

Research Grants for PhD students from the China Scholarship Council

Information Form (please read the guidelines carefully on the website www-csc.utt.fr)

Supervisor's name : Nowamooz

Given names : Hossein

Status (prof., assistant prof., ...): Full Professor

Laboratory : Laboratoire de Génie Civil et Génie Mécanique

Website address :

Institution : Institut National des Sciences Appliquées de
Rennes, France

Website address :

Scientific competence of the supervisor:

Nowamooz has produced seminal experimental data on unsaturated soil cracking, rammed earth, and cyclic hydromechanical behaviour over 15+ years; The co-advisor Balaji Raghavan has developed advanced multi-scale computational frameworks for mechanics. Research focus: unsaturated soil mechanics, desiccation cracking, rammed-earth construction, cyclic hydromechanical behaviour of compacted soils. Author of >100 peer-reviewed publications including seminal papers on cyclic swelling-shrinkage models (Nowamooz & Masrouri, Géotechnique) and soil cracking (Xu et al., 2023). Supervised 12 completed PhDs.

Two major publications in the field proposed for the PhD :

1. Nowamooz, H. & Masrouri, F. (2010). Relationships between soil fabric and suction cycles in compacted and natural swelling soils. *Engineering Geology*, 114(3–4), 444–455.
2. Xu, J., Hu, Q., Nowamooz, H. et al. (2023). A comprehensive review on desiccation cracking of soils: mechanisms, influencing factors, and predictive modelling. *European Journal of Environmental and Civil*

Website address of the personal page : <https://scholar.google.fr/citations?user=oek346kAAAAJ&hl=en>

Supervisor's email : hossein.nowamooz@insa-rennes.fr

Description of the research work proposed for a PhD

Topic # (see list): IV-6

Title : Multi-Scale Experimental and Numerical Investigation of Desiccation Cracking in Unsaturated Soils under Cyclic Drying-Wetting Conditions: Applications to Sustainable Geotechnics and Climate-Resilient Infrastructure

Subject :

Climate change is dramatically intensifying the frequency and severity of drought-rewetting cycles worldwide, placing unprecedented mechanical stress on fine-grained soils that underpin critical civil infrastructure. Desiccation cracking — the formation of networks of tensile fractures as moisture evaporates from restrained soil masses — is a central manifestation of this stress. Once formed, crack networks can increase the hydraulic conductivity of clay barriers by several orders of magnitude, reduce effective shear strength, accelerate contaminant migration through landfill liners and tailings dams, and trigger progressive structural failure in embankments, slopes, and earthen buildings. Despite decades of research, the quantitative prediction of crack initiation, propagation geometry, and long-term cyclically-induced damage in unsaturated soils remains an open challenge. Existing models are largely empirical, tied to specific soils and boundary conditions, and rarely validated against independent three-dimensional experimental data. This PhD project addresses that gap by integrating two world-class competences resident at INSA Rennes LGCGM: advanced experimental characterisation (Prof. Nowamooz, >100 peer-reviewed publications on unsaturated soil mechanics and cracking) and multi-scale numerical modelling (Dr. Raghavan, expertise in finite element methods and computational mechanics).

Keywords :

Desiccation cracking, Unsaturated soil mechanics, Drying-wetting cycles, Multi-scale modelling
Hydro-mechanical behaviour, Soil fissuration, Climate-resilient geotechnics, Micro-macro behaviour

Expected collaborations :

Prof. Balaji Raghavan (co-advisor) INSA de Rennes, France
Prof. Manyu Xiao (Northwestern Polytechnical University, Xi'an, China)
Prof. Subhrajit Dutta (NIT Silchar, India)
Prof. Ashuim Kanti Dey (NIT Silchar, India)

Background required from the applicant :

Master's degree (or equivalent) in Civil Engineering, Geotechnical Engineering, Mechanical Engineering, or Applied Mechanics. Technical skills: demonstrated knowledge of soil mechanics (preferably unsaturated soil mechanics) and/or numerical methods (FEM, DEM, or equivalent). Experience with laboratory testing, computational coding (Python, MATLAB), or constitutive modelling is a strong advantage.

Language: proficiency in English (written and spoken)

Existence of a PDF file detailing the proposal ("yes" or "no") : yes

(see guidelines on the website www-csc.utt.fr)