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Laboratory and in-situ shear tests to study soil-root interaction

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The paper presents results of experimental studies in the laboratory and in-situ focused on the quantitative determination of the root tensile strength and the increase in soil shear strength due to root systems. The influence of root reinforcement on shear strength is determined by direct shear tests in the field and in the laboratory. The tensile strength of roots was determined by testing root systems in the laboratory with the new testing apparatus at the Institute and laboratory of Geotechnics.

The first field studies were carried out using our large shear apparatus to identify the increase in soil shear strength due to root systems. In the research we focus on soil materials consisting of fine-grained material. In order to quantify the contribution of roots to soil mechanical properties, direct shear tests on undisturbed samples of rootless soil and root permeated soil, respectively, were carried out. For the investigation, three years before testing there are planted up to 5 birch (Betula pendula) and maple (Acer platanoides) saplings in the testing field.

The size of the box measured 520 cm ? 520 cm with the height of 25 cm. The normal load ? was applied by means of steel-plates. The horizontal shear force, applied by a hydraulic press. Load (stress) and displacement (strain) were plotted throughout the duration of the test procedure. The testing methodology followed DIN 18137.

After the completion of each test the roots were excavated and photographs were taken. The roots were collected and the diameters of the roots were measured in the shear plane to determine the biomass and root area ratio (RAR).

The increase in the shear strength of the root permeated soil (birch roots) is identifi-

able; the shear strength of all field tests is above the shear strength of rootless soils.

During three years of growing the hydrologic regime in the soil is controlled, too. The soil mois-ture suction in the testing filed is studied by using altogether 6 tensiometers installed in 15 cm and 30 cm below ground surface close to the roots. Furthermore TDR (Time Domain Reflectometry)-probes are located at the same depths to get information about the water content. The precipitation is measured by a rain gauge.