EUROTOP OVERTOPPING GUIDANCE APPLIED IN A TOOL TO THE LARGE VARIETY OF COASTAL PROTECTIONS AT ILE DE RÉ

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INTRODUCTION

Ile de Ré is a low-lying island located on the western edge of France. The extreme storm Xynthia (February 2010), was one of the most destructive natural disasters in this area, causing severe damages and breaches on coastal protections and one third of the total area of the island was flooded.

Storm impact feedback showed that wave overtopping and/or overflow was responsible for more than 60 failures or breaches. From this major event, an important work was undertaken to improve the 100 km of coastal structures.

This paper describes the development of a tool, partly based on numerical modelling, that will prioritise coastal structure monitoring by forecasting overtopping discharges and volumes on the different exposed dikes on Ile de Ré, regarding different storm parameters and structure characteristics. This tool will supply helpful information to manage the maintenance operations and improvements of this important linear of heterogeneous and sometimes old coastal protections.

HYDRODYNAMIC MODEL

A numerical model has been developed in order to determine wave characteristics and water level for normal conditions and also for extreme events such as the Xynthia storm. The joint probability of wave height and water level has been taken into account for extreme events and several scenarios have been set-up according to different return periods.

The Telemac-Tomawac code [1] was used to determine the water level and main wave parameters are derived at the toe of the 100 km coastal structures of the island. These conditions are required as input for overtopping calculations based on the EurOtop manual.

WAVE OVERTOPPING AND OVERFLOW

Every coastal structure was surveyed to know the complete geometry, including foreshore, slope and crest height. Once the water level and waves parameters have been determined at the toe of the structures, overtopping discharges are calculated according to these coastal structures parameters.

New advances in the second edition of the EurOtop manual (Van der Meer *et al.* (2016) [2]) supplied new features, such as very shallow foreshores, very steep slopes, improvements on zero freeboard and tolerable overtopping depending on wave height are used in this work.

The coastal structures around Ile de Ré cover almost all kind of structures that one can imagine. It was a real challenge to apply the new guidance of the new Eurotop to assess tolerable overtopping, mean overtopping discharge and maximum overtopping volumes.

RISK-BASED ANALYSIS AND UNCERTAINTIES

Tolerable overtopping discharges for the different coastal protections have to be determined. A part of this work has been obtained regarding literature and the Xynthia experience feedback.

To describe the wave overtopping process better, overtopping volumes have also been analysed regarding the significant wave height and the storm duration. These values of discharges and volumes have been used to define warning thresholds or give clear indications where improvements of structures could decrease flood damage.

A sensitivity analysis has also been undertaken in order to give ranges of use and uncertainties for the overtopping formulations.

Finally, the goal of this project is to determine a number of scenarios and create risk charts depending on wave and tidal conditions for different return period. From this maintenance or improvement/reinforcement of the important stretches of protections can be organized according to the marine conditions.

Figure 1 shows the risk obtained for an example of scenario with return period of 100 years and from West direction. The different colours give the severity of the expected wave overtopping.

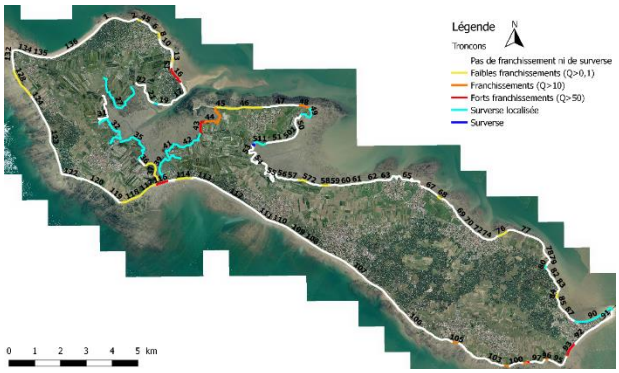

Figure 1 - Overtopping levels according to a storm with return period of 100 years and from West direction.

REFERENCES

[1] Hervouet (2007): Hydrodynamics of free surface flows. Modelling with the finite element method. John Wiley & Sons, Ltd.

[2] Van der Meer, Allsop, Bruce, De Rouck, Kortenhaus, Pullen, Schüttrumpf, Troch, Zanuttigh (2016). EurOtop, Manual on wave overtopping of sea defences and related structures. An overtopping manual largely based on European research, but for worldwide application. www.overtopping-manual.com.