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RIVERBANK PROTECTION USING CONCRETE BLOCK REVETMENT SYSTEM

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Abstract : "The river guide bund protection work was undertaken using Articulating Block (AB) concrete mattress for guide bund and embankment structures upstream and downstream of the location of a new bridge structure over the Jia Bharali River. It is observed during the project that for seamless construction and proper quality control, it is better that the fabric form is prefabricated at a manufacturing unit only including assembling and installation of the steel cable reinforcement into it, and the fabric form is supplied in the form of tailor-made panels (not in mill width only) to suit the site geometry and measurement and on-site stitching or sewing of material is avoided. In addition to the advantages offered by this system in terms of stability, flexibility, durability and no maintenance, the Tech-Revetment technology is observed to have performed satisfactorily after installation thus making a strong case for its adoption in erosion control works along river front infrastructure".

***IndexTerms* – River, Protection, installation, infrastrcuture.**

I. INTRODUCTION

River erosion is one of the major natural disasters facing the country, located in the north-eastern part of India. One hundred years ago the mighty Brahmaputra River, which flows for 740 kilo-meter across Assam, has shown a general trend of expansion over more than 4,500 villages. The Brahmaputra which used to occupy about 4100 km^2 in 1921 has expanded to about 6100 km^2 in 2011 on the flood plains of Assam [1]. Brahmaputra and its many tributaries to the north bank are largely based on the Himalayas.
A case study [8] on embankment breaching in the Moyna drainage basin zone in "West Bengal, India, investigated the physical, mechanical and geotechnology properties of the embankment material and examined existing design methodology for embankment stability analysis. As locally available soils were used in the construction of clay sheets, the study found that the geotechnical properties of building materials needed to be improved using additives or reinforcing materials such as soil-cement, natural fibres or geosynthetic fibre. It is also recommended to use geotextile bags, cement composites that strengthen embankment slope protection".

1.2 TECH-REVETMENT SYSTEM

Erosion protection is an important preventive measure that ensures stability of water-front infrastructure. "Tech-Revetment is a fabric formed concrete grouted mattress system which is pre-engineered in the factory and used for permanent erosion protection works. Depending on project requirements, design considerations and specific application, the type of fabric form can be designed and prefabricated at the factory and delivered to job sites. This technology has been used to protect culverts, dams, dikes, roadway and railway embankments, bridge piers, spillways, underwater pipelines, dry and wet embankments and other hydraulic and marine structures from the forces of flowing water and wave action. It is also used to protect bridge abutments against scour, flood bank and bed protection of major rivers and waterways, lining of canals and for mining and industrial erosion protection and lining applications, to protect geo membranes and geosynthetic clay liners from mechanical damage in landfills, reservoirs, sewage lagoons, ash pits, cooling ponds, and other containment, capping and environmental applications. This system can be installed at rapid speed even under water without the need for dewatering. Tech-Revetment is installed by positioning specially constructed fabric formwork over the areas to be protected followed by pumping high-strength, fine aggregate concrete into the formwork.

This system can be installed at rapid speed and under water without the need for dewatering". In this study a case study is presented in which Tech-Revetment was adopted for permanent erosion protection works.

Fig. 1. Installed Tech-Revetment System

1.3 COMPONENTS OF TECH-REVETMENT SYSTEM

Nonwoven Geotextile as separator layer as per design: Non-woven geotextiles are produced by bonding materials, either chemical or thermal, needle piercing or other methods. They are made of synthetics and are often used in filtration or partition systems. Non-woven geotextiles are generally not suitable for equilibrium or reinforcement projects. They are often used to protect the geomembrane lining systems from internal and external entrances. non-woven geotextile will fall faster than its woven counterparts. However, in projects where water consolidation is a major concern, non-woven geotextiles may be the right choice.

