NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

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Numerical Simulation of Air Pressurization Within Dropshafts

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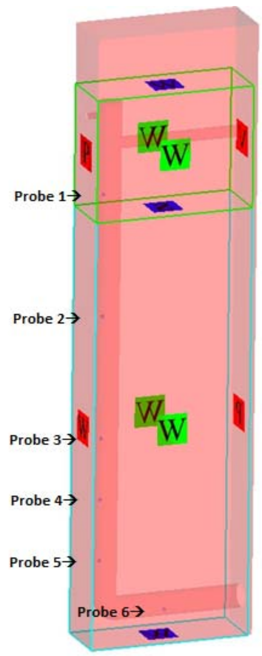
Background

- Dropshaft is a structure commonly used in urban drainage systems to convey water from surface drainage pipe to deep tunnels.
- There are improving needs for the sewers system due to the rapid growth in population and limited land size
- A significant amount of air entrains in the plunging water in the dropshaft.
- The entrained air would cause air pressurization which restrain the flow in the downstream sewers and odour problem.
- To study the feasibility to use simulation as a cost-effective method to assess the design performance of the dropshaft.

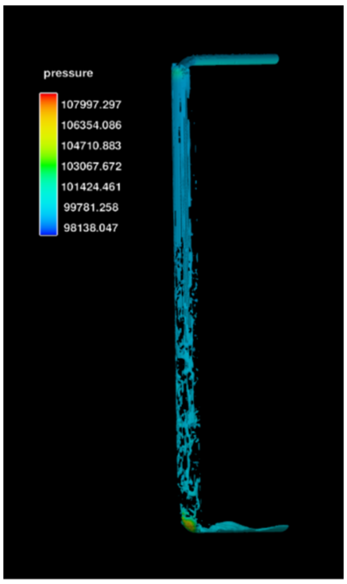
Computational Setup

- Mesh size: 0.02m
- Total grid number: 335000
- Simulation time:100s
- Flow rates: 3.9L/s; 11.3L/s; 42.8L/s and 47.7L/s
- 6 Probes along the shaft to obtain pressure and velocity data
- Boundary conditions:
  - Water Inlet – Velocity
  - Air Inlet – Pressure
  - Outlet – Pressure
  - Remaining - Wall

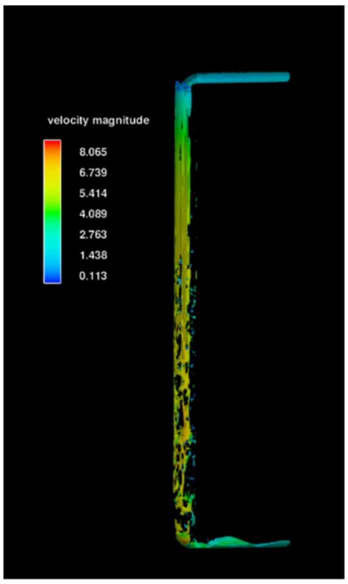


3D Model

(a) water flow pressure when Q=47.7l/s



(b) water flow velocity when Q=47.7l/s



Results

The simulation results show reasonable agreement with the physical model results at 4 flow rates.