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Dr Alexander Royal MEng, PhD

Birmingham Research Fellow

School of Civil Engineering (/schools/civil-engineering/index.aspx)

Contact details

Telephone +44 (0) 121 414 5141 (tel:+44 121 414 5141)

Email a.c.royal@bham.ac.uk (mailto:a.c.royal@bham.ac.uk)

School of Civil Engineering
University of Birmingham
Edgbaston
Birmingham
B15 2TT
UK

About

Alexander Royal was appointed to the position of University of Birmingham Research Fellow in the School of Civil Engineering in 2010 and is undertaking research within the School's theme of resilience and sustainability.

Alexander's research interests include the use of cast in situ barriers for remediation of contaminated land, the use of trenchless technologies for utility installation and the erosion of fine grained soils surrounding leaking water pipes.

Qualifications

- PhD in Geotechnical Engineering, University of Birmingham, 2006
- MEng in Civil Engineering, Loughborough University, 2001

Biography

Alexander Royal qualified with a MEng (Hons) in Civil Engineering from Loughborough University in 2001. He went on to study for a PhD in Geotechnical Engineering at the University of Birmingham, graduating in 2006.

In 2005 Alexander was appointed as a research fellow at the University of Birmingham, working on a number of research projects that focused on trenchless technology and the erosion of fine grained soil surrounding leaking water pipes.

In 2010 he was made a permanent member of academic staff within the School of Civil Engineering at the University of Birmingham.

Teaching

Teaching Programmes

- Surveying course within Construction Design and Professional Skills B Module of the Civil Engineering Undergraduate degree programme
- Groundwater seepage in the Soil Mechanics and Geotechnical Engineering Module of the Civil Engineering Undergraduate degree programme
- Groundwater seepage in the Soil Mechanics Module of the MSc in Geotechnical Engineering

Postgraduate supervision

Alexander is interested in supervising doctoral research students in the following areas:

- Cement-bentonite cut-off walls retarding solute migration
- Subsurface interactions between water and soil with respect to geotechnical applications
- The geotechnical factors impacting upon the successful use of trenchless technologies
- Geohazards, with particular interest in the influence of damaged utilities on behavior of surrounding ground and the role of clay mineralogy on the behavior of the ground

If you are interesting in studying any of these subject areas please contact Helen Booth, the Research and Exchange Programmes Secretary for the School of Civil Engineering, on +44 (0) 121 414 4160, alternatively email **h.r.booth@bham.ac.uk (mailto:h.r.booth@bham.ac.uk)** .

Research

RESEARCH THEMES

Cast in situ barriers for solute plume control, trenchless technology for utility installation, subsurface interactions between water and soil, geohazards.

RESEARCH ACTIVITY

Mapping the Underworld (MTU):

Modern living conditions within the UK are fundamentally related to the successful operation of the buried utility networks that supply electricity, gas, telecommunications and water as well as removing waste water. These networks must be maintained if they are to operate efficiently and current construction practices to access these networks revolves around trenching. The majority of these networks are located under the carriageway and it is estimated that trenching in the carriageway costs the UK economy billions of pounds per annum. Alternative construction techniques are available to trenching, commonly referred to as trenchless technology, but these are considered very risky if the location of the utilities are not known prior to the commencement of the works. Drawings depicting the location of utilities are often imprecise, making it very difficult to predict the location of utilities on a site, and due to the large number of utility owners within the UK ensuring that all drawings are obtained for a

site before construction takes place can prove problematic. Geophysical techniques are available that can be used to detect buried utilities on site but, at present, no single technique appears to be able to detect all utility types in all ground conditions.

MTU is a multi-disciplinary, multi-university research initiative that aims to research and develop the tools necessary to remove the need for trenching in the carriageway when installing, refurbishing or managing buried utilities. To date several interlinked research projects have been undertaken under the MTU banner, including: the development of resonant tags, which can be applied to existing utilities or incorporated into newly installed utilities to increase the probability of detection with geophysical devices in the future; the development of protocols for a utility location database, which uses a common language to store utility data from across the utility industry, providing a common resource for the industry; and the development of surveying techniques to allow the accurate positioning of the utilities in urban areas where traditional surveying techniques can struggle to operate efficiently. The current MTU research project focuses upon the development of a multi-sensor prototype platform that can be used to increase the probability of detecting the buried utilities geophysically. If this research project is successful it could remove the need for trial holes and potentially increase the use of trenchless technologies. In addition to the development of a multi-sensor platform a knowledge based transfer system is being developed that could provide pertinent information to surveyors about the ground conditions they are likely to encounter on site and how these ground conditions will impact upon the geophysical location technologies being deployed. Furthermore, the specifications for a test facility are being drawn up; the test facility would provide a base for training operators in the use of geophysical devices and for the development of these devices in known conditions.

