

Detached breakwaters to create sand bars in a beach recovery programme - DK

1. Policy Objective & Theme

- ADAPTATION TO RISK: Managing impacts of climate change and safeguarding resilience of coasts/coastal systems
- ADAPTATION TO RISK: Preventing and managing natural hazards and technological (human-made) hazards
- SUSTAINABLE USE OF RESOURCES: Preserving coastal environment (its functioning and integrity) to share space

2. Key Approaches

- Participation
- Ecosystems based approach
- Technical

3. Experiences that can be exchanged

The use of detached breakwaters to create sand bars and recover eroded beaches for recreational use as well as protect soft-rock cliff faces from further erosion.

4. Overview of the case

Erosion was threatening a large number of holiday cottages built on top of a soft-rock cliff and the beach facilities adjacent to the cliff. A plan was devised to build up the beach and protect the cliff face using detached breakwaters behind which sand bars would form. The cost of the works was divided equally between the county, the municipality and the affected stakeholders.

5. Context and Objectives

a) Context

Liseleje-Hyllingebjerg is located along 2.8 km of the North Zealand (Sjælland) coastline which consists of both large cliffs and shallow beaches in the Kattegat. The natural dynamics of the coast are characterized by a west-east directed sediment transport: the average erosion rate is ca. 1 m per year. This erosion is due to human interference, through local coastal protection measures and removal of large stones and boulders. Acute erosion due to heavy storm events also occurs. About 80 landowners are situated directly on the cliff tops and there are many summerhouses. The area is intensely used for recreation.

Over the years, individual landowners and local coastal protection groups have built a variety of ad hoc slope protection structures consisting of concrete and timber piles, rubber tyres, rocks etc. A number of wooden groynes and non-integrated, small detached rock breakwaters, located in shallow water, were also built. These inadequately designed structures and a lack of maintenance have led to a deterioration of the slope protection structures and some of the existing detached breakwaters.

b) Objectives

The policy option for the coastal protection scheme is "Hold the line". The beaches should be recovered and the summer cottages on the cliffs protected. The coastal protection should be based on technically sound solutions, e.g. rock slope protection to reduce wave reflection and thus beach retreat. The solutions should also be aesthetic, e.g. by making the slope

protection more uniform and remove all deteriorated and unsightly structures.

6. Implementation of the ICZM Approach (i.e. management, tools, resources)

a) Management

The maintenance of the coastal protection system is in the hands of a coastal guild consisting of members from three groups of stakeholders viz. the county, the municipality and stakeholders. Most of the landowners have agreed with the coastal protection measures and have been unified in a local association according to the Coastal Protection Act. This local board is responsible for the maintenance of the revetments and the county is responsible for the maintenance of the breakwaters and for sand nourishment.

b) ICZM tools

A Master Plan drawn up in 1989 recognised that the area Hyllingebjerg – Liseleje was in need of coastal protection. The purpose was to protect the summer cottages at the top of the cliff in an environmental friendly and visually acceptable way. In 1995, the Hyllingebjerg-Liseleje association conducted a private survey among the 80 landowners (summer cottages) to see whether they were interested in coastal protection (63% were positive and 15% were negative). They then asked the county of Frederiksborg to initiate the process according to the underpinning legislation, the Coast Protection Act.

In 1996, the coastal guild was set up and the public informed about the programme on the internet. An external consulting engineer was hired and in 1997 two alternative proposals were presented to the landowners at a public hearing. Based on this hearing the county decided to go ahead with one of the proposals. The following requirements were established:

- Protection of the summer cottages against slope erosion;
- Preparation of an overall plan for the coastal protection;
- Establishment of as much beach as possible and accessible to the public
- Protection to be near maintenance free i.e. after major storms or every 10 to 20 years for structures and every 5 to 10 years for beach nourishment.
- Uninterrupted access along the coast during normal weather conditions.

The cost would be divided evenly between county, municipality and landowners (1/3 each). Not all the landowners accepted this and they filed a complaint to the Minister of Transport. An agreement was eventually reached and in February 1999 the works started and were completed in June 1999.

Six new breakwaters with lengths of 40 to 60 m were included in the final plan, together with two small existing detached breakwaters which needed to be strengthened. They were designed so that tombolos (sand bars) would develop behind them. They are located in water depths ranging from 0.5 to 2.0 m. Granite stones for the breakwaters were shipped in from Sweden and supplemented by stones obtained from a local gravel pit. Material from removed structures was also used in the construction.

An initial nourishment with about 80,000 m³ of sand was included to fill up the beach to the new expected equilibrium profiles and to avoid significant erosion of the coastline between the breakwaters when sand is trapped behind the breakwater during the formation of the tombolos. The sand for the beach nourishment was pumped ashore through a fixed steel pipe. Beach nourishment will be necessary about every 5 years.

The existing damaged or unattractive slope protection was either replaced by a rubble mound slope or such a slope was placed in front to obtain an aesthetic appearance. Several types of slope protection were used.

7. Cost and resources

No cost figures are available.

8. Effectiveness (i.e. were the foreseen goals/objectives of the work reached?)

This coastal protection has now been functional for a number of years and is working well and has withstood two severe storms, one of which was the worst in the last 100 years. By 2001, large amounts of sand had accumulated behind the new, detached breakwaters and are forming large tombolos thus re-establishing the beach for recreational purposes. The beach surface in front of the cliffs has increased in width providing more effective protection for the cliffs. The summer cottages on the cliffs are no longer threatened by storms because of the wider beaches in front of the cliffs and the better slope protections that were constructed. Aerial photos are used to assess the performance of the coastal protection work. The construction of the new breakwaters is not expected to have a great impact downstream although this is largely because an existing breakwater already interrupts the longshore sediment transport.

9. Success and Fail factors

The funding arrangement was seen as important: the cost of €1,700,000 being shared between the three main parties involved. This type of payment system is, of course, dependent upon the wealth of the private stakeholders. The landowners organized themselves into a private organization to represent their interests. It was clear that it was important that the public always be fully informed about the process and have easy access to the information. In this case, the County of Frederiksborg used its website.

10. Unforeseen outcomes

The large tombolos have resulted in limited sand accumulating in a few of the bays between the detached breakwaters which in turn have caused a retreat of the coastline locally. As a result, a few landowners are critical that they have not got an improvement locally.

11. Prepared by

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12. Verified by

It was not possible to verify this case.

13. Sources

- Hyllingebjerg – Liseleje (Denmark) (2005) P. Skaarup, Technical office Frederiksborg Amt-, Denmark
- Projektforslag (1997) downloadable from www.fa.dk/natur/projekter [in Danish].
- www.liselejekyst.dk (photographs of the development of the sand bars from 2000-2006) [in Danish].



EUROSION_Hyllingebjerg-Liseleje (210.2 KB) 