Delft Hydraulic's Large Wind-Wave Flume

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1 Description of the Flume

Originally designed for the Dutch coastal research and protection program in the seventies, Delft Hydraulics large *wind wave flume* was totally overhauled to fit the needs of scientists working in the field of air/sea interactions. The facility consists of two main parts. A 90 m long, 10 m wide, and 2.7 m high corridor section. It contains a 8 m water channel and two side walks (Figure 1). The water height can be levelled between 0.3 and 0.8 m.

The corridor section ends in a 10 m long, 30 m wide and 5.5 m high wave basin giving the whole facility a T shape (Figure 2). The side basins can be parted from the main 8 m wide channel by removeable Plexiglass walls to keep the water channel 8 m wide up to the beach at 100 m fetch. The spending beach is adjustable (Figure 2) and provides 90 % wave damping.

The water channel in the test section of the facility (75–100 m fetch) can quickly be emptied independently from the rest of the facility. This allows for a quick inspection or modification of submerged instrumentation. All places of the facility are easily accessible. The entire test section can be reached by a travelling crane. In this way even heavy equipment can easily be moved around in the facility (Figure 3). A complete set of standard measurement instruments such as wave height meters, flow meters, and pressure gauges are available.

Wind speeds between 0–15 m/s are generated by four large fans. The facility features a closed-circulation air system; the return flow is located beneath the water channel. One unique feature of this flume is the variable *fetch* limiter. The water surface can be covered from the wind entrance to any fetch with bubble foil. In this way, it is not required to replace any instrumentation in order to perform experiments at fetches between 0 and 90 m. A skimmer at the end of the flume is installed to clean the water surface from surface active materials.

B. Jähne and E. Monahan (eds.), Air-Water Gas Transfer, © *1995 by AEON Verlag*

Figure 1: A view from the sidewalk of the Delft wind/wave flume at about 90 m fetch in downwind direction while the facility is in operation at 12 m/s wind speed. The water channel is 8 m wide. (For color figure, see Plate 14.)

In addition the flume is also equipped with a hydraulic dual piston wave maker for the generation of mechanical waves. Waves are generated by a computer-controlled wave board of which the rotation and translation are adjustable. Wave frequencies between 0–3 Hz can be produced. The maximum wave height is 30 cm, the frequency ranges from 0 to 3 Hz. The maximum steepness of ≈ 0.1 can be reached for 0.5 Hz waves.

2 Projects and Funding

Specific investigations require special devices and equipment, and are normally brought along by the researchers. Apart from this, *Delft Hydraulics* can put a range of services and auxiliary devices at the visiting researchers' disposal. Various international projects have been successfully carried out at the large flume. This includes the Dutch/German VIERS-I program focusing on radar backscatter, an US/German project on gas exchange measurements at high wind speeds (B. Jähne and R. Wanninkhof), and two additional campaigns on air-water gas transfer that were founded by the EC within the European Large Installation Program. This EC research initiative provides access to large experimental facilities for European scientists. The large wind/wave flume is one of the experimental facilities at Delft Hydraulics that is recognized by the EC in the European Large Installation Program, which is currently in its third phase.

Figure 2: Close to the beach and air-flow return section, the 10 m wide corridor section of the Delft wind wave facility (see Figure 1) opens to a 30 m wide and 5.5 m high end section. Instruments can directly built into the bottom of the facility, replacing $2 \times 2\ m^2$ *large and 0.2 m high concrete plates. With a traveling bridge instruments can be mounted at the ceiling. (For color figure, see Plate 15.)*

Figure 3: Heavy equipment can easily be moved around in the Delft wind/wave flume by a travelling crane. Here it is shown how the illumination unit of wave slope imaging is lowered to the bottom of the empty facility. (For color figure, see Plate 16.)

Figure 4: View of the instrumentation deck on the top of facility in the last part of the corridor section from 75–90 m fetch. Through several $1 \times 1\ m^2$ large openings, instruments can be mounted to make measurements from above. (For color figure, see Plate 17.)