

PERFORMANCE OF GEO BAG AND CEMENT CONCRETE BLOCK TO PROTECT RIGHT BANK OF PADMA RIVER AT SHARIATPUR DISTRICT

Kazi Furkan Hossain*¹ and Md. Jahir Uddin²

¹*M.Sc. Student, Department of Civil Engineering, Khulna University of Engineering & Technology, email: kazifurkance@gmail.com*

²*Professor, Department of Civil Engineering, Khulna University of Engineering & Technology, email: jahiruddin@ce.kuet.ac.bd*

***Corresponding Author**

ABSTRACT

River Bank erosion is an acute problem for Bangladesh which intensity rising day by day. A remarkable amount of riverside land is being eroded during the monsoon period for which many people eradicated, destitute and finally affecting on socio economic sides of Bangladesh. Bangladesh water development Board (BWDB) funding a huge amount of money to prevent river erosion works under different places of Bangladesh but there is no remarkable change till now. This research aimed to effectiveness comparison of geo bag and cement concrete (CC) blocks in the river protection works. Geo bag and CC Block area were visited and mentionable information have been collected from the office of the engineers of BWDB and local people regarding the geo bag dumping, CC block dumping and Placing. Finally collected estimated cost of identified area and images of different places of river bank protection works. Based on field data and collecting information analyzed which collect from BWDB engineers and local people. In this research observed geo bag use shows the positives and negative effects on bank erosion and found main causes of failure of geo bag. Mentionable that CC Block much better from geo bag to protect the river bank protection works.

Keywords: *River Bank, Erosion, Protection, CC Block & Geo bag.*

1. INTRODUCTION

Rivers in Bangladesh are morphologically very dynamic. Erosion processes are highly unpredictable and unexpected so that a huge amount of agricultural land is lost in Bangladesh. Bank erosion has been an acute problem in Bangladesh. It is also a great signal to the people especially those who are living in the coastal and vulnerable area. Around 10,000 hectares of land are eroded by rivers per year in Bangladesh and about one million people are being affected. From 1989 to 1992 the maximum erosion rate of the river Jamuna was 21 km² per year and also found an average rate of 13.51 sq. km per year during 1980 to 1989 (Oberhagemann & Hossain 2011, ISSN 2349-4476). Thus a huge amount of property losses in Bangladesh which affect the Bangladesh economic structure. However, complex flow, sediment transport, channel geometry, longitudinal slope, groundwater level, characteristics of bed and bank materials, seepage characteristics, natural and manmade interface in the river bed are main issues for river bank erosion. Generally bank erosion damages a lot of agricultural lands resulting in flooding and other socio-economic problems in the country. Those people who are affected by river bank erosion take shelter in another slum area in cities (Uddin & Basak, 2012).

Bank erosion assessment is the prime objective prior to taking sustainable protective measures against erosion. It is the vital source of sediment deposited at the downstream backwater areas. The erosion process is very active in the Padma River, especially during the pre and post monsoon period and during flooding time. Every year large croplands and numerous habitations and infrastructure experience erosion. Studies find that an increase of 10 percent maximum discharge of the Padma river generates approximately 25 percent increase in riverbank erosion (Islam, M. & Islam, A. 1985). The Padma River is a multi-channel braided river system that frequently develops sand bars and changes in river flow direction. Geographic Information Systems (GIS) and Remote Sensing (RS) are essential tools for detecting changes along coastlines and river bank erosion. The cost of the river bank protection along the Padma river is very expensive.

The Bangladesh Water Development Board (BWDB) has been tried to protect the river bank with its limited resources. Since the early 1970s, bank protection works in the Padma river have been practiced using civil engineering techniques by using concrete or geo bag filling protections. Whereas these techniques proved to be resistant to the flow shear stress in many situations, they are often oversized especially in mountainous streams and reduce considerably the ecological values of the protected bank. BWDB, whose one of the important responsibilities is to arrest bank erosion throughout the country. The organization has implemented a number of river training and bank protection projects on the Padma river (Cavaillé et al. 2013, 2015). Through the migration due to river bank erosion people are losing their social bonding as well as their economic sources becoming impoverished and vulnerable day by day (Chatterjee & Mistri, 2013). Most of the people of India have migrated due to bank erosion of rivers (Iqbal, 2010; Islam, 2016). Many river training institutes in Bangladesh solve river bank erosion problems. At present the popularity of CC blocks to protect river erosion is increasing day by day. Cement concrete (CC) blocks and sand-filled geo bags are used since 1994 as a low cost effective..

