastic cable ties. Do not use binding wire
- Energy piles must be fitted with ball valves and pressure gauges during installation (filling, venting, pressure build-up)
- Energy piles must remain pressurised (8-10 bar) during installation, concreting and follow-up work
- Pressure conditions must be monitored continuously
- Shut-off valves must remain on the energy pile while the concrete is curing
- Observe the bending radii of the pipe manufacturers at the foot of the pile
- The ends of the pipes must extend approx. 0.5 to 1.0 m beyond the end of the pile
- The outlets of the energy piles must be visibly protected against damage (e.g. via protective piping)
- The connection lines are brought together in the base plate (in the bottom reinforcement layer = neutral zone), ideally beneath the base plate in order to prevent negative effects from dew or condensation
- The distance between the connection lines of the energy piles and the distributors should be as short as possible. The lines used should be of the same length wherever possible.
- Flow and return lines should be installed at a distance of around 1 m.
- Any bushings in the base plate should be protected against groundwater penetration
- Avoid welding work on the reinforcement cages once the heat exchanger pipes have been fitted.

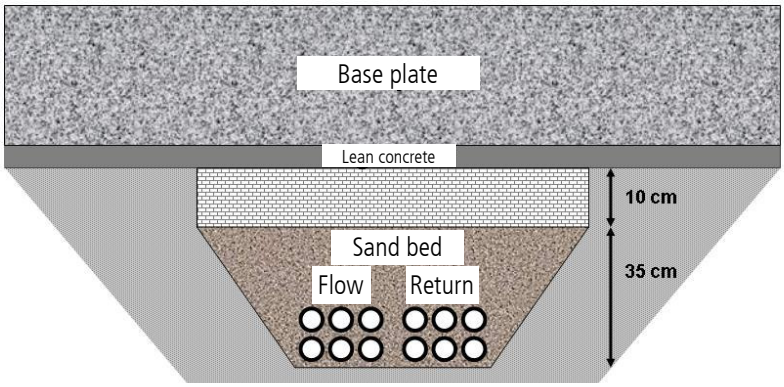
General notes

- Installation of an automatic shut-off mechanism for the system once the minimum temperature of 3° C is reached
- It must be possible to shut off each energy pile separately

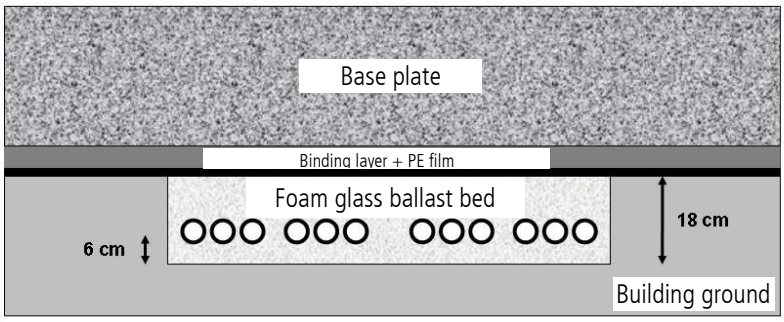
GEROtherm® energy piles – installation information

The connection lines should be in the material quality PE 100-RC and ideally be fitted beneath the base plate.

- Installation of the connection line with insulation (source SIA 0190)



- Installation of the connection line in foam glass bed (source SIA 0190)



- Installation of pre-insulated connection line (source SIA 0190)