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0.1 A model for triggering mechanism of shallow landslides

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A special kind of landslide involving small sections of superficial soil, which is often called “soil slip”, is usually triggered by short duration and intense rainfalls and mostly occurs on slopes composed of an impermeable bedrock and a shallow very permeable layer. Soil slips are characterized by a triggering stage and by a subsequent run-out that can develop in different ways [1]. In the worst case the sliding soil portion flows like a fluid down the slope surface, reaching a velocity of more than 9m/s [1].

Because of their rapid formation, the difficulty in prediction and territory susceptibility, soil slips have caused a lot of property damages and casualties in Italy over the last few years: Piedmont’s “Langhe” in 1994 [1], Campania Region in 1998 [2][3][4][5], Emilia Romagna Region [6]. The economic and social impact of soil slips has recently made it necessary to embark on a research into the problem to identify the key triggering factors, with the final aim of mapping susceptible zones and setting up an alert system for people against these phenomena.

To reach this goal a simplified physically based stability model was recently introduced by Montrasio [7] [8] for the assessment of the safety factor of slopes susceptible to such phenomenon.

The model is able to describe the most important factors influencing the beginning of the slope movement, without introducing too many parameters. It considers an

infinite slope, since only a slight soil thickness is involved, a water-flow parallel to the slope and different drainage capability and strength between the bedrock and the shallow weakly-bonded soil. Based on the limit equilibrium method, the model deals with the definition of the safety factor, which is influenced by soil mechanical and hydraulic characteristics, geometrical configuration and pluviometric conditions. The phenomenon is triggered following the loss of soil shear strength and a sudden growth of water pressure: the soil, firstly unsaturated, becomes saturated in consequence of a certain amount of rainfall, which is strictly related to the initial water content of the soil. The method has been deeply investigated throughout a series of experimental tests reproducing the natural phenomenon in a reduced scale [9] and has been applied to the understanding of some real events [10]. The experimental evidence shows that slope movement occurs in correspondence of the reaching of zero suction and of an increase of pore pressure.

In this paper the model has been used to verify its capability in foreseeing the occurrence of the phenomenon in four recent case histories in the Emilia Appennines, on the basis of the slope geometric features, the geotechnical characterisation of involved soils, the shear strength of the soil both in saturated and unsaturated conditions, the drainage capability of the slope, the way of rainfall infiltration.

The method, which enables a direct correlation between the safety factor and rainfall intensities, shows how in all cases the model well catches the reduction of the safety factor to one in correspondence of the same time when the real event occurred. The model can be then used both for back analysis and prediction, if implemented in a platform for a real-time territory control.

[1] Campus S., Forlati F., Susella G., Tamberlani F. (1998) *Frane per mobilizzazione delle coperture detritiche*. In: Eventi alluvionali in Piemonte, Regione Piemonte, Torino.

[2] Cascini L., Guida D., Romanzi G., Nocera N., Sorbino G. (2000) *A preliminary model for the landslides of May 1998 in Campania Region*. In: Evangelista A and Picarelli L (eds) (2000) Proceedings of the second International Symposium on the Geotechnics of Hard Soils-Soft Rocks, Balkema, Rotterdam, pp 1623-1649.

[3] Cascini L., Sorbino G., Cuomo S. (2003) *Modelling of flowslide triggering in pyroclastic soil*. In: Picarelli L (eds) (2003) Proceedings of Int. Conf. on Fast Slope Movements Prediction and prevention for risk mitigation, Patron Ed., Bologna, pp 93-100.

[4] Olivares L. (2001) *Static liquefaction: an hypothesis for explaining transition from slide to flow in pyroclastic soils*. In: Proceedings of Conference on transition from

slide to flow - mechanisms and remedial measure, Karadeniz Technical University, Trabzon, 25-26 August 2001.

[5] Olivares L., Picarelli L. (2001) *Susceptibility of loose pyroclastic soils to static liquefaction: some preliminary data*. In: Proceedings of International Conference on Landslides - Causes, Impacts and Countermeasures, Davos.

[6] Regione Emilia-Romagna (2002), Servizio Geologico Sismico e dei Suoli, Servizio Provinciale Difesa del Suolo di Reggio Emilia, Servizio Protezione Civile, Servizio Idro-Meteo regionale, CNR-GNDCI, *Carta della pericolosità relative da frana, ai fini di protezione civile*.

[7] Montrasio L. (2000) *Stability analysis of soil slip*. In: Brebbia CA (eds) (2000) Proceedings of International Conf. Risk 2000, Wit Press, Southampton .

[8] Montrasio L., Re F., Valentino R. (2002) *An approach to measure soil slip risk*. In: Brebbia CA (eds) (2002) Proceedings of III Int. Conf. On Comp. Simulation in Risk Analysis and Hazard Mitigation “Risk Analysis III”, Wit Press, Southampton, pp 729-740.

[9] Montrasio L., Valentino R. (2003) *Experimental analysis on factors triggering soil slip*. In: Picarelli L (eds) (2003) Proceedings of Int. Conf. on Fast Slope Movements Prediction and prevention for risk mitigation, Patron Ed., Bologna, pp 371-378.

[10] Montrasio L., Valentino R., (2003). *Validation of a model for triggering mechanism of shallow landslides*, International Workshop “Living with landslides: effects on structures and urban settlements. Strategies for risk reduction”. Anacapri, Italy - October 27-28, 2003.