A METHODOLOGY TO PRIORITIZE INVESTMENTS TO REDUCE RISKS IN PORTS

Carmen Castillo, University of Castilla-La Mancha, mariacarmen.castillo@uclm.es
Álvaro Galán, University of Castilla-La Mancha Alvaro.Galan@uclm.es
Raquel Balmaseda, University of Castilla-La Mancha Raquel.Balmaseda@alu.uclm.es
Ana María Díaz, University of Castilla-La Mancha AnaMaria.Diaz9@alu.uclm.es
Elena Calcerrada, University of Castilla-La Mancha ElenaCalcerrada@hotmail.com

INTRODUCTION

In many countries worldwide, a strong economical effort in the construction of coastal infrastructures has already been faced. Nowadays, due to the financial crisis, most of the efforts are devoted to the conservation and maintenance of coastal structures instead of building new ones.
Furthermore, the expected variations in sea level and met-ocean conditions due to climate change modify the stochastic nature of both wave loading and structural response which is different nowadays from that at the time the structures were designed.
These facts encourage the coastal engineering community towards the development of reliable risk management and decision-making tools.
A key point in the decision-making process is how to prioritize investments when deciding about adaptation or mitigation alternatives.
This paper aims at providing a proposal including tips to select among the possible alternatives based on risk analysis and how each alternative modifies the risk level compared to the do-nothing alternative.
An example on a Spanish port will be provided for better understanding.

METHODOLOGY

The methodology is based on the previous implementation of a risk analysis. Although, in the past few years, several examples dealing with risk assessment and vulnerability have been addressed in the Spanish ports (see Abanades et al., 2012; Alises et al., 2014 or Campos et al, 2012), the method used in the present case includes 4 key terms combined to define risk levels: failure probability, failure intensity, vulnerability of the structure and related activities and exposure of the latter to the former.
For each scenario, the risk analysis is repeated over all the mitigation/adaptation alternatives under study including the unaltered one so that a comparison can be done in terms of their risk levels and costs. Notice that an alternative to mitigate a risk can trigger new risks or modify others (increasing or reducing their levels).
Figure 1 shows how an alternative with increasing freeboard (trying to reduce overtopping) modifies risk levels of 4 failure modes at a rubble-mound breakwater: some remain unaffected while others change their risk levels (increasing or decreasing them) when a threshold value for the freeboard is exceeded.
Prioritization can be applied to several scales: small scale (e.g. for the same failure mode of a breakwater), medium scale (e.g. considering a single breakwater) or large scale (e.g. considering all breakwaters in the port). In all scales, cost-efficiency (in terms of risk level reduction) relation is the key point for decision-making.

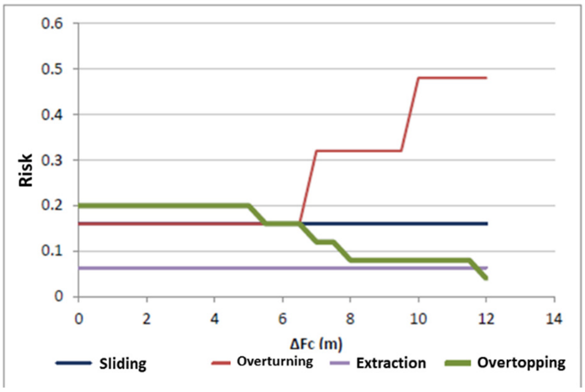

Figure 1 – Risk level variation for an alternative with increasing freeboard.

RESULTS

The methodology has been applied to Dique del Oeste, a rubble-mound breakwater located in the Port of Palma (Mallorca, Spain) where a risk analysis has been performed for different scenarios (met-ocean variables) and different geometries (assuming changes in geometry are adaptation or mitigation alternatives).
The latter cases provide information on how efficient the alternatives are for risk reduction by comparing their risk levels with the unaltered alternative. All alternatives have undergone a cost-efficiency study in order to quantify their costs and benefits in terms of risk reduction.
Examples on how to carry out the prioritization for small, medium and large scale cases will be provided.
Also, several economic scenarios have been considered: full availability and budget constraints.

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