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E-Mail
editor.ijmece@gmail.com
editor@ijmece.com

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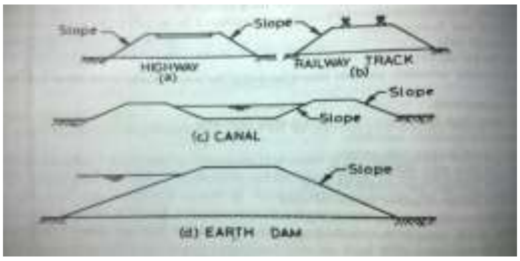
STABILIZATION OF SOIL USING GEOTEXTILE

G PRAVEEN KUMAR[1], K JAIPAL[2], M SRAVAN KUMAR[3], S CHANDU[4], M PRASHANTH[5]

ABSTRACT: Failure of slope may lead to loss of life and property. Slopes for all the embankments might not be same. Steep slopes are not stable and have more chance of failure. Stability may also depend on the shear strength of the foundation soil. Hence, such slopes are to be stabilized against failure, which is done by placing a geotextile in it. Geotextiles due to its high tensile strength can be used to increase the load carrying capacity of the soil. The study of slopes in presence and absence of geotextiles, and its placement in different positions for different soils is carried out.

INTRODUCTION

An earth slope is an unsupported, inclined surface of a soil mass. Earth slopes are formed for railway formations, highway embankments, earth dams, canal banks, and at many other locations.



The cost of earth work would be minimum if the slopes are made steepest. However, very steep slopes may not be stable. A compromise has to be made between economy and safety, and the slopes provided are neither too steep nor too flat. In other words, the steepest slopes which are stable and safe should be provided. Failure of slopes can be prevented to a extent by using geotextiles in them. Geotextiles can be used to increase the load carrying capacity of the soil. Geotextiles are used as reinforcement in the soil, which is poor in tension but good in compression. The action is similar to that of steel bars in a reinforced concrete slab.

[1,2,3,4] UG Students, Dept of CIVIL, Malla Reddy Engineering College (Autonomous), Secunderabad, Telangana State.
[5]Assistant professor, Dept of CIVIL, Malla Reddy Engineering College (Autonomous), Secunderabad, Telangana State.

Construction procedure of embankment:

• In which, two embankments were built on a soft clay deposit to measure the effect of geotextile reinforcement upon stability. Therefore, one of them is reinforced with geotextile whilst the other servedas a non-reinforced reference. After constructing the retaining bank on the subsoil, eachembankment was loaded by hydraulic sand filling. At failure,the reinforced one reordered a sand height of 3 [m] while the non-reinforced failed at a height of 1.75 [m]

BASIC CONCEPTS

1.0The design and construction of embankment pose little problem when the underlying subsoil is good bearing stratum.Soft soil conditions, however create several complexities for the designer and field engineer. When faced with the situation of constructing an embankment on a soft subsoil, the following problems are encountered:

- Low shear strength
- Stability of embankment
- High compressibility and settlement of embankment

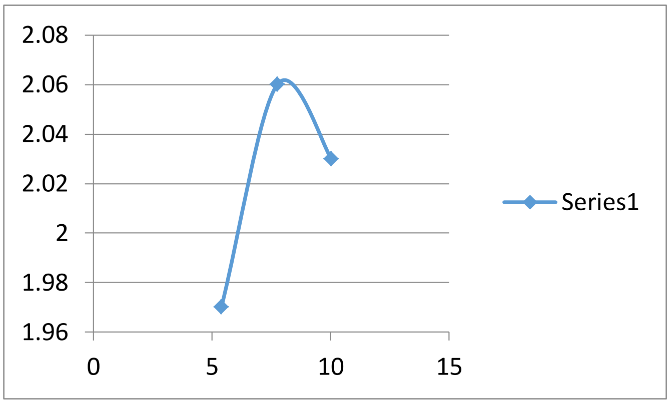
The design of embankments is based on bearing capacity, settlement and stability considerations. All the conditions have to be satisfied with an adequate margin of safety for each of the factors.

2. SHEAR STRENGTH

The shear strength of a soil in any direction is the maximum shear stress that can be applied to the soil mass in that direction. When this maximum stress value is reached, soil is regarded as having failed, i.e., the strength of soil is fully mobilized. The soil gains its shear strength from two sources, viz., internal friction and cohesion between soil particles. A relationship between normal stress and shear strength was given by Coulomb as follows:

DETERMINATION OF SOIL PROPERTIES: Nature of soil is determined before construction of embankment. The following are the tests conducted for determination of soil properties.

