Capability Statement
Vortex Drop Shafts

Introduction

Vortex drop shafts are used to transfer fluid over significant elevations and are used in preference to over-falls for gradual energy dissipation, minimize air entrainment and potential odour. An example of a drop shaft is presented in Figure 1.

Problems Associated with Drop Shafts

Under certain conditions, a significant hydraulic jump can occur in the tapering inlet channel, leading to undesirable overflow problems.

Secondly, the air core that develops inside the drop shaft must be sufficiently large to allow free passage of air to ensure stable operation otherwise large bubbles of air may form which tend to move upwards giving rise to 'burping', flow eruptions and oscillations. If stable operation cannot be achieved, these effects may have adverse consequences on structural components.

A key design parameter is the ratio of the air core area to the drop shaft cross-sectional area. The air core generally decreases with discharge. Hence, the limiting case for stable operation of the drop shaft may not necessarily be maximum flow.

Computational Fluid Dynamics

In order to assess the operation of a drop shaft, the hydraulic performance may be assessed by physical scale models. However, Computational Fluid Dynamics (CFD) allows a full scale model to be constructed and assessed at the design operating conditions. A multiphase model resolves both the water and air and hence captures the shape of the fluid-air interface. The model can be used to verify that fluid overtopping within the inlet channel will not occur or determine the required height of the inlet channel. Additional post-processing of the results enables the size of the air core to be determined and hence, inference of stable operation. Figure 2 presents a view of the air core within the drop shaft.

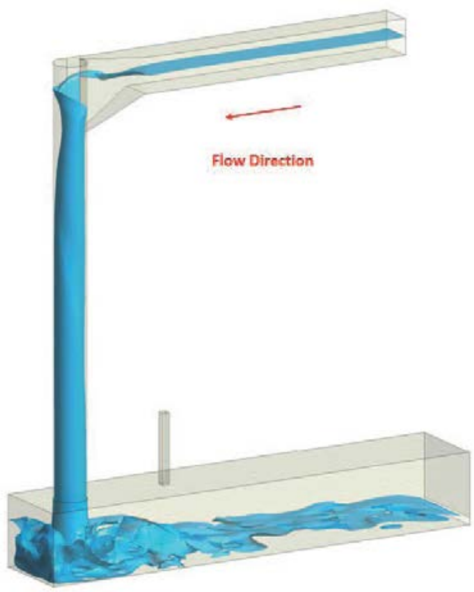

Figure 1: Drop shaft

Figure 2: Air core inside the drop shaft