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Distinct element modelling of the 1806 Goldau landslide event

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September 2006 marked the 200th anniversary of one of the best-known landslides in the subalpine Molasse of the Swiss Alps, the Goldau rockslide (also referred to as the Rossberg slide or Goldauer Bergsturz). The 1806 failure claimed 457 lives when a slide involving nearly 40 million m^3 of rock was triggered by a rapid snowmelt coinciding with heavy rainfall. The slide mass mostly consisted of conglomerates dipping between 15º and 30º and was reported as having failed along bedding plane contacts between the conglomerates and underlying marls

The 1806 rock slope failure has been investigated by many authors, last by Thuro et al. (2006), who conducted detailed field investigations and laboratory tests of the rock material. Subsequently the mechanisms and kinematics was analyzed with the help of the 2D distinct element code (UDEC©Itasca), simulating the progressively developing damage of the rock mass by reducing the shear parameters of marl due to weathering using a elasto-plastic Mohr-Coulomb constitutive yield criterion.

Strength and deformation properties of both intact rock and discontinuities were estimated from laboratory tests, e.g. uniaxial compression and tensile tests of the conglomerates and shear tests of the interbedded marls, as well as from numerical simulation. To gain correct results in our simulation, we took into consideration that, when analysing slope failures in weak rock, the continuum behaviour of the intact rock contributes to the development of the instability in the discontinuous rock mass and must therefore be incorporated in the analysis to properly model and predict the correct failure mechanism.

Therefore the input parameters of the intact marl were varied to simulate the strength degradation due to weathering and to reflect the effect on the slope instability.

By determination of the factor of safety in UDEC the critical friction angle could be gained as 17˚ to 20˚ and the failure took place in the weathered marl of the weathering stage III (heavily weathered; IAEG 1978). In this case, considering a friction angle less than 20˚, the slope would also fail under dry conditions. In a second phase, models were run using a partial hydromechanical-coupled solution (i.e. constant joint hydraulic aperture) with variation of the groundwater level.