International Symposium on Geotechnical Safety and Risk (ISGSR 2019)
Taipei, Taiwan, 11–13 December 2019

Quantitative Risk Assessment of Individual Landslides

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Slope failures or landslides are reported every year in different countries. In spite of improvements in landslide hazard recognition, prediction, mitigation measures, and warning systems, worldwide landslide activity is increasing. Uncertainty is a dominant feature of all landslides. Various uncertainties arise during the resolution of the problem, from climate data of rainfall, to infiltration rate, to site characterization, to material properties, to analysis, design and consequence assessment. These variabilities are rarely taken into account directly in traditional geotechnical analysis, rather some "average" or suitably "pessimistic" property is assumed to act across the whole region of interest. This keynote will focus on the modelling of spatial variability of soil properties in the quantitative risk assessment of individual landslides. Firstly, both infinite (1D) and 3D slope examples are used to demonstrate the importance of modelling spatial variability in the risk assessment of landslides. The infinite slope example shows that ignoring spatial variability will lead to unconservative estimation of slope failure. The 3D slope example shows that ignoring the spatial variability in the third direction can lead to unconservative estimation of slope failure if the slope is long. Then the framework of quantitative risk assessment of landslides is discussed. Slope or landslides can fail shallowly or deeply. Because deep failure leads to more severe consequence than shallow failure, each potential failure mode has a specific consequence associated with it. It is thus necessary to redefine risk as mean consequence other than assuming a constant consequence for all failure modes. One challenge for quantitative risk assessment of landslides is to automatically identify failure modes and assess associated consequences. This issue can be overcome by introducing Machine Learning algorithms within the framework of Monte Carlo simulations. At the end of this keynote, the application of the quantitative risk assessment framework to rainfall induced landslides is discussed.