2. STUDY AREA

The study area is the right bank of the Padma river of Janjira and Noria Upazila under Shariatpur district which is one of the most vulnerable regions of Bangladesh in terms of riverbank erosion. The Padma river along the Janjira and Noria Upazila has been suffering from river bank erosion since long time. The research was conducted in the definite location at Noria and Janjira Upazila of Shariatpur District. The Bangladesh Water Development Board (BWDB) has taken necessary steps to protect the right bank of the Padma river.

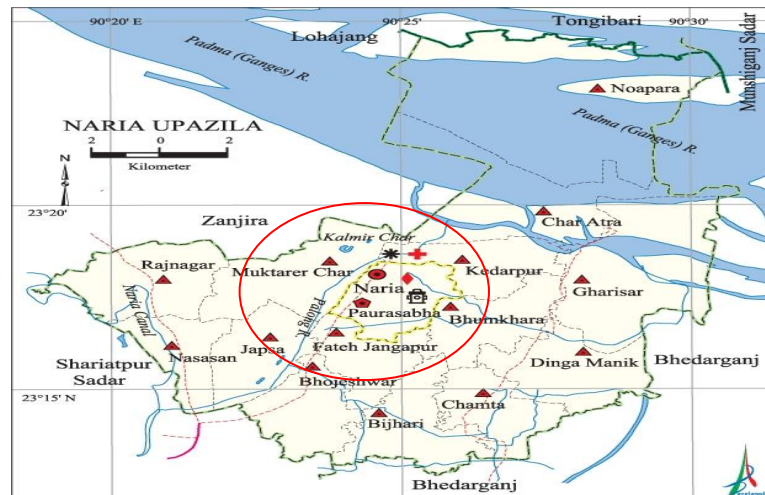


Figure 1: Location Map of Noria & Janjira Upazila, Shariatpur district, Bangladesh

3. METHODOLOGY

This research was carried out using on the field survey, interviews of local Engineering division of BWDB and some local people were involved during the construction and maintenance of bank erosion works. Some working sites were visited to collect the information about processing, preparation, transportation, placing and dumping of geo-bag and concrete blocks. The volume and covering surface area of geo-bags and CC blocks have been calculated in terms of cost.



Figure 2: Primary stage of Geo Bag Filling Mulfatganj, Shariatpur district (10 March 2000)



Figure 3: Final settlement of Geo Bag Filling Chandipur, Shariatpur district (05 March 2001)

In the figure 2 & 3 it is shown that the Initial and Final position of geo bag. The position of geo bag have been changed due to wave action of water. Sometimes geo bag damages due to environmental effect.



Figure 4: Primary stage of CC Block, Shuressor, Shariatpur District (15 November 2000)



Figure 5: Final stage of CC Block, Shuressor, Shariatpur District (15 November 2006)

In the figure 4 & 5 it is shown that the Initial and Final position of CC block. Although the cost of manufacturing and installing CC blocks is high, it will yield good results in the long run. So it can be said that CC block is better than geo bag in terms of longevity as a bank protective materials.

4. RESULTS AND DISCUSSIONS

Based on field surveys, image analysis and interviews, this survey found some positive and negative aspects of both bank security materials and their suitability in certain cases. Also, there is no change for the physical damage to the cement concrete block, the washing and the separate settlement such as geo-bags, but CC blocks are not suitable for emergency dumping. Geo bags filling is very effective for emergency dumping. Cement concrete blocks are used to protect the river banks as they have a higher resistance against scouring or bank erosion process. Sometimes CC blocks has been used like groin or spur are formed as a volumetric structure with a higher surface resistance using and geo-bags to divert the flow direction in order to save the valuable area of the downstream area. On the basis of surface area covering, uses of comparatively smaller sized CC blocks will be more economical than their counterparts. Geo-bags get set physically damaged within few days if they are dumped in the open air where solar radiation can hit them directly.

If sand filled geo-bags are dumped only under the water or they are covered with sand after placing in the river banks then they may last for 10 to 50 years whereas they may not sustain more than two years if they are dumped in the open air or partially in the air and water. In our country geo bag dumping in the sun and monsoon is very regular practice. In dry periods when the water levels in the rivers drop down, geo-bags get exposed to the open air though it was placed under the water during monsoon. Also covering the geo-bags with sand after placing in the field level is not feasible which leads to reduced life span of geo-bags.

