



Hydraulic Modelling for dams and associated structures

Identifying needs

Hydraulic modelling and analysis are critical components in the design of any dam project. Aspects of design where modelling provides important inputs include: analysis of spillway arrangements to assess flow behaviour; design optimisation; derivation of static and dynamic loading as an input to structural design; assessment of flow conditions in and around fishways to optimise their effectiveness; prediction of the effects of natural floods and dam failures through downstream flood modelling; and assessment of potential for erosion around hydraulic structures.

GHD uses the in-house skills of experienced dams engineers and computer modellers and maximises their effectiveness through the use of specialist sub-consultants where needed. Our team assesses each job on its merits and applies the most relevant modelling techniques to design a tailored, practical solution to meet client objectives.

We offer a full range of hydraulic modelling services including:

- Modelling of complex hydraulic problems using a range of Computational Fluid Dynamics modelling packages
- Technical direction and project management of specialist subconsultants for physical scale modelling
- Flood and dambreak modelling

Solutions

Computational Fluid Dynamics (CFD) modelling

GHD has in-house capabilities and experience in a range of CFD packages such as ANSYS CFX, FLUENT and OpenFOAM and have used these in the design of spillways, outlet works, fishways and other dam-related structures. The use of CFD techniques allows for model arrangements

to be generated quickly and is particularly beneficial in the assessment of design alternatives and optimisation of arrangements.

Physical scale modelling

Physical scale models have been used in the design and investigation of hydraulic structures for over 100 years and the methods are tried and tested. GHD has been responsible for the technical direction and project management of a wide range of hydraulic structures including spillways, outlet works and fishways. Such modelling is a crucial component in the design verification and final optimisation process for complex structures.

Dam break and flood modelling

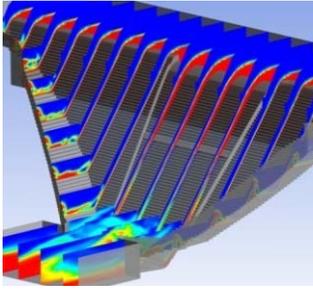
Simulation using modelling packages such as HEC-RAS, MIKE11, MIKE21, MIKEFLOOD, TufLOW, Sobek, Delft 3D and MIKE3 have been used to assess flood and dam break inundation impacts. The studies have been used to assess consequence categories for structures and in the development of disaster management plans.

Benefits

Our extensive experience and in-house capabilities in hydraulic modelling is backed by one of the largest dedicated dams engineering teams across the globe.

Experience

GHD has extensive experience in projects involving hydraulic modelling and analysis. GHD applies its client relationship focus and in-depth dams engineering experience, working closely with client representatives to address key concerns, constraints and issues. Once identified and analysed, sound engineering options are developed to provide tailored solutions to suit the project at hand. Some projects that GHD has recently been involved in are described below.



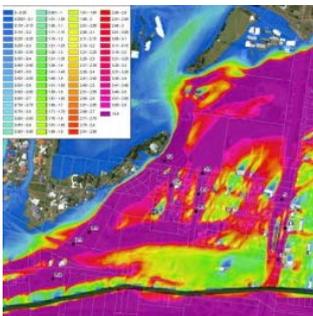
Design of the Enlarged Cotter Dam – Canberra, Australia

GHD was the design partner for the Bulk Water Alliance which was responsible for the delivery of the Enlarged Cotter Dam, an 85 m high roller-compacted concrete structure. As part of the design optimisation process, GHD used the ANSYS CFX CFD model to undertake 2D and 3D modelling of the complex stepped spillway arrangement. GHD also provided technical direction and project management for the 1:45 scale physical model of the spillway that was used for design verification and final optimisation. The model was invaluable in optimising the design of the non-standard stilling basin and assessing the interaction of flow from the central primary spillway and the secondary spillways over each abutment.



Googong Dam Spillway Upgrade – Canberra, Australia

GHD was engaged by ActewAGL to undertake the design of remedial works to repair extensive rock erosion in the spillway at Googong Dam near Canberra. GHD was also involved throughout construction of the remedial works as part of the Bulk Water Alliance. As part of the design phase, GHD was responsible for providing technical direction and project management for a 1:60 scale physical model of the spillway. Key aspects considered in the model study were the alignment of the walls in the chute extension, the effects of waves in the chute, optimisation of the plunge pool excavation and assessment of impacts on infrastructure immediately downstream of the dam.



Burnett River Flood Study – Bundaberg, Queensland

GHD was commissioned by Bundaberg Regional Council to prepare a flood study of the Burnett River for a 130 km reach downstream of Paradise Dam to the mouth. The purpose of the study was to inform a new regional planning scheme and to assist BRC in making better planning decisions with respect to flooding issues. Hydrologic investigations were undertaken using an URBS hydrologic model. Flood level and extent prediction was made using 2D TUFLOW. The hydrologic and hydraulic models were calibrated and verified against a series of historical flood events. Design event flow rates, flood extents and flood levels were generated for a range of events. A fully integrated GIS approach was used throughout the project to present results and assist in the development of an improved flood warning system.



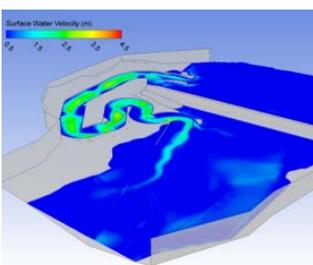
Wellington Dam Remedial Works – Collie, Western Australia

CFD modelling was used to undertake an assessment of crest discharge coefficients, water surface profiles and crest pressures. The analysis was checked against a 1:24 scale physical model and the results were found to be in good agreement. A particular feature of the CFD model was the prediction of crest pressures. The crest design profile had been built to a much lower design head than was currently being considered and the negative pressures under the nappe generated significant loads on the structure and were a significant factor in the design of the remedial works.



Eildon Dam Upgrade – Victoria, Australia

As part of the remedial works at Eildon Dam, for which GHD was the designer, investigation of the ability of the existing spillway to cope with the significantly increased flows expected was based largely on the results from physical scale model testing. GHD was responsible for the technical direction and project management. The study showed that the combination of a gently curved approach channel and the large slots that had been constructed for the vertical lift gates cause significant hydraulic instability in the flow over the crest and down the spillway channel. Options for modifications were trialled with the adopted approach being the inclusion of additional freeboard to account for the increased turbulence of the flow.



Burrum River No 1 Weir Fishway – Hervey Bay, Queensland

Two and three dimensional CFD modelling was undertaken by GHD to model complex hydraulic conditions for the design of the Burrum River No 1 Weir Fishway. The design incorporated both a high flow and low flow channel to facilitate two very different hydrological conditions: one being low flows in the dry season limited to environmental releases from the weir and high flows during spill events and floods. The velocity profiles and turbulent conditions were modelled as well as water levels through the fishway. The modelling was critical to ensuring that the design met both biological and engineering design criteria.

To touch base with the key person in your region, visit www.ghd.com/dams

