

USING CFD AND PHYSICAL MODELLING TO OPTIMISE PUMPING STATION DESIGN: A CASE STUDY

Matyas Benke, Sajid Rafique, David Kelsall

BHR Group

ABSTRACT

Poor hydraulic design of major water, waste water and power generation systems gives rise to inefficiencies such as overly turbulent flows, restricted throughputs, pumping inefficiencies, and induced erosion. All of these factors can have a significant adverse effect on both capital and operating expenditure (capex and opex). The hydraulic design channels, dams, weirs, sluices, culverts, penstocks, wet wells or pump sumps, intercept chambers, and reservoirs is critical to the success of major civil and mechanical engineering projects.

Both computational fluid dynamics (CFD) and scaled down physical models are used to validate the design of civil engineering hydraulic structures in advance of construction. Indeed many advocates believe that CFD technology has evolved to a state where it obviates the need for physical model testing. Simply by looking at the colourful plots of pressure contours, velocity vectors, and streamlines, some might argue that a pump wet well, or pump inlets (as examples) are well designed.

In practice, real life is more complex than that. Unless the CFD model is very sophisticated (and probably expensive to build and to run) it may not capture or describe some of the key features of the flow - such as vortex type or any points of likely attachment.

This paper presents a case study of the practical application of both CFD and physical modelling to optimise the design of a real waste water pumping station in the Middle East. It considers the pros and cons of both CFD and physical modelling, and the lessons learned from applying each technique separately, and together in tandem. In truth it was found that CFD model results influenced physical model tests, and physical model experiences influenced CFD prototypes.

The paper concludes with practical recommendations for the complementary use of both techniques.

SUGGESTED THEMES

CFD, Hydraulic Modelling, Validation