

# PROTOTYPE MEASUREMENTS OF WAVE INTERACTION WITH ZEEBRUGGE RUBBLE MOUND BREAKWATER

## Introduction

At the Zeebrugge harbour (Belgium) on the N.W.-breakwater, a cross-section has been instrumented for the study of physical processes related to the behaviour of a rubble mound breakwater at prototype scale (1:1) in random wave conditions. Within the EC MAST programme (Project MAS02-CT92-0023, co-ordinated by Ghent University) this infrastructure has been re-engineered and extended to a more high-quality full scale data acquisition centre.

Prototype results are obtained from the Zeebrugge measurement project where advice and experiences from European researchers within the MAST project have led to the development of a world-wide unique system with respect to infrastructure, instrumentation and data management.

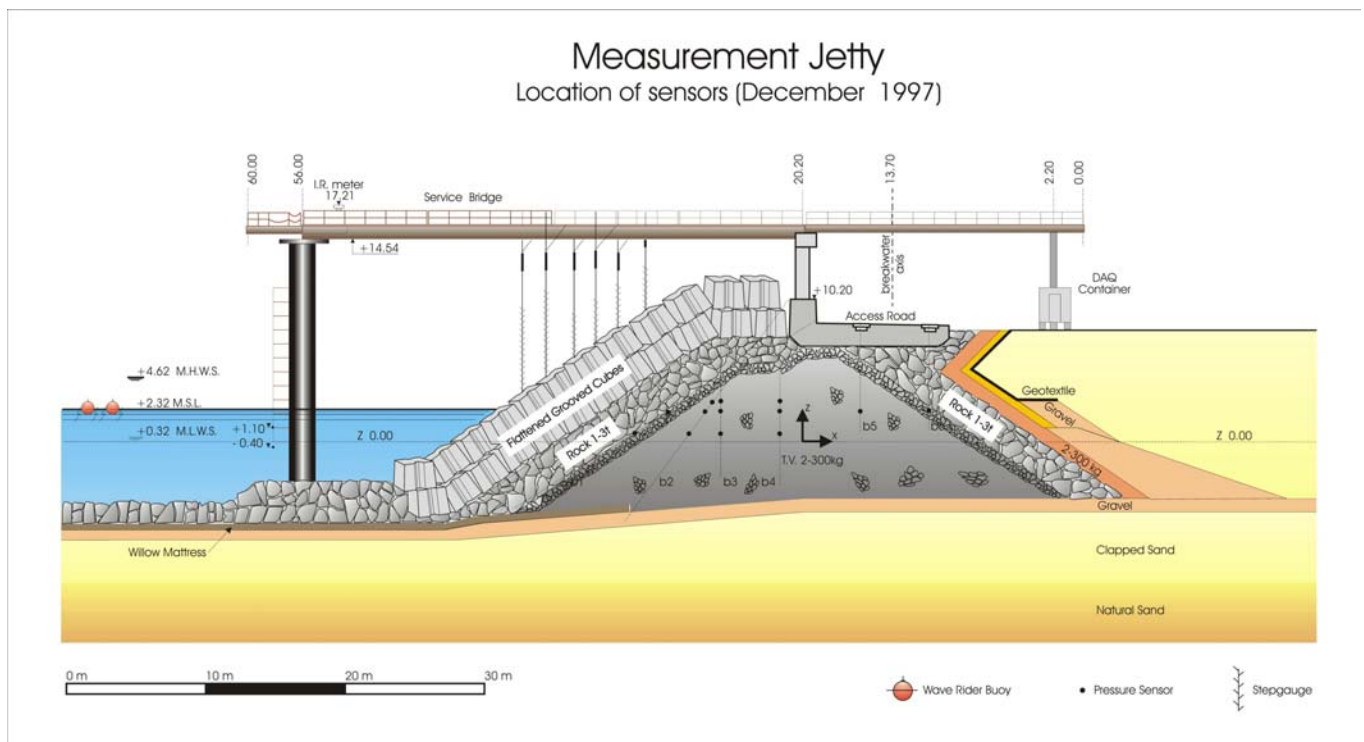
## Infrastructure

A measurement jetty supported by a steel pile at the breakwater toe and by piles on top of the breakwater is

used. In six boreholes, drilled in the core, pressure sensors are mounted shielded by synthetic tubes and perforated heads. A data acquisition system confined in an air-conditioned container is placed on the leeside of the breakwater. Steel pile, bridge and boreholes are used to install the measuring equipment.

## Instrumentation

Wave rider buoys are located in front of the breakwater. The water level at the toe of the breakwater is measured by an infra-red wave height meter and by two pressure sensors located in front of the steel pile. Inside the core 13 pressure sensors are installed in the six boreholes. Mounting of the sensors is conceived to allow flexible placement in the boreholes, ease of maintenance, ease of calibration in the calibration pit. A set of vertically placed stepgauges from the bridge to the armour layer is able to detect the wave run-up and rush-down on the armour layer. Materials used have been chosen because of their resistance to hostile marine environment.



**Fig. 1.** Cross-section of Zeebrugge breakwater with measurement jetty, and position of prototype instrumentation.

## Data Management

A strategic data management plan is developed for storage, processing and distribution of all full scale data. A software package for presentation, evaluation and signal analysis has been included. Procedures have been developed for the quality control of raw data.

## Full Scale Data Analysis Results

Up to date (April 1998) about 20 storms with significant wave heights ranging between 1.00 m and 3.50 m have been registered. Prototype measurements consisting of wave data and pore

pressure data inside the breakwater core have been analyzed in order to determine the hydraulic response of the full scale Zeebrugge breakwater.

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## Contact

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