WEEG NEWSLETTER May 2024

The newsletter is published by the University of Southampton's Water and Environmental Engineering Group WEEG, and reports things of interest in this field worldwide, as well as ongoing undergraduate student and research work in WEEG itself.

We believe that water and energy are the most important topics worldwide for the next decades. Our work covers river and coastal engineering, water and wastewater and energy related to water.

Editorial: Education in Hydraulic Engineering is often a not-quite-so-easy task. The theory can be quite complicated, some of the concepts are not easily grasped (why is the water surface in the middle of a river lower than at the banks?) and very often experiments and laboratory work are necessary to see and understand. At Southampton University, we have developed a rather unique way of teaching hydraulics at graduate level.

Group Design Project (GDPs):

Hydraulic design: In the fourth year, Engineering students at Southampton University have to do a Group Design Project where groups of 5 to 6 students work together for a full year on one project. The GDP accounts for 40% of the final mark, so the students take it very seriously.

Hydraulics GDPs: In hydraulic engineering, we have developed our own approach to GDPs. The projects are set alongside actual problems we are involved with. They always contain a theoretical component plus the design, construction and testing of physical models (sometimes numerical models) as part of the design process. The physical model is thus not the aim of the project but, as in a real project, a tool for the development of the final design solution.

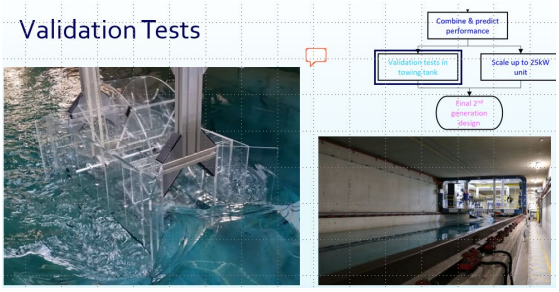

Fig. 1: Towing tank tests with 1:20 model

The projects often run in co-operation with industry or stakeholders.

Floating Hydrokinetic Power Converter: One recent example was the development and optimisation of a floating hydrokinetic Power Converter – a flow augmented floating waterwheel - for application in Iquitos on the Upper Amazon River. This project ran in co-operation with BigMoonPower Inc, a Utah based developer of HPCs. https://www.bigmoonpower.info/ In this project, theoretical work and model tests were combined which led to a significant performance increase over the original or benchmark geometry. For some tests, the students used the 132 m towing tank, Fig. 1. Even the Peruvian Government was interested, but sadly this interest fell victim to the following series of political crises in the country.

Hydropower in irrigation systems: many, irrigation systems have a large number of drop structures with head differences between 0.5 and 4-5 m. The hydropower is not used, since there are no cost-effective hydropower converters (HPC) for these specific conditions, i.e. low head and flow volumes up to 4 m^3/s.

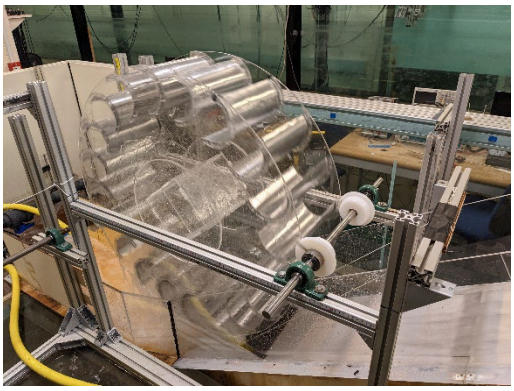

Fig. 2: 700 mm diameter impulse wheel model

In this project, the students developed a novel HPC which can work with a minimum of site modifications and a comparatively high efficiency of 60 to 70%. The impulse-type waterwheel was developed, a 700 mm diameter wheel built and tested, Fig. 2, and a wheel installation was designed for a typical site in Pakistan. We published the results in an international journal, and this is now the most read paper of the journal – check this out:

https://www.tandfonline.com/action/showMostReadArticles?journalCode=tish20

GDP Video: in the GDPs, the students must submit a final report, give a presentation and produce a 3-minute project video. The video describes the project and becomes a very good means to communicate. In hydraulics, where water is flowing, and wheels and things are moving, the video becomes an important addition to the project outcomes. In still images, water is often very difficult to see

since what we see is not the (transparent) water, but the *movement* of the fluid. So especially in hydraulics we should make maximum use of the possibilities of visual communication. Here's our YouTube channel with the videos:

https:www.youtube.com/@sergiomaldonado2655

Outlook: in general, the hydraulic engineering GDPs work very well. They allow the students to work on a current problem, finding solutions, optimising their designs and eventually come up with a design solution. This gives them a first-hand experience of up-to-date hydraulic problems and problem-solving techniques. Because there are 5 to 6 students in one group, the physical models can be quite complex. Unlike in many other student tasks, here the students have to take the responsibility for the design and construction of a fairly complex hydraulic model: it has to work as intended, and it must produce results. This of course is not always easy, and if you think about it, that's as close as students can get to a real project…

Contact: Dr G Muller, g.muller@soton.ac.uk

Research Funding: *Environmental Biotechnology Innovation Centre*

Members of WEEG are part of a consortium led by Cranfield University which successfully bid for one of six Engineering Biology Hub grants. The Environmental Biotechnology Innovation Centre (EBIC) has received £13M to combine cutting-edge techniques from synthetic biology, biotechnology, computation modelling and engineering science in order to develop innovative solutions in bioremediation and environmental protection. Dr Yue Zhang is leading Cluster 7's work on microbial fermentation for value-added product synthesis from organic waste, while Dr Yonqiang Liu's work in the Hub will mainly focus on removal of recalcitrant organic pollutants in engineered bioremediation systems. Two postdocs will work on the project, which runs from 2024-2029 and includes flexible funding for new research topics and priorities that emerge during the Hub's lifetime. Two linked PhD studentships will also be offered - more details on the EBIC website coming shortly!

Contact: Sonia Heaven, S.Heaven@soton.ac.uk

Fig. 3: EBIC partners and funders

Technology exchange: *IEA Task 37*

Task 37: Energy from Biogas is a Technology Collaboration Programme of the International Energy Agency (IEA), with 17 participating countries. As UK National Lead, WEEG's Prof Heaven recently ran a **small** pilot survey on the next 3-year work programme. Popular topics included reviewing risk prevention measures in AD plants; regulatory obstacles; and combined thermal/biological processing. A larger survey and dissemination event is planned for this autumn. For more details on IEA Task 37 see: https://task37.ieabioenergy.com

Fig. 4: Current IEA Task 37 member states

ECR event: *Environmental Biotechnology Network Conference*

The Environmental Biotechnology Network, hosted by Southampton, is running its 5th Early Career Researcher conference from 24-26 July. For details contact EBnet@EBNet.ac.uk

Jobs in water engineering:

This section gives you ideas of the type of work you can do when working in industry.

Advert: One of a series of fascinating posts in hydraulic and flood risk management:

Hydraulic Modeller

https://www.icerecruit.com/job/223938/hydraulic-modeller/

Civil and Environmental Engineering at Southampton University:

WEEG: our modules offer the chance to deepen your knowledge in water-related areas, and give better preparation for environmental engineering projects.

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Further information:

We have two Facebook pages, which provide a logbook of our laboratory activities:

www.facebook.com/Hydraulicslaboratory/

www.facebook.com/environmental.lab.university.of.southampton/

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