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INVESTIGATION ON EROSION CONTROL FORDIFFERENT SLOPE CONDITIONS IN LANDSLIDE MITIGATION

[1]Samuel Thanaraj- Assistant Professor,[2]Madhan P - Assistant Professor, [3]M. Vadivel- Assistant Professor
Department of Civil Engineering
Nehru institute of Technology
Madhan.nsa@nehrucolleges.com - Corresponding Author

Abstract— Landslide is one of the major natural hazards the world is facing. It happens as a result of both man-made as well as natural factors. It causes severe effects on the environment as well as for the mankind. The main triggering factors of landslide are rainfall/snowfall, tectonic activities and human activities. There are many methods adopted for controlling landslides. The study is to know the application of geo-textiles in slope stabilization.Ooty is one of the main areas in India which is prone to landslides. Landslides cause severe damage to the life and property every year. The present study will be attempted in lake area. It is planned to collect 1.5m^3 of soil sample from the landslide site and Physical, chemical and Engineering properties of the soil are to be tested in the laboratory. To understand the application of geo-textile for soil erosion and slope stabilization, laboratory models will be created, and the soil will be tested by varying the slope and rainfall intensity. The main objective of our study is to measure the effect of slope and runoff on soil loss An automatic rainfall simulator will be designed, considering the local conditions.Experiments will be conducted on a model of 2.0m length and 1m width with variations in slope. The collection trough will be made of size 1.0 x 0.3 x 0.3m below the experimental model. A sprinkler system is planned to be set up to produce artificial rainfall. The water supply will be given from an overhead water tank by adjusting a valve. For different intensity of rainfall by providing a pressure gauge, with this experimental setup and the sample collected, test will be collected to know the soil erosion quantity.

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INTRODUCTION

A landslide is a geological phenomenon which is simply defined as the mass movement of rock, debris or earth down a slope and has come to include a broad range of motions whereby falling, sliding and flowing under the influence of gravity dislodges earth material. Landslide is defined as the movement of a mass of rock debris, or earth down the slopes (Cruden, 1991). The term “Landslide” encompasses events such as ground movement, rock falls, and failures of slopes, topples, slides, spreads, and flows such as debris flows, mudflows or mudslides (Varnes, 1996). They often take place in conjunction with earthquakes, floods and volcanic eruption.Nilgiri region is highly noted for the active landslides. All kinds of landslides has been occurred and accounted largely. The impact of landslide is accounted in and around 21 States and Union Territory of Pondicherry, hilly regions of Himalayas, North Eastern parts of India, Nilgiris, Eastern Ghats, and Western Ghats, in every year and makes loss of life, infrastructure and property The area precipitated with rainfall in both the southwest and northeast monsoon. Southwest monsoon 50% in west and 40% in west are accounted as precipitation. It was moderate in northeast monsoon which contributes near 40% of rainfall. Significant level of rainfall accounted in both winter and summer periods. The temperature is salubrious in all the year of the climate.The humidity is more in afternoon than mornings when in range exceeding of 90% (Subramanian, 2012).As the landslides of 1979 were more massive and of larger magnitude, detailed profiles of landslides, detailed mapping on larger scale and study with earthly photogrammetric work, were taken up (Sharda, 2008). In 1979 November a heavy rain occurred in coonor and in sales heavy landslides too occurred. In this a house totally buried and including 2 women with 3 children dead in the debris (Ganapathy, 2012).Vibrations created by heavy vehicular traffic may also accelerate the landslide esespecially during continuous heavy rainy season and flooding on the slope.In the Nilgri Hills, it has been found that steep as well as gently slopes have failed. The synthesis of this correlation with rainfall data reveals that the intensity of precipitation in 1978 and 2006 were high only for three days, whereas the rainfall in 1979, was distributed in the months of August and December. This indicates that the 1978 and 2006 slides occurred due to heavy precipitation in a short period when there were flash floods and water spreading and consequent soaking on the slopes resulting in mass movement of the material over relatively steeper slopes. These steep slopes have failed where the toe had been removed either by stream action or by man.Deforestation has marked effect in rendering the slopes slide prone (manimaran et.al. 2012).It has been observed that 21 States and Union Territory of Pondicherry, located in hilly tracts are affected by this hazard every year and suffer heavy losses in terms of life, infrastructure and property (Sharda, 2008).Twelve persons lost their live and more than 10 missing and passengers too washed away in two vehicles.

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TYPES OF LANDSLIDES

The various types of landslides can be differentiated by the kinds of material involved and the mode of movement. Other classification systems incorporate additional variables, such as the rate of movement and the water, air, or ice content of the landslide material.