Erosion of fine grained soils surrounding leaking water pipes:

Leakage of potable water from the water distribution network within the UK is undesirable and wastes a valuable resource. Modern installation techniques for the construction of a water distribution networks buries the pipes in granular backfill. Detecting leaks in such situations can be relativity straightforward. However, historic construction methods would bury the water pipes in the host soil; in many cases this would be a fine grained soil, where the detection of leaks becomes more problematic. The UK's water distribution network still contains a considerable proportion of old pipes buried in host material; in London it is estimated that a third of the water pipes in use date back to the Victorian era, and predicting how these pipes will perform when they develop a leak can be difficult for the water company. Water leaking into a fine grained soil has the potential to weaken the soil fabric or erode it, creating a void adjacent to the pipe, and in such situations can lead to the catastrophic failure of the pipe with changes in loading conditions acting on the soil. A recent feasibility study investigated the interaction between various fine grained soils surrounding a leaking pipe. Relationship between flow rate, water pressure, surcharge acting on the soil, soil type were investigated resulting in a number of findings. Additional funding is being sought to continue this research initiative.

Cablepipe:

The next generation of major power stations within the UK will inevitably be built outside urban areas. Many of the best sites are on the coast or off-shore, often in very remote locations in Scotland, Wales and England, hence long transmission lines are inevitable. When transmitting the power through urban areas, sites of outstanding natural beauty and from offshore to onshore, overhead power lines are undesirable. An alternative to overhead distribution would be to use underground transmission. Conventional tunnelling is considered expensive and trenching is disruptive; however trenchless technologies are more economic construction method and have developed to a point where they form a realistic option for the installation of cables over short and medium distances.

The Cablepipe project investigated the limiting factors preventing the use of trenchless technologies to installing multiple high voltage cables in small diameter conduits over long distances without the need for intermediate access shafts. Two trenchless technologies were considered as suitable over long distances (taken as 2.5km to 10.0km in one continuous drive) and the project has addressed the challenges posed by the limitations of directional drilling and microtunnelling (at the University of Birmingham) when operating over such drive lengths. The project also considered the mechanical and electrical limitations (at Newcastle University) associated with transmitting power in confined conditions. Additional funding is being sought to continue this research initiative.

Other activities

- Member of the Pipeline Industries Guild's panel for Utilities
- Committee member for the Midlands Geotechnical Society

Publications

Royal, A.C.D., Atkins, P.R., Brennan, M.J., Chapman, D.N., Chen, H., Cohn, A.G., Foo, K.Y., Goddard, K., Hayes, R., Hao, T., Lewin, P.L. , Metje, N., Muggleton, J.M., Naji , A., Orlando, G., Pennock, S.R., Redfern, M.A., Saul, A.J., Swingler, S.G., Wang, P. and Rogers, C.D.F. (In press) Site Assessment of Multiple-Sensor Approaches for Buried Utility Detection. International Journal of Geophysics' Special Issue on Noninvasive Sensing Techniques and Geophysical Methods for Cultural Heritage and Civil Infrastructures Monitoring

Royal A.C.D., Hunt D.V.L., Rogers C.D.F. and Chapman D.N. (2010) Numerical Analysis to Simulate the Creation and Performance of Extruded Concrete Linings in Microtunnelling. Tunnelling and Underground Space Technology, Vol. 25, n 6, December 2010, Pages 754-765

Royal, A.C.D., Riggall, T.J. and Chapman, D.N. (2010) Analysis of HDD Steering Using Down-Hole Motors. Tunnelling and Underground Space Technology, Vol. 25, n 6, December 2010, Pages 745-753

Royal A.C.D., Polak M.A., Rogers C.D.F. and Chapman D.N. (2010) Estimating the Pull-In Forces Associated with Long Distance Horizontal Directional Drilling. Geotechnical Engineering, Proceedings of the Institution of Civil Engineers, Vol. 163, n 4, p 197-208

Royal A.C.D. (In Press) Arid Soils. In the ICE Manual of Geotechnical Engineering, Thomas Telford Publishing, London, UK

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