

DESIGN AND PERFORMANCE OF ARTIFICIAL REEFS AS SUBMERGED BREAKWATERS FOR BEACH STABILIZATION, ECOSYSTEM RESTORATION, AND RECREATION ENHANCEMENT

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INTRODUCTION

This paper presents applications of artificial reefs for ecosystem restoration, submerged breakwaters, and recreation enhancement. Designs and performance of projects constructed over the past 10 years are presented. These projects include post-tsunami and post-hurricane reef restoration with coral rescue and propagation techniques, and artificial reef submerged breakwaters for beach stabilization. Project sites include Florida, Thailand, and Caribbean sites, where recreational and ecotourism amenities are essential design elements.

ARTIFICIAL REEF UNITS

Artificial reef units were originally designed to attract and provide habitat for pelagic and benthic marine life. Both material of opportunity and custom designed reef units have been deployed world-wide. The custom designed reef units offer several potential advantages including designs and methods for unit fabrication, deployment, anchoring to the bottom, and functioning as habitat for selected benthic and pelagic species, including aquaculture applications and propagation of corals. Figure 1 shows post-hurricane coral rescue and propagation in Curacao, N.A. using concrete Reef Ball units.



Figure 1 – Coral Rescue and Propagation

A special concrete mix was developed that allows the concrete reef modules to be deployed within 48 hours of being fabricated, and with special formulations that reduce the concrete pH to match that of natural seawater. The pH balancing and unique textured surface of the reef modules ensures that coral larvae and other marine life can easily attach to the modules to develop into a natural biological reef (see Figure 2).

Anchoring techniques have been developed to increase the stability of the reef units, especially in shallow water, including pins or pilings drilled or jetted into the bottom and articulated mats. This has allowed reef units exposed to direct hits by Category 5 hurricanes to remain stable.



Figure 2 – Coral Growth on Reef Ball after 5 years

SUBMERGED BREAKWATERS

The use of submerged breakwaters for beach stabilization has been increasing in popularity, both in conjunction with or as an alternative to beach nourishment, which may not be technically, economically or environmentally suitable for some sites. Even successful beach nourishment projects such as Miami Beach, Florida have required coastal structures to assist in stabilizing the beach at “hot spots” that erode at higher rates than adjacent areas. Figure 3 shows a Reef Ball artificial reef unit breakwater deployed offshore Grand Cayman, C.I. This and other submerged breakwater projects are presented with details of the designs, installation methods, and project performance.



Figure 3 – Reef Ball Submerged Breakwater

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