

Effectiveness of the piles used to reduce the rainfall-induced mobility of active landslides

Antonello Troncone, Luigi Pugliese, Andrea Parise, Enrico Conte

Summary

Installing one or more rows of piles in unstable slopes is recognised as an effective measure for their stabilisation. The effect of the presence of the piles on slope stability is usually quantified in terms of a safety factor against a possible reactivation of the landslide. However, such an event might still occur for example owing to a significant raising of the groundwater level, especially for active landslides in clay that are periodically reactivated by rainfall. Although the mobility of this type of landslides is usually prevented or attenuated by suitable drainage systems, the piles could be designed to perform a function of reducing the landslide displacements during the reactivation stages. Therefore, a more rational and economical design approach than the conventional limit equilibrium method, consists in admitting the occurrence in some time intervals of limit conditions of the slope in the presence of the piles, and evaluating the effectiveness of such a stabilising measure in terms of accumulated permanent displacements of the unstable soil mass. The resulting displacements should avoid the occurrence of significant damage and preserve the serviceability of existing structures. In this context, a simplified methodology is employed in the present paper to predict the rainfall-induced movements of landslides in the presence of stabilising piles. Specifically, the proposed method uses a water balance equation to relate rainfall to groundwater level changes, and a motion equation of a two-block system representing the landslide body, to relate the aforementioned changes to the landslide displacements accounting for the passive resistance exerted by the piles. This force is evaluated on the basis of the arrangement of the piles and their expected failure mode, using some practical solutions available in the literature. The method is applied to some case studies to quantify the effectiveness of the piles in reducing the landslide mobility, and to show how this method can be used for predictive purposes. The obtained results demonstrate that the presence of the piles can significantly reduce the landslide mobility during the reactivation stages. Their effectiveness mainly depends on the location of the piles respect to the slip surface and their geometric and material features, which in turn influence the occurring failure mode of the pile.