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RIVERBANK PROTECTION USING SAND FILLED GEOBAGS

[1]Vishal Chopra, [2]Vinod Kumar Sonthwal,

[1]Student of M.E CTM, [2]Associate Professor,
[1]Department of Civil Engineering,
[1]National Institute of Technical Teachers Training and Research, Chandigarh, India

Abstract : Geobags are generally filled with sand, sometimes geotextile containers, having mass nearly 1000 to 1500 kg. Geobags are used to create long guiding revetments along sand-bed rivers, having the advantage of acting as both the filter layer and the protection element against scour and erosion (6; 16). Geobags have been found to be a viable solution for riverbank erosion in sand-bed rivers. The success of the geobag revetments is credited to some unique qualities of the geobags, primarily, geobags' resistance against winnowing in the self-launching, underwater apron due to the flexible and porous nature of the bags. The scour that occurs at the toe of the apron undermines the covered bed, and causes the geobags to 'launch' down the eroded slope**.** Using physical model tests, this study re-examined the stability of geobags under current loading. The study used larger scaled elements than previous tests in order to capture the flexibility of the geobags in the experiment. The following conclusions have been made from this study. First, dumped geobags are much more stable than orderly placed bags. Second, the current USACE stability formula can be improved in order to better predict the incipient motion of geobags. We proposed that the geobag thickness be used as the characteristic diameter as it is a more intuitive way to describe how the geobag obstructs the oncoming flow.

***IndexTerms* – Geobags, protection, characteristic, flexible.**

I. Introduction

In 2005 Northwest Hydraulic Consultants (NHC) conducted model tests to analyze the stability of the geobag (4). Additional physical model studies were conducted by NHC 2010 (8). Both studies used small geobags, with an average weight of 1:20 with 126 kg, 90 kg and 38 kg geobag (38 × 28 × 9.5 mm, 34 × 25 × 9 mm and 25 × 19 × 7 mm, respectively). The geobags of the models show a lack of presence, which is likely that the size of the full grain grains is much larger compared to the size of the measured bags. As a result of these studies, the modified USACE formula is currently being used in Bangladesh to increase geobags to protect the river bank

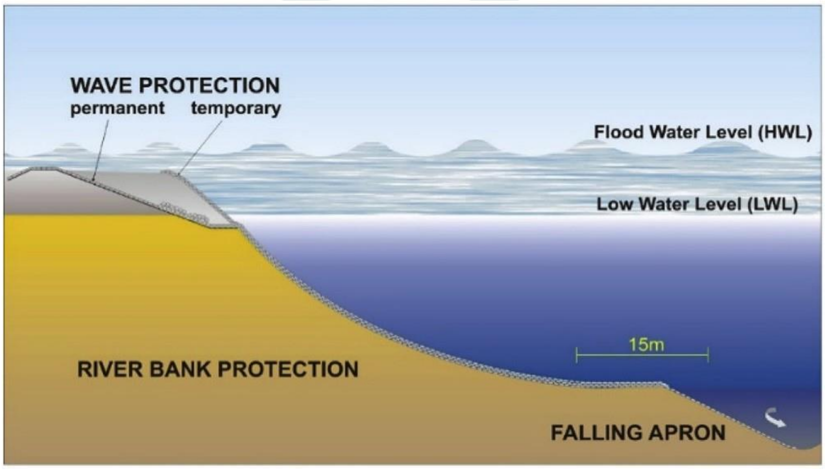

Fig. 1. Schematic diagram of geobag revetments.

(2) discuss geobags resistance to current attacks and the need for additional testing details of the final construction recommendations and recommended computers for the stability of geobags based on the engineer's decision applied. Contrary to the NHC's proposed approach, (13) provided guidelines for measuring geobags with current loading based on Pilarczyk's formula. The sizes of the funds proposed by the guide are more sensitive than those recommended by the USACE formula. The built-in demolition view shows that smaller bags are more stable at higher speeds than the suggested direction. Figure 2 shows the density of velocity potential on the surface in addition to the existing geobag exposure, collected from oat track data. It can be seen from the view that

high velocity values of up to 3.4 m / s are recorded over 125 kg of solid geobag stairs. According to the relationship provided by (13) the 125 kg bag starts to become unstable on the surface of 3 m / s. According to the relationship provided by (8), the 125 kg bag does not fit well at 3.7 m / s at a depth of 5 m.

