Thesis proposal:

Mechanical response in reinforced granular soil: 4D observation via x-ray tomography

Background

Soil reinforcement is one of the most prominent and universal tools used in Civil Engineering right now. The simplicity of its implementation, coupled with the effectiveness and economic feasibility allowed it to spread all over the engineering world and infiltrate many different branches of it. Soil reinforcement is used in infrastructure, construction of flood defences and water management solutions, developments of areas that are to be used in heavy construction and as one of the methods of disaster effect prevention and mitigation. On the basis of the mechanisms that ensure soil stability, the practices of soil reinforcement can be divided into "systematically reinforced soil" (e.g., geotextile and geogrids) and "randomly distributed fiber reinforced soil".The proposed project will be focusing on the latter group. In contrast with systematic reinforcement, fiber reinforcement contributes to soil strength in an isotropic manner, due to the random distribution.

Aim

The goal of this project will be comparing the hydro/mechanical behaviour of granular soil reinforced with active dynamic intruders (plant roots) and inactive static intruders (nylon fibers). We will be answering these research questions:
(i) How is the Soil Water Retention Curve changes between the two type of intruders?
(ii) How can we link the water content extracted from the x-rays images to the measured suction?
(iii) Is the pore network changing in times during the samples are subjected to different water cycles?

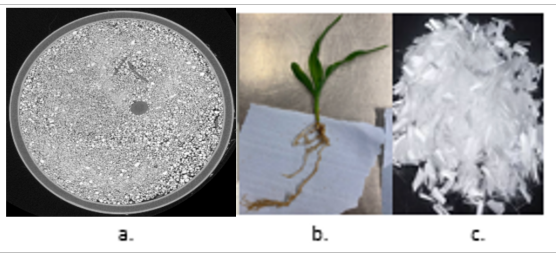

Figure 1: a) Slice from a x-ray tomographies of a sand sample reinforced with fibers. b) Maize root structure. c) Polypropylene fibers.

Method

Experimental research within the Soil Micro Mechanics Chair @ University of Twente (NL).
The student will be asked to perform images with x/ray tomography at UT. design a protocol to have lab-scale samples of sand containing in-vivo plant roots and polypropylene fibers. Such samples will be subjected to mechanical tests (i.e. direct shear tests and triaxial tests). The ultimate goal is to pursue a parametric study identifying the link between, fibers length, root age, soil granulometry, water content, retention properties of the reinforced soils.

Contact people

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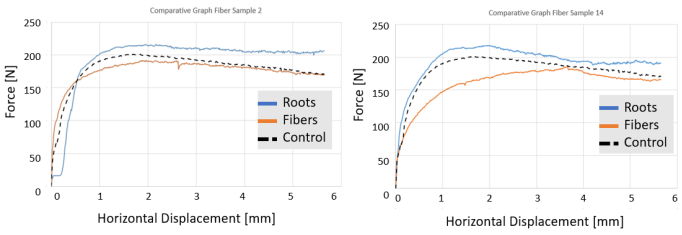

Figure 2: Mechanical response at shearing of granular soil. Comparison between bare soil(black), root reinforced soil (blue), and fibre reinforced soil (orange).