The Cimaganda rockslide (2012): recent geomorphological evolution of the paleo-event

Morcioni Andrea*, Bajni Greta* & Apuani Tiziana*

*Università degli Studi di Milano, Dipartimento di Scienze della Terra "Ardito Desio" via Mangiagalli 34, 20133 Milano, Italy. (andrea.morcioni@unimi.it)

The San Giacomo Valley (Sondrio, Italy), as many alpine areas, is quite frequently affected by rock slope landslides at different scales, due to its geological and morphological features. Their interaction with anthropic activities represents one of the main natural risk along the Valley. The analysis and understanding of slope instability processes are thus so crucial to forecast landslide events, and to plan risk mitigation and civil protection actions.
This work deals with the study of the Cimaganda rockslide, occurred in September 2012 after some days of persistent rainfall. It involved a rock volume of about 20.000 m^3, blocking the main road (SS36) and isolating the municipality of Madesimo and Campodolcino in the upper Valley. The rockslide developed in an active geomorphological context, along the right flank of the historical Cimaganda landslide, dated at least to the 17th century with a volume involved valued in 7.5 million of m^3.
Following a procedural scheme including field surveys, remote sensing and geomechanical laboratory tests, this work develops an accurate characterization of the slope, that lead to a solid geological and geomechanical conceptual model extended to the slope directed involved in the 2012 event and to the surrounding area of the historical large landslide. Geological, geomorphological and geomechanical surveys allowed to recognize typical features of deep-seated gravitational deformations and largescale stress release: trenches and counter-slopes at the crown of the ancient landslide, sub-vertical tensile fracturing along the slope and shear planes mainly along the right flank.
Using Finite Element Method (FEM) the conceptual model was built specifying the joint network orientation and the elasto-plastic properties of rock and joints. Hydraulics properties and anisotropy conductivities of rock mass, necessary to simulate hydrogeological flow, were calculated based on joint features of each discontinuity set. First, the numerical modelling, developed to simulate the slope scenarios before the landslide event, was able to reproduce a deformation pattern coherent with filed observations. Then, the introduction of a rainfall infiltration process, as triggering factor, with a semi-coupled hydro-mechanical analysis, allowed to simulate the evolution of the 2012 rockslide.
This work represents a solid base to improve the analysis of the Cimaganda paleo-landslide and explore instability-forecasting scenarios in order to enhance rockslide risk management.