WEEG NEWSLETTER October 2017

The newsletter is published monthly 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: irrigation is a vital part of hydraulic engineering, especially in dry regions. Just to give you an idea: the world's largest irrigation canal, the Narmada Canal in India, carries a flow volume of 1,132 m3/s - that's seventeen times the River Thames! In this issue, we will look at a typical irrigation system in Spain to show you the wide variety of hydraulic conditions and design requirements which characterise such a system.

Hydraulic Engineering International: The *Canal principal del Campo del Turia*

This canal supplies an irrigation system near the Town of Lliria in Valencia/Spain, with an average flow volume of 1.44 m^3/s, and an irrigated area of 7000 ha. The system has a number of surprising features, amongst them that there is an available hydropower potential of at least 100 kW, which is completely unused.

Fig. 1: Inflow drop

Fig. 1 shows the 3 m drop at the inflow, with a chute and energy dissipation downstream. Here, around 32 kW of electricity or pumping power could be generated to irrigate areas above the main system level. The inflow drop is followed by a 400 m stretch of a 1.5 m wide channel where the water flows with a velocity of 3 m/s and a water depth of 0.3 m. And yes, this is supercritical flow with a Froude Nr of *Fr* = 1.6. Supercritical flow is not just a textbook invention: it does actually exist and in this case it serves to overcome a large head difference without having to build expensive drop structures. The disadvantage is of course that the energy, my guess is 110 kW, is wasted.

Fig. 2: Supercritical flow, v = 3 m/s, *Fr* = 1.6

Another drop serves to dissipate energy with a hydraulic jump, Fig. 3:

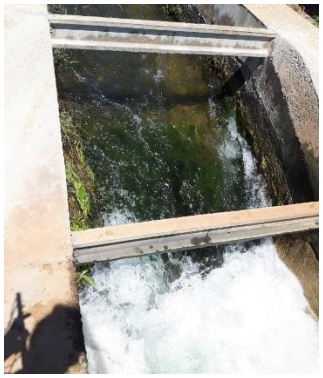

Fig. 3: Drop with hydraulic jump

Further down, the canal widens, this time with a 2m drop. A slow section now follows, with a typical trapezoidal cross section of 2.6 m width at the top, a water depth of 1.0 m and a flow velocity of 0.6 m/s, Fig. 4:

Fig. 4: Wide canal, v = 0.6 m/s

So, you can see that within a typical small irrigation system there are quite a few very interesting hydraulic situations which are coupled and must work together. One specific

and striking aspect is that all of the available hydraulic energy is dissipated.

WEEG IP projects (3rd year projects) just started:

In our group, we have a number of IPs which just started: here is a selection of topics:

(1) Artificial beaver dams: looking at nature-based solutions for the redevelopment of the Upper Mattole River in California. Supervisor: Dr G Muller

(2) Design and testing of a new fish-friendly river flow gauging structure. Supervisor: Dr G de Almeida

(3) Wave current interaction: developing a wave paddle which can be retrofitted into flumes to generate waves in a current. Supervisor: Dr G Muller

(4) Conceptual design of a wastewater treatment system for combined sewer overflow. Supervisor: Dr Y Zhang

(5) Development of a costing component for the WasteCAT model for urban waste collection systems. Supervisor: Dr S Heaven

(6) Rainwater harvesting and utilization: development of a concept to utilise rainwater on the Highfield Campus. Supervisor: Dr Y Liu

New funded projects:

Over the last month, we have had some successes including two research grants.

1. Hydropower for water-saving irrigation: the project aims at the development, installation and testing of water wheels to power drip irrigation systems in Spain. The project will run in cooperation with aQysta Ltd (Delft / Netherlands), and is funded by the European Commission. Budget: €182,000, Supervisor: Dr G. Muller g.muller@soton.ac.uk

2. Debris accumulation at bridge piers: in this project, the effect of debris accumulation on scouring / stability of bridge pier foundations will be investigated. Budget £90,000, Supervisor: Dr G de Almeida.

Co-operation with developing countries:

Some of the technology we are developing, such as low-head hydropower and the condensing steam engine, has great application potential in developing countries. We have just started two small projects to create a foundation for larger projects.

1. Water wheels for pumping; this project runs with the aim to develop simple pumping solutions not just to pump water e.g. for irrigation, but also to provide pressurized water for filtration. In the Niger delta, for example, the iron content of ground water is so high as to make it not drinkable. The water can be purified using reverse osmosis cells. They require a water pressure of 50 m or more, which will be supplied by our water wheels.

2. Combined treatment systems for textile industry wastewaters. Textile production is both water intensive and highly polluting, and is a major industry in many developing countries. It is thus a key target for innovative wastewater treatment technologies which need to be robust, low cost and if possible contribute to closed-loop reuse of energy and resources. We are working to develop highly effective combined aerobic-anaerobic systems using granular biomass reactors.

Fig. 5: Pilot-scale installation in Singapore

Jobs in water engineering:

This gives you an idea of the type of work you can do when working in industry.

Advert: Spoilt for choice - there are lots of jobs right across the water and environmental engineering sectors: see e.g.

Assistant Wastewater Engineer - London

https://www.ch2mcareers.com/job/170004V0_GB_LON_en/europe/London/Assistant-Wastewater-Engineer-London-UK?source=JB-10482

Civil and Environmental Engineering at Southampton University:

WEEG: the Civil and Environmental Engineering pathway offers the chance to deepen your knowledge in water-related areas, and gives you a better preparation for environmental engineering projects.

Contact: Dr Sonia Heaven, s.heaven@soton.ac.uk, Bldg. 7, Room 5004

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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