

CHAPTER 178

DESIGN AND CONSTRUCTION OF BERM TYPE BREAKWATERS

Rubble Mound Structures Committee
Waterways, Port, Coastal & Ocean Division,
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The standard design for a rubble-mound breakwater as reported in recent text books and manuals has consisted of a core of rubble quarry-run that is protected from wave action by two layers of relatively large quarried stone or concrete units. Filter layers of intermediate size stone are recommended beneath the armour layer to prevent loss of the core material through the armour. The pioneering work of Hudson provides coefficients for a formula that allowed widespread use of this design concept throughout the world.

A breakwater of this form tends to require the smallest volume of stone; however, it may not represent the least cost structure for a specific location because of the cost and availability of local materials.

Recently, design engineers and hydraulic laboratories have given considerable attention to alternative forms of rubble mound structures. The objective of this work has been to minimize cost while maintaining the same or improved level of stability when the breakwater is subjected to extreme wave conditions.

Principally, emphasis has been given to the utilization of locally available quarried stone and to maximizing the use of the full yield of a local quarry. This has required the design of breakwaters using smaller armour stone and a wider range of sizes than was used in the more conventional breakwater. These designs have also given consideration to the realities of construction and the limitation of construction equipment on the assumption that cost savings will be achieved with relatively simple construction methods.

Clearly the use of smaller armour stones requires a change in other properties or characteristics of the armour layer, compared to a conventional design, in order to achieve the same stability. The principal characteristics of a berm breakwater are the high permeability of the armour-layer and the significantly larger volume of armour. Berm breakwaters generally consist of a relatively large and permeable mass of armour stone (of smaller size than required for a conventional design).

Breakwaters range from coarse sand barrier beaches to a more conventional breakwater protected by one layer of large armour stones. For the breakwaters using the smaller material, movement of the stone is an important consideration. For

breakwaters with larger stones where significant movement of stones does not occur the permeability of the mass of stones is an important consideration. In all structures the durability and strength of the armour stones is important.

The recent work towards "non-conventional" structures is based on extensive tests in hydraulic laboratories. Basically, a trial and error approach is undertaken and the success or failure of a structure is based on the observations of the model.

In September 1987, a two day workshop was held in Ottawa, Canada to discuss "non-conventional" breakwaters (1). Participants from Australia, Canada, Denmark, Netherlands, United Kingdom and the United States discussed design concepts, construction, materials and the performance of as-built structures. The workshop was sponsored by the American Society of Civil Engineers, Canadian Society for Civil Engineering and the National Research Council of Canada.

For the most part, the "non-conventional" breakwaters discussed consisted to a larger mass of smaller stone replacing the two layers of armour stone in a conventional breakwater. These breakwaters were referred to as mass armoured breakwaters or berm breakwaters.

Considerable discussion took place on the process by which a wave interacts with the mass of stone and processes by which stability is achieved.

It was concluded that very successful non-conventional breakwaters have been built in recent years. These structures have resulted in considerable cost savings to the owner while providing the required protection and stability when exposed to extreme waves.

However, these designs have all been supported by considerable engineering and model tests in a hydraulics laboratory. While numerical methods are being developed to assist with this process and to compare one design with another, it is unlikely that the site specific design work that can be undertaken with a physical model will be replaced by numerical methods in the near future.

Based on the results of the Ottawa workshop, it is concluded that properly designed and constructed Berm Type Breakwaters are an important and cost effective means of protecting exposed coastal harbors and locations from severe wave attack at specific locations.

The Rubble Mound Structures Committee acknowledges the contribution of Mr. Dave Willis and the Ottawa Hydraulic Research Laboratory of the National Research Council of Canada for assistance in providing the berm breakwater laboratory demonstration and venue for the workshop.

REFERENCES

- (1) Berm Breakwaters: Unconventional Rubble-Mound Breakwaters. Proceedings of a workshop at The Hydraulics Laboratory, National Research Council of Canada, Ottawa, Canada, September 15-16, 1987. Published by American Society of Civil Engineers.