Physical modelling of tailings dam breach

M. McKellar¹, A. Walsh², W. A. Take³, S. McDougall⁴ and S. G. Evans⁵

1. MASc Student, Department of Civil Engineering, Queen’s University, Kingston, Ontario, Canada. Email: megan.mckellar@queensu.ca
2. MASc Student, Department of Civil Engineering, Queen’s University, Kingston, Ontario, Canada. Email: 7aw14@queensu.ca
3. Professor, Department of Civil Engineering, Queen’s University, Kingston, Ontario, Canada. Email: andy.take@queensu.ca
4. Assistant Professor, Department of Earth, Ocean and Atmospheric Sciences, University of British Columbia, Vancouver, British Columbia, Canada. Email: smcdouga@eoas.ubc.ca
5. Professor, Department of Earth and Environmental Sciences, University of Waterloo, Waterloo, Ontario, Canada. Email: sgevans@uwaterloo.ca

ABSTRACT

Recent tailings dam failures have heightened public awareness of the hazard posed by storage facilities for mining waste, illustrating the need for a more critical examination of tailings dam breach mechanisms and the potential mobility of liquefied tailings. Knowledge and information resulting from tailings dam breach studies will help to improve safety and risk management through more accurate inundation maps, dam consequence classification, and emergency preparedness plans.

Tailings dams differ from conventional water retaining dams, however dam breach relationships used in practice for breach analysis have not been properly validated to simulate the case of flowing tailings. Physical modelling offers a controlled environment to further the understanding of breach processes specific to tailings dams, allowing for modelling of simple geometries and boundary conditions to test hypotheses. Experiments conducted investigate prototypical tailings dam configurations and material behaviour, with the objective of validating numerical modelling methods that will enable practitioners to better assess and mitigate tailings flows resulting from tailings dam failures.

A test series comprised of eleven 1 m high dams was previously carried out in the large landslide flume facility at Queen’s University Coastal Engineering Laboratory, investigating the breach process of tailings dam failures due to overtopping initiated by a v-notch incised in the dam crest and examined the relationship between dam upstream geometry and reservoir volume on peak outflow. The objective of this research is to expand on these tests by investigating overtopping as a result of shear failure and assessing the potential for liquefied tailings. The first phase of this research aims to investigate the potential relationship between dam failure mode and the breach outflow hydrograph.