If it can be ensured that geo-bags are protected from the solar radiation or dumped only under water, geo-bags are likely to turn out much better than CC blocks in all respects. On the other hand, CC blocks can hold out much longer time than the sand filled geo-bags and geo bags are displaced by heavy wave actions due to own self weight. CC Blocks are very expensive but its longevity is very

high compare to geo bag. However, this study did not deal with bank erosion processes and the interaction of geo-bags or CC block with the flowing streams along the banks.

Table 1: Physical properties and cost of CC blocks (Source- BWDB, Shariatpur, Site Office-2006).

Size (in cm ³)	Volume (m ³)	Coverage Area (m ²)	Mixing Ratio	Manufacturing Cost (BDT)	Average Dumping Cost (BDT)	Total Cost (BDT)
50X50X50	0.125	0.250	1:3:6	1200.27	164.92	1365..19
45X45X45	0.091	0.202	1:3:6	1175.25	155.36	1330.61
40X40X40	0.064	0.160	1:3:6	1155.25	148.25	1303.50

Table 2: Physical properties and cost of geo-bags (Source-BWDB, Shariatpur, Site Office- 2006)

Weight (KG)	Volume (m ³)	Coverage Area (mm ²)	Thickness (mm)	Manufacture Cost (BDT)	Filling cost (BDT)	Average Dumping Cost (BDT)	Total Cost (BDT)
275	0.1825	1325x1050	3	450.75	125.00	40.00	615.75
250	0.166	1200X950	3	435.55	123.30	38.00	596.55
175	0.116	1075X850	3	395.45	118.00	35.00	548.45

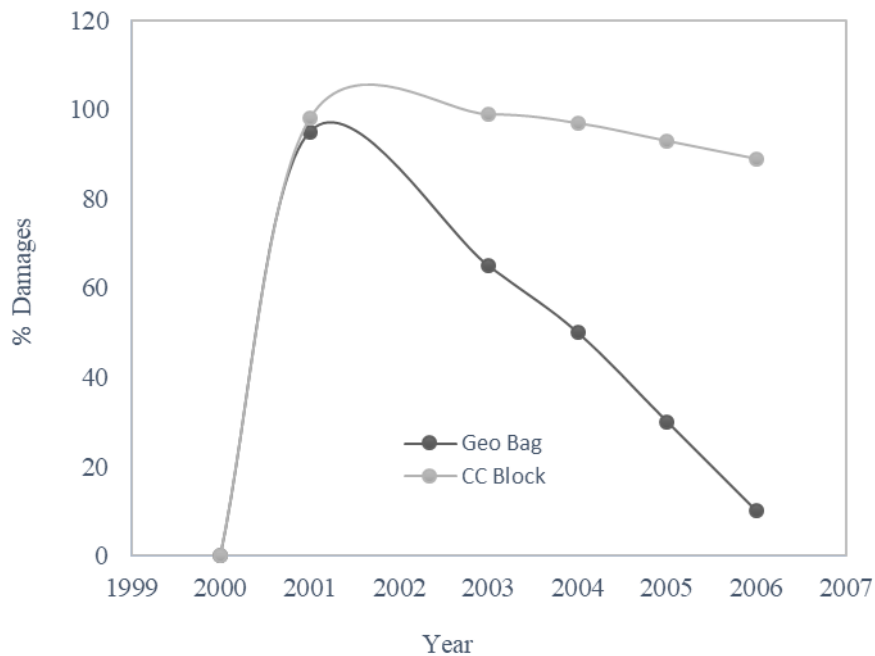


Figure 6: Percentage damages of CC block and Geo bag

Figure 6 presents that the performance of CC Block and geo bag varies over time. It gives effective results for protecting riverbank protection works. One of the main benefits of concrete blocks is its longevity. Concrete blocks are infected with high pressure and vibration, which makes the blocks very strong and able to withstand high levels of load. Concrete blocks are easy to install due to their uniform size and shape. Concrete blocks are very environmentally friendly.

