Application of MPM to model internal erosion processes in bi-modal soils

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ABSTRACT

Internal erosion mechanisms are the main cause of failure of hydraulic and water retaining structures such as dikes and dams. The study of the detachment of soil grains due to fluid flow and its movement through a solid skeleton is an important research field in geotechnical and hydraulic fields, which encompasses many different processes such as piping, contact erosion, or suffusion. In practice, the real threat of internal erosion is not the prediction of the mechanism itself but its consequences. In many cases it can involve a global failure and large deformation of the material.

In the literature, several formulations have been presented to model this type of interaction between fluid and solid skeleton. Most of them have been integrated to classical finite element, finite difference or finite volume codes. However, these approaches have serious limitations to model large deformation processes in history-dependent materials, such as the collapse of a dike as a result of internal erosion.

In this work, the material point method (MPM) [1] is proposed as a good alternative. The first coupled hydro-mechanical MPM approach presented very recently in [2], and designed to simulate internal erosion processes is reviewed. Focussing on the analysis of bi-modal internally unstable soils, a numerical example of internal erosion is presented in a sample subjected to a bi-dimensional flow conditions. The effect of considering different erosion laws is also discussed.

REFERENCES

[1] Sulsky, D., Chen, Z. and Schreyer, H. (1994) A particle method for history-dependent materials. *Computer Methods in Applied Mechanics and Engineering*, 118(1-2):179–196.

[2] A. Yerro, A. Rohe, K. Soga (2017) *Modelling internal erosion with the Material Point Method*, *Procedia Engineering* DOI 10.1016/j.proeng.2017.01.048.