**ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE**

Numerical simulations of dam foundations in rock masses

One of the aims of numerical simulations, in addition to trying to reproduce the observed behaviour of existing dams, especially the hydromechanical coupling of joints, is to show the relative influence of different calculation parameters necessary for numerical codes in order to better target reconnaissance work.

The modelling of dam foundations was carried out with the two dimensional distinct element programme UDEC, in which the rock mass is simulated by an assemblage of blocks which react among themselves through contact at the top and edges. The Montsalvens and the Albigna dams were studied.

The monitoring system of the support on the left bank of the Montsalvens arched dam (FR) showed that, in addition to the elastic deformations dues to the variation in the water retention level, irreversible displacements downstream perpendicular to the bedding were produced (Figure 1).
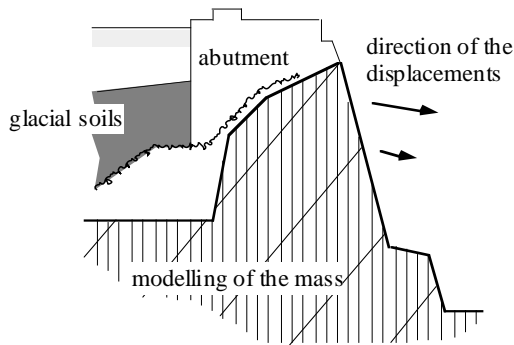

Fig. 1 Section of the left dam support at Montsalvens and the chosen model

Numerical simulations carried out at the LRM showed tangential displacements along the bedding (left-handed toppling movement) and produce irreversible deformations of the same order of magnitude for each filling cycle of the water retention.
During use of the water retention of the Albigna dam (GR), certain fissures in the mass on which the dam is founded were subjected to pressure and slowly opened, causing irreversible displacement directed downstream. The dam was repaired in 1981 and equipped with various monitoring devices. The measurements permitted the

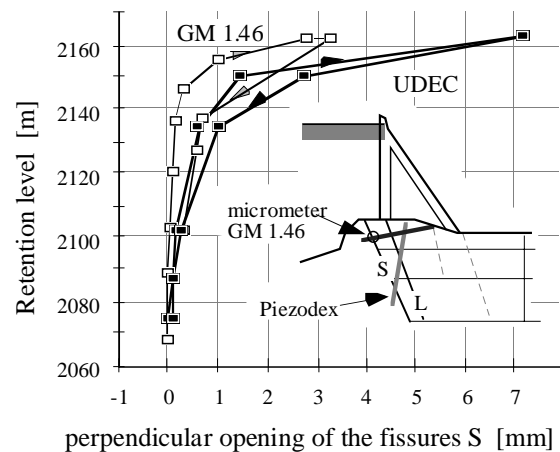fitting of the hydro-geomechanical parameters necessary for the UDEC code.

Fig. 2 Normal opening of the fissures S as a function of the retention level. Micrometric measurements and results of the UDEC simulations.

The numerical simulations carried out at the LRM reproduce correctly the total and relative displacement at the dam crown for various retention levels, as well as for different load-unload cycles. The increase in fissure opening S as a function of retention level also showed good correspondence with the micrometric measures made (Figure 2). The hydraulic pressures simulated in the mass also show good correspondence and the hydromechanical coupling is perfectly shown.

Publications

Fontana O., Egger P., Descoeudres F., 1995. Etude des écoulements et des déformations couplées dans le massif de fondation du barrage d'Albigna (GR), *Proc. Symp. on Research and Development in the field of Dams, ICOLD,* Montana, pp. 465 - 476

Fontana O., Egger P., Descoeudres F., 1996,. Modélisation numérique, par un programme aux éléments distintcs, du comportement du barrage d'Albigna et de son massif de fondation, *Proc. séminaire sur la recherche dans le domaine des barrages,* EPFL, Lausanne.