NEW SHORE PROTECTION WORKS ALONG THE ROMAN SANDY BEACHES

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INTRODUCTION

The beaches at the two sides of the microtidal river Tiber convex delta are eroding for over 60 years due to the lack of sediment supply and significant positive gradients of the longshore transport (Iadanza and Napolitano, 2006). Various defense interventions have been made over time, particularly at Ostia (southern side) and at Fregene (northern side) (Figure 1), including a novel "perched beach" scheme (Ferrante et al. 1993), pure sand nourishments and groins. This coastal area is highly urbanized with a busy and widespread seaside tourism from Spring until Autumn because of the proximity to Rome. Therefore, several protection works were built over the years in order to reduce the loss of seashore caused by the coastal erosion.

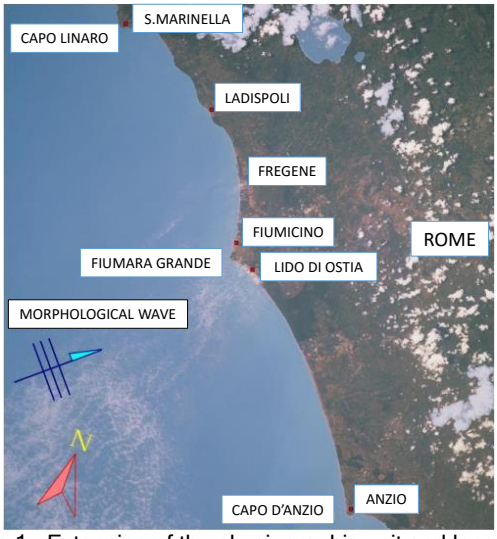

Figure 1 – Extension of the physiographic unit and location of eroding beaches and project sites along Tiber delta.

Experience has shown that, given the large longshore transport rate (about 30,000 m^3/yr) the pure free nourishments have a limited life and the use of parallel detached submerged breakwaters without groins has partial success. On the other hand, local stakeholders do not favour groins for their localized staggering effect on the shoreline and their potential obstacle to alongshore walking and sporting activities, besides visual and environmental impacts. Recent shore protection projects have been developed which account for new criteria of environmental and social sustainability, using semi-submerged rock groins and sand filling. In particular, two new projects are shown: a short groin with submerged T head at Ostia Levante, completed in 2021, and a larger "box" defense system at Fregene Sud.

The paper describes the specific design criteria, legal and socio-environmental constraints, modelling studies, construction peculiarities of the two projects.

THE OSTIA PROJECT

The project is one of the five urgent coastal restoration projects planned by the Lazio Region in 2020.
The project consists of one short low-crest rock groin with seaward submerged trunk and head combined with sand nourishment in Ostia Levante (Figure 2). The groin is characterized by a trunk with a variable crest width of 3 ÷ 10 m at a level of +1.5 ÷ -0.5 m MSL and a length of 70 m, the T-head has a width of 16 m, a length of 60 m and a depth of -0.5 m MSL. Total cost of the project is 1.29 million €.

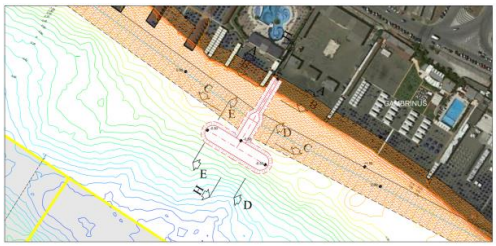

Figure 2 - Plan, the short T-groin at Ostia Levante.

Figure 3 - Comparison of the shoreline before (05/2020) and after (03/2022) Ostia Levante coastal restoration project.

The effects of the groin on the whole shoreline are well predicted by one-line modelling and confirmed, as shown in Fig.3, by an ongoing periodic long-term monitoring

program, carried out with shoreline surveys by drone and systematic control of the beach fauna and flora.

THE FREGENE PROJECT

At Fregene instead the project resulted from a combination of two separately funded designs (groins by Regione Lazio and offshore barrier by Fiumicino Municipality) with a relatively long authorization process which includes verifications and permissions related to many different environmental (also due to a neighboring protected area) and technical aspects, such as: archaeology, biodiversity, landscape, social use, war residuals reclamation from the seabed. The long time between the delivery of the design (2021) and its approval with consequent start of construction (late 2022) required an update of the topo-bathymetry and related design quantities (increased due to the ongoing beach erosion), leading to a total cost of ca 4.5 million €.

The project includes an 850 m long submerged breakwater in a depth around -3 m MSL, four partly emerged groins and a final fill with fine sand dredged from the near seabed at -8 m MSL (outside the closure depth) (see Figure 3). The impacts on neighbouring northern beaches were checked by means of a widely used one line model called GENESIS (Hanson and Kraus, 1989): the model was used to study the long-term effects of the new coastal protection; limited impacts were observed over a 10-year simulation period.

Figure 3 - Plan of the new protection works at Fregene, with drone view of the ongoing works in 2023.

Land-based construction started at the end of 2022 with the emerged barrier and groins to form a closed cell: two gaps were opened during the summer season (May – September 2023) to avoid interference with the works and allow water circulation. The new protected “sea pool” was much favored by bathers.

A rare severe “Mediterranean tropical storm”, which is commonly known in literature as *medicane* (MEDIterranean hurriCANE) (Romero and Emanuel, 2013), occurred at the end of august 2023 (offshore Hs = 4.5 m). The frequency and intensity of such extreme events seems to be increasing over recent years, probably as a consequence of climate change.

This *medicane* caused significant damage to the breakwater under construction (see Figure 4): the damage consisted in the displacement of armour rocks and the removal of the vehicles tracks over the crest. The damage delayed the construction of the shore protection, nonetheless suspended works are to be completed before summer 2024.

CONCLUSION

In order to contrast the erosion of the Roman coast, two different kinds of structures have been designed taking into account modern criteria of environmental and social sustainability. The impact of such shore protections was analyzed by means of one-line models. Extreme events caused by the climate change need to be taken into account in the design and construction of these works.

Figure 4 – Comparison of the breakwater before and after the Medicane.

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