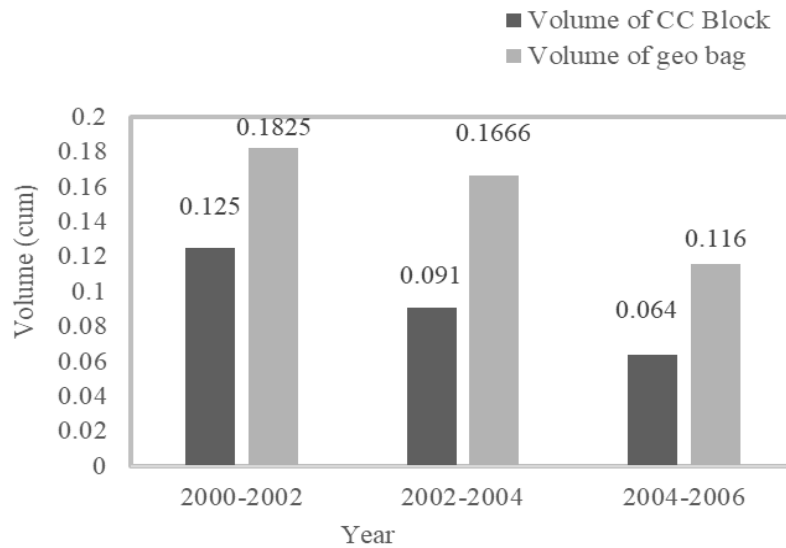


Figure 7: Volume of Geo bag and CC block

In the figure 7 shows that the comparison between volume of geo bags and CC block.

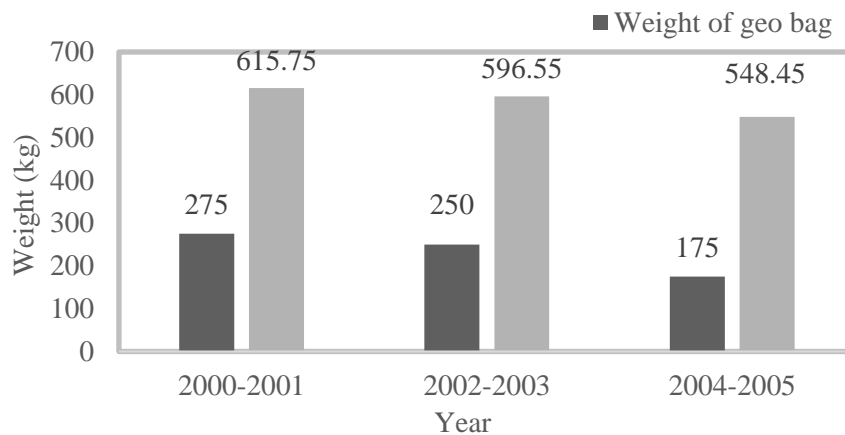


Figure 8: Weight of Geo bag

In the figure 8 it is shown that the changing condition of geo bag and CC block with rate.

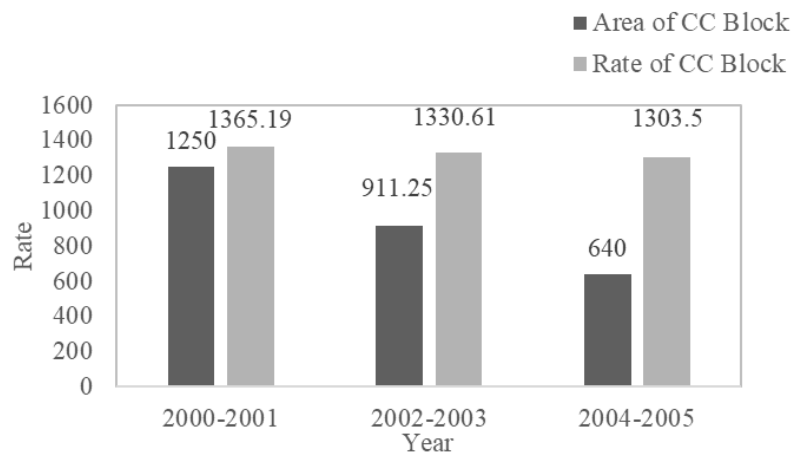


Figure 9: Rate of CC block

In the figure 9 it is shown that the rate of CC block depends on its size. Although the CC block rate is very high, it gives a good and effective result for defending bank security operations. Concrete blocks popularity as a bank protective materials increasing day by day.

