Novel geo-materials for sustainable construction

TWO 36-MONTH "MARIE CURIE" EARLY STAGE RESEARCH FELLOWSHIPS

each leading to a double PhD degree from
the Universite de Pau et des Pays de l'Adour (France) and Durham University (UK)

The Université de Pau et des Pays de l'Adour (France) and Durham University (UK) seek to recruit two Early Stage Marie Curie Research Fellows, each for a period of 36 months in the framework of the "Marie Curie" Innovative Training Network TERRE (Training Engineers and Researchers to Rethink geotechnical Engineering for a low carbon future). The Network TERRE is funded by the European Commission under the Horizon 2020 programme involving eleven academic and three industrial partners collaborating towards the delivery of a Europe-wide PhD programme on the carbon-efficient design of geotechnical infrastructure. The network will deliver 8 Joint PhD degrees and 7 Industrial PhD degrees, with a balance of fundamental and applied research.

The eleven academic partners are the Université de Pau et des Pays de l'Adour (France), Institut National de la Recherche Agronomique (France), Centre de Coopération International en Recherche Agronomique pour le Développement (France), Universitá degli Studi di Napoli Federico II (Italy), Universitá degli Studi di Cassino e del Lazio Meridionale (Italy), University of Strathclyde (UK), University of Glasgow (UK), University of Durham (UK), Technische Universiteit Delft (Netherlands), Centre Internacional de Metodes Numerics en Enginyeria (Spain), Ecole Polytechnique Fédérale de Lausanne (Switzerland). The three industrial partners are Limitstate Limited (UK), Nobatek (France), Kempfert Geotechnik Gmbh (Germany).

Post descriptions

It is expected that the Marie Curie Fellowships will each lead to the award of a double PhD degree from the Université de Pau et des Pays de l'Adour and Durham University.

Fellowship 1: "Eco-reinforced geomaterials"

The Research Fellow will work for 24 months at the Université de Pau et des Pays de l'Adour (France) under the direction of Prof. Domenico Gallipoli immediately followed by 12 months at Durham University (UK) under the direction of Prof. Charles Augarde. The 24-months appointment in France will take place at the Basque Coast campus of the Université de Pau et des Pays de l'Adour (http://goo.gl/maps/OqJoM), which is located next to the city of Biarritz and about 100 km from the city of Pau.

Research Fellow 1 will work on the design, manufacture and testing of a new sustainable geo-material for masonry construction exhibiting low levels of embodied/operational energy and a small carbon footprint. Recent research by the project partners has already resulted in the production of raw earth construction materials, which are obtained from a mix of moist sand and clay subjected to a relatively high compaction pressures without any chemical binder such as cement or lime. These materials possess levels of strength and stiffness comparable to those of conventional 'cooked' masonry bricks. However, the durability is relatively poor especially in wet climates and must be significantly improved while preserving the desired eco-friendly attributes.

This project will aim to improve the mechanical characteristics of current raw earth materials and, in particular, their durability in humid climates. The addition of natural reinforcing fibres could enhance the strength and stiffness of the material while increasing its ability to preserve an adequate level of mechanical performance over time. The addition of natural fibres is however only one of the possible

options and different alternatives will be considered during the course of the project. Potentially, this material could be used not only for the construction of masonry buildings but also, at a larger scale, for improving construction of geotechnical fills such as, for example, infrastructure embankments.

Another area of investigation of the present project concerns the characterization of the hygro-thermal performance of raw earth materials. Preliminary studies have demonstrated the ability of raw earth materials to control fluctuations of humidity and temperature inside dwellings with consequent savings in terms of air conditioning needs. These advantageous properties are however yet to be characterized in detail especially at the scale of a masonry wall.

In this respect, the expertise of the Université de Pau et des Pays de l'Adour in terms of experimental testing and constitutive behaviour of highly dense raw earth materials will be complemented by the expertise of Durham University in terms of computational modelling of the hydro-thermo-mechanical behaviour of real structures.

