

An Indian-Australian research partnership

Project title : Studies on the response of synthetic fibre reinforced expansive soils

Project number: IMURA0119

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Research Academy theme(s)

The research academy theme/s that is relevant to the project

1. Infrastructure engineering
2. Advanced computational engineering, simulation and manufacture

The research problem

India and Australia both have extensive deposits of reactive (shrink/swell) soils. They incur substantial damage to infrastructure annually, especially for light structures such as single to several storey buildings, roads, pipelines, and railway lines. The annual cost of such damage to civil engineering structures is estimated at £150million in the UK, \$1000 million in the USA and many billions of pounds worldwide. Influence of these soils is expected to increase as the effects of climate change advance further. Currently there is a knowledge gap in engineering as well as in soil science on how to accurately model these soils when they are subjected combined hydro/thermal/stress conditions. Another area where this knowledge is quite useful is isolation of nuclear waste surrounded by highly reactive clay, used as an isolation barrier. For mitigating the problems posed by expansive soils various innovative techniques have been attempted such as belled piers, chemical alteration, stabilization with different additives. In the recent past, the interest of using discrete fibre reinforcement has arisen to modify and improve the engineering behaviour of expansive soils. This research project is intended to advance fundamental theoretical (along with response of expansive soils to shrink/swell cycles with and without fiber reinforcement) knowledge in this area, providing advanced computational tools for engineers to use in future engineering works involving these soils.

Project aims

The aim of this project is to advance fundamental knowledge in modelling thermo/hydro/mechanical behaviour of reactive soils. In particular, the project intends to:

- . Develop a centrifuge model set up suitable thermo/hydro/mechanical modelling;
- . Efficacy of using discrete fibre reinforcement to improve the engineering behaviour of reactive soils
- . Undertake centrifuge model tests of Indian reactive soils under various boundary conditions;
- . Develop a set of fundamental partial differential equations describing thermo/hydro/mechanical behaviour of reactive soils.
- . Implement a numerical solution to the fundamental equations developed using FEMLAB software.

Expected outcomes

Main outcome of the project will be development of new knowledge and accurate theoretical/centrifuge modelling basis for thermo/hydro/mechanical modelling of reactive soils. The models developed can be used to assess the moisture and temperature changes in ground and how it affects the geo infrastructure such as roads, houses etc, as well as in nuclear waste isolation. Another major outcome of the project is to frame guidelines for utilization of improved reactive soils with optimum fibre dosages or for improving reactive soil deposits in India and Australia.

Which of the above Theme does this project address?

Primarily the project addresses infrastructure engineering. In addition, it will develop advanced simulation methods.

How will the project address the Goals of the above Themes?

The project will be advanced using both experimental and theoretical work. Experimentation will include instrumented centrifuge models. Particle image velocimetry will be used for measurement of both water and material flow. Theoretical simulations will be advanced with finite element technique.

The project will address goals of the above themes by addressing sustainable infrastructure, where India and Australia both suffer extensively from reactive soil induced distress to vital infrastructure that underpin respective economies.