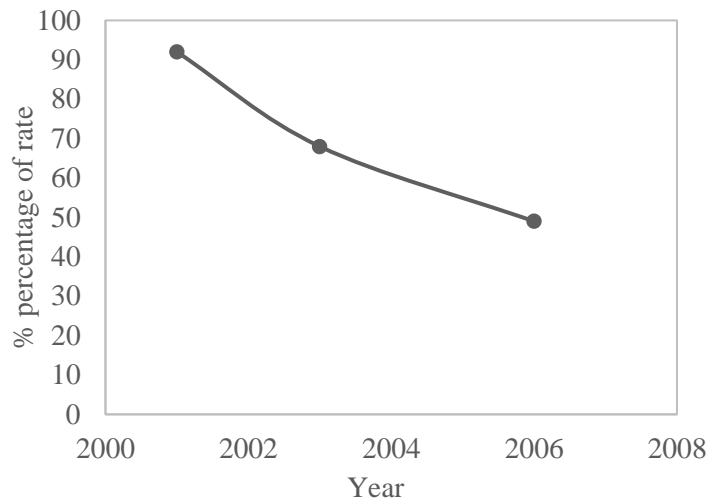


Figure 10: Percentage rate of Geo bag

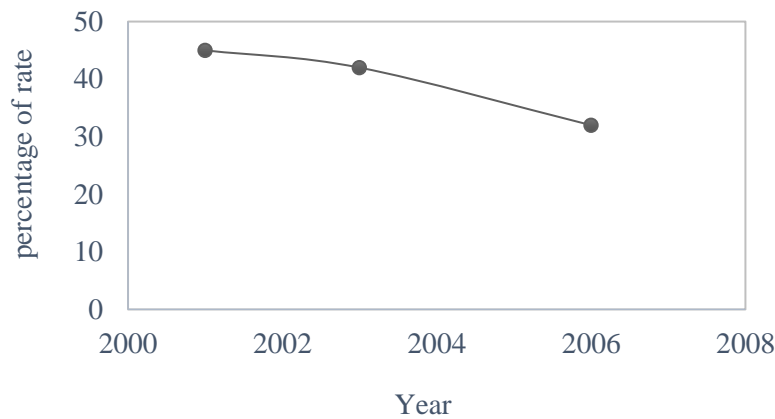


Figure 11: Percentage rate of CC block

In the figure 10 & 11 it is shown that the percentage rate of geo bag and CC block. CC block has been considered as the longevity of most of Bangladesh's projects related to riverbank security.

5. CONSLUSIONS

The main object of this research was to compare the performance between geo bag and cement concrete blocks as a protective-materials. Geo bag and CC Block both are well experienced protective materials but geo bag is effective only for short term or emergency purpose. On the other hand CC blocks is very effective and well balanced for long life.

ACKNOWLEDGEMENTS

The authors would like to give very special thanks to the related representative of BWDB along with their different site offices for providing necessary information, related images of site and supplying documents. The authors also appreciate to the local people for giving the necessary information about different failure modes of both bank protection materials.

REFERENCE

- Chatterjee, S., &Mistri, B. (2013). Impact of river bank erosion on human life: a case study in Shantipur Block, Nadia District, West Bengal. *International Journal of Humanities and Social Science Invention*, 2(8), 108-111.
- Cavallé, P.; Dommaget, F.; Daumergue, N.; Loucougaray, G.; Spiegelberger, T.; Tabacchi, E. &Evette, A. Biodiversity assessment following a natural gradient of riverbank protection structures in French prealps rivers *Ecological Engineering*, Elsevier BV, 2013, 53, 23-30
- Cavallé, P.; Ducasse, L.; Breton, V.; Dommaget, F.; Tabacchi, E. &Evette, A. Functional and taxonomic plant diversity for riverbank protection works: Bioengineering techniques close to natural banks and beyond hard engineering *Journal of Environmental Management*, Elsevier BV, 2015, 151, 65-75
- International Journal of Engineering Technology, Management and Applied Sciences*
www.ijetmas.com December 2016, Volume 4, Issue 12, ISSN 2349-4476
- Islam, A. R. M. T. (2016). Assessment of fluvial channel dynamics of Padma River in Northwestern Bangladesh. *Universal Journal of Geoscience*, 4(2), 41-49.
- Iqbal, S. (2010). Flood and erosion induced population displacements: a socio-economic case study in the Gangetic riverine tract at Malda District, West Bengal, India. *Journal of Human Ecology*, 30(3), 201-211.
- Islam, M. and Islam, A. (1985) A Brief Account of Bank Erosion, Model Studies and Bank Protective Works in Bangladesh. *REIS Newsletter*, 2, 11-13
- Nath, B. Naznin, S.N. and Paul, A. (2013) Trends Analysis of River Bank Erosion at Chandpur, Bangladesh: A Remote Sensing and GIS Approach. *International Journal of Geomatics and Geosciences*, 3, 454-463.
- Oberhagemann, K., & Hossain, M. M. (2011). Geotextile bag revetments for large rivers in Bangladesh. *Geotextiles and Geomembranes*, 29(4), 402-414.
- Uddin, A. F. M. A., & Basak, J. K. (2012). Effects of riverbank erosion on livelihood. *Unnayan Onneshan-The Innovators: Dhaka, Bangladesh*.