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Slope failure experiments triggered by external loads in a laboratory flume - Effects of water content

K. Germer and J. Braun

Universität Stuttgart, Institute of Hydraulic Engineering, Research Facility for Subsurface Remediation VEGAS, Germany (kai.germer@iws.uni-stuttgart.de)

Rapid infiltration processes are observed at a hill slope located in the vicinity of the mountain village of Ebnit, Vorarlberg, Austria. These infiltrations generate at upper slope positions a fast increase of soil water saturation in sections of the subsurface several hundred meters down gradient. It is postulated that the seeping soil water leads to a rapid increase in head and hence to buoyancy forces in the lower regions of the slope resulting in slope deformations, observable in the form of slow slope creeping.

In order to systematically investigate and quantify the development of slope deformation and slope failure processes, laboratory flume experiments were performed at the Research Facility for Subsurface Remediation (VEGAS) at the Universität Stuttgart. The flume was constructed as a 100 cm high, 200 cm long and 80 cm wide steel container. One long side of this flume is constructed by a glass pane. At the both short sides it is possible to maintain constant head boundary conditions in order to control the flow of groundwater or to adjust a steady state groundwater table. The soil material in the flume is shaped to a slope. On the upper side of the slope a hydraulic cylinder is installed to simulate a load on the slope. Varying either the external load on the slope or the location of the groundwater table provides important information on the factors affecting the stability of the slope and their interdependence. In a first set of experiments, the effect of saturation on the slope stability was investigated. It was shown that in the case where the water along the whole shear band was at negative pressure the slope could sustain 20% more load than in the case where parts of the shear band were underneath the groundwater level.