Project Description

Caisson Placement at Chioggia Inlet, Venice

Assignment
Physical modelling of the placement of the Venice Flood Barrier gate caissons at the Chioggia Inlet.

Client
Strukton Immersion Projects (SImP)

Period
2014

Introduction
The Venice Flood Barrier consists of 20 m wide steel gates that are resting on the sea floor in large concrete caissons. The caissons were lowered into a trench located across the tidal inlet. When the barrier should be closed, air is pumped into the gates. The gates float up and close the tidal inlets. The principle of the barrier is shown in Figure 1. In total over 1500m of gates were placed in the three inlets to the Venice Lagoon. In the Chioggia inlet in total eight caissons of 60m width were placed for the foundation of the storm surge barrier.

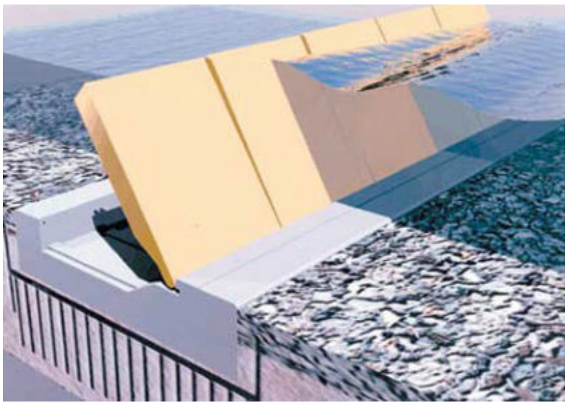

Figure 1 Schematic view of Venice flood barrier.

During placement the caissons were suspended under the floating barge Golia, which was used as an immersion pontoon (60 m long and 20 m wide). In the tidal inlet the caissons are loaded by currents and waves.

2D physical model tests
Before the placement, physical model tests were performed in a wave-current basin to optimize the placement procedure, and to determine the line forces and pontoon motions.

The pontoon motions were captured using a laser optical measurement system and acceleration sensors. During the tests the wave height (standard resistance type gauges), discharge (electromagnetic discharge measurement in return pipes), water depth, and flow velocity (electromagnetic velocity probe) were monitored to ensure constant conditions during a test run. The wave height was measured at sufficient distance from the caisson such that the reflections did not significantly influence the wave measurement (no nodes or antinodes present anymore). Under water video recordings were made to monitor the caisson movements. The overtopping onto the pontoon

Keywords:
Flood barrier, Italy, physical modelling

deck was monitored visually and recorded by video. Additionally, accelerometers in the corners of the caisson were used to detect collisions of the caisson to the trench sides or the bed.

A geometric scale of 1:34.5 was applied and Froude scaling. The caisson and pontoon models were constructed from water proof plywood. The required weight and weight distribution of the floating bodies were applied by trimming with steel weights. The correct mass and (roll and pitch) moments of inertia and centre of gravity were calculated from the weight (distributions) on the as-built drawings and reproduced in the caisson and pontoon model. The load on each of the 14 cables was measured. To ensure the right weight (catenary) and flow resistance flexible steel cables with scaled diameter were used in the model. As material stiffness does not follow Froude scaling, the stiffness of the ten horizontal lines on the pontoon and caisson was modelled by adding springs at the end of the cables with scaled elasticity.

The typical (extreme) wave and current characteristics during which placement was modelled were:

- Significant wave height: Hm0 = 0.75 m,
- Peak wave period Tp = 5.5 s,
- Bulk mean flow velocity U = ±1.25 m/s.

Based on the test results and analysis of the behaviour of the system, the required strength of various parts of the set-up was determined. The caissons have now been placed in the inlet. The methods applied can also be used for future immersion operations under waves and currents.