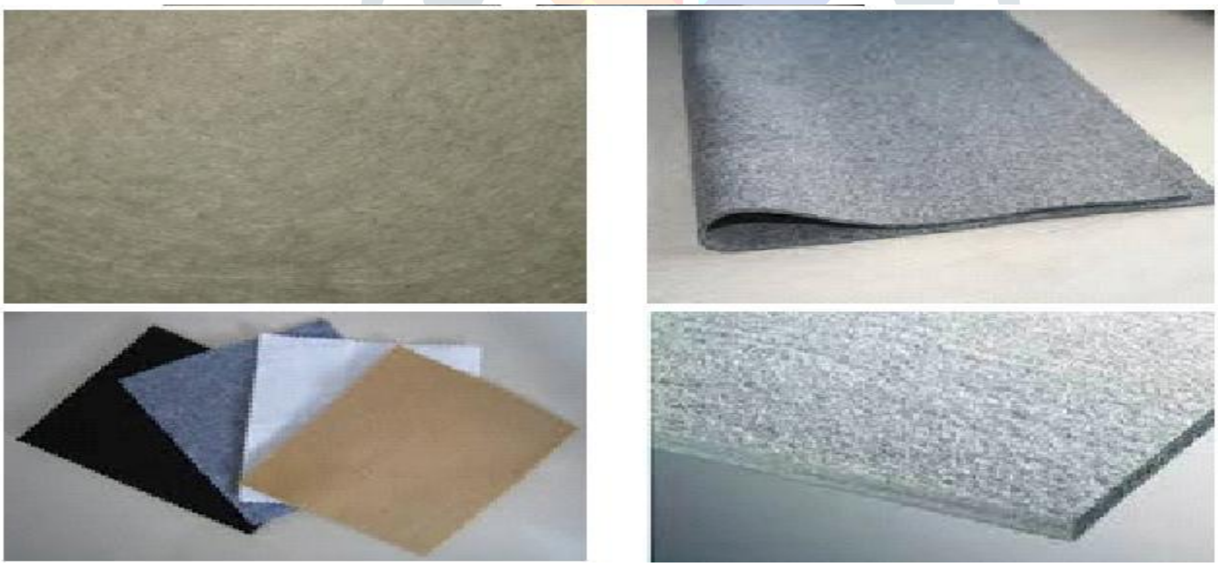

Fig. 2. Non-Woven Geotextiles

Flexible Geotextile Concrete Former (made of Polyester woven geotextile – double layered) as per hydraulic design: These kinds of geotextiles are made by weaving. Each thread, be it monofilaments, fibrillated yarns, slit films or other material, is stitched together to loom one large, identical piece. This process gives the geotextiles woven a large load, making it ideal for projects such as road construction. Weaving threads or films together means that the geotextiles are less aggressive, making them less suitable for projects where drainage is important. The same feature makes them ideal for erosion control projects where water should be allowed to pass over a surface without draining through to the soil below. Woven geotextiles will also resist corrosion and comply to long-term applications.

Fig. 3. Installation of Woven Geotextiles

Flow-able fine aggregate concrete as per design: "Flowable fill concrete is a self-compacting cementitious slurry consisting of a mixture of fine aggregate or filler, water, and cementitious material which is used pumped/grouted to fill into the reinforced woven geotextile to form solid concrete articulating block".

2.1 LITERATURE REVIEW

2.1.1 "JAMES R. LEECH, STEVEN R. ABT, CHRISTOPHER I. THORNTON, AND PHIL G. COMBS, 1999 [12]"

There is a requirement of providing the flood protection while maintaining stable beds and banks in the river system, stabilizing groundwater dams and floodplains, and stabilizing road or railway barriers and transportation systems. Another way to provide erosion protection and stabilization of station banks, bars and spills is to prevent concrete block systems. There are many identified concrete block systems that stabilize bank reinforcement. However, prior to field installation there are several methods available to test the effectiveness of these block systems. For designer to assist in predicting the suitability of a particular site, a series of hydraulic testing protocols are designed for analysis of system performance. Two block system test principles have been introduced that show how hydraulic block features can be determined and provide performance assurance to both designers and owner.

