PhD Studentship in Computational Geomechanics

Resilient design of heat-exchanger piles for sustainable use of geothermal energy

Institution: University of Bath, UK

Department: Architecture & Civil Engineering

Centre: Decarbonisation of the Built Environment

Supervisor: Dr Loizos Pelecanos

Keywords: Civil Engineering, Geotechnical Engineering, Finite Element Modelling, Computational Analysis

Application Deadline: 30th April 2017

Preferred Start Date: 2nd October 2017

Project Description

Geothermal energy is energy generated and stored in the earth. It has recently attracted considerable attention from the engineering community because it is a sustainable type of energy that can help to reduce carbon emissions from other sources of energy. Recent studies have shown that future buildings can achieve zero-energy balance by using energy from the ground underneath their foundations.

Using a very simplistic description, during winter engineers may take advantage of the higher temperature in the ground to heat up buildings and, likewise, the lower ground temperature during summers to cool buildings. This is done by circulating water (or other liquid) through a closed loop that passes through the ground and the building. In order to approach large temperature differences, one needs to take this liquid medium deep in the ground and therefore existing foundation piles are usually used to accommodate the geothermal loop pipes.

Although this is a very promising technology for energy savings, concerns were raised about the potential degradation of the bearing capacity of the foundation piles. This had a significant impact in delaying the adoption of energy piles as a sustainable energy solution. Clearly, there is a need to quantify the potential effects on the structural-geotechnical capacity of the foundations and therefore help to promote this sustainable technology. Although major efforts have been recently done in this area, computational tools that consider all these highly complicated concepts cannot be directly used in industry for routine pile design yet. For this reason, appropriate and simplified computational models need to be developed so that the complicated academic knowledge is demystified and transferred directly to Industry and therefore being used in practice for the routine design of energy pile foundations.

This project consists of a computational effort and aims to investigate the effects of temperature on the shaft and base resistance of energy piles subjected to temperature cycles and propose simplified conceptual finite element models that can be directly used in design of energy piles. The models will be validated against relevant available field and laboratory data. It will involve numerical analysis with both in-house developed codes and commercial software. Therefore, the suitable candidate should

have a strong interest in engineering mechanics, geotechnical/structural modelling and computational analysis. This is currently a very active research topic that is expected to lead to a series of publications in top journals. The student will acquire valuable computational analysis skills and knowledge of an emerging field that are directly relevant to Industry and will have the chance to interact with practising engineers.

This project will be co-supervised by Professor Kenichi Soga from the University of California at Berkeley.

Interested candidates are encouraged to contact the primary supervisor (L.Pelecanos@bath.ac.uk) to inquire about the project.

More details may be found on FindAPhD.com and candidates should apply online before the deadline.

Funding Notes

The Centre for Decarbonisation of the Built Environment will provide full tuition fees and an annual training support fee of £1,000 per annum.

Applicants with a home/EU fee status will also be eligible for a maintenance stipend of £14,553 pa (2017/8 rate). Overseas fee status are not eligible for a stipend.

The position is located within the Department of Architecture & Civil Engineering at the University of Bath. The department was ranked first the UK out 45 submission to Sub-Panel C16 architecture, Built Environment and Planning in the 2014 research Excellence Framework and it has been consistently ranked as the third top Civil Engineering department in the UK. The University is located in southwest England in idyllic Bath, a UNESCO World Heritage Site known for its ancient Roman baths, gothic abbey and Georgian architecture.