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SIMPLIFIED SOIL-STRUCTURE INTERACTION MODELS FOR CONCRETE GRAVITY DAMS

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The seismic evaluation of existing dams is a major issue that is even more relevant in the light of the recent events around the world. Researchers and engineers need reliable and quick tools to assess the complex behavior of the dam – reservoir – soil system. Nowadays, the finite elements method is the most common for a coupled study using both structural and acoustic elements, and it can also simulate the unboundedness of both terrain and reservoir. In this regard, Soil-Structure Interaction (SSI) is addressed by many authors who are searching for a reliable simulation of wave propagation in a semi-infinite medium.
In this paper, SSI for concrete gravity dams is studied, investigating its effects numerically on a 2D plane strain model under earthquake excitation. In order to highlight the importance of simulating the unboundedness of soil, different modelling approaches have been considered. Results are presented in the form of frequency response curves. In order to evaluate the effect of the change in stiffness and density of soil, a parametric study has been performed for each previously defined modelling approach. Finally, a 2D simplified model capable of taking into account the SSI has been proposed. In particular, dam response is simulated by introducing springs and dampers at the dam base. The relevant global parameters, stiffness and viscous damping characterizing the semi-infinite soil behaviour have been identified by comparing the frequency response of the simplified model with that of a more refined one provided by Perfectly Matched Layer (PML) domains at the bottom and sides of the terrain. Tuning is performed through a Bayesian updating procedure.
Due to the very large number of analyses required, the response of the FE model has been previously approximated by a response surface that is obtained through the general Polynomial Chaos Expansion (gPCE) technique.
The main contribution of this paper is to highlight the importance of modelling SSI in the seismic assessment of gravity dams and the importance of considering soil as half-unbounded domain. In addition, the main parameters playing a role in the SSI for a simplified model have been identified.

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