Further research has been done on the behavior of geobag in open channels. (3) basically, two formulas were found to describe the onset of geobags acquisition movement. They deal with the problem of initiating geobag movement in a simple way using rectangular-shaped bags on the face and using the speed of depth measurement as a critical velocity. (11) studied circular bag movement machines for failing to use laboratory tests. The model captured the mechanisms for the failure of geobags and detected dragging and lifting bag contracts and analyzed the hardness values of geobag areas. It did not display any formulas for resistance to the acquisition movement. Also, the study focused on the arrangement of geobags, similar to those found on the upper water slopes where the bags are placed, but unlike the discarded bags found in deeper parts. Pulling and lifting a simple partner cannot be used in discarded bags because the elements have an uneven shape. In addition, small measuring bags, 103 × 70 mm in size, 1.03 × 0.70 m, 126 kg field bags were used.

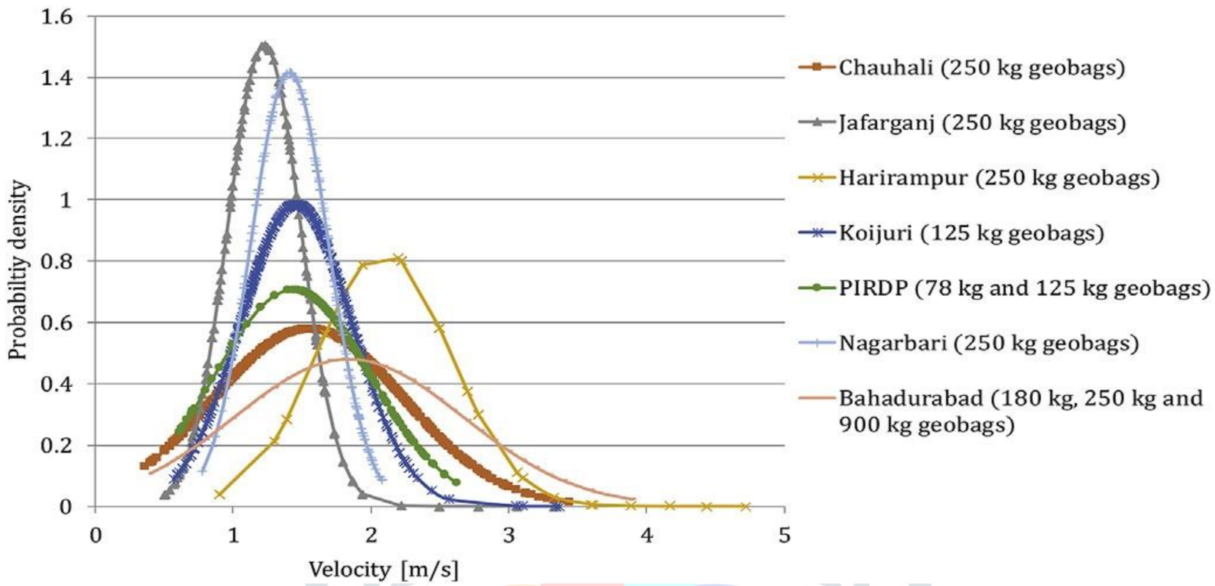

Fig. 2. High-speed distribution of track research data of more than seven levels of geobag in Lower Brahmaputra.

