

Seismic Vulnerability Analysis of Arch Dam Based on Response Surface Method

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Abstract : Earthquake is one of the main loads threatening dam safety. Once the dam is damaged, it will bring huge losses of life and property to the country and people. Therefore, it is very important to research the seismic safety of the dam. Due to the complex foundation conditions, high fortification intensity, and high scientific and technological content, it is necessary to adopt reasonable methods to evaluate the seismic safety performance of concrete arch dams built and under construction in strong earthquake areas. Structural seismic vulnerability analysis can predict the probability of structural failure at all levels under different intensity earthquakes, which can provide a scientific basis for reasonable seismic safety evaluation and decision-making. In this paper, the response surface method (RSM) is applied to the seismic vulnerability analysis of arch dams, which improves the efficiency of vulnerability analysis. Based on the central composite test design method, the material-seismic intensity samples are established. The response surface model (RSM) with arch crown displacement as performance index is obtained by finite element (FE) calculation of the samples, and then the accuracy of the response surface model (RSM) is verified. To obtain the seismic vulnerability curves, the seismic intensity measure α is chosen to be 0.1~1.2g, with an interval of 0.1g and a total of 12 intensity levels. For each seismic intensity level, the arch crown displacement corresponding to 100 sets of different material samples can be calculated by algebraic operation of the response surface model (RSM), which avoids 1200 times of nonlinear dynamic calculation of arch dam; thus, the efficiency of vulnerability analysis is improved greatly.

Keywords : high concrete arch dam, performance index, response surface method, seismic vulnerability analysis, vector-valued intensity measure

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