WEEG NEWSLETTER January 2021

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: We will all have seen pictures or videos of waves crashing onto breakwaters or seawalls, with a jet of water being thrown upwards to great heights, an audible impact and – if you are near the structure – a noticeable shaking of the ground. Spectacular.

You would think that engineers and scientists will be fascinated by this effect, and that lots of work on it is available. Well, think twice... there isn't even a Wikipedia article on the topic, so here we go:

Hydraulic Engineering International: *Wave uprush*

When a breaking wave slams onto a vertical wall, a very fast uprush jet develops which can reach 50 m or sometimes even 100 m. This is so exciting that lots of people actually go 'storm watching', i.e. they go to the coastline to watch the waves come in.

Fig. 1 shows a wave crashing onto the Ricasoli Breakwater in Valletta, with an uprush height of 50 to 55 m. The Mediterranean Sea can look quite different during the winter.

Fig. 1: Ricasoli Breakwater La Valletta, Malta

Lomener Breakwater is famous for the dramatic scenes it creates. Fig. 2 shows an uprush height of around 80 m. The heights can be estimated from pictures if some identifiable dimensions of the breakwater are known. In Valetta it is the height of the lighthouse (9.1 m), in Lomener the height of the apron wall (1.00 m). Well, spectacular. The height of the uprush corresponds to initial uprush velocities of 33 to 40 m/s, or 120 to 144 km/hour.

Some research has been done on the initial velocity of the jet of breaking waves, where small and large scale experiments indicated velocities of 6 to 8 times the shallow water wave velocity. In Lomener we also have the water depth of approximately 4.7 m, so that we can determined the wave speed as v_c = 6.6 m/s so that we have a ratio of v_0 / v_c = 6.0.

Fig. 2: Lomener Breakwater Plomeur, Bretagne

But I am afraid that is as much as we know about this very special fluid mechanics effect. What mechanism causes the very fast uprush? (Remember, the wave approaches at only one sixth of the uprush velocity, whilst momentum theory implies that a fluid leaves a control volume with the same velocity with which it entered). How long does it take to reach the highest point, how much of the wave energy is transformed into the uprush, what height could it theoretically reach? Practically all the pictures are taken not by engineers, but by amateur and professional photographers interested in a dramatic scene rather than in science – and all these questions are unanswered.

Fig. 3: Side view of uprush

In particular the question about the energy in the uprush appears very interesting since the uprush takes place in a short period of time. This implies that if a significant part of the wave's energy is contained in the uprush, then wave breaking is not just an instability but also an energy-focusing event. A nice side view of a wave uprush can be seen in Fig. 3, which also gives a good impression of the dynamics of the situation. The falling water can create quite high pressures, about which there is also not a lot known.

Lastly, it needs to be mentioned that the very fast uprush jet can carry stones etc with it, which subsequently fall down on the land, so going too close because "it's only water" is not recommended – even if the scene is so spectacular.

WEEG staff: *New Experimental Officer - Hydraulic Engineering*

After more than two years with no-one in post, we have appointed Hannah Williams as the new Experimental Officer for our guidance in the Hydraulics Laboratories.

Fig. 3: Hannah, new Experimental Officer

Hannah completed a BEng degree in Civil Engineering at Swansea University, and went to work for a large civil engineering consultancy.

A few years later, she took an MSc in Environmental Engineering at Queen's University Belfast. This included a research project investigating the hydraulic performance of a rubble mound roundhead breakwater using a physical model. Following this, Hannah moved to the University of Nottingham to pursue a PhD on 'Uncertainty in the prediction of overtopping parameters in numerical and physical models due to offshore spectral boundary conditions'.

Since then she has worked in a number of positions including as a numerical modeller for a Tidal Energy developer, as a researcher in collaboration with a tidal stream energy developer, as a researcher on the large European project Hydralab+, and most recently just over the road from our lab, as a researcher in the Geography and Environmental Sciences. The two main themes for all these jobs are modelling and water, which should make her perfectly suited to this new role.

Contact: Dr Williams, h.e.williams@soton.ac.uk

Individual Project: *Soton CSO*

This IP has been put forward for our Part 3 students: During storm events, the flow in combined sewer systems can exceed the capacity of wastewater treatment works and therefore combined sewer overflow (CSO) will occur. This type of overflow contains pollutants from both raw sewage and stormwater. To minimise the impact on receiving water bodies, treatment needs to be implemented reflecting its variability nature.

The IP will aim to identify appropriate treatment measures for pollutants in CSO, and to design a treatment system which can be integrated into the overflow. The project will take Southampton as a case study and explore whether it is possible to develop a system to remove primary pollutants from CSO before they reach Southampton Water. Suitable treatment processes and options for maintenance will be analysed.

Contact: Dr Yue Zhang, Y.Zhang@soton.ac.uk

Jobs in water engineering:

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

Advert: A pretty topical post given our editorial and the recent weather...

Coastal & Flood Management

https://www.icerecruit.com/job/198192/team-leader-coastal-and-flood-management-highways-network/

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: Prof Sonia Heaven, s.heaven@soton.ac.uk, Bldg. 178, Room 5015

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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