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

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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

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