CASE STUDY ON THE SEDIMENTATION OF A HARBOR IN THE NORTH COAST OF PORTUGAL

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INTRODUCTION

The harbor of Vila Praia de Âncora, located in the north coast of Portugal, for small fishery vessels, is not accessible at low tide conditions due to sedimentation at its entrance. The objectives of the study are the understanding of the sedimentation tendency causes and future evolution (natural reversibility, permanence or aggravation). These were achieved through the investigation of the hydro-morphological behavior of the adjacent beaches.

STUDY SITE

The study area, Vila Praia de Âncora bay, is confined between two rocky headlands and includes two beaches: Âncora and Gelfa (Figure 1). Âncora beach, with extension 400 m, is limited at north by the harbor and at south by the river Âncora mouth. Gelfa beach, with extension 1700 m, is limited at north by the river Âncora mouth and at south by Forte do Cão headland.

The study area was monitored based on a program executed between October 2001 and April 2004. This monitoring program included topo-hydrographic, sedimentological and sea conditions surveillance. The topo-hydrographic surveillance was continued until 2006.

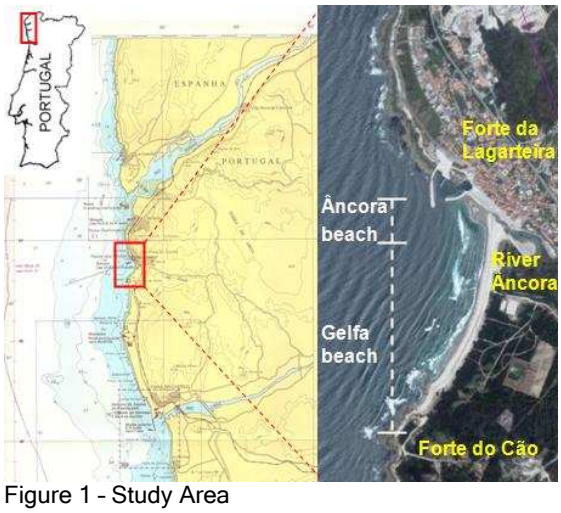

Figure 1 – Study Area

METHODS

The methodology applied integrates the treatment and analysis of the monitoring program data with process based mathematical modeling of the alongshore and cross-shore beach dynamics.

RESULTS

The active part of the beach extends until -9 m depth bellow chart datum (CD, 2 m bellow mean sea level). This result, derived from the numerical analysis of the cross-shore distribution of the longshore sediment transport, agrees with the observed seabed geometry changes. Besides, the numerical simulations of the beach profile changes under storm events show that these short duration episodes can generate cross-shore sand displacement up to -7 m bellow CD.

During the study period, there was no consistent pattern of seasonal evolution of the beach planform, i.e., cyclic retreat/advance of the bay extremes correspondent to longshore sand displacement. Despite this result (obtained from comparison of topo-hydrographic surveys) being consentaneous with the inter-annual variation of the wave regime during the study period (two atypical maritime winters were identified), it was observed a general tendency for net transport towards south during the maritime summer (from April to September), and towards north during the maritime winter (from October to March).

There is a significant amount of seasonal cross-shore transport, i.e., sand transference between the beach face and the surf zone and vice-versa, based on the comparison of the profiles surveyed. Mathematical simulations of the short-term profile evolution under storm events reveal that, due to the differences in the geomorphologic characteristics, Âncora beach is more vulnerable, i.e., suffers more changes, than Gelfa beach, under highly energetic wave action.

CONCLUSIONS

The process of accumulation of sand at the entrance of the harbor is not reversible without human intervention. In fact, simulation of the hydro-morphologic behavior of the study area shows that the sedimentation process occurs mainly during the maritime winter, when the longshore transport is predominantly towards north. In this situation there is transference of sediment from the beach face to deeper water, which, in the case of Âncora beach, coincide with the harbor entrance (placed at depth under -5 m bellow CD).

During the maritime summer, when the longshore transport is predominant towards south (from Âncora beach to Gelfa beach) and the cross-shore transport is predominantly onshore, the volume of sand accumulated during the maritime winter at the harbor entrance is not mobilized. This is due to the sheltering effect of the harbor breakwater at the harbor entrance, where, by diffraction, the accumulated sand is pushed into the harbor interior.

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