Manoeuvring in Discharge Flow

New Lock at IJmuiden

As part of a large-scale development project of the Amsterdam Sea Ports, the Netherlands, the possibilities for receiving larger vessels was studied. In 1997 the size of the vessels was limited to approximately 60,000 DWT by the dimensions of the largest lock. In order to receive vessels up to 150,000 DWT a new lock has to be built at IJmuiden.

Because of the limited space available at that location, one of the possible new locations could create a situation where ships entering into the lock would have to navigate through the flow coming from the discharge sluice situated immediately adjacent to the lock. MARIN's Nautical Centre MSCN, in association with WL|Delft Hydraulics, was commissioned by the Ministry of Transport, Public Works and Water Management to investigate the nautical difficulties and to propose and evaluate measures in order to arrive at an acceptable situation. It should be noted that discharging is often a necessity to keep the water level in the inner land sufficiently low. On the other hand accessibility is regarded as a must for a new large lock.

In order to predict the flow pattern, the WL|Delft Hydraulics software package DELFT 3D was used. The three-dimensional flow pattern calculated by the model was transformed to a format representing the average current force on the vessel under consideration. This information was then put into the fast-time simulation program SHIPMA, used by MSCN to calculate the ship's manoeuvres.

For the present situation some manoeuvres were studied to serve as a reference. These included the approach to the present largest lock with the 60,000 DWT vessel and the approach to the steel mill quay, just outside the locks, with the 150,000 DWT vessel. Through discussion with the local pilots, the fast-time simulation results were linked to their experience, allowing a more comprehensive judgement of the future situations.

The flow model was then modified to represent the future situation (see Figure 1), in which the same manoeuvres were studied, as well as manoeuvres involving the larger ships entering into the new lock. It appeared that in this future situation manoeuvring into the new lock had to be limited to situations with zero or low quantities of discharge from the sluice, which was considered unsatisfactory.

In consultation with the client, a number of consecutive measures were studied. One of the measures studied was a short guiding wall deflecting the flow away from the approach to the lock (see Figure 2). It was concluded that this configuration allows safe manoeuvring into the new lock in combination with large discharges.

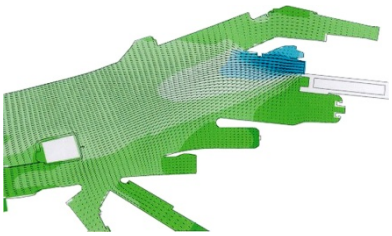

Figure 1: Flow pattern at the surface caused by fresh water (blue) being discharged onto the salt water (green) in the harbour. The figure shows the flow crossing the approach towards the lock.

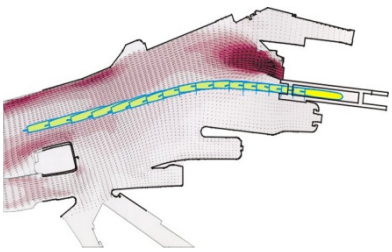

Figure 2: The approach and entry into the new lock of a 150,000 DWT bulk carrier in one of the possible future situations. The flow pattern shown is averaged over the draught of the ship in such a way that a correct representation is given of the forces on the hull. The colours show the flow velocity.

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