

**DEVELOPING A RISK ASSESSMENT FRAMEWORK
FOR SAFETY EVALUATION OF EARTH DAMS
IN SRI LANKA**

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(11/8012)



University of Moratuwa, Sri Lanka.
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Degree of Master of Science

Department of Civil Engineering

University of Moratuwa
Sri Lanka

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Thesis submitted in partial fulfillment of the requirements for the degree

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April 2012

DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree in any other university of institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published by another person except where the acknowledgement is made in the text.

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The above candidate has carried out research for the Masters thesis under my supervision.

Signature of Supervisor:

Date:

ABSTRACT

Sri Lanka has a rich history of earth dam construction with over 300 large and medium scale dams and over 12000 small scale earth dams currently in service. According to ICOLD (International Commission of Large Dams) classification, there are 76 large dams in Sri Lanka. A vast majority of those earth dams were built several centuries ago and limited scientific investigations have been conducted on the performance of such ancient earth dams from a geotechnical point of view.

After serving the nation for centuries, a large numbers of ancient earth dams are suffering partial failures due to excessive seepage, piping, slope instability, and excessive lateral deformations and cracking due to vibrations caused by heavy vehicles and tremors. No regular monitoring schemes were implemented to investigate the mechanisms of above failures.

The quantitative risk assessment seeks to enumerate the risk in terms of likelihood (probability) and consequences. The probability of failure for each mode involves engineering assessment of the particular failure mechanisms, and looking for solutions that can reduce the probability of those failure modes or minimize the consequences of a failure. There is no standard framework adopted in Sri Lanka for the risk assessment process of earth dams.

The main objectives of this report are to propose a quantitative risk assessment framework for safety evaluation of earth dams in Sri Lanka and to apply the developed risk assessment framework to an ancient earth dam of Sri Lanka to investigate its performance under different conditions. Here, as a case study, initial level risk assessment has been done for Nachchaduwa dam, using the developed framework. The critical loading conditions which are relevant to Sri Lanka were included in the study.

Nachchaduwa is an ancient tank, which was built 17 centuries ago to supply water for irrigation purposes. It was restored in 1906 and improved in 1917 by the Irrigation Department of Sri Lanka. According to an investigation carried out by Dam Safety and Water Resource Planning Project (DSWRPP), Nachchaduwa dam is selected as one of the dams with a higher risk of failure with some signs of excessive seepage and slope instability along the dam embankment. Risk assessment can provide valuable

information on the risk reduction measures and benefits of structural and non-structural risk reduction options. In addition, risk assessment outcomes can strengthen the case for funding capital improvements, additional investigations, and on-going dam safety activities, such as monitoring and surveillance and emergency management.

This report produces a quantitative risk assessment framework to be used for any type of earth dams in Sri Lanka and summarizes the risk assessment process, results, findings and recommendations for Nachchaduwa dam.



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