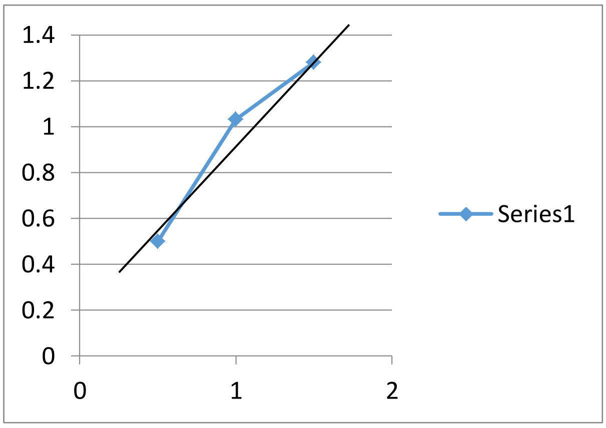
1.MODIFIED COMPACTION TEST:



Optimium moisture content = 7.7%

Maximum density = 2.06

2.DIRECT SHEAR TEST:



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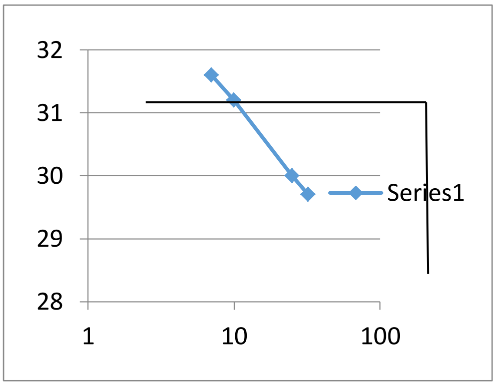
3.LIQUID LIMIT AND PLASTIC LIMIT:



FREE SWELL INDEX :

Weight of soil taken = 10 ml

Volume of soil after swell (Vd) = 12mm

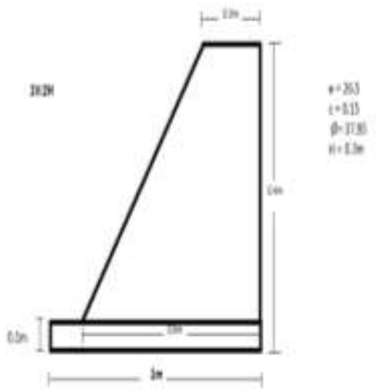
Free swell index = (Vd – Vk)/Vk x 100%

= (12 – 11)/11 x 100

= 9.09 %

As the free swell index % is less than 20% , it is a low expansive soil.

DESIGN OF EMBANKMENT



METHOD ADOPTED : After determination of soil properties, a slope is fixed for the design of

Factor of safety can be determined by Taylor stability number ,

Sn = C/ɣH

= 0.15/2.06 x 0.3

= 0.2427.

Now factor of safety,

FS = C/Sn x ɣ x H

= 0.15/0.24 x 2.06 x 0.3

= 1.01 (safe)

A rectangular tank of dimensions 1m x 0.6m is taken for the construction of embankment. Based on the slope and the dimensions of tank selected, the embankment is designed as shown in the above figure.

Firstly a base layer of height 0.1 m is laid in the tank and compacted for the required density. Then the embankment is constructed in two layers each of 0.15m, and the density and water content to be added is calculated as shown below.

BASE LAYER:

ɣ = w/v = 2.06

w = ɣ x v

= 2.06 x (10x100x100)

= 206 kg.

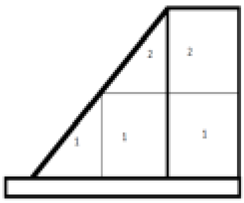
Water content = 0.0556 x 206

=11.45 litres

LAYER 1 : Layer 1 consists of 3 portions : 1. Triangle.

2. Rectangle.

3. Rectangle.



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V2 = (½ x 0.3 x 0.15) + (0.3 x 0.15) + (0.3 x 0.15)

= 0.1125 m^3

= 0.1125 x 10^6

W = 2.06 x 112500

= 231.75 kgs

Water content = 0.0556 x 231.75

=12.8 litres

LAYER 2: layer 2 consists of a rectangular and triangular portions.

V3 = (1/2 x 0.3 x 0.15) + (0.15 x 0.3)

= 0.0675 m^3

= 67500 cm^3

W = 2.06 x 67500

= 139.05 kgs

Water content = 0.0556 x 139.05

= 7.78 litres the total amount of soil is placed adding water content to each layer and compacted layer wise. The excess soil is trimmed of neatly.

A loading plate is placed on the top and load is applied till the failure of the slope is caused.

Due to high shear strength of selected soil sample, the slope hasn't failed for the applied loading. hence, the selected soil sample doesn't need a geotextile for stabilization. In further stage a soil with low cohesion shall be selected and geotextile can be placed in the slope for stabilization.

CONCLUSION

Laboratory tests on two soil samples with and without using geotextiles are conducted and results are plotted. From the results it is clear that by the usage of non-woven geotextiles, the properties of the soil increases. ii. Effectiveness of the geotextile is known from pavement model. Non-woven geotextiles works effectively as the drainage and separation layers. iii. They acts as excellent filters in order to prevent piping. iv. Non-woven geotextiles have good friction though it has less tensile strength. They develops internal frictional résistance and control the deformations and tension developed in the soil, It also acts as a good binding material with soil particles In this way the shear parameters like frictional angle and cohesion of the soil increases. v. From stress strain curves behaviour , the

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curve gradually goes on increasing in case of reinforced soil rather than unreinforced soil which indicate the increase in shear strength of soil. vi. Hence detailed study was done on various functions of nonwoven geotextiles in Civil engineering.

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