A STUDY ON KING ISLAND’S GRASSY RUBBLE-MOUND BREAKWATER TRUNK DESIGN BY ONE-TENTH SCALE MODEL TESTS

BY

FRANS RABUNG
DEPARTMENT OF CIVIL ENGINEERING
HASANUDDIN UNIVERSITY
MAKASSAR, INDONESIA

SUPERVISOR
ASSOCIATE PROFESSOR J.B. HINWOOD
DEPARTMENT OF MECHANICAL ENGINEERING
MONASH UNIVERSITY
CLAYTON VICTORIA 3168
AUSTRALIA

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ABSTRACT

Currently, there is a need felt amongst practising engineers to improve the design methods of rubble-mound breakwaters for both better stability and more economical construction. The large numbers of breakwaters suffering serious damage in the recent years, and the discard of available small stones in the conventional design using large armour rocks, have encouraged research around the world to find new design procedures.

The construction of Grassy’s breakwater in King Island using limited size waste rock from nearby mine, and the improvement of Bruun’s beach profile theory by Dean, had provided an idea to conduct a study. The study was based on the prototype field data, new development in the equilibrium beach theories, and model tests as the main method. The aim of the study was to establish a new design basis for rubble-mound breakwaters based on the equilibrium beach principles, and to predict the future final profile of the prototype after design wave attack.

Tests were conducted on a one-tenth scale model of the trunk of Grassy’s breakwater in Monash University’s large wave flume. Two series of tests were applied, the first was with sinusoidal waves, and the second was with spectral waves. The procedure of the tests followed the prototype carefully both in construction and environmental condition.

The model comprised a mound of rock of two layers, ie the core and armour layers. The core was of continuous gradation with maximum size was less than 2 kg. The armour layer was in the range of 2-10 kg rock with average of 6 kg. The mound was
approximately 2 m in height and 2.2 m width with initially natural dumping slope at the face of incoming waves. The water depth at the location of the model was 1.5 m.

For each series, the condition for the first test was a storm which occurred on 9/10 December 1970 during the construction period; the designed significant wave of 7.6 m high (prototype); and finally, the same design wave was applied after repairing the damage caused by the previous test in order to verify the final equilibrium profile. For each wave height two wave periods were applied, ie 11 and 10 seconds to study the effects of wave periods. The total duration of the tests was not less than 76 hours; this was equivalent to 240 hours in the prototype.

The result showed that the final equilibrium profile had a slope steeper than the one predicted by the conventional Hudson’s equation, thus more economical in the use of material. The result also showed that the stability of the breakwater with the new design procedure was very good.

In general, it can be said that Grassy’s breakwater will act as a beach, but its final profile slope will be slightly different from Dean’s equation. It also can be concluded that the use of equilibrium beach principles will give better stability to rubble-mound breakwaters, and the use of wider range of available material, in turn, will result in more economical construction.