

Joint PhD Research Position (Nancy, France, and Exeter, United Kingdom)

Swelling and shrinkage of stabilised expansive soils

A fully funded joint PhD scholarship for 3 years between the University of Technology of Lorraine (F) and the University of Exeter (UK) is available to start in September 2011. The proposed subject about the swelling and the shrinkage of stabilised expansive soils is a part of the research & development activities within both institutions. The swelling and the shrinkage of clayey soils cause differential displacements that damage individual buildings that are often founded on shallow foundations. As an example, in France, these damages occurred following periods of drought between 1989 and 2002 with a cost of €3.3 billion. This figure is about £150 million per year in the UK and almost \$2 billion per year in the USA. Moreover, the mitigation of the damages induced on individual housings costs billions of Euro.

This research project deals with the study of the use of lime to mitigate the swelling and shrinkage of soils. The main objective of this work is to build a model of behaviour of clay soils treated with lime when subjected to a succession of water cycles. In this context, the work will first focus on the study of coupled chemo-hydro mechanical processes in swelling clay soils treated with lime. In a second step, a model of behaviour of swelling clay soils will be developed using a technique of evolutionary polynomial regression (EPR), taking into account specific aspects of the behaviour of clay soils treated with lime.

PhD works will be of experimental and numerical nature, relying on state-of-the art laboratory equipment and strong numerical modelling resources.

Candidates should own Master Degree in civil or geotechnical engineering at the beginning of the research project (September 2011), and have a strong interest in mechanics of geomaterials.

The candidate will spend half of the PhD period in each laboratory involved in this research. A joint PhD will be awarded to the student.

Knowledge of the French language is not mandatory, and the thesis will be written in English.

To be eligible to the full scholarship, candidates must be originated from the European Union.

Conditions

Starting date : September 2011 for a duration of three years

Net Salary / Studentship ≈ 1450 € per month

Partner n°1 : Laboratoire Environnement Géomécanique & Ouvrages www.laego.org
Institut National Polytechnique de Lorraine <http://english.inpl-nancy.fr/>

Partner n°2 : College of Engineering, Mathematics & Physical Sciences, <http://www.secam.ex.ac.uk/cgg>
University of Exeter <http://www.exeter.ac.uk/>

How to apply ?

Send before April, 30st 2011 a CV (2 pages max), if available a copy of the Master thesis (pdf file, internet link etc.) and the name of one referee to both correspondents:

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List of references

- Cuisinier, O. & Deneele, D. 2008. Long-term behaviour of lime-treated expansive soil submitted to cyclic wetting and drying. *First European Conference on Unsaturated Soil*, 2-4 July 2008, Durham, UK. 327-333.
- Cuisinier, O., Javadi, A.A., Ahangar, A. & Masrouri, F. 2011. Identification of coupling parameters between shear strength behavior and chemical's effects with an evolutionary-based data mining technique. Submitted to *Computers and Geotechnics*.
- Cuisinier, O., Le Borgne, T., Deneele, D. & Masrouri, F. 2011. Quantification of the detrimental effects of some chemical compounds on soil stabilization. *Engineering Geology*, 117, 229–235.
- Cuisinier, O. & Masrouri, F. 2005. Influence of complex hydromechanical loadings on the behaviour of a compacted expansive soil. *Canadian Geotechnical Journal*, vol. 42, n°3, 731-741.
- Cuisinier, O. & Masrouri, F. 2005. Hydromechanical behaviour of a compacted swelling soil over a wide suction range. *Engineering Geology*, vol. 81, n°3, 204-212.
- Cuisinier, O., Masrouri, F. (2004) Testing the hydromechanical behaviour of a compacted swelling soil. *Geotechnical Testing J.* 27, 598-606.
- Estabragh, A.R., Javadi, A.A. (2008): Critical state for overconsolidated unsaturated silty soil, *Canadian Geotechnical Journal*, 45(3), pp 408-420.
- Javadi, A.A., Johari, A., Ahangar-Asr, A., Faramarzi, A. and Toll, D. G. (2009): Using Evolutionary Polynomial Regression in Modelling of Unsaturated Soils, *Proceedings from 17th. conference on computational mechanics (ACME-UK)*, 6-8 April 2009, Nottingham, pp 353-356.
- Javadi, A. A., Rezania, M. and Nezhad, M.M. (2006), "Evaluation of liquefaction induced lateral displacements using genetic programming", *Computers and Geotechnics*, 33(4-5), 222-233.
- Javadi, A. A., Rezania, M. (2009). Applications of artificial intelligence and data mining techniques in soil modelling, *Geomechanics and Engineering; An International Journal*, 1 (1): 53-74.
- Javadi, A. A., Rezania, M. (2009). A New Approach to Constitutive Modelling of Soils in Finite Element Analysis using Evolutionary Computation. *Journal of Advanced Engineering Informatics*, 23, 442-451.
- Le Runigo, B., Cuisinier, O., Cui, Y.-J., Deneele, D. & Ferber, V. 2009. Impact of the initial state on fabric and permeability of a lime treated silt under long term leaching. *Canadian Geotechnical Journal*, 46, 1243-1257.
- Nowamooz, H., Mrad, M., Abdallah, A. & Masrouri, F. 2009a. Experimental and numerical studies of the hydromechanical behaviour of a natural unsaturated swelling soil, *Can. Geotech. J.*, 46(4): 393–410.
- Nowamooz, H. & Masrouri, F. 2009b. Density-dependent hydromechanical behaviour of a compacted expansive soil *International Journal of Engineering Geology* 106 (3-4), pp. 105-115.
- Rezania, A., Javadi, A.A. & Giustolisi, O., 2008. An evolutionary-based data mining technique for assessment of civil engineering systems, *Journal of Engineering Computations*, 25, pp. 500-517.
- Rezania, M., Javadi, AA, Giustolisi, O. (2009): Evaluation of Liquefaction Potential Based on CPT Results Using Evolutionary Polynomial Regression, *Computers and Geotechnics*, 37(1-2) 82 - 92.