Geophysical Research Abstracts
Vol. 12, EGU2010-7238-1, 2010
EGU General Assembly 2010

Relation between pore water pressures and movements in reactivated landslides: A case study from Turkey

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Reactivated landslides in stiff clays and shales typically move on a pre-existing shear surface and they display little or no internal deformation within the sliding mass. These landslide movements can be classified in “extremely slow” and “very slow” categories, with rates of movement of less than 16 mm/year, and between 16 mm/year to 1.6 m/year, respectively, according to the classification by Cruden and Varnes (1996). The rate of movement in these landslides increase with an increase in porewater pressure acting on the failure surface.

The slow but pervasive movements of reactivated landslides are not expected to cause loss of life, however, they can severely damage structures including residential developments on slopes, or interrupt the serviceability of lifelines. These movements have a much longer life than rapid landslides; in some cases they last centuries or hundreds of years (e.g. Washington Park Reservoir slide in Oregon), indicating a potential use of monitoring, early warning and forecasting systems.

The relations between piezometric levels, factor of safety and rate of movements can possibly be used as a forecasting tool. In recent years, some researchers have suggested linear or nonlinear relations between the movement rate and pore pressures on the pre-existing shear surface. It might be possible to come up with such relations, and together with established values of rate of movements, they can be used in defining different warning/alarm levels for a landslide.

In this study we will investigate the relations between rainfall, piezometric levels, factor of safety and rate of movements for a reactivated landslide case history in Turkey, in addition to other landslides in the literature. This landslide is an example of a slow-moving, deep seated landslide in cohesive material with movement rates of up to 15 cm/year. The landslide movements have been observed in the past 60 years and movements have caused buildings to tilt, settle and crack significantly. The displacements have been observed to increase with every rainfall, with increase in the piezometric levels in the marl and sandstone beds forming the slope. Relations between the rise in groundwater level, factor of safety and the rate of movement in this reactivated landslide is presented for a possible use in early warning systems. Such correlations may be improved as more monitoring information becomes available.