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Parametric Study of Earth Dam Deformations with Material Point Method Under Various Pipe and Hydraulic Conditions

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ABSTRACT

Various numerical methods, such as the finite element method and the finite difference method, have been employed to analyze the failure of earth dams. However, these numerical methods may not adequately capture the entire failure process in case of significant deformations. Material Point Method (MPM) is an effective approach for evaluating the entire process, from small displacements at the onset of failure to large displacements in earth dams (Martinelli et al., 2017; Ceccato et al., 2021). The objective of this study is to investigate earth dam failure under various pipe and hydraulic conditions using MPM. The model of an earth dam with a pipe is developed, and tests are conducted under different hydraulic conditions. The accuracy of the MPM simulations is verified through comparison with results from previous studies. Experimental results show that, depending on the pipe and hydraulic conditions, the earth dam models exhibit different displacement evolutions. Furthermore, the failure behavior of the earth dam model characterized using MPM closely aligns with experimental results. Thus, the MPM can be used as a promising tool for identifying the causes of earth dam failure under large displacements.

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