2.1.2 "OBERHAGEMANN, KNUT; STEVENS, M. A.; HAQUE, S. M. S.; FAISAL, M. A., 2006 [13]"

The main rivers in the mountainous region of Bangladesh reach a depth of 100 feet [30 m], and they strike even deeper. The strong currents of the rivers wash the fine sand from the toe, steeping its slope. "The upper bank then fails as a slide wedge or in some cases as a slide wedge. The river removes the slide material from the toe of the slope and the erosion process repeats itself. On the Juna River, banks have retreated for more than 1 km in one year. In addition, there are many small rivers with similar sand banks. In this country, bank erosion is a pandemic. Traditional bank erosion protection is very expensive for almost all applications in major rivers. Costs ranged from USD 29 M to 6 M per kilometer of horizontally protected bank. There is a lack of local concrete integration; there is no proper rock to mature; no heavy marine construction equipment; heavy river currents; and great depth of protection. Instead, the country's resources are sand, workers, and information about simple floating machines. Geobags - geotextile bags filled with fine river sand - works to reduce costs to the right level of protection. Initially, geotextile cloth was imported in large quantities. Now, it is also being produced locally. Here are described the ongoing efforts to protect the Padna Irrigation and Rural Development Project (PIRDP) with geobags along the Juna River". Another project at the confluence of the Padma and Upper Meghna Rivers was similarly protected at the same time, but is not reported it the study.

2.1.3 "MAMINUL HAQUE SARKER, JAKIA AKTER, AND MD. RUKNUL FERDAOUS, 2011 [14]"

Different types of bank protection works were tried with different construction materials to obtain an economic but sustained solution for the Jamuna River. "This article attempts to evaluate the overall performance of different types of structures constructed with different materials along both banks of the Jamuna River in reducing the river bank erosion. Satellite images were taken to understand the natural processes of erosion at the bank along both sides of the river. Satellite images were also used to assess the performance of individual structures. Many of the bank protection works have been sitting idle for several years within a protecting shell of attached bar and some of those are only exposed to minor braided channels. The performance/stability of those structures could not be assessed using their age. Rather the number of years of exposure to the flow of the major braided channels has been considered as indicator of the stability of the structure". The results of this study will help to understand the natural process and guide the selection of appropriate interventions for further bank protection works.

3.1 CONCLUSIONS AND FUTURE SCOPE

Conclusion

This paper presents a case study of 600 m length of permanent erosion and scour protection works for a guide bund where Tech-Revetment technology was adopted. "The river guide bund protection work was undertaken using Articulating Block (AB) concrete mattress for guide bund and embankment structures upstream and downstream of the location of a new bridge structure over the Jia Bharali River. It is observed during the project that for seamless construction and proper quality control, it is better that the fabric form is prefabricated at a manufacturing unit only including assembling and installation of the steel cable reinforcement into it, and the fabric form is supplied in the form of tailor-made panels (not in mill width only) to suit the site geometry and measurement and on-site stitching or sewing of material is avoided. In addition to the advantages offered by this system in terms of stability, flexibility, durability and no maintenance, the Tech-Revetment technology is observed to have performed satisfactorily after installation thus making a strong case for its adoption in erosion control works along river front infrastructure".

Future Scope

The river bank protection measures with bed apron using geotextile bags, although effective in protecting an intended area, has the potential of pushing the erosion problem towards the downstream area of the same bank. Such project planning needs to include measures to reduce downstream bank erosion particularly if the geotechnical properties of the bank soil in the downstream stretch are found to be poor or river protection measures using similar Tech-revetment system may be adopted for suitable length on downstream/other side of the river also. Further, more practical experience at various loading conditions is still needed.

REFERENCES

[1] Mitra AK (2010) Brahmaputra river—flood and erosion management in Assam. In: Proceeding of 26th National Convention of Civil Engineering organized by the Institution of Engineers (India), Guwahati, pp 59–73.

[2] Kotoky P, Bezbaruah D, Baruah J, Sarma JN (2005) Nature of bank erosion along the Brahmaputra river channel, Assam, India. Curr Sci 88(4):634–640.

[3] Gogoi C, Goswami DC (2013) A study on bank erosion and bank line migration pattern of the Subansiri river in Assam using remote sensing and GIS technology. Int J Eng Sci 2(9):1–6 (ISSN(e): 2319–1813).

