

## Technical Summary FD2409

# Low cost rock structures for beach control and coast protection – practical design guidance.

### Background to R&D Project

Rock structures are widely used in coastal engineering for a variety of purposes, including controlling the morphological development of beaches, and providing protection against coastal erosion and the effects of sea level rise. Strict adherence to existing design guidance often leads to complex structures using multiple rock sizes, imported rock and carefully prepared foundations. Construction of such structures is in many cases too costly for this option for beach management or coast protection to be economically viable.

Some coastal authorities have trialled low cost structures using locally available rock, with simpler cross-sections, and placed on unprepared foundations. Many of these structures appear to have functioned satisfactorily over time, without significant reduction to the overall performance of the defence scheme. However there is no existing design and management guidance available for these types of rock structures. The aim of this project was therefore to provide practical guidance relating to the design and assessment of low cost rock structures for beach control and coast protection, based on a review of the performance (in the context of the overall defence scheme) of a range of rock structures used in the UK for these purposes.

### Results of R&D Project

Most existing literature on the design and assessment of coastal rock structures is based on research primarily directed towards the large, relatively deepwater structures which shelter ports and maritime facilities from wave disturbance. These are often designed for minimal maintenance and optimised to make maximum use of the yield from a particular (often dedicated) quarry. Beach control and coast protection structures are normally much more easily accessible, and the long-term performance of the overall scheme is seldom critically dependent on the short-term integrity of the structure. Materials are usually by-products of commercial quarries and, since regular maintenance is much easier than for the large port breakwaters, the whole life costs of simple, inexpensive structures with a regular maintenance commitment are often lower than those for more complicated structures.

The compromise between cost and performance is likely to be most beneficial where maintenance is relatively easy, and a reduction in the integrity or performance of the structure will not jeopardise the success of the overall scheme. The former will require easy access to the structure and plant and materials to be readily available, the latter will require an understanding of the functioning and performance of the scheme as a whole and good monitoring arrangements. Most beach control and coast protection structures function in a predominantly morphological manner with the structures influencing the long-term development of the beach, but providing minimal protection in the event of a storm. However, structures such as revetments protecting tidal flood embankments provide critical performance during storm events, and any failure could be catastrophic. In these and similar situations conventional rock structures will continue to be preferred, particularly where there are significant assets being protected.

This project collated all available information on a wide range of existing coastal rock structures, and also undertook a more detailed review of several case studies. For each case study the performance requirements were identified, the design was reviewed against existing guidance, actual performance was analysed, and cost savings were estimated. Practical guidance relating to the design, assessment and management of low cost rock structures was then prepared by a team of experienced coastal engineers based on synthesis of the salient points from the case study analysis.

## R&D Outputs and their uses

The Practical Design Guidance report is intended for coastal engineers involved in the design, assessment and management of low cost rock structures for beach control and coast protection, and is divided into 7 chapters.

- Introduction, including the background to the project, and describing common structure types and functions, as well as the rationale for adopting low cost rock structures.
- Design and assessment of coastal rock structures, including performance and scheme requirements, failure and adaptability, environmental impacts, and safety considerations.
- Established design guidance and techniques, including a review of guidance for geometrical design, structural design, and rock materials. However this chapter is not intended to replace existing and comprehensive design references, which should be consulted for more detailed guidance.

The remaining chapters then look more specifically at low cost rock structures.

- Understanding cost issues, during design and assessment; selection of rock armour; construction; monitoring, maintenance and repair; and programming expenditure.
- Lower cost rock structures, examining the three basic ways of reducing the cost of rock structures, namely using less material, adopting more efficient construction, or using cheaper rock (including the re-use of rock materials)
- Design and detailing for lower cost, including appropriate armour sizing, foundation and toe details, and monitoring and maintaining low cost rock structures.
- Conclusions

The practical design guidance summarised in this report is not intended to replace any aspect of existing design references, but rather to complement them by describing a different approach which may be appropriate in certain situations. It is not intended to be prescriptive, and due to the nature of the research cannot be considered comprehensive, but it is hoped that it will advance best practice by providing a checklist of issues to be considered in developing lower cost coastal rock structures.

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This R&D Technical Summary relates to R&D Project FD2409 and the following output:

- **Low cost rock structures for beach control and coast protection. Practical design guidance.** Defra/Environment Agency Flood and Coastal Defence R&D Technical Report CSA 6020. Published by Defra Flood Management Division, 2003.

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