Numerical Simulation of Failure Scenarios in Concrete Dams Using a Discrete Element Based Particle Model

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ABSTRACT

The analysis of failure scenarios, static and dynamic loading, associated to concrete failure requires the use of a computational tool that can deal with the formation, propagation and localization of cracks and their effects on the overall behaviour of the structure. This complex behaviour is difficult to characterize in terms of a continuum formulation.

Particle models are conceptually simpler than a continuum approach, and the development of cracks and rupture surfaces appears naturally as part of the simulation process given its discrete nature. Assemblies of discrete particles connected through simple interaction laws are able to capture the global behaviour of quasi-brittle macro-material, like concrete. The interaction law parameters require some calibration through fundamental testing.

In this work a particle model based on the discrete element method is adopted [1]. Given computer restrictions the particle model is only assumed on the zones where failure is expected to occur, for the remaining areas including the dam foundation a finite element model is adopted following the algorithms presented in [2].

The particle model is validated against numerical results based on a damage model that incorporates two scalar damage variables and against experimental data of concrete dam prototypes loaded to failure [3]. The results show the applicability of particle models to the study of failure scenarios on concrete dams, even if the adopted aggregate structure is much larger in size than the adopted concrete agregate.

REFERENCES

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