Selection of Critical Earthquake Loading and Embankment Sections for 2D Seismic Stress-Deformation Analyses

Behrooz Ghahreman Nejad1,2

1. Global Technical Advisor, ATC Williams, VIC 3195. Email: BehroozG@atcwilliams.com.au
2. Principal Honorary Fellow, Department of Infrastructure Engineering, Melbourne University

Keywords: Earthquake, Site Response, Seismic Deformation, Modelling, Tailings, Embankment.

# ABSTRACT

The principal seismic concern for design of an embankment dam is the development of displacement patterns that could lead to the embankment failure and uncontrolled release of water and/or tailings in the event of the design earthquake. The prediction of such movements is dependent on the accuracy and complexity of the analysis procedure used, and for plane strain (2D) analyses would also depend on the embankment section considered for the analysis.

In a standard limit equilibrium stability analysis, the most critical embankment section is usually adopted based on the maximum height (i.e. higher stresses) and/or foundation conditions. This approach may not be necessarily applicable to assessments of earthquake induced stresses and deformations. The critical embankment height for the seismic analysis that can experience the maximum deformation depends on the embankment natural frequency, which is a function of its shear wave velocity and height. If the embankment natural frequencies approach the dominant frequencies of the design earthquake, the risk of resonation will increase and could potentially result in greater deformations and damages. The natural frequencies of an embankment dam are not constant for a number of reasons including variations in its height due to elevation differences at the foundation level, dependency of the shear wave velocity to confining stresses (i.e. depth). Furthermore, and for a tailings dam its height and hence natural frequencies will vary over time given tailings dams are usually constructed in stages over the life of mine.

Cyclic softening and reduction in shear wave velocity of materials may also occur during earthquake loading which would in turn result in further uncertainties in calculation of the embankment dams natural frequencies.

This paper investigates the critical earthquake loading and variations in embankment natural frequencies and their effect on the predicted deformations for a 180m high tailings retaining embankment dam. A simplified framework is proposed for selection of the most critical embankment sections for 2D seismic stress-deformation analyses.