PhD Studentship:

Mathematical Modelling of Poro-Mechanics of Soil

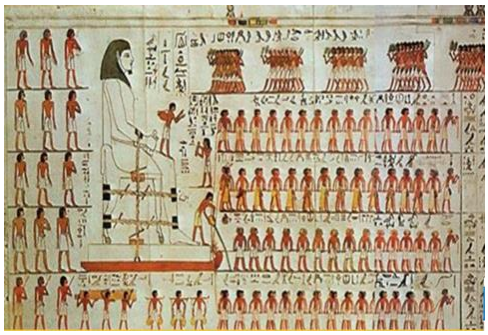
University of Southampton

Qualification Type:	PhD
Location:	Southampton
Funding for:	UK Students, EU Students
Funding amount:	£15,009 per annum
Hours:	Full Time

Supervisor: Tiina Roose
Co-supervisor William Powrie

Project description

Soil is one of the most complex and important self-assembling organo-mineral composites in the world. All human food supply, ecosystem and infrastructure services depend on soil, yet we have very little understanding of what happens in soil. Developing such understanding is important, as climate change is likely to alter soil function and we need to find new robust engineering practices and modify existing ones to enable effective soil resource management. Combinatorial experiments, especially those involving climate effects, are very expensive and time consuming, hence the development of mathematical models to describe soil processes is needed to help design more cost effective and powerful experiments. However, such models are only as good as the data used to validate them. As part of an ongoing program of research we have accumulated a body of novel data to describe soil function and are now in a position to develop new mathematical models for the mechanical and flow behaviour of partly saturated soils.



We will particularly investigate how the degree soil water saturation influences soil mechanics. It is clear to any person walking on the beach that there is an optimal level of water content that makes the sand most stable/hard; if the water content is too high the sand is fluid and one gets bogged down in it, and if the sand is completely dry it is very mobile again making it hard to walk on. The ancient Egyptians recognised this effect; when building the pyramids, they watered the sand ahead of the barges transporting the rocks to improve its trafficability (see the picture below). The concept is well known in soil mechanics, but established theory does not address the non-uniformity of moisture content distribution within the soil, which becomes more significant as the range of grain sizes present increases. Thus prediction of the strength and bulk behaviour of a real soil, with a mixture of grain sizes and mineralogies, has not been addressed before.

In this project we will develop new mathematical models of soil function that allow for:

1. the development of new understandings of how soil mechanics and water flow interact
2. the role plants play in the determination of soil mechanics
3. the effect of (spatially and temporally) heterogeneous wetting and drying cycles on the soil mechanical behaviour.

Entry Requirements A very good undergraduate degree (at least a UK 2:1 honours degree, or its international equivalent).
Closing date: applications should be received no later than 31 August 2020 for standard admissions, but later applications may be considered depending on the funds remaining in place. Email: Professor Tiina Roose, t.roose@soton.ac.uk for further information.