LANDSLIDE MITIGATION

Vulnerability to landslide hazards is a function of location, type of human activity, use, and frequency of landslide events. The effects of landslides on people and structures can be lessened by total avoidance of landslide hazard areas or by restricting, prohibiting, or imposing conditions on hazard-zone activity.

LANDSLIDES AND GEOTEXTILES

Landslides are the major land disturbing activities in the Nilgiri region causing mass erosion problems leading to heavy land degradation, decline in the quality and quantity of water resources and disruption in the communication lines. Re-vegetating of these areas is the final insurance against erosion but such highly degraded lands are difficult to vegetate due to their unstable nature and poor fertility status. ***Jute and coir geotextile materials have been most popularly used for erosion control and slope stabilization purposes in Europe/USA and most of the geotextile material produced in India is exported to these countries. In India, however, use of these materials for erosion control is not popular***. Therefore, natural geotextiles (jute and coir) were experimented to study their efficiency for providing initial mechanical protection and help in establishment of vegetation on degraded steep slopes so that the ultimate protection against erosion would be provided by the lush vegetative cover established in due course of time.

Major Applications of Geosynthetics

- Geo synthetics applications for railroads
- Geo synthetics to deal reflection cracking in pavements
- Geo synthetics applications for hydraulic structures
- Geo synthetics to mitigate coastal and riverbank erosion
- Geo synthetics applications for food and agriculture
- Geo synthetics applications in mining engineering
- Geo synthetics applications in tsunami
- Geo synthetics applications for waste water treatment
- Geo synthetic for landfills
- As early warning system for rain-triggered landslides and debrisflows
- Geo synthetics applications as noise barrier
- Combat or mitigate the acts of terrorism and/or natural disasters.

SCOPE OF THE STUDY

This project work is carried out to study the applicability of Jute Geo textiles for slope stabilization. Landslides in the hilly region causes loss of life and property, damage to natural resources and damage to roads, bridges, telephone, electric lines etc. This leads to immobility of goods and services leading to huge loss of revenue. We can recommend the use of Jute geotextiles for the stabilization of the slopes in that area.Jute plant is woody type growing to about 3m high and under its bark bundles of fibres run longitudinally down the stem (stem dia. varies between 20 to 30mm) held together by sticky resin. When harvested, the cut stems are tied into bundles and kept submerged in water for between 20 to 30 days. This process is known as retting. The tissues of the stems are then broken down under bacterial action. The resulting soggy mass consists of strands of overlapping fibres. The fibres are then stripped off from the stem manually, washed in water and dried under the sun. Jute geotextiles (JGT) has emerged as a strong alternative to synthetic geotextiles for many civil engineering applications. Synthetic geotextiles being made from non-biodegradable polymer based constituents such as polypropylene, polyester or polyethylene, have inherent advantage over natural fiber based biodegradable JGT for long- term applications. Due to their short life span, JGTs are used as separator, vegetation growing mesh on slopes or as vertical drains. Recently, Bangladesh Jute Research Institute **(BJRI)** and Bangladesh Jute Mills Corporation (BJMC) have developed some treatment techniques for JGTs which may enhance their life up to or even more than twenty years. Development of such durable JGT materials is likely to allow them to be used in short-term to medium-

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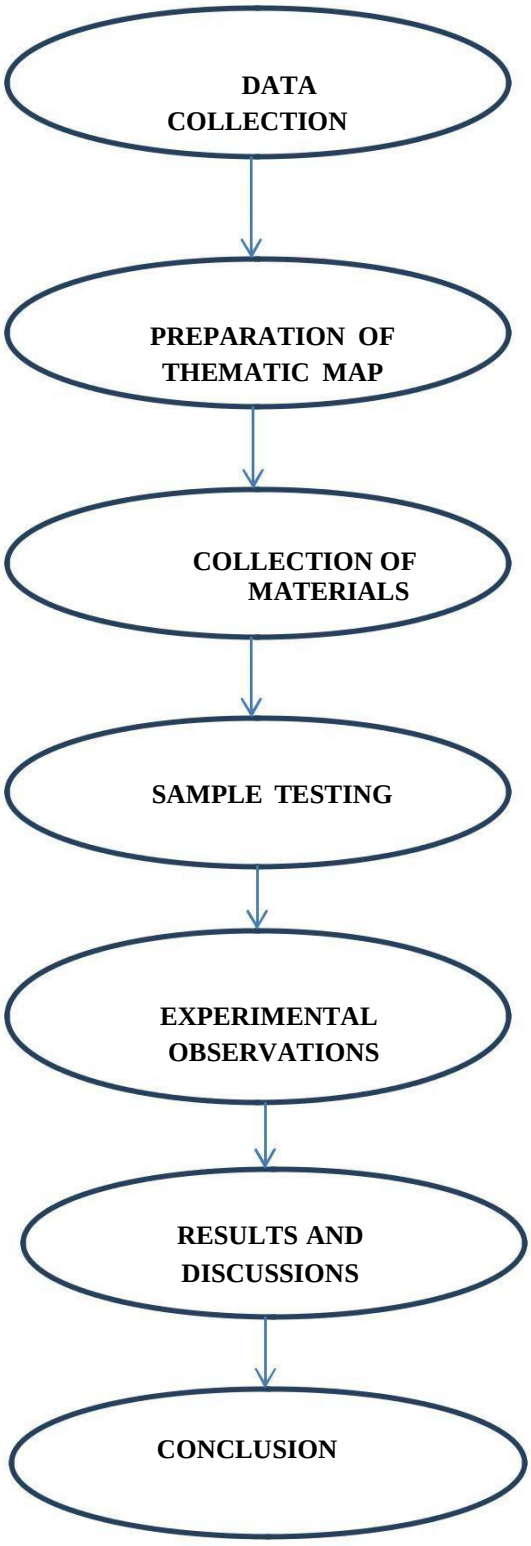
term soil reinforcement applications, e.g. rural roads, construction access roads, flood and road embankments etc.

