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IOS Basins 1 & 2

Two separate multifunctional basins are available for scale model testing of pump sumps and other intake and outfall structures. These tests are carried out on scale models of large civil works to ensure optimum hydraulic behaviour with respect to:

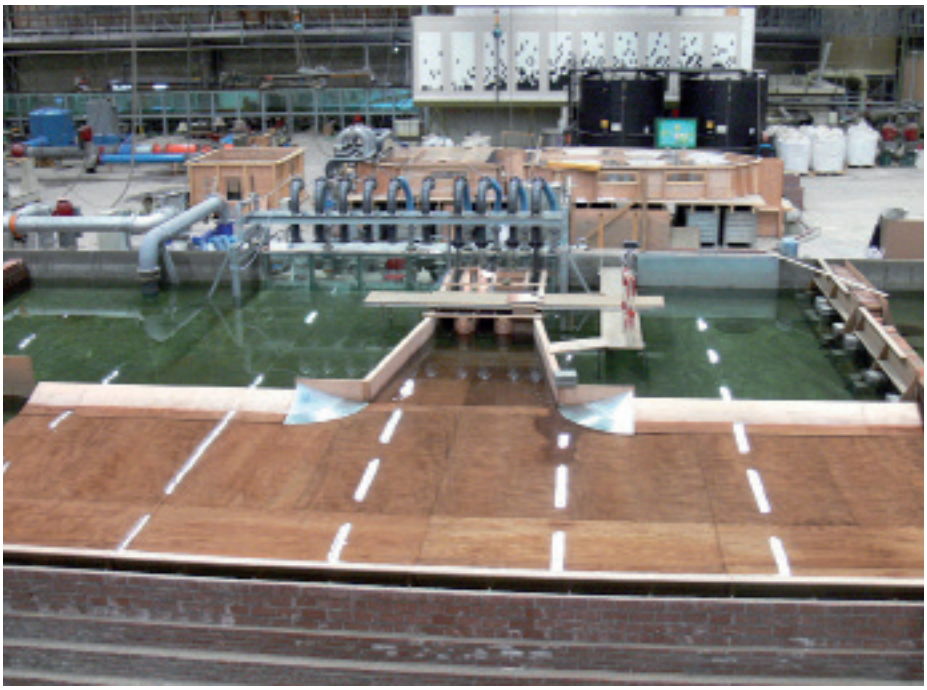
- Energy dissipation (outfall)
- Losses (intake)
- Pump performance and uniform approach flow (pump sump)
- Sedimentation (intake)
- Dead zones and eddy formation
- Tornadoes, air entrainment (Pump sump)

Scale models still provide the best and most detailed answers in order to optimise these large civil constructions from a hydraulic point of view. Where possible, tests are performed in accordance with international standards such as ANSI/HI 9.8-1998, often complemented by in house knowledge and experience.

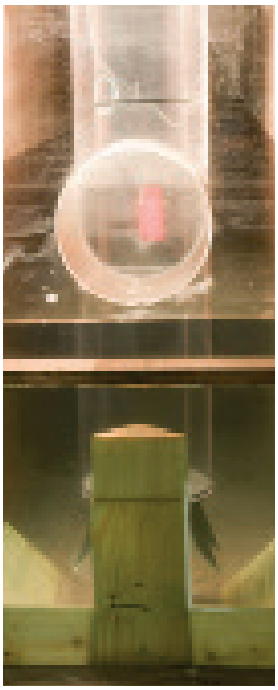
Two facilities are available for model testing of almost any kind of hydraulic structure. The large facility with an area of 20 * 12.5 m, allows for cross flow in order to model (cross) channels and/or rivers. The other facility of 6 * 16 m facilitates a higher water level for smaller models on a larger scale. (contractors, plant owners, engineering companies) through offering a broad scope of hydraulic studies.

Outfall of power plant

Technical data



Model of pumping station with intake channel in IOS-1



Pump compartment with optimisations

Header for flow withdrawal

Glass wall for observation

IOS-1 Basin

Length : 20 m
Width : 12.5 m
Height : 1.2 m

Min. water depth : 0.2 m
Max. water depth : 1.15 m

Pump capacity
Max pump capacity: 350 l/s
Max number of pumps: 20

Features
Glass wall for observation
EMF flow meters
Dye injection (flow visualisation)
Cross flow upto 500 l/s
Automatic water level control
Automatic data acquisition
Dedicated instrumentation
depending on experiment

IOS-2 Basin

Length : 16 m
Width : 6 m
Height : 1.4 m

Min. water depth : 0.0 m
Max. water depth : 1.35 m

Pump capacity
Max pump capacity: 250 l/s
Max number of pumps: 6

Features
Glass wall for observation
EMF flow meters
Dye injection
(flow visualisation)
Manual water level control
Automatic data acquisition
Dedicated instrumentation
depending on experiment

Pump model in pump compartment

Topview of screening channel

Tested phenomena of pump sumps

For pump sumps, tests are corried out in accordance with international standards (ANSI). All relevant parts of the pumping station up to the bell mouth of the pump are reproduced to the selected scale based on minimum Reynolds and Weber numbers. The pump bell mouths and suction pipes are modelled in detail. Pump operation is simulated by siphoning. A suction header connects all individual model pumps. The maximum model flow is 350 l/s, supplied by two pumps with variable speed. Following phenomena can be measured and observed:

1. pre-rotation (swirl) by using rotometers
2. (surface and submerged) vortex building, by visual observation, supported by dye injection
3. velocity profile distribution by using pitot tubes

General test procedure of pump sumps
Testing of scale models includes the following steps:

Initial tests

The original design is tested for several operating conditions. The worst-case operating conditions are selected to design local modifications. Selection is based on severity of swirl, vortex formation, and expert judgement of the overall flow patterns.

