

## ABSTRACT

Analysis of stability of the waterfront at Barcelona: Olympic beaches

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The election of Barcelona to host the 1992 Olympic Games implied a deep transformation of the Barcelona waterfront and its structures. The Olympic Port was constructed, beach nourishment was conducted on the existing beaches and brand new beaches were created to the north of the new port. Also, an urban rehabilitation took place along the city's coastal neighbourhoods, which were quite degraded at the time.

However, all of these implementations consisted on groins for lateral support which ended up being relatively sort, as well as beach nourishment volumes not significant enough. Therefore, still some work needed to be done to complete the rehabilitation of the city's waterfront and the stabilization of its beaches.

The decrease in the rivers' sediment input, construction of new groins and marinas which act as littoral barriers for the sediment implying an asymmetric distribution along the coast, as well as the erosion that takes place after storm events have caused a retreat of the beaches along the Barcelona coast.

All of the above have motivated the necessity to understand how the Barcelona beach system works. In order to so, the littoral dynamics, wave propagation to the shoreline and circulation patterns induced by breaking waves have been studied along the Barcelona coast.

Based on this analysis a number of different alternatives are proposed in order to accomplish the stabilization of the beaches in Barcelona, providing the city with wider and more stable beaches that satisfy the existing necessities.

All the studies conducted on the area based on multiple topo-bathymetric campaigns show that the mean annual sediment lost rate for all the beaches in Barcelona is  $70.000 \text{ m}^3/\text{year}$ . Also, studies of the beach profile show that as a natural response to storm events the sediment is moved to the lower part of the profile. Once the sediment is located at the bottom of the equilibrium profile, since that is located at depths lower than the lateral support provided by the different groins along the coast results on a lost of sediment in the alongshore direction to the south, causing the above net sediment lost rate.

The proposed works on this thesis are based on the combination of two types of structures well differentiated. On the one hand, a number of 'rigid' structures (rehabilitation and protection of the existing structures, a detached breakwater and a series of emerged and submerged breakwaters) which pretend accomplish the full functional function of the beaches, as well as provide for full lateral support and better protection against storm wave events. On the other hand, extensive beach nourishment is proposed as a 'soft' structure, using compatible sediment from a marine borrow pit which guarantees its duration in time (except for the small losses of the finer sediment). This way, the beaches functionality and waterfront protection will be assured for a long period of time. This solution is considered to be the best front a functional, economic and public interest point of view.