

GEOTEXTILE TUBE REVETMENT WITH TETRAPODS IN MAYU ISLAND, MYANMAR

Hein Thit Aung, Star Engineers United, heinthit.aung@starhigh.com.sg
 Chit Yan Toe, Star Engineers United, chit.yantoe@starhigh.com.sg
 Hendra Hidayat, Geotechnical Systemindo, hendra@ptgsi.com

INTRODUCTION

Mayu Island (formerly known as Oyster Island) is a very small island of 7,284m² located off the north-western coast of Myanmar, Bay of Bengal. It is under the administration of Sittwe District, Rakhine State. The island is formed by sand bars on a shallow rocky plateau. An old lighthouse on the island warns vessels of the rocky waters. During the monsoon months, it is subjected harsh weather with strong winds and waves forces which seasonally shift part of the sand bars. The significant wave heights are predicted to range from 3.0m to 3.5m.

In mid-April 2006, Cyclone Mala had caused partial damages to the stone revetment. Over the years, the raft foundation of the lighthouse was badly affected and starting to give way. In addition, the safety of the Navy personnel stationed on the island is a major concern as well. Therefore, rectification works has to be carried out to protect the island from total destruction. However, the Government's budget is limited and thus hindering a complete rectification for the whole island.

Not only the budget was tight, this project also posed many challenges to the Design Engineers and Project Management team. The harsh weather conditions faced by this remote island is the key challenge which affects most aspects of the operation. From motivating the site workforce to accessibility and to the limited operational hours per day.

To meet these challenges and keeping the cost within budget, a combination of geotextile tubes and layers of rocks were designed to create a robust revetment that is strong enough to withstand the pounding waves. Due to the short operational hours, the contractor had to use a small dredger to fill up a 25m tube in 30 mins.

This paper presents the proven viability of integrating geotextiles tubes into a rock revetment facing harsh weather conditions from the open sea, and the fastest method of filling up geotextile tubes.

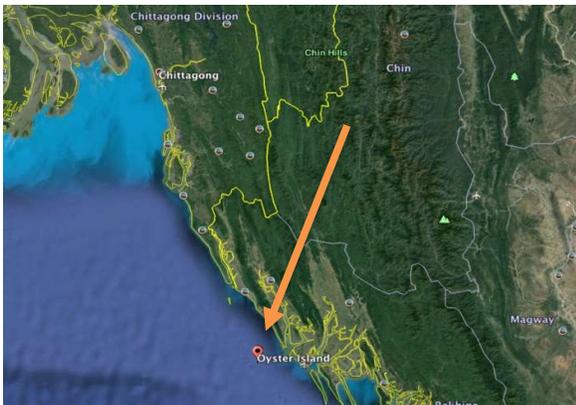


Figure 1: Mayu Island (red point) in the west coast of Myanmar (source: Google Earth).

PROJECT

The use of geotextile tubes as the core of rock revetment is the first case implemented in Myanmar which is functioning extremely well till date. The project lasts from January, 2018 until the beginning of March, 2020, and it was completed by a work force of about 40 staff.

For design calculation, the wave height is assumed to be 4 m. The height of geotubes are determined by the equation

$$a = D (1 - \sqrt{1 - \phi})$$

where a is geotube height, D is diameter of geotube, ϕ is the ratio of filling grade to filling percent (assumed 0.8). The weight of crushed stones is again determined with the equation

$$W = 0.02323 \frac{S_s v^6}{K (S_s - 1)^3}$$

where W is the weight of stone, S_s is specific gravity, v is the surface velocity, K is the coefficient defined by

$$K = \left(1 - \frac{\sin 2\theta}{\sin 2\phi}\right)^{\frac{1}{2}}$$

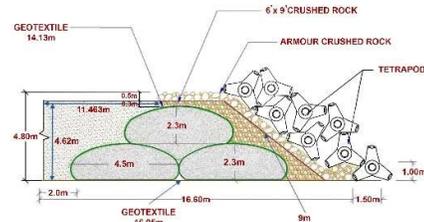


Figure 2: Design of protective measures.

in which θ is revetment slope, and ϕ is the angle of repose. The size of stone (D_s) is calculated by the equation

$$D_{stone} = 0.124 \left(\frac{W}{S_s}\right)^{\frac{1}{3}}$$

The theoretical diameter of the geotextile tube is 4.1m with its height of 2.3m. The sandfills was dredged in Mayu River and brought to the island with a dredger. 21 tubes of 25m were used. Before placing the tetrapods on the geotextile tubes, a non-woven geotextile layer was laid on the geotextile tube, then crushed stones were placed on top of the geotextile tubes to form 3:4 slope. After crushed stones layer, armored rocks were placed up to 0.5 m thick. Finally, 2 layers of 6 ton tetrapods were placed on top of the armor rock layer to form two-layer protection (Figure 2). Finally, 964 tetrapods are installed to break the waves forces. An additional jetty has to be constructed for unloading the tetrapods from the barge.

After one year of construction, significant improvements

are observed such as the decrease of sand loss due to erosion and reduction of wave impacts.

TECHNICAL CHALLENGES

During the project implementation, technical challenges were encountered such as the tidal window and weather conditions causing the operation downtime. As shown in the Figure 3, the mild slope of the island exposed during the low tide hinders the barge that transports the tetrapods. Moreover, the severe weather conditions delay the construction phase. It is, therefore, crucial to be aware of environmental conditions and tidal situations such that the project should be realized in the planned time frame.



Figure 3: Mild slope of the Island exposed during the low tide.

As mentioned earlier, since there is lack of transportation facilities e.g. harbor, jetty, and long navigational channel, the difficulties in transportation of construction materials and staff are encountered. It takes a typical barge carrying the tetrapods 5 hours to arrive the island from the nearest port, Sittwe.

Besides, since there is a lack of measured data for hydro-metro-ocean data for Mayu Island project, it is difficult to produce exact design for construction. Therefore, it is not possible to compare the conditions before and after the construction.

PROJECT COMPLETION

The project is finished on March, 2020. It is expected to protect the island from removal of sands by wave attacks. The Figure 4 depicts the situation immediately after the construction.



Figure 4: Mayu Island after the construction.

ACKNOWLEDGEMENT

The authors are indebted to the Mayu Island project team, especially Win Lwin Moe and Soe Ko Ko, for their efforts and sharing of experience and photos. Last but not least, the authors are grateful to Si Thu Phyo, Managing Director of SHAP, and Darren Lum, Director, of SEU.

REFERENCES

Shore Protection Manual 1984 vol 2 Department of the Army Waterways Experiment Station, Corps of Engineer, *Coastal Engineering Research Center*, 6, 93-98, 7, 16-32, 7,202-249.

Lawson, C.R. 2006. Geotextile Containment for Hydraulic and Environmental Engineering, *Proceedings of 8th Geosynthetics International Conference*, Millpress, Rotterdam. 9-48