Harbor Access Road Stabilization Project

Henrick Roman Martinez
Hector J. Cruzado, PhD, PE - Advisor

ABSTRACT

Many location of shoreline erosion have been identified in the United States coast and their territories. AES Puerto Rico Harbor road has eroded and created unstable soil conditions. The California Department of Public Work and the University of California have researched the causes of this erosion and the topographic conditions. Several techniques have been created and implemented to solve the problem worldwide, with effective results, preserving the original shoreline condition. Based in the laboratory soil test result, the proper technique to implement can be Rip Rap and Gabion. The designer has recommended the Rip Rap instead of Gabion. The engineering consultant requested a Joint Permit Application from the United States Corps of Engineer and the Department of Natural and Environmental Resources. The Rip Raps technique demonstrated to be the most adequate and cost effective for the eroded shoreline.

Key Terms *—Gabion, Joint Permit Application, Rip Rap, Shoreline erosion.*

INTRODUCTION

AES Puerto Rico is a Power Plant Coal Generation which has a harbor for unloading 70,000 tons of coal for energy generation. The company personnel's access to the harbor is thru a dirt and gravel road. The road has been eroded and deteriorated by the energy of the naturally occurring tidal wave. Thru the years, the company has been evaluating the possibility of restoring the dirt road without considering the possibility of creating an additional road to cross the harbor and killing mangroves, which are a species protected by the Department of Natural and Environmental Resources. The project consists of the rehabilitation of the existing dirt and gravel road on the western side of the harbor near the Guayama AES Power Plant facilities. The affected road has an exhibits erosion scarp by the energy of the naturally occurring tidal wave avoiding the possibility to drive thru the dirt and gravel road. This has been created a safety issue to our employees driving thru the harbor area. The project main purpose is to restore the dirt and gravel road to its original condition and to install rip rap to stabilize and protect road bank.

PROJECT OBJECTIVE

The project consists of the rehabilitation of the existing dirt and gravel road on the western side of the harbor near the Guayama AES Puerto Rico Power Plant facilities. The affected road has an exhibits erosion scarp by the energy of the naturally occurring tidal wave avoiding the possibility to drive thru the dirt and gravel road. This has been created a safety issue to our employees driving thru the harbor area. AES Puerto Rico Company need to comply with safety standards, the Puerto Rico Highway and Transportation Authority and preservation of the mangrove protected by the Department of Natural and Environmental Resources.

LITERATURE REVIEW

The University Of Santa Cruz Of California has investigated and research several erosion in the coast of state of California. [1] The research has provided vital information for the proper stabilization of the erosion of the coast and several technics that has been implemented base in the geographical condition. Basically six technics has been adopted as engineering coastal armoring structure to prevent erosion and these are:

- Rock riprap.
- Rubble riprap
- Wire-enclosed rock (Gabions).
- Pre-formed blocks.(Seawall)
- Grouted rock.
- Paved Lining.

However there are a natural condition that are affecting the beach line or landform and this are the passive erosion. The passive erosion is described in Figure 1.

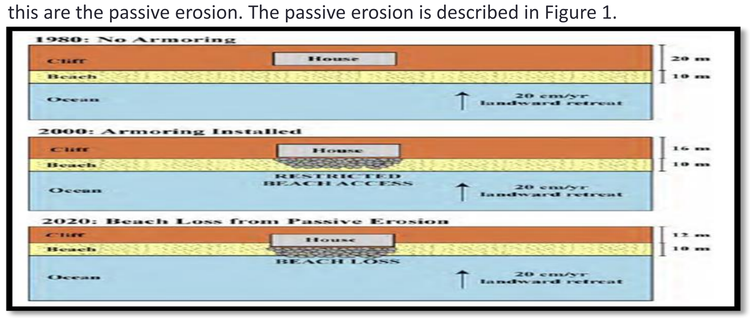


Figure 1
Passive erosion stages

Passive erosion occurs regardless of the type of structure used; riprap and seawalls both fix the coastline and prevent the landward migration of beaches, cliffs, bluffs and dunes. One way to mitigate passive erosion is to nourish beaches with sand from other locations, though this is only a temporary solution to an incessant problem. As an alternative, removing dams from rivers will increase the sediment supply to beaches along much of the California coast [1]