Fellowship 2 : "Exploiting suction for strength in earthen construction materials"

The Research Fellow will work for 24 months at Durham University (UK) under the direction of Prof. Charles Augarde immediately followed by 12 months at Université de Pau et des Pays de l'Adour (France) under the direction of Prof. Domenico Gallipoli.

Research Fellow 2 will investigate the development of design techniques for earthen construction materials based on a geotechnical approach. To date these materials (both heritage and new-build) have been regarded as weak concrete or masonry and crude design approaches applied accordingly. In fact it is clear that the role of water is key in the stability and stiffness of these materials (which include rammed earth, cob and adobe). Research Fellow 2 will conduct experimental testing to improve understanding of the link between microstructure and intrinsic properties (mainly associated with strength rather than stiffness). This may include: a campaign of geotechnical tests including triaxial and shear box tests, potentially under varying environmental conditions, the development of a new constitutive modelling framework for these materials based on current frameworks for unsaturated soils and bonded materials, and the validation of the approach through implementation into FE software followed by testing. Research Fellow 2 will make use of a newly-constructed Vadose Zone lab at Durham led by Dr Paul Hughes in which to conduct environmentally controlled testing and may also make use of the Durham XRCT facility (led by Prof. Augarde) in investigations of microstructural features.

For both Fellowships, is expected that the Research Fellows will help with the preparation of periodic project reports and with the organization of Network meetings/events. Each Fellow will be offered the opportunity to register for a Dual Award PhD, with a supervisory team drawn from both institutions. Further details on the Université de Pau et des Pays de l'Adour and Durham University can be found at http://www.univ-pau.fr and https://www.dur.ac.uk , respectively.

Professional requirements for both posts

Essential: applicants should hold a first class degree in civil engineering or mechanical engineering or materials engineering or science of materials (or equivalent discipline). Applicants must be capable of communicating in good oral and written English.

Preferable: applicants with some skills in laboratory testing of soils and/or finite element analysis of geotechnical problems will be favourably considered.

Other requirements for both posts

Candidates must meet the following eligibility criteria according to EU rules:

1. At the time of recruitment by the first host organisation, candidates must NOT have more than 4 years' research experience measured from the date when they obtained the degree which would formally entitle them to embark on a doctorate, either in the country in which the degree was obtained or in the country in which the research training is provided. Also, they must NOT have been awarded a doctoral degree.

2. At the time of recruitment by the first host organisation, candidates must not have resided or carried out their main activity (work, studies, etc.) in the country of their host organisation for more than 12 months in the 3 years immediately prior to the reference date. Short stays such as holidays and/or compulsory national service are not taken into account.

3. At the starting time of the positions, candidates must have completed the courses that would have allowed them to enrol in a doctorate program either in the country where they are studying or in the country offering the position.

Monthly salaries for both posts

During the appointments by the Université de Pau et des Pays de l'Adour the monthly salary will be about 2850 € gross for a single person or about 3200 € gross for a person with family.

During appointments by Durham University the monthly salary will be about £2500 gross for a single person or about £2800 gross for a person with family (figures dependent on the exchange rate between UK £ and the Euro.

Gross living allowance / related allowances are subject to employment laws and compulsory employer and employee costs deductions.

Application procedure

Candidates should specify which one of the two fellowship positions they are applying for or, if applying for both, what would be their preferred choice.

Applications consisting of:

a) a full CV including a transcript of the marks obtained for all exams passed at undergraduate level and, if applicable, postgraduate level

b) a letter of motivation stating the reasons why the applicant is interested in this position

c) the names, addresses and emails of two referees, to be contacted if necessary

should be emailed both to Prof. Domenico Gallipoli at the address domenico.gallipoli@univ-pau.fr and to Prof. Charles Augarde (Charles.augarde@dur.ac.uk) before **3rd June 2016**. The start date of the post is 1st October 2016.