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GEOTHERMAL PILES

Providing Geothermal Piles for use in ground storage systems is one way that Balfour Beatty Ground Engineering (BBGE) can help with the provision of renewable energy and reduce carbon emissions.

Concrete piles are used in a ground storage system to house closed circuits made from plastic piping. The pipes are used to circulate a heat transfer fluid which transports the ground temperature to the central control system for the building services. In the central control system a heat pump is used to increase the temperature to a level suitable for heating purposes.

While the average temperature to be found in the concrete foundations is in the region of 12°C, the heat pump produces temperatures of between 25°C and 40°C in the heat transfer fluid, which is suitable for low temperature heating systems in floors and ceilings. These systems can be used for both heating and cooling purposes. BBGE can use bored, CFA, precast concrete and steel piles as geothermal piles.

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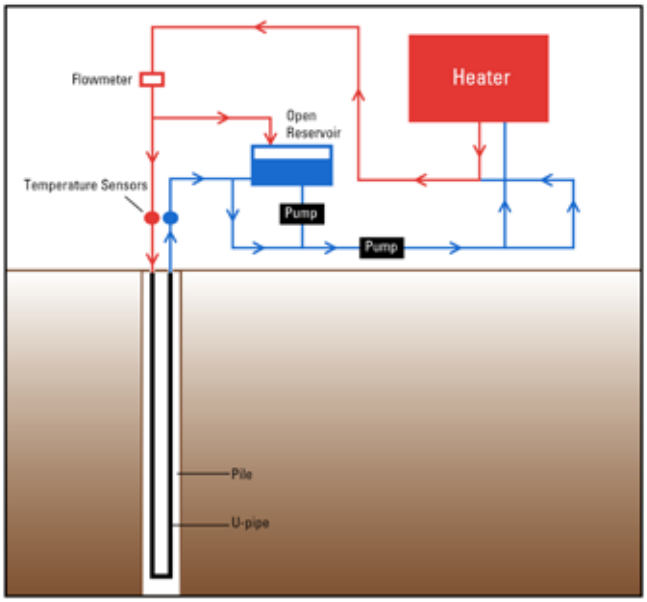
The Government has set a goal of supplying 20% of the UK's electricity from renewable sources by 2020, Geothermal Piles have the potential to play a leading role in achieving this target.

In view of the complexity of the planning and engineering processes necessary for ground storage systems, the architect, structural engineer, geotechnical engineer, geothermal engineer and building services engineer need to be included right from the beginning to undertake an integrated feasibility study.

// HOW DO THEY WORK?

Within the ground, only the top 1.5m of soils are effected by temperature fluctuations in the climate and below this soils remain at a constant temperature, usually around 12°C. Closed ground source heat loops use this temperature constant to either heat up cold water or cool down hot water by pumping a liquid solution through pipework in contact with soils at depth.

At the surface, a heat exchanger is used to amplify the temperature difference in a similar way to the workings of a fridge. The heat exchanger then uses the temperature differences to either heat or cool a building via standard central heating systems.



to the heating or cooling available measured in W/m/K. A thermal response is carried out using a self contained portable test unit towed behind a 4 x 4 vehicle. A properly conducted test will take 3 to 4 hours to set up and then 3 to 4 days to complete. Analysis of the results and reporting can then take place.

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Geothermal Piles can become an integral part of new projects, ensuring maximum gains are made from a natural resource.

// ASSESSING HEAT ENERGY FOR YOUR BUILDING

As a rule of thumb, most small diameter geothermal pile installations will achieve at least 30 watts of heating and cooling energy per metre depth of soils. 1 kilowatt of energy (one 33m deep precast pile) is enough to heat and cool a well insulated 4m by 4m room. A typical two storey office arrangement for 20 people, if constructed to modern insulation standards, would require around 50kW of energy from a ground source loop.

Ideally BBGE requires the building heating and cooling energy requirements over a 12 month climate cycle. This is an M&E type calculation based on insulation quality and extent and type of glazing required to the building.

// WHAT HAPPENS AFTER INSTALLATION?

BBGE will provide and install piping and a manifold connection to the head of each pile, normally leaving the remainder of the infrastructure connection to the main contractor. BBGE can undertake all the infrastructure connection if required.

Geothermal piles require integration with the construction sequence and careful design. BBGE is happy to work with clients and their engineers to ensure both are successfully achieved.

// RESEARCH AND TESTING

BBGE has taken the concept of geothermal piles a step further when becoming the first UK company to offer precast concrete geothermal piles. BBGE conducted its own research and developed a prototype system for precast concrete piles that has been installed and is heating part of its Balmore precast piling factory, north of Glasgow.

The system was put to the test when temperatures in the region fell to -6°C duing the day and -15°C during the night for a two week period. Although frequent monitoring of the ground temperature showed a drop during the bad weather, this had recovered by early February proving the system is robust despite the coldest winter in Scotland since 1914.

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PUBLISHED PAPERS

- Suckling, T.P. and Smith, P., 2002, Environmentally friendly geothermal piles at Keble College, Oxford, UK, Deep Foundations Institute Conference, Nice, France.
- Suckling, T.P. and Cannon, R., 2004, Energy piles for Pallant House Art Gallery, Chichester, UK, Ground Engineering, July.
- Lennon, D.J. Watt, E. and Suckling, T.P., 2008, Energy Piles in Scotland, International Conference on Deep Foundations on Bored and Auger Piles, Ghent. Belgium.

CAPABILITY STATEMENT

Tony Suckling, BBGE Technical Director, was responsible for the first ever project using geothermal piles in the UK.

Tony Suckling, BBGE Technical Director, and Rob Cannon, BBGE Southern Area Operations Manager, were responsible for the second ever project using geothermal piles in the UK.

Derek Lennon, BBGE Scottish Area Design Manager, developed the first use of geothermal precast concrete driven piles in the UK. BBGE has enough confidence in geothermal piles that they are used to provide energy for our new Scottish office and precast piling factory. The performance of the piles and the energy system is being monitored and the results are being made available to independent organisations including Southampton University and Virginia Tech in the United States.

Derek Lennon, BBGE Scottish Area Design Manager, has also undertaken trials on steel driven tubular geothermal piles and has also worked with Lankelma on their pushed-in geothermal loop system which is an economic alternative to geothermal piles in many ground conditions.

Tony Suckling, BBGE Technical Director, is also chairman of the Deep Foundation Institute Sustainability Committee and is helping to introduce geothermal piles into the United States. As part of this work BBGE is supporting current research being undertaken by Virginia Tech in collaboration with Cambridge University. Tony is working with independent piling contractors in the United States to investigate the performance of micropiles, grouted CFA piles and bored piles as geothermal piles both in the northern states and also in the southern states where the building energy requirements differ due to the different weather conditions.

FOR FURTHER INFORMATION CONTACT:

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