METHODOLOGY:

To achieve the set of objectives the methodology has been divided into eight major parts which is illustrated in the figure.



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DATA COLLECTION:

- Literatures related to Jute Geotextile and landslides mitigation ,erosion and its application
- Toposheet of the study area and various satellite images were collected for preparation of various thematic maps pertaining tothis study
- Rainfall details were collected form government departments
- The available maps such as soil and geology of the areawere collected
- Jute geotextile materials
- Coir geotextile materials
- Geo grid geosynthetic materials

SAMPLE TESTING

General

The soil sample was tested in the laboratory to understand its various physical and engineering properties.Recent landslides and old landslide scars were investigated in the field. About 1500kg soil sample was collected from Ooty landslide prone site and transported to the laboratory for assessing engineering properties and preparing models.

Engineering Properties

Engineering properties

SL. NO	PROPERTIES		OBSERVATIONS
1.	Specific Gravity	(G)	2.60
2.	Liquid Limit	(W_L)	45%
3.	Plastic Limit	(W_P)	32.02%
4.	Optimum moisture content	(omc)	14%
5.	Unconfined compression test	(Ucc)	0.0056N/mm^2
6.	Cohesion	(C)	0.0028 N/mm^2
7.	Angle Of Internal Friction	(Ø)	41^0
8.	Maximum Dry Density	(MDD)	1.61g/cc

Preparation of Slope Model

The model was made for 2 different slopes i.e., 30^0 and 35^0 using solid blocks of 6 inches size. The heights of each model with respect to the different degree of slopes were arrived by trigonometrically calculation.

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HYDROMETER ANALYSIS

Application

The percentage of sand, silt and clay in the inorganic fraction of soil is measured in this procedure. The method is based on Stoke's law governing the rate of sedimentation of particles suspended in water pact to the different degree of slopes were arrived by trigonometrically calculation.

CONCLUSION

The experimental result from (fig 6.13) clearly shows the erosion pattern of two different slopes.

- It is observed that as slope increases gradually, erosion also increases and there is a considerable increase in erosion due to increase in intensity also.
- The result obtained from (fig 6.14) shows the erosion control in slope after the use of geotextile.
- It is well observed that erosion is controlled to a greater extent after the use of Geogrid.
- Comparison of jute, coir geotextiles the geogrid is gives the best result to control the soil erosion in slope area.
- Since erosion is controlled the nutrients loss from the soil also will be controlled which will help for healthy growth of plant.

With this we conclude that the from the laboratory model observations, the application of geotextiles (geogrid) is very effective in controlling the erosion of soil and thus could prevent the hilly regions from landslides in future.

As the Geogrid geotextile is cost effective and eco-friendly it will not affect the environment. Plantation can also be done over the geotextiles.

REFERENCES

The template will number citations consecutively within brackets [1]. The sentence punctuation follows the bracket [2]. Refer simply to the reference number, as in [3]—do not use "Ref. [3]" or "reference [3]" except at the beginning of a sentence: "Reference [3] was the first ..."

Number footnotes separately in superscripts. Place the actual footnote at the bottom of the column in which it was cited. Do not put footnotes in the abstract or reference list. Use letters for table footnotes.

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For papers published in translation journals, please give the English citation first, followed by the original foreign-language citation [6].

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