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Impact on a soil monolith during lysimeter filling

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In general, lysimeters are vessels containing disturbed or undisturbed soil blocks, for the most realistic scenario with regard to real outdoor conditions an undisturbed soil block so called soil monolith is preferable. The lower boundary condition was realized in two different ways: as a zero-tension lysimeter with a perforated bottom plate or as controlled lower boundary condition with a suction plate. The optimal surface area and the lysimeter length depend mainly on the scientific question. For cropped lysimeter experiments the lysimeter length has to reflect to a maximum root length. The base area is strongly connected to the scale of observation, whereby small-scale heterogeneity will be averaged using large base areas. For our experiments lysimeters with 2.5 m length, 2 m^2 base area and with a wall thickness of the round vessel of 10 mm were used. A base frame weighted down by 120 t of concrete weights is necessary to press a lysimeter cylinder into the ground by the aid of a hydraulic press. The hydraulic press is connected with the base frame via chains. Because of the control of the four hydraulic cylinders a very precise vertical pressing process is guaranteed. To visualize the impact of the lysimeter filling on the intactness of the soil monolith a finite element computation was conducted.

The finite element package ANSYS Release 11 was used to execute a nonlinear static analysis on a 2D-axisymmetric finite element model, to simulate the pressing process starting from a soil initial stress state and ending with the full length of the vessel driven into the soil, after which the hydraulic press and the concrete weights are deactivated and the vessel-surrounding soil is excavated. The numerical model of the pressing process considers among other things, a cap non-associative plasticity model

with shear and volumetric hardening, soil to soil contact with cohesive zone modelling, soil to vessel contact with high friction, soil excavation using element birth and death and a stagger-loop over the complete pressing process to determine the actual cutting plane

The results of this computation will be presented.