



MarCom - WORKING GROUP 47

Criteria for the selection of breakwater types and their optimum damage risk level (breakwater type selection)

Terms of Reference:

Breakwaters are of vital importance, especially to ports on exposed locations. Moreover, the costs of breakwaters are quite often very large. The costs depends of course on the type of breakwater, on the water depth and the wave climate, but also on the safety level applied for the design. When the design is safer, the expected cost of repair during structure service lifetime will be smaller. Damage to a breakwater can cause downtime for port operation. This is certainly the case if berths for vessels are located along the inner side of a breakwater. But also a breach in a breakwater might cause wave disturbance enough to affect operation for example of a container berth.

The optimum damage risk level of a breakwater should be the one that gives minimum total costs during the structure service lifetime. The total costs are the sum of initial (construction) costs, repair costs, and downtime costs. The relation between damage cost and safety level is different for each breakwater type, so the optimum is also different for each breakwater type. In the past the optimisation method has been worked out in detail for rubble mound breakwaters (see for example VAN DER KREEKE & PAAPE [1964]), but taking only into account initial costs and direct maintenance costs. Indirect costs (downtime costs) have not been included.

In this respect the cost curves, showing the optimum design, have a complete different shape for the various types of breakwaters (rubble mound, caisson, berm breakwater).

Apart from the overall financial aspects, there is also the cash-flow problem. For a port authority financing regularly the repair of small damage may be much easier than financing a large repair work. Also the financial resources are usually different. A second point is that there is also damage to third parties, which is not included in the budgeting plan of the port owner.

The design specifications given in national standards and recommendations are not based on cost optimisation analyses but simply reflect common practice. There is a need for a more stringent investigation of the optimum damage risk levels for breakwaters reflecting the circumstance for the individual breakwaters.

Typical cases should be selected for analyses of optimum damage risk levels as a basis for more thorough standards. In doing so, the more difficult steps will be to assess down-time costs and to define structure service lifetime.

This topic has been discussed during the special MarCom session at the Sydney conference. It was suggested to start, as a follow up, a new Working Group which should come up with a report on criteria for the selection of breakwater types and their optimum damage risk level.

The working group has to identify four existing ports in which the following situations exist:

1. A high cost breakwater protecting a port section which has high downtime costs;
2. A low-cost breakwater protecting a port section with high downtime costs;
3. A high-cost breakwater protecting a port section with low downtime costs;
4. A low-cost breakwater protecting a port section with low downtime costs.

For each of the four cases the Working Group has to analyse –by cost optimisation- the optimum design failure probability for the breakwater.

Participants in the Working Group should be:

- representatives from the selected ports, able to estimate down-time costs;
- designers of breakwaters, able to estimate initial and maintenance costs of breakwaters;
- experts in cost optimisation related to probabilistic design of breakwaters.

References:

VAN DER KREEKE, J. AND PAAPE, A [1964] On optimum breakwater design, proc. 9th ICCE
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