With the widespread use of geobags such as those used in the mighty Brahmaputra River in India and Bangladesh, there is a great need to understand how river and bags interact, and to increase bag size to prevent entry. If the separating elements that include the revetment fail, a local blow can occur and cause a structural failure. Using experimental model experiments, this study analyzed what velocity expressed the movement of geobag acquisition objects and also examined how geobags were measured. Contrary to previous work, this study used larger geobags in the scaled model to better capture the performance of the bags. In this paper, after a discussion of geobag applications on the Brahmaputra River, the previous setup is described. An example of measuring data and detailed analysis is presented next. The results of geobags measurement results are also discussed and future research needs to be identified.

II. NEED OF GEOBAGS IN SOIL STABILIZATION

Geobags can be filled with sand or gravel (or cement, perhaps). Bags can vary in shapes and sizes, varies from known sandbags for emergency dikes to large flat shapes or separate "sausages" (see Figure 3). The most common use for sandbags in hydraulic engineering is designed for temporary structures. Use of bags filled with sand- or cement, among other items:

- Corrective actions (see Figure 3).
- Increased slopes and toe formation.
- Temporary or permanent groynes and offshore breakwaters.
- temporary dikes surrounding dredged material containment areas.

Because this item is easy to use and cheap, it is extremely suitable for temporary system. Groyne training is a good example. The performance of a groyne is difficult to predict. That's why it's a good idea to do such a construction using a cheap product first, to see how something works, and later to improve or, after some time, a permanent structure. Above a velocity of 1.5 m/s, sand-filled geosystems cannot be used because the sand in the systems is no longer stable internally. When installing geosystems, one must be careful that this does not happen on a bad basis. Sharp objects can easily damage the size of objects. Geosystems should not be fully charged. With a filling rate of about 75% complete stability of the material is achieved. Sensitive soil protection is required when using sausages (sandstones) in situations where they are prone to flow or waves.
The first indication of stability, according to small tests, is given below:

- Stability on slopes

$$\left(\frac{H_s}{\Delta D}\right)_{cr} = \frac{2.5}{\sqrt{\xi_{op}}}$$

In sand-filled bags the relative density including water in pores (Δ=1).

- Stability of crest features of breakwaters around SWL (for units lying parallel to the axis of a structure)

$$H/\Delta\, b = 1$$

Where ‘b’ is the width of the unit.

III. LITERATURE REVIEW

2.1.1 “J. GRUNE, U. SPARBOOM, R. SCHMIDT-KOPPENHAGEN, Z. WANG AND H. OUMERACI, 2007 [5]”

Monopile structures for marine wind turbines set up on a moving sand bed are affected by the disease mainly due to the waves. New helmet protection has been proposed using geotextile sand containers. A system for researching the stability of such barriers to protection has been launched recently. Examination of large models is performed on the Large Wave Channel (GWK) of the Coastal Research Center (FZK). The basic test series is made up of a single container of geotextile sand and container groups with different vessel metals, varying in size and percentage of filling. Preliminary results are reported, indicating the influence of the fill percentage and the direction of the wave flow. In addition, initial measurements in the construction of sand containers are proposed as a means of generating energy depending on wavelength and percentage of filling.

2.1.2 “MOHAMED ELKHOLY AND M. HANIF CHAUDHRY, F.ASCE, 2011 [11]”

Experimental tests to understand the mechanical movements of large sandbags and to mimic their adjustment methods are reported in this paper along with details of the test setup and procedures. Two high-definition charge-coupled device (CCD) cameras record sandbags on the side of the glass water tank and digital particle tracking velocimetry (DPTV software on geobag revetment performance reported in the accompanying paper. a set of quasi-physical run models and delivery limits) was developed and a process was performed to determine the speed of settling bags. The coefficients for drag and extension of the mas are estimated at sandbags and the values of the additional coefficient-mas are compared to those of the solid sectors. Unit weight adjustments and drag-equity adjustment methods are being investigated to mimic the behavior of permitted sandbags. The results show that the unit weight adjustment provides better results than the coefficient adjustment approach, when the reduction of the pull coefficient due to porosity is considered and the effect of the sandwich bag on the coefficient of gravity is small and ignored. A descriptive statistical estimate of the percentage increase in the unit weight of the sacks used is presented.

