

Characteristics of Air Core and Surface Velocity for Water Flow in a Vortex Sediment-Extraction Chamber Measured by Using Photo Images and PTV Technique.

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A vortex sediment-extraction chamber, consisted of cylindrical chamber, inflow system, bottom orifice and overflow weir, is used to separate sediment from sediment-laden water flow. A tangential inflow is introduced into a cylindrical chamber with a bottom orifice; thus, a strong vortex flow is produced there. Under actions of gravity and centrifugal force, heavier sediment particles are forced to move towards the bottom orifice, and relatively clear water flows over through the top overflow weir. The flow field in the cylindrical chamber consists of forced vortex and free vortex. When the bottom orifice is opened during the sediment-extraction process, an air core appears and changes with different settings. In this study, the air core and water surface velocity in the cylindrical chamber were measured by using a photo image process and particle tracking velocimetry (PTV), as well as numerically simulated by using a commercial software, Flow-3D. Laboratory experiments were conducted in a vortex chamber, having height of 130 cm and diameter of 48 cm. Five kinds of bottom orifice size from 1.0 cm to 3.0 cm and four kinds of inflow water discharge from 1,300 cm³/s to 1,700 cm³/s were used while the inflow pipe of 3 cm in diameter was kept the same for all experiments. The characteristics of the air core and water surface velocity, and the inflow and outflow ratios under different experimental arrangements were observed and discussed so as to provide a better design and application for a vortex sediment-extraction chamber in the future.