[4] Sarkar A, Garg RD, Sharma N (2012) RS-GIS based assessment of river dynamics of Brahmaputra river in India. J Water Resour Prot 4:63–72. doi:10.4236/jwarp.2012.42008.

[5] Goswami U, Sarma JN, Patgiri AD (1999) River channel changes of the Subansiri in Assam, India. Geomorphology 30:227–244.

[6] Talukdar R (2011) Geomorphological study of the Jia Bharali river catchment, N.E. India. PhD thesis, Gauhati University. http://hdl.handle.net/10603/5456.

[7] Gogoi C (2013) Environmental geomorphology and natural hazards of the lower Subansiri basin. PhD thesis, Gauhati University. http://hdl.handle.net/10603/50837.

[8] Mondal M, Bhunia GS, Shit PK (2012) Vulnerability analysis of embankment breaching—a case study of Moyna drainage basin in Prurba Medinipur, West Bengal, India. Int J Geol Earth Environ Sci 2(3):89–102 (ISSN: 2277-2081).

[9] Maurya S, Gupta M, Kumar N (2013) Use of geosynthetics in restoration and bank protection from Dhola-Hatiguli to Rohmoria along the river Brahmaputra—a case study. Int J Latest Trends Eng Technol 3(1):136–144 (ISSN: 2278-621X).

[10] Iverson NR (2010) Shear resistance and continuity of subglacial till: hydrology rules. J Glaciol 56(200):1104–1114.

[11] Das N, Wadadar S (2012) Impact of bank material on channel characteristics: a case study from Tripura north-east India. Arch Appl Sci Res 4(1):99–110 mm

[12] Leech, J. R., Abt, S. R., Thornton, C. I., & Combs, P. G. (1999). DEVELOPING CONFIDENCE IN CONCRETE REVETMENT PRODUCTS FOR BANK STABILIZATION. Journal of the American Water Resources Association, 35(4), 877–885. doi:10.1111/j.1752-1688.1999.tb04181.x

[13] Oberhagemann, Knut, et al. "Geobags for Riverbank Protection." Proceedings 3rd International Conference on Scour and Erosion (ICSE-3). November 1-3, 2006, Amsterdam, The Netherlands. 2006.

[14] Sarker, Maminul Haque, Jakia Akter, and Md Ruknul. "River bank protection measures in the Brahmaputra-Jamuna River: Bangladesh experience." International Seminar on'River, Society and Sustainable Development, Dibrugarh University, India. Vol. 121. 2011.

[15] Nakagawa, H., Zhang, H., Baba, Y., Kawaike, K., & Teraguchi, H. (2013). Hydraulic characteristics of typical bank-protection works along the Brahmaputra/Jamuna River, Bangladesh. Journal of Flood Risk Management, 6(4), 345–359. doi:10.1111/jfr3.12021.

[16] Das, Utpal Kumar. "A Case Study on Performance of Jia Bharali River Bank Protection Measure Using Geotextile Bags." International Journal of Geosynthetics and Ground Engineering 2.2 (2016): 12.

[17] Saikia, Lalit. Sediment properties and processes influencing key geo-environmental aspects of a large alluvial river, the Brahmaputra in Assam. Diss. 2017.

[18] Oberhagemann, Knut, A. M. Haque, and Angela Thompson. "A Century of Riverbank Protection and River Training in Bangladesh." Water 12.11 (2020): 3018.

[19] Chang, J.-Y., & Feng, S.-J. (2020). Dynamic shear behaviours of textured geomembrane/nonwoven geotextile interface under cyclic loading. Geotextiles and Geomembranes. doi:10.1016/j.geotexmem.2020.10.010.

[20] Duc, N. Viet. "Improving the Mechanical Performance of Shell Precast Concrete Blocks for Coastal Protection Structures of Hydraulic Works." Engineering, Technology & Applied Science Research 11.1 (2021): 6787-6791.

[21] Kafle, Mukesh Raj. "Critical Review and Improvement of Bank Protection Methods in Nepalese Rivers." Journal of the Institute of Engineering 16.1 (2021): 15-25.