Nonlinear Seismic Simulation of an Arch Dam using XFEM

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Abstract

The “Committee on Computational Aspects of Analysis and Design of Dams” in International Commission on Large Dams (ICOLD) is responsible for organizing benchmark workshops every second year, where the 12th benchmark workshop was held in the city of Graz back in October 2013. One of the three topics in this benchmark workshop was titled “Fluid Structure Interaction, Arch Dam - Reservoir at Seismic Loading”, formulated by the Institute of Hydraulic Engineering and Water Resources Management from Graz University of Technology. The focus of this topic was on the interaction between the reservoir and the dam, and thereby studies the influences of different approaches to simulate the reservoir. To keep the results comparable between the 13 participants the simulations had to be performed just linear. However, structures like arch dams undergo nonlinear behavior. Due to the massive amount of concrete, such structures are divided into almost independent vertical blocks acting like cantilevers. Furthermore, the hydrostatic water pressure can lead to openings in the contact plane between dam and the foundation. A cooperation between Graz University of Technology and KTH Royal Institute of Technology led to the idea to investigate the structures behavior by taking into account the contacts (block joints, abutment) and cracking (tensile failure), due to the seismic acceleration by using XFEM. The results are pointing out the possibilities and borders of such complex nonlinear simulations.