COASTAL RESILIENCY: MULTI-TIER PROTECTION SYSTEM & RISK MANAGEMENT STRATEGY

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INTRODUCTION

North Atlantic hurricanes pose a significant threat to Caribbean islands and their low-lying coastal communities through storm surge, long period swells, coastal flooding, and duration wind and rain events. The increasing intensity and frequency of these damaging storms and rising sea levels require advances in the traditional approaches to coastal protection systems and risk management strategies. Adaptation strategies for coastal locations that do not have the option of mitigated retreat due to the significant infrastructure investment require innovative and tailored solutions to combat the threat of these storm events. In this paper, an 18-year case study of a Caribbean island Resort evaluates a long-term cumulative process of providing coastal protection solutions in stepped tiers and assessing their effectiveness over four Category 4 hurricanes (Lenny, 1998; Omar, 2008; Earl, 2010; Matthew, 2016).

The Four Seasons Resort, Nevis employs half of the island's population and is a lead contributor to the island's main revenue stream, tourism. Resort closure due to storm damages results in significant losses for the island government and community (e.g., loss of 40% GDP due to Hurricane Lenny closure).

PROJECT FEATURES

The multi-tiered coastal protection system for the Resort resulted in several unique Project features, including:

- Physical modeling and numerical simulations (MIKE BW, XBEACH)

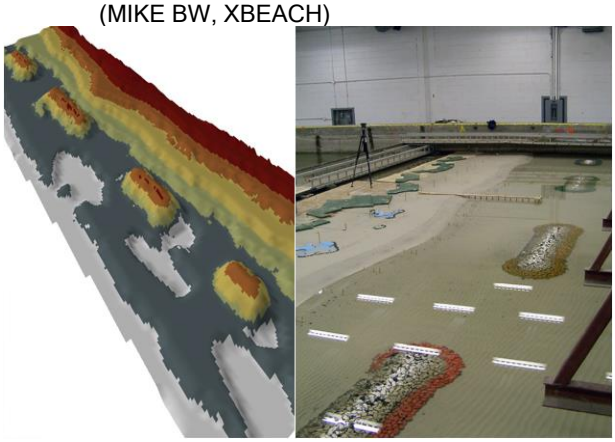

Figure 1 - Bathymetric Survey (L) & Physical Modeling (R)

- Determining design water levels and return periods for anomaly storms & flash flood conditions
- Coastal system response to storms and proactive adaptation measures, including long-term shoreline monitoring
- Challenges of changing ownership/ government
- Storm water management and land use plan
- Biological profiling & using invasive seagrass to the Project's advantage
- Balancing engineered solutions with owner expectations & guest experience

COASTAL SOLUTIONS

The current coastal protection system at the Resort is the result of storm response and proactive damage prevention induced by the four Category 4 storms. The engineered solutions in response to the storms are outlined as follows:

Hurricane Lenny (1998)

- Offshore low-crested breakwaters
- Beach nourishment with vegetated & elevated dune system
- Buried Revetments at critical infrastructure
- Storm water management plan

Hurricane Omar (2008) – Hurricane Earl (2010)

- Beach nourishment & elevated dune system
- Increased pump system capacity

Hurricane Matthew (2016)

- Beach nourishment & elevated dune system
- Pier extension with wave attenuator
- Coastal flood barriers & gates

Figure 2 - Coastal Protection Tiered System

SYSTEM RESPONSE

The level of post-storm damage dropped significantly as a result the multi-tier system approach and subsequent coastal protection installations. It was found that the greatest Return on Investment for protecting Resort infrastructure was to increase dune elevations, resulting in a 20-fold decrease in wave overtopping volumes. Evaluation of all Project elements and their respective response to storms will be presented in the paper. Furthermore, the 2017 hurricane season is currently testing the implemented system. Results will be included in the coastal protection system response analysis.