

Equilibrium configuration of sandy embayed beaches from the Southwest Portuguese rocky coast

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ABSTRACT

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The planform of five embayed sandy beaches (São Torpes, Furnas, Amoreira, Monte Clérigo and Arrifana), from the Southwest Portuguese rocky coast were compared to theoretical equilibrium curves (logarithmic spiral and parabolic). The beach planform configurations were defined based on aerial photography and the 2 m (MSL) contour extracted from DGPS field surveys (Furnas and Amoreira beaches). In order to analyse beaches morphodynamic, the volumetric active sediment changes, wave climate characteristics and wave propagation effects to nearshore were characterized. The wave breaking height and beach configuration is responsible for different degrees of exposure to the dominant NW wave direction. Major volumetric changes were largely associated with storm incidence. Comparison between real beach planform and predicted static equilibrium configurations suggests that the Arrifana beach represents a perfect example of a fully developed parabolic bay shape while, the other four beaches are not represented by any theoretical curve approach. In fact, the 2 m (MSL) contour at the Amoreira beach describes a convex beach planform tendency. The effect of the wave direction over the diffraction point was tested but the results points to a low diffraction effect. The Furnas beach revealed a high width variation at the northern extreme related with a more energetic wave climate, dominant from West, with lower diffraction.

This study shows that the studied beaches presents a complex dynamic equilibrium that is a function of the subaerial beach configuration, the intertidal bar system variation, the degree of exposure to the dominant NW wave direction and the storm incidence.

ADDITIONAL INDEX WORDS: *beach planform, static equilibrium, Parabolic spiral, Logarithmic spiral*

INTRODUCTION

Headland embayed beaches characteristic, of rocky shorelines with sea-cliffs represent 51% of the world's coast (Short and Masselink, 1999). The alongshore variation of morphodynamic characteristics including planform rotation and establishment of equilibrium state of those particular beaches have been studied on detail during the last six decades (Bascom, 1951; Yasso, 1965; Silvester and Hsu, 1997; Short and Masselink, 1999; Klein and Menezes, 2001). Klein and Menezes (2001) reasserted that for a headland bay coast the range of alongshore beach morphology mainly results from the distance from the headland, the shape of the bay, the wave obliquity, alongshore grain size distribution and the nearshore beachface slope. Morphodynamics of such kind of embayed beaches are mainly dependent on geological inheritance (indentation ratio) and hydrodynamic factors (wave breaking height, period, wave exposure and relative tidal range). In this work we present new data of five different embayed beaches (São

Torpes, Furnas, Amoreira, Monte Clérigo and Arrifana) from the southwest Portugal rocky coast to analyse their morphodynamic behaviour. The surveyed period includes different wave climate conditions with the incidence of three winter storms. These five beaches were analysed according to morphometric embayed parameters, the dominant wave direction and the diffraction effect. The real embayed shape was compared with the static equilibrium configurations predicted by logarithmic spiral and parabolic spiral formulations.

STUDY SITE

The southwest Portuguese rocky coast extends along 115km between the Sines and São Vicente capes. This coast is irregular and includes several small embayed sandy beaches. The selected beaches for this study (São Torpes, Furnas, Amoreira, Monte Clérigo and Arrifana beaches; Figure 1) represent small bays that in some cases are located close to river or stream mouths.