A Field Study of Artificial Sea Forest Using Spar Buoy

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Abstract

Artificial sea forests assembled by spar buoy units are employed to protect eroding sand beaches. The spar buoy is made of PVC pipe, geo-textile sand bag, used car tires, chain or rope and accessories. According to experiences the wave behind the forest becomes smaller and sand will be accreted. Two forests can form a concaved beach which is stable. This may be a new coastal protection structure.

1 Introduction

It is proved that the coastal mangrove forest can mitigate tsunami disaster (Kathiresan and Rajendran, 2005). However, wind waves can be more easily to be diminished by a sea forest. A multiple-layer fences, which is composed of slotted spar buoys, was proposed to serve as a floating breakwater where a lower level stability is required (Liang, Huang and Li, 2004). The spar buoy is constructed as follows:

A pipe made of PVC is closed at one end. Holes are drilled for anchoring at the other end. The semi-closed pipe is aerated from the open end. This pipe becomes a tautly moored spar buoy if the water depth is deep enough. To suppress spar buoy pitching, two slant wires are anchored at the top of the buoy. Successive spar buoys are installed on a line like a slotted vertical column fence. More fences can be added to increase the sheltering effect. Two rods are used to pierce the lower end of the pipe with used tires piled on it to enlarge the cross section and protect the pipe. The transmission coefficient is a function of the porosity, the relative spacing and the number of layers. For a three layer breakwater the transmission coefficient can be kept under 0.3 (Liang, Huang and Li, 2004).

To simplify the installation procedure and to diminish the wave force, the two slant wires/ropes are skipped. The single mooring spar buoy can be an artificial sea tree which is used to set up an artificial sea forest. Sand bags are used as anchorage that there is no need of heavy cranes.
2 Design Concept

There are sand beaches where sand is eroded offshore. This is due to higher wave or larger wave steepness. The erosion causes steeper bottom slope then it erodes more. The trees can be arrayed in layers or just deployed in random. The wave transmission characteristics should be studied in laboratory at first. However, the wave behind the forest should become smaller. According to theories and experiences, sand will be accumulated after the forest (Longuett-Higgins and Stewart, 1964; Sunamura and Horikawa, 1974). Behind a natural offshore rock, a tombolo will be formed (Photo A). For the sea forest, the sea bottom behind will at least become shallower. If another sea forest is installed at some distance from the former one at a similar water depth, then concave contour lines will be formed. The original straight contour lines are extended into longer concave lines (Fig. 1). The wave height will be smaller due to refraction, then more sand will be accumulated on the beach and the beach is protected. Using an artificial sea forest, the spar buoy units have the merits of low cost, free from fishing boat damage, no sand blockage and removable possibility.

3 Field Experiment

The first critical question for this new coastal protection method is: whether the spar buoy unit can be survived during a strong typhoon? A field experiment was executed at the coast of Yan-Liao, which is a restricted area for the cooling water outlet of the 4th Nuclear Power Plant. An installed spar buoy unit is shown in Photo B. The detailed installation procedure will be presented in the Workshop.

4 Reference


Photo A Tombolo behind a natural rock

Fig. 1 Concave contour lines formed by two artificial sea forest
Photo B A spar buoy unit installed at Yan-Liao coast