



## Hydrological survey and modeling of a landslide in Borgata Gros (Bussoleno, Italy)

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The instability of the slopes is a problem of major concern in the mountain areas.

The aim of this work is the individuation of the depth of soil layers with low safety coefficient ( $F_s$ ), through the evaluation of the *Infinity slope stability under steady unsaturated seepage conditions* model proposed by Ning Lu and Jonathan Godt (2008), employing an experimental dataset.

The infinite slope stability under steady unsaturated conditions proposed by Lu and Godt, (2008) is a model that simulates the soil behavior during precipitations in function of hydrological and physical parameters of soil, such as porosity, texture, bulk density and hydraulic conductivity.

The data were collected on a landslide in Borgata Gros (Bussoleno, Torino) originated during the flood occurred in Northern Italy in the Autumn 2000.

The intense and abundant precipitations caused the erosion of a big part of the top soil and the detachment of a landslide in correspondence of the change of inclination in a meadow facing Borgata Gros.

The land slide interested an area of 10000 m<sup>2</sup>, with a volume of material estimated in 8000-9000 m<sup>3</sup>.

Field infiltration tests were performed on 15 stations and soil samples were collected for the determination of the physical properties of the soil. Furthermore a campaign of water contents measurements by TDR (Time Domain Reflectometry) was performed from May to October 2008. A total of 45 TDR probes were installed on the land slide area. Each station is composed by three vertically installed probes with length of 15 cm, 30 cm and 60 cm.

The hydraulic conductivity was calculated fitting the measured infiltrations rates and water content data on the Green and Ampt (1911) infiltration model.

The Lu and Godt, (2008) model has been programmed to show the trend of  $F_s$  for five values of steady infiltration. Four of them were referred to precipitations of different intensity taken by the meteorological station of Bussoleno, and the fifth value was imposed equal to a precipitation sufficiently intense to cause an infiltration rate corresponding to the hydraulic conductivity at saturation.

The Infinite slope stability under unsaturated conditions method proved to be a very useful tool for the prevision of landslides, especially for the situations in which the angle of inclination of the slope is similar to the internal friction resistance angle. The Safety Factor is mainly function of the relation between the above-mentioned angles: when the slope exceed the internal friction angle of 10 °, in such cases the  $F_s$  is under the critical value of 1 for the entire soil profile. On the contrary when the inclination is equal or inferior to the frictional angle, the slope remains in safety conditions. The method is therefore especially useful in the intermediate situations, when the difference between angles is very low.