Soil Mechanics Laboratory (LMS)
GCB (Ecublens) CH- 1015 LAUSANNE
: 021 - 693 23 15 TÉLÉFAX: 021 - 693 41 53
http://lmswww.epfl.ch/lms_f.html; e-mail: lms@dgc.epfl.ch

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

Modelling natural slopes in slow movement

Natural slopes undergoing slow movement are outside of the habitual domain of limit calculations. The very notion of a factor of safety loses its meaning for a slope which has been in movement for decades and exhibits continuous displacements.

We have developed original calculation models in two and three dimensions for slopes undergoing slow movement. The first such model (Figure 1) considers the mass to be an incompressible viscous body which moves under the influence of its own weight and may slide on its base (sliding surface). The second model is an extension of the case of a two phase medium (grains and water). It takes into account the effect of hydromechanical coupling.

Calculations carried out for several sites in Switzerland and France have proven the potential of the method. Recently (July 1994), our laboratory was given the task of predicting the future behaviour of the Chlöwena landslide in the canton of Fribourg (Figure 2). These calculations permitted the evaluation of the position and the height of the dam (40 m) that would be formed at the base of the valley. Reality has validated the predictions for the most part, in spite of the enormous simplifications which were necessary due to the lack of data.

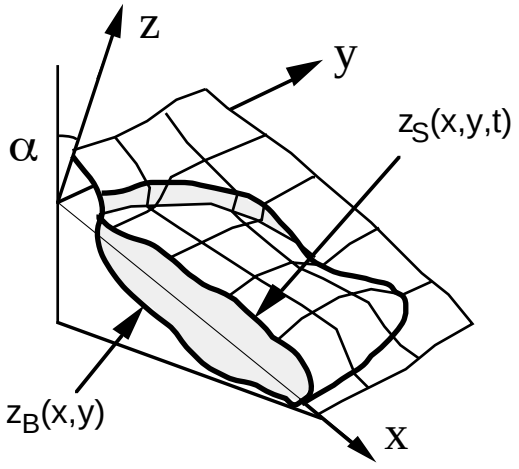

Fig. 1: The mass in movement is considered as a non-linear three dimensional gravity-driven viscous body. The mass in movement may slide on its base z_B.

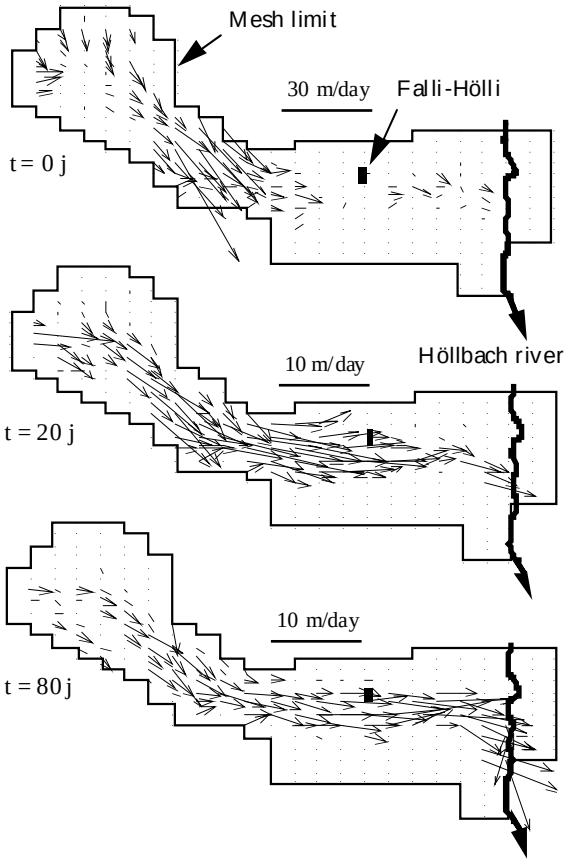

Fig. 2: Calculation example for the Chlöwena landslide (canton of Fribourg), July 1994.

Publications

Vulliet L. & K. Hutter, 1988. Continuum model for natural slopes in slow movement. *Geotechnique* Vol. 38, No 2, pp. 199-217

Vulliet L., 1995. Predicting large displacement of landslides. *Proc. 5th Int. Symp. on Numerical Models in Geomechanics - NUMOG V*, Davos 6-8 September 1995, pp. 625-532

Vulliet L. & Ch. Bonnard, 1996. The Chlöwena landslide: Prediction with a viscous model. *Proc. 7th Int. Symp. on Landslides,* Trondheim, Norway, Vol. 1, pp. 397-402

Vulliet L., 1997. Three families of models to predict slowly moving landslides. *Proc. 9th Int. Conf. on Comp. Meth. and Advances in Geomech., IACMAG,* Wuhan, China, pp. 277-284