METHODOLOGY

AES Puerto Rico methodology consist in hiring the proper engineering professional and consultant to develop and manage the project thru a successful process. The following method was followed:

- Perform a land survey to identify land stability in the affected area.
- Create designer drawing for construction.
- Acquire consultant services for federal permits.
- COE Permit (United State Corp of Engineer).
- DRNPR Permit (Departamento Recursos Naturales de Puerto Rico) Habitat Categorization.
- Acquire consultant services for local permits (OGP's).
- Construction Permit.
- Environmental Assessment (REA & DEA) (Compliance with Puerto Rico Environmental Public Policy Law).
- General Consolidate Permit (Plan CES, PFE & DS-3).
- Extraction Permit for an Incidental Activity.
- Use Permit.
- Prepare the Scope of Work.
- Perform auction for proposal construction and selection of the contractor.

ANALYSIS

After evaluating the soil condition considering laboratory tests, the engineering group analyzed after completion of the reclamation fill construction, the rip rap rock revetment shall be installed. The rip rap extension and size shall be in accordance with coastal design.

Considering the natural soft soil condition encountered within the site, the same crushed rock fill material could be used to stabilize subgrade within the base of the lower rip rap rock. Figure 2 illustrates a schematic drawing of the herein provided recommendation. Also, a full-time resident field technician is recommended to monitor fill construction. In Figure 3 is a photo of the existing scarp area which will be install the proposed rip rap.

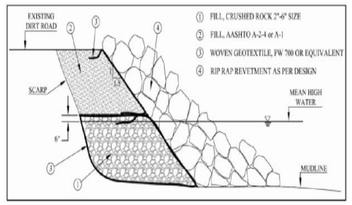
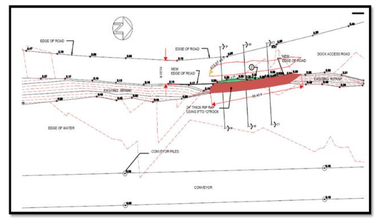


Figure 2
Rip Rap

Figure 3
Harbor road erosion

RESULTS

According to the designer the volume of fill material bellow the Mean High Water (MHW) mark would be approximated 8 cubic meters. Also, 6.5 cubic meters of crushed rock from 8 inches to 12 inches and 1.5 cubic meters of crushed rock from 2 inches to 6 inches were included. There is an area covered with an existing rip rap which will not be affected with the proposed road improvement, however this area will be protected with additional 24 inches rip rap. The length of the existing rip rap area to be improved is approximately 40 meters and the volume of additional rip rap over this existing area would be approximately 95 cubic yards. In Figure 4 the red area represents the affected area on which the rip rap will be installed.



CONCLUSION

The harbor access road stabilization project was one of the most challenging budget projects. The project focused was to stay within the budget, however the main agencies that forced the AES Companies to add more money to their budget was the permitting. The Corps of Engineering and the Department of Natural and Environmental Resources together delayed the process requesting additional information thru our consultant increasing the our proposed budget. However, the local permit was straight forward for the construction. The breakdown construction project is as follow:

- Federal Permit Consultant - $41,900.00
- Local Permit Consultant - $18,000.00
- Designer - $18,000.00
- Contractor -$73,750.00

The total amount of the project estimated are $151,650.00. There was an exceedance of $61,000 approximated. The main purpose of this exceedance was the delay created by the Corps of Engineering that causes the consultant and designer to charge additional work design and consultant working hours.

REFERENCE

[1] Rebecca Stamski (2005). "The Impacts of Coastal Protection Structures in California's Monterey Bay National Marine Sanctuary" P.13