ABSTRACT

Diagnosis and structural behaviour of pathologies in concrete dams. Application to Mequinenza dam.

Author: Miquel Crusells Girona

Advisors: Antonio Aguado de Cea, Carlos María López Garello

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The main aim of the proposed dissertation is to study the diagnostic process of pathologies in concrete dams following a three-levelled structure: detection of the anomaly, formulation of a first hypothesis and verification of it through a structural analysis by Finite Element Method. The dissertation is settled in the dam group work of the Department of Construction Engineering from the Universitat Politècnica de Catalunya.

So to be developed, the document is divided into two clearly distinguished parts, each outlining a specific approach to the dissertation objective. The first part, a basically descriptive one, is formed by chapter 2; the second part, which adds a more numerical approach, is made up by chapters 3 and 4.

In the first part, every different level of the diagnostic process is described. This generalist analysis aims at defining the course of action to be followed by an exploitation engineer in each possible circumstance. In this chapter, the possible symptoms, ones related to morphology and others related to deformations, are presented. Furthermore, the chapter includes a description of the main experiments considered in this field and the mathematic bases of the Finite Element Method. Moreover, the reader is presented with some cases which have been studied by the dam group of the Department of Construction Engineering in order to be provided with clear references. Some of these examples are Rumedo dam, San Esteban dam or Paso Nuevo dam.

The second part of the dissertation presents the application of the previous methodology to one specific case: the Mequinenza dam. This example lets the reader clarify the described steps and, at the same time, it offers a diagnosis of the structural behaviour of the studied dam. This part starts with a contextual situation of the Mequinenza dam, describing the researches which have been made (local geology, concrete testimonies and observed dam movements) and the corrective actuations carried out. After these, a setup based on two effects is presented. The first effect is a local one, only observed in the concrete block between 13 and 14 joints which has larger movements than others, and is pretended to be caused by an opening of dam fissures. The other effect is a global one, which affects the whole dam body and is pretended to be caused by either an expansion of the lignite foundation or an expansion due to concrete swelling. Following this behaviour model, some numerical simulations, ones with a linear model and others with a non-lineal one, have been calculated, using joint elements to model material interfaces.

Eventually, in chapter 5 the reader is presented with the conclusions obtained by the dissertation, both related to the diagnostic process and the particular study of the Mequinenza dam. This chapter also includes the future lines of investigation which seem to be interesting and a personal valuation of the work.