Optimisation tests

Local small modifications such as splitters, corner fillings, curtain walls, surface beams and baffles are detailed (in consultation with client) and tested, resulting in a pump sump design complying with the acceptance criteria.

Final testing

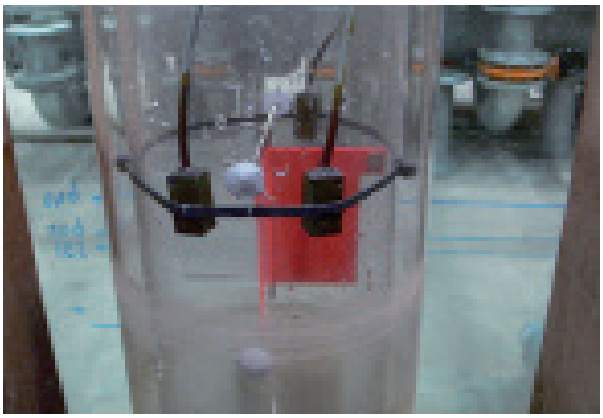
During final testing the optimised design is verified by velocity measurements in the suction pipes, screen clogging, air entrainment and exaggerated velocity tests.
At the end, the result is shown to the client during a witness test.

Type III bottom vortex (Vapour core)

Outfall of power plant

Stand alone model of pump

Flow meters and butterfly valves



Rotometer for swirl measurements

Free surface vortex type 6

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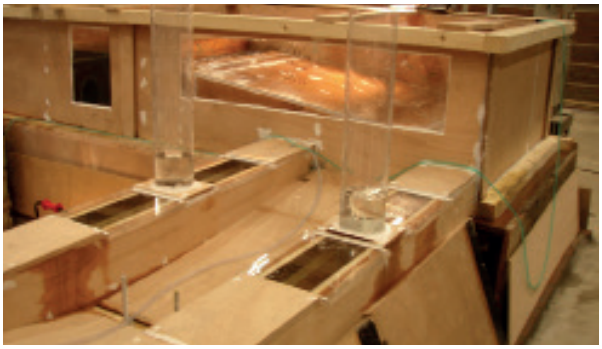
Intake and outfall structures

Minimum head losses, eddy formation, sedimentation, air entrainment, distribution of water, wave oscillation, energy dissipation and level control are some of the hydraulic questions to be answered for intake and/or outfall structures. Main civil dimensions but also local details are optimised to minimise construction volume and cost and to optimise the required flow parameters.



Model of an outfall

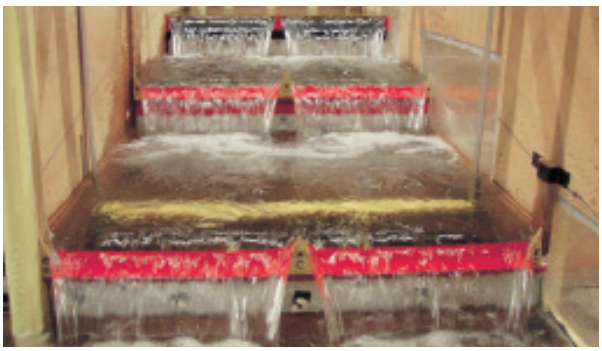
Application areas

Deltares has a long term (> 30 years) experience with physical model studies of pump sumps and intake/outfall structures for a diversity of systems, including:

- Cooling water for power, desalination and industrial plants
- Sewage water treatment plants and pumping stations
- Irrigation and drainage systems

Physical model testing project list (intakes and outfalls)

Project	Client	Year
Canoas (Colombia)	KSB (Germany)	2007
Nong Fab (Thailand)	SPCC (Italy/Taiwan)	2006
Jawa-1 sea water intake (Indonesia)	Meindo (Indonesia)	2007
Jawa-1 cooling water pumping station (Indonesia)	Hyundai Turbomachinery (S. korea)	2007
Intermediate reservoirs (UAE)	Gasos (UAE)	2007
Sharqiah (Oman)	Doosan (S. Korea)	2007
Shin Kori Unit 5&6 ESW (S. Korea)	Kepco E&C (S. Korea)	2007
Shin Kori Unit 5&6 CW (S. Korea)	Kepco E&C (S. Korea)	2007
Cairo West Power Plant (Egypt)	KSB (Germany)	2008
Assiut Power Plant (Egypt)	KSB (Germany)	2008
IDRIS project Qatar: vortex drop shafts	COWI (Denmark)	2008
Iolanda pumping station (Mali)	Denys (Belgium)	2009
Hydraulic studies for power plant in Myanmar	TTCL (Thailand)	2008
Review outfall design Sur power plant	DNV GL (UAE)	2009



Ras Laffan discharge structure: prototype and model

enabling delta life

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Deltares is an independent institute for applied research in the field of water, subsurface and infrastructure. Throughout the world, we work on smart solutions, innovations and applications for people, environment and society. Deltares is based in Delft and Utrecht.

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