AN INTEGRATED STUDY OF WAVE PROPAGATION IN OOSTENDE HARBOUR

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INTRODUCTION

An extension of the existing Oostende harbour entrance with two new (rubble mound) breakwaters is necessary due to safety and economical reasons. The design of the breakwater layout depends on navigation requirements and wave penetration into the inner harbour. For the assessment of the risk of flooding in the inner harbour, the water level during storm conditions needs to be analysed. Moreover long waves inside the inner harbour may cause unwanted ship agitation. For an integrated study of the wave penetration in Oostende harbour, the waves are being acquired and numerical and physical modelling is carried out. This paper deals with the *integrated set-up of the three approaches*. Three port configurations are considered: the present, an intermediate and the final configuration with two new rubble mound break-waters.

FIELD MEASUREMENT SET-UP

Fig. 1 shows the present situation. Inside the harbour, 7 wave gauges have been placed (Fig 2). Two wave buoys, east and west of the harbour entrance (about 800m off the coast) measure the incident wave climate. The wave gauges (DRUCK pressure sensors) have each battery power supply and dedicated signal conditioning and data-acquisition for stand-alone use. The sensors are placed about 2 m below low water. Pressure is converted to surface elevations. Short and long waves, and storm set-up are derived, as well as 15 min. wave spectra.

NUMERICAL MODELLING

The numerical model used in SimWave (Sinha et al. 1998) is based on Nwogu's extended Boussinesq model equations, which are solved in the time domain. Wave propagation and transformation are simulated, including shallow water effects (e.g. shoaling, refraction, diffraction, wave run-up and breaking). Previous simulations have been carried out (Geeraerts et al., 2002) to study the wave propagation for the final configuration. Currently, numerical simulations are run for the present and intermediate configuration. The numerical results in the inner harbour are validated using the wave data acquired in the field measurement campaign. Hydraulic conditions with return period 1 year simulate the condition in service and are used for the validation with field data. Storms with higher return period indicate the risk of overtopping over the quay walls in the inner harbour. Results of the numerical simulations are presented using a disturbance coefficient for the calculation domain.

Fig. 1. Oostende harbour, present situation.

Fig. 2 Seven wave gauges in the inner harbour.

PHYSICAL MODELING

Physical model tests (3D at scale 1:100) are carried out to study the present situation, intermediate near-future situation and the planned configuration with two new breakwaters. Wave gauges are placed in the physical model at the 7 validation positions. A set of hydraulic boundary conditions is applied in the physical model with a variation of the parameters within a range of uncertainty that is bound to the statistical extrapolation of storms with longer return period. The conditions as applied in the numerical model are generated in the physical test set as well.

Detailed results from the validation will be presented in the paper.

REFERENCES

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