Títol: **GEOTECHNICAL ANALYSIS OF BELICHE DAM**

Autora: Núria Mercè Piñol i Puigmartí
Tutors: Eduardo Alonso Pérez de Agreda i Sebastià Olivella Pastallé

ABSTRACT

Beliche Dam is an earth dam located in the southeast of Portugal, in the Algarve province. It was built between 1982 and 1985, over a ground composed of sands and gravels coming from the Beliche River, a tributary of the Guadiana River. It consists of a low plasticity clay core reinforced by two different sorts of rockfill, corresponding to the two different conditions upstream and downstream of the dam.

Beliche Dam represents an interesting case because of the important documented subsidence happened during its construction phase, where strong rainfalls caused a partial filling of the reservoir, as well as in later episodes.

During the previous 4 years to the construction of the dam, the Civil Engineering National Laboratory in Portugal (LNEC) carried out an in-depth test so as to determine the characteristics of the materials to be used. All the construction through, the dam was monitored and different episodes of subsidence were measured until 8 years after the complete filling of the reservoir, which is its operating condition, in 1988.

The main objective of the analysis put into effect in this dissertation is to model the behaviour of the dam during construction and subsequent filling of the reservoir, reproducing the real time line evolution. An important effort has been put to simulate the rainfalls happened during construction and those that caused the unforeseen filling before completion, due to the importance of the water effect on material response.

The model to reproduce the dam performance makes use of two different constitutive models. On one hand, the constitutive model for granular materials by Oldecop and Alonso (2001) and, on the other hand, the constitutive model for partially saturated soils by Alonso, Gens and Josa (1999). The finite element program used for simulation has been Code-Bright, developed to the thermo-hydro-mechanical modelling in a geological media (Olivella *et al.*, 1996).

In the first part of the dissertation, the finite elements tests carried out by the LNEC are simulated for the materials appearing in the dam: two types of rockfill shells, clay in the core and alluvial sands and gravel in the foundation. The objective of this first part is to calibrate the parameters that are going to characterize the materials after the two different constitutive models.

Through an ongoing analysis, the construction, the unforeseen fill and the final one are simulated. In a first approach, parameters from the test simulations are introduced and results compared with the measurements in the upstream and downstream side of the dam, as well as in the core (Naylor *et al.*, 1997). Because of an underestimation in the subsidence, other analyses have been carried out using different elastoplastic parameters for core clay and rockfill, as well as different permeabilities for the core material.

The outcome from the modelling reasonably reflects the measurements upstream and downstream of the dam. As for the downstream subsidence, absolute values are not reached during the first year, but certainly well the relative subsidence from then on.