11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20–25, 2014, Barcelona, Spain

ACCOUNTING FOR UNCERTAINTIES ON THE MODELING OF AN RCC DAM CONSTRUCTION.

A. Gaspar[1,2], F. Lopez-Caballero[1], A. Modaressi[1] and A. Gomes-Correia[2]

[1] Laboratoire MSSMat CNRS UMR 8579, Ecole Centrale Paris, Grande Voie des Vignes, 92290 Châtenay-Malabry, France, ana.pimentel-torres-gaspar@ecp.fr, www.mssmat.ecp.fr
[2] Universidade do Minho, Escola de Engenharia, Centro do Território, Ambiente e Construção, Campus de Azurém, 4800-058 Guimarães, Portugal

Key words: *RCC dams, sensitivity analysis, thermo-chemo-mechanical model, probabilistic risk analysis*

The use of probabilistic tools within dam safety assessment has been increasing during the last two decades. This work aims to be a contribution in this domain by applying some probabilistic tools to propagate uncertainties and assess a target probability of failure.

Even if it is known that the security of dams is a concept of probabilistic nature, its evaluation has been done in a deterministic and mostly qualitative manner over the years, based on the concept of the global security coefficient. Therefore, that evaluation should take into account uncertain parameters by means of a probabilistic approach and not only in an empirical manner. With the arrival of the Eurocodes, the limit state and partial factors of safety concepts were introduced. A semi-probabilistic safety assessment of dams has then begun to be implemented in European countries.

In the case of a roller-compacted concrete (RCC) dam construction site, the composition of the produced material may be object of some variations during the construction period. The object of this study is then to take into account some of those uncertainties by giving a random character to some of the RCC characteristics which have an influence on the evolution of its mechanical properties (i.e. the water-to-cement ratio or the cement content) and evaluate a probability of exceeding a certain damage level, which is here accounted by a cracking index and measured on each constructed layer/lift. Therefore, the numerical simulation of a gravity RCC dam layered construction is done. The material behavior is modeled by a thermo-chemo-mechanical model which couples the chemical hydration reaction at early ages with the mechanical properties evolution by introducing an ageing parameter [1]. This model is performed in a 2D plane-strain finite element analysis.

In order to improve the understanding of the influence of each adopted random variable

on the model output, a sensitivity analysis is carried out using the random balanced design Fourier amplitude sensitivity test (RBD-FAST). Also, the results of the RBD-FAST allow the estimation of the probability of exceeding a damage level. This damage level is a measure that depends on the cracking index during construction. Moreover, the ambient temperature variability is also considered by means of random fields theory. The Monte Carlo Sampling (MCS) method is used to compute the random fields, which are generated from Gaussian correlated fields by applying the inverse CDF method to obtain non-Gaussian random fields.

The work presented here is in the framework of a PhD thesis in current development and that benefits of a partnership between the Universidade do Minho (Portugal) and the Ecole Centrale Paris (France). This thesis aims to be a contribution to the increasing use of Probabilistic Risk Analysis in dam safety control by characterizing the probability of failure of a roller-compacted concrete (RCC) gravity dam through a probabilistic numerical analysis.

REFERENCES

[1] M. Cervera, R. Faria, J. Oliver and T. Prato. Numerical modelling of concrete curing, regarding hydration and temperature phenomena. *Computers and Structures*, Vol. **80**, 1511–1521, 2002.