Accepted Manuscript

Hydraulics of Air-Water Flow in a Supercritical Bottom Rack Intake

S.N. Chan, Colin K.C. Wong, Joseph H.W. Lee

PII: S1570-6443(18)30019-4
DOI: https://doi.org/10.1016/j.jher.2018.08.001
Reference: JHER 452

To appear in: *Journal of Hydro-environment Research*

Received Date: 17 January 2018
Revised Date: 1 April 2018
Accepted Date: 7 August 2018

Please cite this article as: S.N. Chan, C.K.C. Wong, J.H.W. Lee, Hydraulics of Air-Water Flow in a Supercritical Bottom Rack Intake, *Journal of Hydro-environment Research* (2018), doi: https://doi.org/10.1016/j.jher.2018.08.001

Hydraulics of Air-Water Flow in a Supercritical Bottom Rack Intake

S.N. Chan[a,b], Colin K.C. Wong[c], Joseph H.W. Lee[a,*]

[a] *Department of Civil and Environmental Engineering, The Hong Kong University of Science and Technology, Clear Water Bay, Hong Kong, China*
[b] *Institute for Advanced Study, The Hong Kong University of Science and Technology, Clear Water Bay, Hong Kong, China*
[c] *Civil Engineering and Development Department, Hong Kong Special Administrative Region Government, Hong Kong, China*

Abstract

A compact bottom rack structure is used for diverting storm water flow on steep catchments in the hinterland of a densely built city into a drainage tunnel through a vortex dropshaft. This study investigates the complex three-dimensional, turbulent and aerated flow of the bottom rack intake structure by comprehensive experiments and three-dimensional **Computational Fluid Dynamics** (CFD) modeling. Extensive physical model tests were conducted on a 1:9.5 Froude scale model over a wide range of **discharges** and different rack bar shapes. The water depth, velocity and air concentration were measured. **As the rack interception induces an energy loss, the depth of the supercritical flow increases as it passes across the racks. The rack interception also gives rise to a sheet jet beneath it.** In the rack chamber, the flow consists of a wall jet that impinges on a spiral circulation of aerated flow, inducing significant turbulence and air entrainment. The average air concentration ranges from 20% - 50% and decreases with increasing discharge. The air concentration in the chamber appears to be little affected by the presence of the bottom racks or the cross-sectional shape of the rack bars. The complex flow features and air concentration distribution in the rack

*Corresponding author
Email address: jhwlee@ust.hk (Joseph H.W. Lee)