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Remediating Mass Movements, induced by Water, in Urban Environments – an example from Chalki Village, Peloponnese, Greece

D. Rozos , C. Loupasakis, J. Koumantakis, P. Tsangaratos , and K. Markantonis

National Technical University of Athens, School of Mining and Metallurgical Engineering, Athens, Greece (corresponding author D. Rozos: rozos@metal.ntua.gr)

The Village of Chalki, located in Korinthos Prefecture, Northern Peloponnese, Greece, is being affected by severe mass movements that have disrupted large portions of the urban settlement, since 1950. In the following years, these phenomena where occasionally reactivated either as a consequence of human interventions and activities or extreme natural events, such as heavy rainfall and seismic activity. In 2003, after a three years long period of heavy rainfall, a number of serious damages were recorded in the region. Specifically, the direct consequences that followed the reactivation of the mass movements were identified as damages recorded on existing buildings, fencing walls, water supply networks as well as on the road network. The observed mass movements caused serious problems in the region that surrounded the village of Chalki, impeding its development, and spreading insecurity among the residents. The severity of the damages forced the authorities to assign the study of these slope movements to our research team.

The purpose of this study was to highlight the slope stability problems and systematically study the evolution of the mass movement. More specifically, a detailed geotechnical survey was conducted by (a) collecting and processing the available bibliographical data, (b) mapping and classifying the lithological structure of the research area, (c) executing several field and laboratory tests for the estimation of the physical and mechanical properties of each lithological unit, (d) installing and monitoring specific landslide monitoring systems and (e) conducting all necessary limit equilibrium stability analysis for the design of the proper remedial measures.

The monitoring systems included (a) a number of inclinometers for measuring deep displacements, (b) a number of tell-tale crack meters, to measure the surface movements and (c) piezometers, to control the fluctuation of groundwater level. The recordings of the monitoring systems showed a differentiated evolution, according to the type of mass movements in the research area, i.e. multiple surface movements situated at a shallow depth and very slow movements located at a major depth along a slide surface. However, the latter (soil creeps) are the most common type of slope movements observed.

As for the preparatory and the triggering causal factors, the study showed that these are (a) the type of the lithological units constituting the area, such as the Pleio-Pleistocene clayey marl horizons and the underlying calcite marls, (b) the weathering action of the surface water and mainly (c) the raising of the underground water that alters the physical and mechanical properties of the formations. The instability problems are encountered in the region, in the form of shallow slope movements restricted to specific areas and characterized by slow deterioration of the ground.

The outcomes of the study highlighted the need for addressing certain mitigation measures, like the permanent reduction of ground water level, in order to protect residential and agricultural environment from future mass movements' evolution.