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Sewer chamber design under critical conditions using computational fluid dynamics (CFD)

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ABSTRACT

Transient sewage flow patterns inside a utility chamber are studied using open source computational fluid dynamics software, OpenFOAM. The solver used is based on Reynolds-averaged Navier–Stokes equations with $\kappa - \in$ turbulence model. We found that there are two distinct flow regimes based on the inflow rate. For a low inflow rate, the sewage level does not exceed the outlet pipe, and a steady state is reached within a minute. For a high inflow rate, the tantalizing phenomenon is observed such that the sewage level periodically moves up and down passing the top of the outlet pipe. In this case, a steady state is intrinsically absent, and the sewage level continuously fluctuates for a long time. A chamber overflow occurs with a small outlet diameter and a fast inflow rate. Using Scotch algorithm, parallel computation of an OpenFOAM solver, interFoam, has been efficiently conducted within a reasonable amount of time.

Keywords: Computational fluid dynamics; OpenFOAM; Sewer design; Manhole flow; Urban runoff

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