2.1.3 “AYSHA AKTER; GARETH PENDER; GRANT WRIGHT; AND MARTIN CRAPPER, 2013a [14]”

To improve the basic understanding of the operation of geobags at high altitude, the laboratory testing system was performed using both a fixed bed and a mobile sewage bed. In the experimental study, 600 bags were used to construct the geobag exposure, and failure mechanisms were identified with these two-bed adjustments. In general, there was a common tendency for both bed adjustments (i.e., lifting, turbulent explosions - caused by voidment flow, overflow, discharge, and / or internal sliding), but in the case of a mobile bed, toe has a significant negative impact on geobag performance. To expand the laboratory-measured laboratory parameters, a distribution measurement system (CES) was used. The CES model was validated by a fixed bed test, and the validated model was then used to predict the design of the mobile bed. CES bed predictions have been used to produce an ineffective diagram under the geobag - the flow of water for the formation of the bed under the geobag link - flow water-riverbank. It is concluded that CES can be a useful and effective tool in monitoring hydraulic and bed structure parameters. In the next phase of the study, the evaluation of the test program will be used to validate a different geobag revetment material model, which will be used to help improve the design direction of the geobag design.

2.1.4 “AYSHA AKTER; MARTIN CRAPPER; GARETH PENDER; GRANT WRIGHT; AND WAISAM WONG, 2013b [15]”

Extensive research was conducted involving laboratory tests and the use of computer-assisted computer (CES) software to predict effective shear pressure on geobags and the formation of a mobile sand bed. CES can predict the mid-range explosion in laboratory measurements with precision accuracy. This paper reports on the second part of the study, which deals with the imitation of discrete element modelling (DEM). CES results have been used to prepare a map velocity field for the purpose of DEM integration of geobag revetment failure. An authorized DEM model can accurately pinpoint the location of a sensitive bag at various water depths and in different bed formats. The toe, which is one of the major factors of exposure to exposure, and its impact on the layers under the bags were also well represented in this DEM model. It is envisaged that the use of the DEM model will provide more details on the operation of geobag sites along river banks.

IV. CONCLUSIONS AND FUTURE SCOPE

Using physical model tests, this study re-examined the stability of geobags under current loading. The study used larger scaled elements than previous tests in order to capture the flexibility of the geobags in the experiment. The following conclusions have been made from this study. First, dumped geobags are much more stable than orderly placed bags. Second, the current USACE stability formula can be improved in order to better predict the incipient motion of geobags. We proposed that the geobag thickness be used as the characteristic diameter as it is a more intuitive way to describe how the geobag obstructs the oncoming flow. Additionally, the stability coefficient in the formula should be adjusted to account for the filling percentage of the bags. These results confirm suggestions originally proposed by (2).

Although these adjustments may fix some of the issues designers face using the USACE sizing formula, there are still limitations to its applicability. The USACE relationship suggests that bag sizes get smaller as the channel becomes deeper. Points in the Brahmaputra can be extremely deep (up to 70 m depth has been recorded at Chandpur, at the confluence of the Upper Meghna and Brahmaputra). At great depths the USACE formula suggests unrealistic bag sizes. As well, the formula uses the depth-averaged velocity. Different velocity profiles with the same depth-averaged velocity will have different shear stresses. Although shear stresses are difficult to work with, using the Shields relationship may be a more theoretically appealing approach for sizing geobags at locations such as Chandpur.

Future Scope

These results are preliminary and further testing is needed for a more complete understanding of how the fill percentage affects the stability coefficient. It is suggested that for future studies regarding incipient motion of geobags shear stress measurements be made to find the pressure differences between the up-stream and downstream end of a geobag in order to find the bed shear stresses resulting from form drag. As well further focus on how the stability of geobags placed on sloped surface would be beneficial because of the geobags which lay on the launched slopes.

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