ISSN 2362–0412

ABS-053

Hydrodynamic Dam Breach Modelling of Ancient Earthen Embankment Dams in Sri Lanka: A Case Study

G.K.P. Wickramasinghe[1], S.W. Seneviratne[1], A.G. Jayasinghe[2]*

[1] Department of Civil and Environmental Engineering, Faculty of Engineering, University of Ruhuna

[2] Department of Civil Engineering, Faculty of Engineering Technology, The Open University of Sri Lanka

**Corresponding author:* samanthi@cee.ruh.ac.lk

Dams, reservoirs, and downstream communities are identified as major components of the irrigated agriculture system in Sri Lanka. However, the aging and deterioration of ancient earthen embankment dams and their vulnerability to extreme rainfall events have raised serious concerns regarding dam safety. Despite the low likelihood, a dam breach could result in catastrophic consequences including loss of life and severe damage to infrastructure and the environment. Thus, hypothetical dam breach modeling has become an effective tool in dam safety management to forecast breach flood exposure downstream. The objective of the present study is to model a hypothetical dam breach scenario at Giritale Dam in Polonnaruwa, triggered by seepage-induced piping. Breach analysis is carried out using HEC-RAS. The initial condition is set as the reservoir at a 10 m headwater stage being subjected to a Probable Maximum Flood (PMF) inflow, and a two-dimensional unsteady flow analysis is simulated to assess dam breach flood behavior downstream. Simulation results estimate a maximum breach discharge of 893.45 m^3/s occurring 3.5 hours after breach initiation. An inundation map for the dam breach outflow flood was developed, revealing a total inundation area of over 17.25 km^2 spanning 12 Grama Niladari (GN) divisions downstream. According to Land Use/Land Cover (LULC) overlay on the inundation map, a 15.08 km^2 area of paddy cultivation is completely inundated (87% of the total inundation area). Given that irrigated agriculture is the key source of livelihood in the Giritale downstream area, a significant socio-economic impact would result from dam failure. With a great number of aging earthen embankment dams in Sri Lanka currently suffering from alarming seepage issues, insights from this hypothetical dam breach modeling effort are timely for proactive dam safety management in the country.

Keywords: Dam breach, Earthen embankment dams, HEC-RAS, Inundation mapping, Seepage-induced piping