Press release

Landslides monitoring in modern societies

(Athens, February 2020) A landslide is any geologic process in which gravity causes rock, soil, artificial fill or a combination of the three to move down a slope. In many cases, landslides and flood event coincide, feeding a chain of socio-economic impacts, even in the absence of serious injuries and fatalities[1]. A common case is the loss of utility in road networks parts. Any disruption in infrastructures results to direct clean-up and repair/replacement, and, sometime, search and rescue costs; these are the direct costs.

There are, also, direct and indirect consequential impact costs. The former is related to "infrastructure disruption", e.g. delays due to lane(s) closure. The latter involve any other adverse effects, e.g. reduced visitors flow due to fear of further incidents. Case studies set the global landslide impact at US$20 billion in overall losses annually, e.g. the Federal Republic of Germany is associated with damage costs of about US$300 million on annual average[2]

Prevention and post-disaster management planning is important, since it can minimize or eradicate any undesirable situations. Towards that direction, simulations using numerical models can be extremely beneficial. Such an analysis allows for hazard zoning, leading to the creation of a landslide hazard maps, to be used as a reference in future land planning and disaster prevention. However, identifying potential landslide areas requires historical terrain data, remote sensing images, field experience, and an acute interpretation of landslide characteristics, which is not an easy feat.

Two broad analysis categories can be considered: (i) empirical–statistical methods that rely on statistical geometric correlations and (ii) analytical methods that rely on process-based modelling. Landslide modelers tend to rely heavily on empiricism, due to lack of universal constitutive laws governing landslides that are straightforward to incorporate into numerical models[3]. PANOPTIS established procedures include seismic fragility curves for the hybrid caisson–pile group foundation systems, which have been designated as slope stabilizing structures, in addition to carrying the loads transmitted by the bridge superstructure.

Numerical modelling with nonlinear 3D finite elements has been employed, together with site-specific hazard-consistent selection of ground motion records, for the generation of fragility curves via nonlinear time history analysis. The effect of groundwater recharge after rainfall periods is considered in a simplified manner, using different scenarios for water table elevation. Focusing on the performance of the foundations, damage is described in terms of their permanent displacements while transient loads associated with the dynamic response of the superstructure are considered, via a single-degree-of-freedom approximation.

Additional information can be found in PANOPTIS site, just follow the link: http://www.panoptis.eu/

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[1] Winter, Mike G., et al. "The economic impact of landslides and floods on the road network." *Procedia Engineering* 143 (2016): 1425-1434.

[2] Klose, Martin, Philipp Maurischat, and Bodo Damm. "Landslide impacts in Germany: a historical and socioeconomic perspective." Landslides 13.1 (2016): 183-199.

[3] Pastor, M., et al. "Landslide runout: Review of analytical/empirical models for subaerial slides, submarine slides and snow avalanche." Numerical modelling. Software tools, material models, validation and benchmarking for selected case studies. SafeLand Deliverable 1 (2012).

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no769129.