# Template for adverting PhD project on FindAPhD.com

## ****Please read accompanying guidance notes****

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| **Department** | School of Engineering and the Built Environment |
| **Supervisors** | Dr Daniel Barreto, Dr John McDougall, Dr Juan Bernal-Sanchez |
| **Funding Status** | Funded PhD Project (Worldwide) |
| **Application Deadline** | 14/04/2022 |
| **Project Title** | The influence of particle characteristics on the field-scale geomechanical behaviour of soils |

**PROJECT DESCRIPTION**

It is well recognised that many geotechnical phenomena, such as liquefaction, crushing, dissolution effects and failure are affected by macro-scale properties such as initial density, anisotropy, permeability and compressibility, amongst others. On the other hand, it is well understood micro-scale properties such as particle morphology, roughness, particle shape and size distributions underlie many of these observed macro-scale behaviour. Much of this insight is the result of extensive experimental and numerical investigations. Of particular interest is the use of Discrete Element Method (DEM) simulations that account for the particulate nature of soils. There is significant advance on computational capabilities and techniques to realistically model particle properties such as morphology, particle shape and soil-fluid interactions. In spite of this, the efficient DEM modelling of anything beyond laboratory scale soil element tests still remains a challenge.

This project aims to develop and validate efficient and realistic numerical techniques that enable the simulation of boundary-value problems including retaining walls, excavations, embankments, etc. A truly innovative micro-to-macro approach that includes particle properties via DEM, fluids via computational fluid dynamics (CFD) as well as homogenization techniques [1-3] optmised by machine learning approaches [4] will be validated by shaking table experiments and available field data of relevant construction scenarios.

As part of this project you will help develop the required numerical techniques under the supervision of Dr Barreto, and performing a limited set of laboratory experiments (including dynamic conditions in the shaking table) under the supervision of Dr McDougall and Dr Bernal-Sanchez. In short, you would be joining a dynamic team well recognised around the world and with ample research experience on their corresponding research fields. Your work will lead to the creation of the next generation of simulation techniques for geotechnical analysis.

**Academic qualifications**

A first degree (at least a 2.1) ideally in civil engineering with a good fundamental knowledge of soil mechanics, geotechnical engineering and computer programming.

**English language requirement**

IELTS score must be at least 6.5 (with not less than 6.0 in each of the four components). Other, equivalent qualifications will be accepted. Full details of the University's policy are available online.

**Essential attributes:**

- Experience of fundamental laboratory soil element testing
- Competent in the use of numerical tools based on the discrete element method (DEM) and/ computational fluid dynamics (CFD)
- Knowledge of numerical modelling techniques in geomechanics.
- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management

**Desirable attributes:**

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| Evidence of relevant publications and/or research outputs, as well as an MSc. in geotechnical or related discipline would be advantageous. | |
| **Indicative Bibliography** | [1] Guo, N., & Zhao, J. (2016). Multiscale insights into classical geomechanics problems. International Journal for Numerical and Analytical Methods in Geomechanics, 40(3), 367-390.<br>[2] Coetzee, C. (2020). Calibration of the discrete element method: Strategies for spherical and non-spherical particles. Powder Technology, 364, 851-878.<br>[3] Di Renzo, A., Napolitano, E. S., & Di Maio, F. P. (2021). Coarse-grain dem modelling in fluidized bed simulation: A review. Processes, 9(2), 279<br>[4] Tejada, I. & Antolin, P. (2021). Use of machine learning learning for unravelling hidden correlations between particle size distributions and the mechanical behaviour of granular materials. Acta Geotechnica. |
| **Funding notes** | This project may be funded by a scholarship of the School of Engineering and Built and Environment. Please see School-funded PhD scholarships - RESEARCH AND INNOVATION (napier.ac.uk) for information on the scholarships and how to apply for them. |
| **Enquiries** | For informal enquiries about this PhD project, please contact Click here to enter text. |
| **Web page** | https://www.napier.ac.uk/research-and-innovation/research-degrees/application-process |

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