Part I

Advances in Slope Stability Modelling

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Slope modelling traditionally refers to the analysis of detail-scale slope stability under known specific boundary conditions. Many methods have been proposed and used in the last 30 years to cope with the related problems and, lately, new numerical solutions have been developed to improve our ability to model the behaviour of a given slope, both in two and three dimensions. However, even more recently, new advances in constitutive models and computational methods, software engineering, field and laboratory instrumentation, quantitative geomorphology and hydrology seem to have set the stage for a new breakthrough in slope modelling, making it possible to positively face the challenge of going from slope-specific to basin-scale analysis and from limited time frames (single event approach) to continuous, real-time applications. Recent advances in slope modelling are not confined to analysis concerning the conditions prior to the onset of landslides or complete detachment of ground mass, but also the simulation of post-failure dynamics. Numerical models have evolved to assess the runout of landslide debris, which have practical applications in hazard and risk assessment.

In this context, this chapter addresses a wide range of case studies and methodological applications on landslide modelling offering an overview of actual issues worldwide.

Slope stability modelling issues are reported under both seismic (China, Japan) and pore water pressure stresses (Brazil, Switzerland, Italy). Run-out modelling is also treated, with examples in China for rock slides, Hong Kong and Italy for debris flows and Mexico for mud flows. Some interesting case studies on landslide behaviour are also included, in Russia, Croatia, Greece, Italy and Spain.

Besides, more theoretical studies are devoted to the hydrological and geotechnical modelling for landslide stability, to the data retrieval on important slope stability parameters using new methods (using TLS for rock falls, modelling for soil depth, specific new devices for roughness), to rock fall modelling in Italy (Alps and the Carrara marble basins). A final case on mitigation measures to cope with slope instability in Italy concludes the chapter.