Mossa, Michele

The coastal engineering laborator (LIC) of the technical university of Bari - Italy

Hydrolink

THE COASTAL ENGINEERING LABORATORY (LIC) OF THE TECHNICAL UNIVERSITY OF BARI – ITALY

BY MICHELE MOSSA

The *Coastal Engineering Laboratory* (LIC) of the *Department of Civil, Environmental, Building Engineering and Chemistry* of the *Technical University of Bari* was designed for advanced research and technical support to the Public Administration in coastal territorial management. The LIC was financed by the EU (European Union) and the Apulia Region (so-called *Programma Operativo Plurifondo Puglia* – D.R. 29/10/90 n. 6155, Structural Funds CEE-REG. CEE n. 20522/68 e 4253/88, Sottoprogramma 6, Misura 6.3). The construction of the laboratory was completed and started operating in February 2001.

The mission of the laboratory is to provide facilities for researchers, PhD and MSc-students, as well as to perform practical work and demonstrations in support of teaching at the University. It also has the potential for physical-experimental research in the fields of Maritime and Environmental Hydraulics.

The core activities of the LIC are managing, procuring and maintaining the facilities and equipment in the laboratory. These activities also include setting up, performing and processing of measurements in experiments, as well as developing the required numerical codes. Furthermore, the laboratory provides support to the design and construction of experimental facilities, specific installations, apparatus and equipment.

The laboratory has a total surface area of 30 000 m^2, a laboratory area of 12 000 m^2 and an office area of 500 m^2 of 5 000 m^2.

The laboratory has several wave basins and channels. The major experimental facilities at LIC are:

1. Two tanks used for three-dimensional physical models for maritime and coastal engineering research. The model area consists of two large basins; one (figures 1 and 2) used for coastal modelling and the other for offshore modelling (figure 3). The coastal model basin is 100 m long, 50 m wide and 1.2 m deep (figure 2), while the offshore model basin is 50 m long, 30 m wide and 3 m deep. The coastal model facility is equipped with a series of three-dimensional wave makers, having 6 modules, 8 paddles 60 cm wide, with maximum wave front length equal to 28.8 m and maximum height 30 cm.

As an example, the basin for off-shore physical models was used in a National Interest Research Program to analyse tsunami waves generated by landslides in water, the mechanics of wave generation and propagation, the development of forecasting tools and the real-time warning systems based on tidal measurements (for further details, please see Di Risio et al., 2008 and visit the following page of the IAHR Media Library: http://www.iahrmedialibrary.net/stromboli-islandtsunami-1/).

2. Two wave channels, which are 2.4 m wide, 50 m long and 1.2 m deep. They are equipped with a two-dimensional wavemaker with one module, 4 paddles, each 60 cm wide, providing a maximum wave height of 30 cm (figure 4).

For further details, see for example De Serio and Mossa (2013).

3. Very large flume for sea currents

The very large flume (figure 5) consists of a rectangular steel channel, with base and lateral walls of 15 mm thick transparent glass material, connected and sealed internally with watertight silicone rubber, able to prevent thermal dilatation. The base has a surface of 15 m by 4 m and the depth of the channel is 0.4 m. To create a current inside the channel, a closed hydraulic circuit was constructed. The water is supplied by a large metallic tank with a centrifugal electro-pump downstream which sucks the water into a 200 mm diameter steel pipe. The same water is then discharged into the upstream steel tank. A side-channel spillway with adjustable height made from different plates mounted together is fitted into the upstream tank. The water that overflows is directed into a pipe with a 250 mm diameter similar to that used for the water supply and parallel to it, and is finally discharged into the tank downstream of the channel. Two different electromagnetic flowmeters are mounted onto the two parallel pipes described above in order to measure the flow rate in the channel as the difference between the two discharge measurements. The upstream and downstream gates can be used to control the channel flow.

The very large flume is used to study different environmental problems such as wastewater ocean outfalls. While there are several studies in the literature on nonbuoyant and buoyant jets

Figure 1 - The basin for coastal physical models

Figure 2 - View of the LIC with the basin for coastal physical models

Figure 3 - Basin for off-shore physical models

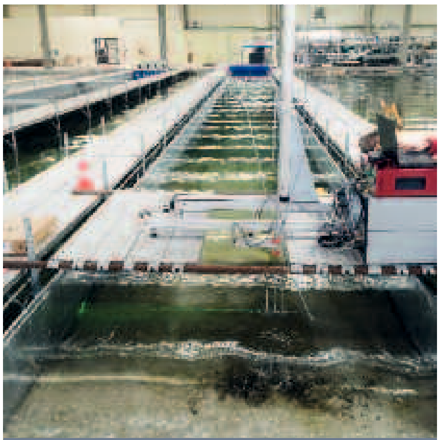

Figure 4 - One of the wave channels

Figure 5 - The very large channel of the LIC

and their interaction with currents, few deal with jet-wave interaction. The majority of studies emphasizes the importance of a wave flow field in diffusion processes and the need for experimental tests to better understand jet-wave interaction dynamics and possibly confirm the validity of proposed mathematical models. Although stagnant ambient conditions are of interest, they are almost never present in real coastal environmental problems, where the presence of waves or currents is common. As a result, jets cannot be analyzed without considering the surrounding environment, which is only rarely under stagnant conditions. This study deals with this problem and, for example, shows experimental results of a turbulent non-buoyant jet discharged in a stagnant ambient and in the presence of a wave flow field in order to compare both conditions and to experimentally analyze the behavior of different flow regions. For further details on the interaction of jets with waves see Mossa (2004a; 2004b).

