Mechanical response of a soil subjected to an internal erosion process: effect of the degradation of the micro-structure

PhD subject proposal

Context

The micro-structure of soils can be degraded by an internal erosion process. This occurs for instance for an internal erosion by suffusion: the fine fraction of the soil is first detached from the granular skeleton under the action of the water seepage; then the detached particles are carried away within the pore space, by the interstitial flow. Such degradations of the micro-structure can result in a weakening of the mechanical properties of the soil leading to strong deformations and settlements, or even to its failure.

Water retaining structures made of soils (such as dams and dykes) are possibly exposed to internal erosion by suffusion. The description of the effects of internal erosion on the mechanical properties of soils is necessary to assess their durability and predict any local (as landslides) or global collapse of these structures.

PhD research work

The proposed PhD consists in characterizing the effect of internal erosion on the mechanical behaviour of soils. The study, conducted in a first time at the scale of a soil sample, will be based on both numerical modellings with the discrete element method (DEM), and laboratory tests with a triaxial apparatus. For both, numerical simulations and laboratory tests, the PhD student will develop degradation models and experimental methods to generate granular assemblies, and soil samples, representative of soils degraded by suffusion. Then he will characterise their behaviour by performing numerical and experimental drained and undrained triaxial tests. Relations, taken into account the change of the micro-structure, and describing the effects of internal erosion of mechanical properties, will be built from the numerical and experimental results obtained.

A second step will be dedicated to the validation of the identified relations on real cases of internal erosion. Finally, after the validation step, the study of the response of a soil structure (as a dyke), or the analysis of the degradation regarding complex loading paths (related to changes of the interstitial water pressure) could be considered.

Location and practical aspects

The PhD student will be based at 3SR Laboratory (Grenoble) to conduct the numerical approach. He will also perform visiting periods at IRSTEA (Aix en Provence) where the experimental approach is developed.

Contacts and application

- Luc Sibille (luc.sibille@3sr-grenoble.fr), 3SR Laboratory (office E137), Grenoble.
- Nadia Benahmed (nadia.benahmed@irstea.fr), IRSTEA, Aix en Provence.

Candidates should send electronic applications to Luc Sibille and Nadia Benahmed, including a cover letter, a curriculum vitae, and academic results (concerning essentially the master degree, with the rank of the candidate within the master class). Applications will close as soon as a suitable candidate is found.