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Converting old shore protection structures into softer defence

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Beach erosion has been affecting several developed countries since the middle of 19th century, which led to the construction of many different protection structures. These frequently proved to be ineffective locally, while being negative for downdrift coastal segments. In addition, such defence structures modified the coastal morphology, often transforming a sandy beach into a rocky coast.
Softer shore protection projects have been developed in the past years, mostly accompanied by beach nourishment that uses quarried material or shelf sediments. This proved to be efficient in defending the beach, without negative fallouts on unprotected sectors.
These techniques can be easily applied to beaches where no "archeaostructures" had been realized before. On the other hand, difficulties arise when such "old style" structures are to be replaced with softer techniques, since traditional hard defences usually cause such changes to beach profile that innovative ones become "too soft".
Due to profile deepening in front of reflective structures, wave shoaling is reduced and energy dissipation concentrated in a narrow beach band. Restoring a milder profile needs a large amount of sediments and fine sands are not stable under those conditions.
The new challenge for coastal engineers, coastal geomorphologists and coastal planners is managing the transition from old archaeostructures to new soft shore protection techniques. This process requires years of progressive adaptation – an unsuitable timing for politicians who demand fast results to be sold during the next elections.
In Italy, along the Tuscany coast, where more than two kilometres of breakwaters protect each kilometre of coast, such a process has been initiated after a long phase of stakeholder participation in order to overcome public scepticism towards "invisible" defences.
Detached breakwaters were lowered below sea level at Follonica and Marina di Pisa, while the number of groins is to be reduced at Marina di Massa in the near future. At Follonica, no beach nourishment has so far been realised along with such works, whereas at Marina di Pisa a gravel beach has been created for absorbing the higher energy that overpasses the lowered structure. At Marina di Massa submerged structures (groins and detached breakwaters) will be realized to counterbalance the demolition of the emerged groins.
Beach evolution is being presently monitored in all these sites. This will help evaluate the efficiency of projects, providing data and results that will be useful when beach profile becomes milder and height/number of defences may need to be further reduced.
Preliminary results at Follonica suggest that some beaches were overprotected, and redimensioning of structures did not result in beach erosion, since decrease in protection was accompanied by reduction in negative side-effects of the original defence, such as piling up.
In Marina di Pisa, where detached breakwaters were lowered and a gravel beach realized, there was an increase in water quality and users got the possibility of using a new beach suitable for recreational activity, without any reduction in coastal protection.
Project execution at Marina di Massa has just started a few months ago and monitoring results are not yet significative - however, 3D physical model experiments, carried out to optimize the design, have been encouraging.
These and further results will guide additional projects to be realized in other parts of Tuscany, as well as in other Italian coastal segments presently undergoing the negative effects of past widespread archaeostructure construction.