A problem investigated in the very large flume is the effect of corrugated and vegetated channel beds on buoyant or non-buoyant turbulent jets, vertically discharged into a crossflow. The main aim of this research is to study the background turbulence, generated by corrugated or vegetated channel bed surfaces, which affect the jet behavior (i.e., jet penetration, spreading, mixing performance, turbulent structures). For the interaction of jets with a vegetated crossflow, see for example Ben Meftah et al. (2015).

Michele Mossa **is full professor of Hydraulics at the Department of Civil, Environmental, Building Engineering and Chemistry of the Technical University of Bari and Chief Scientist of the LIC (Coastal Engineering Laboratory). The main topics of Michele Mossa's research group are relevant with the Environmental and Maritime Hydraulics, examining the mechanisms of waves, sea currents, local erosion phenomena, buoyant and non-buoyant jets issued in steady or wave environment or in crossflow, also with macroroughness at the bottom (ripples or vegetation), channel flows and their local phenomena, such as hydraulic jumps. For further details, please visit the website www.michelemossa.it**

4. Positive and negative buoyant jet systems

A physical model for the study of buoyant jets was constructed at the LIC. The channel flow permits to simulate sea currents interacting with buoyant jets issued in the same channel through diffusers with different number of nozzles. This channel includes a buoyant jet thermal-hydraulic system. The discharged heated water generating the turbulent buoyant jet is pumped into the channel through a round steel tube mounted at the bottom of the channel in the central longitudinal section.

A process computer and control software (that oversees all the system and stores the test data) can be used to control and manage the buoyant jet system. They can generate the desired jet temperature and flow rate issued into the very large channel (Figure 6). Recently another apparatus for the analysis of the dilution of salt jets was constructed.

The LIC has many advanced equipment and instrumentation for morphological and hydraulics analysis, such as: bottom propellers, Acoustic Doppler Velocimeter (ADV), Vessel-Mounted Acoustic Doppler Current Profiler (VM-ACP), micro whirls flow meters, pressure gauges, bottom profiler, densimeter, ultrasonic wave height meter, high-precision GPS transceivers, spectrometer, LDA (Laser Doppler Anemometer) system. Figure 7 shows the new LDA system.

In addition to the specific pieces of equipment and instrumentation discussed above, the laboratory is also equipped with software and data acquisition systems for the study of the

Figure 6 - Buoyant jet thermal-hydraulic system with the process computer

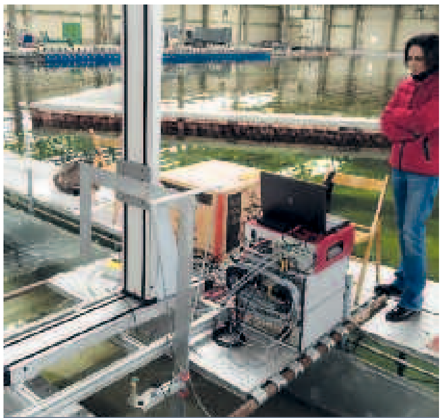

Figure 7 - The laser Doppler anemometer of the LIC

wave climate hindcasting and forecasting, wave propagation, storm and swell activity inside harbours, solid transport, beach evolution (also with remote sensing, see for example Bruno et al. 2016), circulation currents and pollutant diffusion.".

The LIC hosts also equipment of the colleagues of the mechanical engineering department of the Technical University of Bari, such as a wind tunnel and an experimental apparatus to determine the performance of pumps and turbines.

The LIC staff includes many researchers, technicians and students whose hard work makes the laboratory a reference point in the field of Hydraulics, Maritime and Environmental Hydraulics. The LIC promotes relationships and cooperation with international universities and research institutions.

References

Web site: http://www.iahrmedialibrary.net/stromboli-island-tsunami-1/

Ben Meftah M, De Serio F, Malcangio D, Mossa M, Petrillo AF (2015). Experimental study of a vertical jet in a vegetated crossflow. Journal Of Environmental Management, vol. 164, p. 19-31, ISSN: 0301-4797, doi: 10.1016/j.jenvman.2015.08.035

Bruno M.F., Molfetta M.G., Mossa M., Nutricato R., Morea A. and Chiaradia M.T., Coastal Observation through Cosmo-SkyMed High-resolution SAR Images, Journal of Coastal Research, 2016.

De Serio F, Mossa M (2013). A laboratory study of irregular shoaling waves. Experiments In Fluids, vol. 54, ISSN: 0723-4864, doi: 10.1007/s00348-013-1536-0

Di Risio, M., P. De Girolamo, G. Bellotti, A. Panizzo, F. Aristodemo, M.G. Molfetta, and A.F. Petrillo (2008), Landslide generated tsunamis runup at the coast of a conical island: new physical model experiments, J. Geophys. Res.

Mossa M (2004a). Behavior of Nonbuoyant Jets in a Wave Environment. Journal Of Hydraulic Engineering, vol. 130, no. 7, p. 704-717, ISSN: 0733-9429, doi: 10.1061/(ASCE)0733-9429(2004)130:7(704)

Mossa M (2004b). Experimental study on the interaction of non-buoyant jets and waves. Journal Of Hydraulic Research, vol. 42, p. 13-28, ISSN: 0022-1686, doi: 10.1080/00221686.2004.9641179