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Numerical modeling of progressive failure in large rock slopes in the Central Alps (Ticino, Switzerland)

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Large rock slope movements are common in Alpine mountain belts. They are controlled by lithological, geomorphological, and structural features [1]. We present three examples of deep-seated slope deformations in the Central Swiss Alps (Cerentino, Campo Vallemaggia, Peccia). The three examples are different in morphology, size, state of activity, geology and structural set-up. An integrated multi-disciplinary approach was performed to achieve a clear comprehension of the phenomenon. A series of investigations, carried out in the last 3 decades, such as field surveys, aero-photo interpretation, seismic campaigns, boreholes, inclinometer measurements, geodetic surveys, precipitation monitoring, have resulted in a very high density of information clarifying the structural, geological and geomorphological model of the landslides. A conceptual kinematic model of the slope deformations was developed through the analysis of morpho-structures and their relationship with different lithological and structural features.

Numerical modeling was performed to validate the hypotheses made on the kinematics and driving factors of the phenomenon, which demonstrated the importance of lithological and structural constraints, postglacial debuttressing, groundwater fluctuations, and weathering [2]. We also demonstrate relations between structural and gravitational features and discuss the possibility that structural elements have both passive and active roles in the development of saggings.

The models are done using the commercial computer code FLAC-2D [3], which is capable to reproduce the evolution of the landslide instability in a four-step sequence: 1. Glacial retreat causes decompression and elastic rebound, leaving the landslide mass in a plastic state. 2. Slope failure initiates at the toe of the slope and prograte uphill.

3. Completion of rupture surface. 4. Landslide enters kinematic phase of potentially unstable equilibrium, moving slowly downhill.

References

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[3] FLAC-2D: HCItasca, Minneapolis, U.S.A. Internet: www.itascacg.com.