Gravitational Collapse of Granular Rectangular Blocks

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Abstract

Flows of granular materials are frequently seen in a wide spectrum of industrial applications and geophysical processes, including oil-sand and agricultural sectors and landslides and avalanches. Flow and collapse of granular media are poorly understood. Particularly when, currently available mathematical models encompass difficulties in capturing stable heaps. In the present paper, a model for frictional behavior of granular material is employed. The model is based on a Mohr-Coulomb plasticity model leading to a pressure and strain-rate dependent shear viscosity. The governing equations of the problem are then numerically solved for a dam-break two-dimensional collapse of granular rectangular blocks. The problem is treated as a two-phase flow and the interface-tracking level-set method of COMSOL CFD module is employed. Evolutions of shape, velocity field, and basal pressure for collapsing slumps of different initial geometries are investigated. The results are compared with experimental data available in literature. Figure 1 shows a comparison between final profiles predicted by the present model and observed experimentally [1]. The present results are in general agreement with the experimental measurements.

Reference

1. Balmforth, N.J., Kerswell, R.R. (2005). “Granular collapse in two dimensions", J. Fluid Mech., Vol. 538, pp. 399-428.

Figures used in the abstract

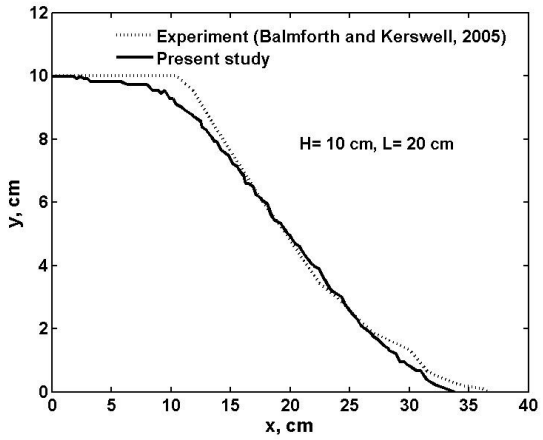

Figure 1: Comparison of final profiles obtained by the present modelling and the experiment reported in the literature for a grit block of 10 cm height and 20 cm width.