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Analysis of groyne placement on minimising river bank erosion

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Abstract

Bank erosion is the wearing away of the banks of a stream or river. Impacts of river bank erosion are multifarious: social, economic, health, education and sometimes political. Groynes are structures constructed in rivers to protect the shore. Groynes are generally made of wood, concrete, or rock piles etc. In the present study coir geotextiles in the form of cocologs are used as the groynes to make the groyne more ecofriendly. Study mainly concentrates on analysing the effects of placing groynes at different angles from 45^0 to 135^0 and to find the most effective arrangement for minimising the erosion. Results indicate that cocolog-groynes are effective in minimizing the erosion and protecting the bank. Maximum protection is observed for groyne angle of 135^0.

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Keywords:cocologs; groynes; optimum layout ; river bamk protection

1. Introduction

Rivers have been used as a source of water, for obtaining food, for transport, as a defensive measure, as a source of hydropower to drive machinery. Riverbank erosion is one of the main phenomena causing the instability of the bank. Predicting the cause of riverbank erosion and preventing it is the main aim of the river bank protection. Rainfall, soil structure, river morphology, topography of river and adjacent areas, and floods are the main factors affecting the erosion. In some areas, vegetation act as protection to the riverbanks. Sometimes these vegetation cover has been destroyed by human activities which eventually resulting in the bank erosion.

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Rivers are often managed or controlled to make them more useful, or less disruptive, to human activity. Commonly used methods are by vegetation, sacks and blocks, gabions ripraps, guide banks, groynes etc. Groynes or spurs are structures constructed perpendicular to the rivers to protect the shore. Groynes may either be impermeable or permeable. Groynes deflect the flow from the shore and protect the shore. It has to be taken care that the groynes simply move the erosion zone to another location. By blocking the flow at a side the groynes tend to increase the water depth and velocities in the stream. In the nose of the groyne, there is also chance of turbulence which eventually cause scour in the nose.

A spur angled upstream repels the river flow away from it and is called a repelling spur. These are preferred where major channel changes are required. A spur angled downstream attracts the river flow towards it and is called an attracting spur. The angle of the groynes generally varied between 45 to 135 degrees.

Cocologs are made from coconut fibres. Coir fibres are densely packed into a circular outer covering of coir or poly ropes etc. Sometimes it is even reinforced with sisal twines for more strength. Commercially available cocologs are in diameters of 20cm, 30cm 40cm etc. Coco logs are an economical, durable, biodegradable material and easy to install. That's why cocologs are used for wide range of purposes. These provides good condition for plant growth and then it acts as a shelter and become part of the eco system. Once the routing of vegetation is complete the function of the Coir geotextiles is over and the same will biodegrade itself into soil, without causing environmental issues.

Mojtaba and Bahare [5] conducted experimental studies on effect of groin location on minimizing river bank erosion by placing groins at three locations i.e. before, at the beginning and after erodible material. They found that groins placed 30 cm before erodible material was suitable for reducing bank erosion. Anil et al. [3] conducted field experiments using cocologs placed as spurs in southern Kerala. They found that cocologs strengthened river bank and was cost effective compared to other conventional technologies.Yossef et al. [10] conducted experiments in a mobile bed and found that there is net import of sediment into the groyne fields.

2. Experimental setup

An undistorted model was created in a rectangular flume size 12.95 m x 1.2 m x 0.95 m in the Hydraulics Engineering Laboratory of College of Engineering, Trivandrum. Scale selected for the study is 1:25.Bed slope of the model is 1 in 6000 and side slope is 1:1.25. Cross section is shown in Figure 1 (a).

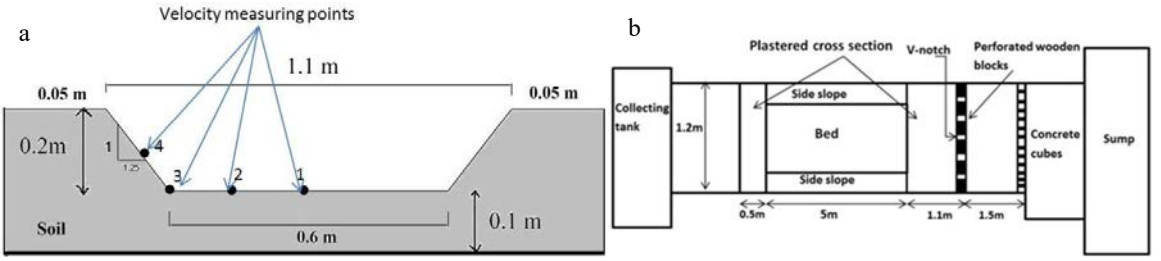

Fig. 1. (a) Cross section of the river model; (b)Schematic diagram of the model setup in the flume.

Concrete cubes and perforated wooden blocks were placed in the upstream to reduce turbulence of the flow. A 60^0 v-notch was placed 1.1 m upstream from the model in order to measure the discharge. The v-notch was calibrated and the calibration equation obtained was $Q=0.95\ H^{2.5}$. Soil collected from Neyyar river basin was used to fill the flume. Field density was found out using core cutter method. The same field density was maintained in the model. Rectangular flume was used for the study and symmetrical trapezoidal section was used for river model. Soil from the field was filled in the flume for a length of 5 m and total length of the model setup was 8.1m. Two pumps of 5hp are used for lifting the water from the sump into the flume.

2.1. Materials and methods

Commercially available cocologs are in diameters of 20cm, 30cm 40cm etc. Cocologs has made in small scale using polypropylene net of opening size of 1.27cm as the outer cover. Cocolog model was created by filling coir fibres in