EGU24-10833, updated on 04 Apr 2024
https://doi.org/10.5194/egusphere-egu24-10833
EGU General Assembly 2024

Geophysical survey for the estimation of geotechnical parameters and for the stability assessment of the Tehilly landslide (VdA, Italy)

Veronica Pazzi[1], **Agnese Innocenti**[2], Elisa Gargini[3], Samuele Segoni[2], Ascanio Rosi[4], Elena Benedetta Masi[2], Veronica Tofani[2], and Nicola Casagli[2]

[1]University of Trieste, Department of Mathematics, Informatics, and Geosciences, Trieste, Italy (veronica.pazzi@units.it)
[2]University of Florence, Department of Earth Sciences, Firenze, Italy (agnese.innocenti@unifi.it, samuele.segoni@unifi.it, elenabenedetta.masi@unifi.it, veronica.tofani@unifi.it, nicola.casagli@unifi.it)
[3]Center of Civil Protection, Firenze, Italy (elisa.gargini@unifi.it)
[4]University of Padova, Department of Geosciences, Padova, Italy (ascanio.rosi@unipd.it)

An efficient stability analysis is closely linked to a good assignment of geotechnical parameters to the strata identified in the construction of the geological model. However, it is not always possible to determine the geotechnical parameters from direct tests, but there are indirect methods in the literature for determining the main geotechnical parameters of the ground using seismic parameters such as seismic velocities.

Numerous correlations exist in the literature between shear wave velocity (VS), and the N-SPT value derived from penetrometric tests.

This study presents the geotechnical model of the Theilly landslide (Western Alps, Italy) obtained by integrating the results of a multi-parameter geophysical survey (H/V seismic noise and ground-penetrating radar) with stratigraphic and geomorphologic observations, digital terrain model and field survey data. It is shown how VS values can be related to values obtained from direct tests such as N-SPT and, using the direct or estimated N-SPT value, it is possible to directly derive the friction angle value (φ'). Although, the indirect estimation of N-SPT is subject to a higher level of error, it could be very useful in the early stages of an emergency, when direct data are not available, and a preliminary forward and backward stability analysis could be performed to assess landslide evolution and civil protection actions.

Geophysical surveys were conducted on the landslide body and on nearby locations. The H/V survey identified the presence of 2 discontinuity surfaces and thus the presence of 3 seismo-layers. The GPR survey allowed the surface portion of the slope to be studied, identifying an extremely heterogeneous debris layer.

The H/V data allowed the interface depth to be related to the frequency of the identified peaks and the VS of the identified seismic layers. It was then possible to apply empirical equations to derive the value of N-SPT, and consequently φ', from the VS obtained through the H/V measurements.

The geotechnical parameters obtained from geophysical and direct tests were used to create a geotechnical model of the landslide to perform a reliable stability analysis. The analysis of the triggering conditions of the landslide was conducted through hydrologic-geotechnical modelling, evaluating the behaviour of the slope under different rainfall scenarios, and considering the stabilization interventions present on the slope.

The results of the filtration analyses showed a top-down saturation mechanism, which resulted in the generation of positive pore water pressure in the first few meters of soil and the formation of a saturated front with a maximum thickness of 5 m. Stability analyses conducted for the same events showed the development of a shallow landslide affecting the first few meters of saturated soil.

The geotechnical parameters estimated from the geophysical tests are in agreement with the data from the direct tests and have made it possible to create a geotechnical model that is faithful to reality.

The modelling results are compatible with the actual evolution of the phenomenon and have provided insight into the triggering mechanism, providing models to support future interventions.