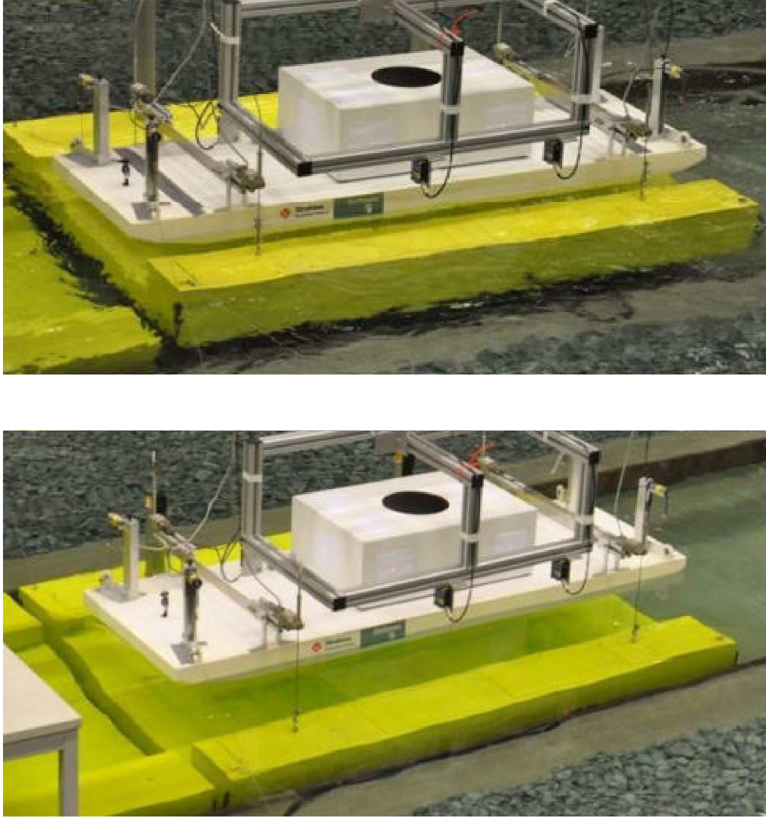

Figure 3 Model caisson (yellow) suspended under pontoon (white) at two stages of immersion.

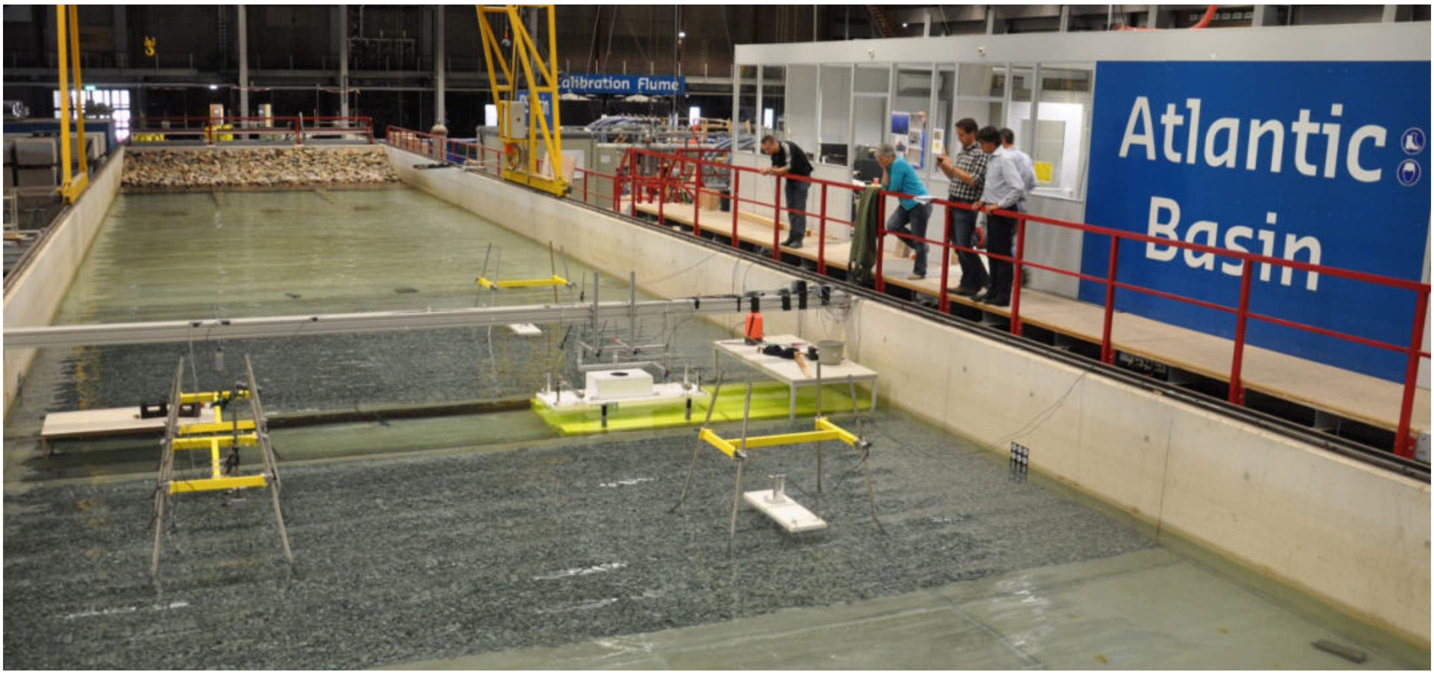

Figure 2 Atlantic Basin with present Chioggia set-up.

More information: info-hye@deltares.nl

Deltares

PO Box 177
2600 MH Delft, The Netherlands
T +31 (0)88 335 82 73
info@deltares.nl
www.deltares.nl

Deltares is an independent institute for applied research in the field of water, subsurface and infrastructure. Throughout the world, we work on smart solutions, innovations and applications for people, environment and society.
Deltares is based in Delft and Utrecht.