School of Computing, Engineering, and the Built Environment
Edinburgh Napier University

PHD STUDENT PROJECT

Funding and application details

Funding status: Self funded students only

Application instructions:
Detailed instructions are available at https://blogs.napier.ac.uk/scebe-research/available-phd-student-projects/

Prospective candidates are encouraged to contact the Director of Studies (see details below) to discuss the project and their suitability for it.

Project details

Supervisory Team:

- DIRECTOR OF STUDY: Dr Juan Bernal-Sanchez (Email: J.Bernal-Sanchez@napier.ac.uk)
- 2ND SUPERVISOR: Dr Daniel Barreto

Subject Group: Built environment

Research Areas: Civil Engineering, Geotechnical Engineering, Soil Mechanics, Soils Materials

Project Title: Environmental Impact of Construction on Peatlands

Project description:

Reducing greenhouse gasses (GHG) emissions is one of the main goals of the 1997 Kyoto Protocol and the Paris Agreement (signed in 2015 during COP21) which seeks to limit the global raise in temperature to 1.5 °C. Contributions from all the sectors are needed to reach this objective, and in recent years additional attention been set on the protection of wetlands and other natural habitats.

Peatlands are a key asset in the drive to reduce annual carbon emissions due to their potential as a carbon sink and this is even more important in Scotland where

20% of the land is covered by peat [1]. However, peatlands have historically been considered as wastelands that needed to be re-used for other, more productive, purposes. This is the reason why circa 80% of UK peatlands are degraded. The favoured foundation option for any construction has been to excavate the peat and replace it by a granular soil [2]. The excavation process risks, however, drying sections of the peatland with the associated detrimental effect on the carbon storage. The current regulatory framework, e.g. National Planning Framework, seeks to protect these habitats of new developments due to the high environmental value that they bring to the ecosystem [3].

According the work produced by Dr Bernal-Sanchez, in collaboration with CSIC, Highland Council, SEPA, NatureScot, and Highlands & Islands Enterprise, the project team (together with Dr John McDougall and Dr Daniel Barreto) identified up to six alternative foundation techniques (e.g. timber piling or mass stabilisation) that could be undertaken to minimise the high environmental impact of excavate-and-replace techniques. Although the results obtained demonstrated that other forms of foundation exist, the most sustainable ones are barely used in the UK and other parts of the world. The latter is due to the fact that default foundation techniques are well-established, cost-effective, solutions whereas other (more sustainable) techniques would entail higher costs and there is still little experience [4]. Amongst the uncertainties, it is still not entirely clear how much better the new techniques are from the environmental point of view due to the lack of research in this topic.

Building up on what the research team did in the previous project, key questions are sought to be answered whilst studying the identified foundation options and thus provide research-based recommendations, based on specific case studies, to contribute to a future geotechnical design guidance. The project will make use of the information as well as the connections made with the various stakeholders (i.e. CSIC, SEPA, NatureScot, H&IE and Taylor Wimpey). This will be essencial to locate a series of potential sites where the investigation will be based on.

The main aim of this investigation will be focused on understanding the environmental impact of current foundation options on peatlands and compare it with alternative approaches to promote a sustainable solution for construction development. A series of advanced geotechnical testing will be also considered to understand the mechanical properties of proposed new foundation techniques. Thus, the project schedule will consist of three work-packages as follows:

- Work-Package 1. Review previous work in the field of construction on peatlands, carbon stability and adaptation of carbon calculator to new developments.
- Work-Package 2. Study of potential location sites, contact with stakeholders, and estimate environmental impact of default construction techniques at the identified sites.
- Work-Package 3. Study and geotechnical testing of alternative (more sustainable) construction techniques, such as mass stabilisation, appraisal of environmental impact for the identified site and comparison with previous foundation techniques.

Perspective applicants are encouraged to contact the Supervisor before submitting their applications. Applications should make it clear the project you are applying for and the name of the supervisors.

References:

[1] Bruneau, P.M., and Johnson, S.M. (2014). Scotland's Peatland - Definitions & Information Resources. Scottish Natural Heritage Commissioned Report No 701.

[2] Huat, B. B. K., Prasad, A., Asadi, A., and Kazemian, S. (2014). Geotechnics of Organic Soils and Peat. http://www.crcnetbase.com/isbn/9780415659413. Last accessed 15th December 2021.

[3] Highland Council (2020). The Highland Council Response to National Planning Framework 4: Position Statement. https://www.highland.gov.uk/download/downloads/id/23532/response_to_the_npf4_position_statement.pdf. Last accessed 15th December 2021.

[4] Bernal-Sanchez, J., McDougall, J., Cook, D., Medero, G., Barreto, D. (2021). Housing Construction on Peatlands. https://www.mis-hub.com/files/Housing_Construction_on_Peatland_-_Phase_1.pdf.

Candidate characteristics

Education:

A first-class honours degree, or a distinction at master level, or equivalent achievements in Civil Engineering or Sustainable Engineering

Subject knowledge:

- Soil Mechanics,
- Environmental Geotechnics,
- Environmental Sustainability,
- Geotechnical Engineering,
- Materials

Essential attributes:

- Experience of fundamental geotechnical engineering
- Competent in sustainable and earthquake engineering
- Knowledge of how to conduct and manage fundamental laboratory investigations
- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management