WEEG NEWSLETTER October 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: Waves are familiar to many of us, rolling gently on the sea etc. Recently, we looked at a particular type of wave, the solitary wave, which is a bit different. In today's editorial we will see that there is much more to waves, and that there are some pretty strange things happening in the sea

Hydraulic Engineering International: *Strange waves*

In many coastal areas we can have situations where wave fields are coming from different directions. Sometimes, the waves are at 90 degrees which then creates a field of square waves as shown in Fig. 1. Square waves look very nice, but they also create strong undercurrents that can be dangerous for swimmers, so be careful…

Fig. 1: Square waves at the Ile de Ré

The clapotis wave: often, and especially in front of vertical seawalls, we can see the spectacle shown in Fig, 2. A high crest forms seawards of the wall, and a vertical jet of water is produced at the 'crest'. What is going on?

Fig. 2: Clapotis wave

Or is it really one wave crest? Fig. 3 shows the explanation. What happens is that first the crest at the seawall is reflected by the wall and travels backwards towards the sea. Then, at a distance of a quarter wavelength from the wall, it collides with the crest of the next incoming wave and it is re-reflected back to the wall. The jet forms during the collision, similar to the uprush at the wall. And the cycle repeats with every wave.

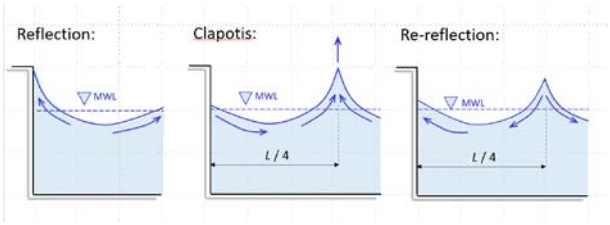

Fig. 3: The *clapotis* standing wave

So what we have here really is a standing wave, a *clapotis*, in front of the wall, although there's no reflective boundary on the seaward side.

Rip currents and the non-existent wave: rip currents are seaward currents which can occur at beaches where the waves arrive near parallel. Fig. 4 shows such a current, which researchers from Australia conveniently dyed green so that it is better visible. Rip currents can be very fast, and every year there are fatalities when the current carries unobservant swimmers out to sea.

Fig. 4: Rip current, visualised with food dye

How are the currents created? Fig. 5 shows the mechanism. Breaking waves carry water onto the beach, which forms a current running parallel to the beach. If one such current meets another in the opposing direction, the water Is diverted towards the sea: *et voilà*, we have a rip current. How can you see a rip current? well, the waves have disappeared where the current is, and that's the interesting part. Conventional wisdom has it that waves become shorter and higher when travelling against a current. What many people do not know, however, is that when the current reaches a velocity of around half the wave speed, then the particle motion of the wave is completely disrupted and the wave simply disappears – this is called wave blocking, and that is what is happening here.

Fig. 5: Rip current mechanism

The N-wave: Usually, we assume a wave train to begin with a wave crest. There are however N-waves, waves with a preceding trough as well. N-waves occur e.g. in tsunamis, see Fig. 6. N-waves create a very strong seaward surge when approaching the coastline.

Fig. 6: Tsunami, initial wave trough

Earlier this year, we had an editorial on solitary waves: waves which have a crest only and travel with mass transport. The N-wave of course raises the question whether a trough-only wave, like a negative image of a solitary wave, exists. We've been doing some theoretical work which indicates that such a wave is actually possible. It would be a strange wave, where the particles move against the direction of propagation, and where the wave travels with a negative mass transport, Fig 7.

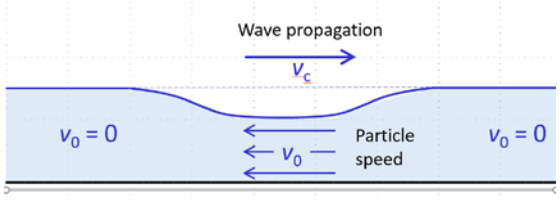

Fig. 7: The elusive trough-only wave

As far as we know, such a wave has never been described or generated in the laboratory. Last year however we did some test on N-waves where we generated N-waves with a trough depth of 15 mm, and a crest height of only 4 mm. A more controlled experiment may just result in this travelling trough...

MSc topic: *Stormwater overflow*

Wastewater has been hitting the national headlines again, with a major debate in the House of Lords this week leading to a promise by the UK Government to introduce a new statutory duty to reduce sewage discharges. This reflects several issues, from the growing public unacceptability of stormwater overflows to accidental events and even illegal dumping attracting record fines for major water undertakers: perhaps an Editorial is needed on this topic. For now, a brief mention of an MSc project on methods of treating sewer flows to reduce or prevent discharge. Siraaj Idrees looked at options including the so-called German and Italian approaches, and selected a retention treatment basin design, using the River Chess as a case study site. This project is one of several on this topic in the past few years: our knowledge is growing, but so far no perfect solutions to offer!

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AD and FOG events: *staff participation*

Opportunities for international travel have been limited in recent months, but WEEG staff were able to join the Anaerobic Digestion: Quo Vadis? webinar hosted by the University of Valladolid this month. Consensus is growing that there are better uses for the carbon in organic wastes and wastewaters than making it into biogas as a fuel - a topic very close to our hearts and central to our research. Two colleagues also attended the European Summit on Fats, Oils and Greases (FOG) in Brighton representing Soton and the Environmental Biotechnology Network (www.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: A fascinating and unusual job for anyone interested in canals:

Principal Water Engineer

Canal & River Trust
Making life better by water

www.icerecruit.com/job/202706/principal-water-engineer/

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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