42-month PhD research position at University of Dundee

Innovative use of Geothermal Piles as heat storage to enhance Embankment Performance

Post description:

The University of Dundee (UoD) seeks to recruit a PhD student for a period of 42 months to explore on the use of geothermal piles for slope stabilisation, in collaboration with Energy Technology Partnership (ETP) and Scottish Road Research Board (SRRB), Transport Scotland, and University of Glasgow (UoG). The research will be predominantly based on physical model studies utilising the geotechnical beam centrifuge at UoD. The successful applicant will be fully trained in the use of the centrifuge under the direction of the primary supervisor, Dr Anthony Leung, and will also be co-supervised by the second supervisor, Professor Simon Wheeler, at UoG. This project is in association with SRRB, Transport Scotland, practicing chartered engineer, Mr Forbes Macgregor, from which will provide technical advice to the project. This will give the candidate the opportunity to learn skills in an academic setting whilst maintaining project relevance to the industrial sector.

The studentship is only open to **UK and EU nationals**. The full award will cover tuition fees at the Home/EU rate and will provide an annual stipend at standard EPSRC rate.

Candidates should hold or expect to gain a first class degree or a good 2.1 and/or an appropriate Master's level qualification (or their equivalent) in Engineering or a related discipline.

How to apply:

Application must include the following Information:

- A full CV (including transcript of marks from their first degree);
- A letter of motivation stating (i) why you are interested in pursuing a PhD degree; (ii) why you are interested in working on this project; (iii) what you would bring to the project; and (iv) what you would hope to gain from the project

The application should be emailed to Dr Anthony Leung (**a.leung@dundee.ac.uk**) before 25th April 2014, 17:00pm GMT. Note that application after the deadline will still be considered if no offer has been made on the basis of applications received by the deadline. The expected start data of the post will be August or September 2014.

Further information about the vacancy can be found in **http://uod.ac.uk/thermalpiles2014**. Any enquiries with regard to the position can be directed to Dr Anthony Leung (**a.leung@dundee.ac.uk**).

Project description:

Infrastructure embankments/slopes make up a huge proportion of the UK transport network. Their stability, and hence engineering sustainability, are largely controlled by the amount of negative pore-water pressure (or suction) developed in unsaturated soils. In temperate European climates, the season of peak suction developed in slopes (summer/dry season) is out of phase with the season of peak suction demand for maintaining slope stability (winter/wet season). This lag is becoming more severe under the impacts of climate change, as evidenced by the increasing intense rain received over the last 20 years.

Given that existing and new-build infrastructure embankments will be in use for at least 50 years, there is an urgent need to seek sustainable engineering solutions to narrow the lag down – to preserve/increase suction and hence slope stability in winter time – so as to adapt to the effects of climate-change. Whilst installing a row of discretely-spaced piles at the mid-height of slope has been a common method for slope stabilisation, one novel approach that could exploit renewable energy source is to modify the piles for solar energy storage, referred to as geothermal piles. It is to use the geothermal piles as storage of surplus solar heat *in summer* for evaporating soil moisture, which in turn leads to increase in soil suction and slope stability *in winter*. The aim of the project is to explore the effectiveness of using this mechanism to improve the stability of infrastructure slopes. To investigate the effects of pile heating on the soil water regime, greater understanding on the water-heat-vapour flow mechanism(s) in unsaturated soil will be developed.

The outcome of the research will be to provide a high-quality dataset and physical evidence (through predominantly centrifuge modelling) to justify the use of geothermal piles for enhancing embankment performance under the threat of climate change. Greater understanding gained on water-heat-vapour flow mechanism in unsaturated soil will help to improve the numerical modelling of the simultaneous events of precipitation and evaporation at soil-atmosphere boundary.