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OVERVIEW OF SOIL STABILIZATION USING MICRO PILES

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Abstract: Soil stabilization using micro piles has gained rapid popularity in many foreign countries as an alternative of piles for sustainable housing. It is being always challenge for researchers to make soil stabilize using micro piles at low cost and improve the performance of soil against the loose soil bearing capacity of soil. An experimental effort made in this concern. The main objective of this study is to investigate the use of micro piles as strengthen materials in geotechnical applications and to evaluate the effects of micro piles on shear strength of unsaturated soil by carrying out direct shear tests and unconfined compression tests on various different soil samples.The results obtained are compared for the various samples and inferences are drawn towards the usability and effectiveness of reinforcement as a replacement for deep foundation as a cost effective approach. The use of micro piles is very limited in our country as it is a very new method of soil stabilization.The subject is defined as a drilled and grouted, cast-in-place, reinforced pile of nominal diameter less than 300 mm.[7]The insertion of micro piles does not require high strengthen equipment for use. It can simply be inserted using hand operated equipment. Also micro piles can be used at places where heavy machinery cannot be taken.Micro piles have exceptional qualities not least of which are their relatively high axial load holding performance and their ability to be installed in very difficult locations and geologies.

Keywords: Soils, Stabilization, Micro piles, Bamboo, Grout, Drilling

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INTRODUCTION

Soil stabilization using bamboo micro piles is one of the most bearable building supplies on the planet and is termed as vegetable steel with a ductile strength. It provide's earthquake resistant structures. The use of bamboo micro piles is very cost effective against the use of iron micro piles. It provides a high stability ratio in correspond to iron micro piles. Bamboo contains high levels of starch which attracts insects without proper treatment; bamboo has a natural durability of less than two years.

With the ever-increasing urban expansions, it is not always possible to find good supporting ground at or close to surface level. Therefore, foundations other than spread footings were designed to transfer compression loads down to a suitable load-bearing stratum. Higher and slender structures subjected to wind and seismic loads need foundations capable to support compression as well as uplift and lateral forces. Instead of large, mass concrete foundations, which require large areas and mass excavations, smaller and deeper drilled shaft or pile foundations became a more economical alternative, in which steel reinforcing systems embedded in concrete and cement grout are the major component. Since mankind started to design and build structures for different usages and environments, foundation systems to support such structures had to be developed in order to match the architectural and structural needs [1].

FIG1: Micro pile Installation[5]

MATERIALS AND METHODS

SOIL - Most of stabilization has to be taking on in soft soils (silty, clayey, peat or organic soils) in order to achieve necessary engineering properties. According to (Sherwood, 1993)[8] fine-grained granular materials are the easiest to stabilize due to their large surface area in relation to their particle diameter. A clay soil compared to others has a large surface area due to flat and elongated particle shapes. On the other hand, silty materials can be sensitive to small

change in moisture and, therefore, may prove difficult during stabilization. Peat soils and organic soils are rich in water content of up to about 2000%, high porosity and high organic content. According to (Pousette, et al 1999; Cortellazzo and Cola, 1999; Åhnberg and Holm, 1999)[8]the consistency of peat soil can vary from muddy to fibrous, and in most cases, the deposit is shallow, but in worst cases, it can extend to several meters below the surface. Organic soils have high exchange capacity; it can delay the hydration process by retaining the calcium ions liberated during the hydration of calcium silicate and calcium aluminate in the cement to satisfy the exchange capacity. In such soils, successful stabilization has to depend on the proper selection of binder and amount of binder added.

LIME - Lime provides an economical way of soil stabilization. According to Sherwood, 1993 lime modification describes an increase in strength brought by cation exchange capacity rather than cementing effect brought by pozzolanic reaction[8]. In soil modification, as clay particles flocculates,transforms natural plate like clays particles into needle like interlocking metalline structures.According toRoger et al, 1993 clay soils turn drier and less vulnerable to water content changes [7].

According to Sherwood, 1993, EuroSoilStab, 2002lime stabilization may refer to pozzolanic reaction in which pozzolana materials reacts with lime inpresence of water to produce cementitious compounds[8]. The effect can be brought by either quicklime, CaO or hydrated lime, Ca $(OH)_2$. According to Hicks, 2002 slurry lime also can be used in dry soils conditions where water may be required to achieve effective compaction [8]. Quicklime is the most commonly used lime; the followings are the advantages of quicklime over hydrated lime [8].

According toEuroSoilStab, 2002; Sherwood, 1993[8]quicklime when mixed with wet soils, immediately takes up to 32% of its own weight of water from the surrounding soil to form hydrated lime; the generated heat accompanied by this reaction will further cause loss of water due to evaporation which in turn results into increased plastic limit of soil i.e. drying out and absorption.The effect can be explained from Figure 1 for soil at a moisture content of 35% and plastic limit 25%. According toSherwood, 1993 addition of 2% lime will change the plastic limit to 40% so that the moisture content of the soil will be 5% below plastic limit instead of 10% above plastic limit[8].

Sherwood (1993) investigated the decrease in plasticity as brought about in first instance by cation exchange in which cations of sodium and hydrogen are replaced by calcium ions for which the clay mineral has a greater water affinity.Even in soils (e.g. calcareous soils) where, clay may be saturated with calcium ions, addition of lime will increase pH and hence increase the exchange capacity. Like cement, lime when reacts with wet clay minerals result into increased pH which favors solubility of siliceous and aluminous compounds. These compounds react with calcium to form calcium silica and calcium alumina hydrates, a cementitious product similar to those of cement paste. Natural pozzolanas materials containing silica and alumina

(e.g. clay minerals, pulverized fly ash, PFA, blast furnace slag) have great potential to react with lime [8].

According to Ingles and Metcalf, 1972 lime stabilizations technology is mostly widely used in geotechnical and environmental applications. Some of applications include encapsulation of contaminants, rendering of backfill (e.g. wet cohesive soil), highway capping, slope stabilization and foundation improvement such as in use of lime pile or lime-stabilized soil columns. However, presence of sulphur and organic materials may inhibit the lime stabilization process. Sulphate (e.g. gypsum) will react with lime and swell, which may have effect on soil strength.

TREATMENT - Untreated bamboo, just like almost any other wood, has a high chance of being attacked by insects. Bamboo insect infestation occurs due to the presence of starch and other carbohydrates. Insects obtain their food supply from the bamboo and degrade it, therefore bamboo should be chemically treated to avoid infestation.Beetles and termites are the most commonly occurring insects in bamboo. They do not require any specific conditions, except for warm and moist climate conditions [7].

CHEMICAL BAMBOO PRESERVATION -Chemical preservationensures long term protection. Depending upon the method of bamboo treatment, chemical preservatives can impart short term or long term protection.With a few exceptions, chemical preservatives to protect bamboo against biological attacks and degradation are toxic. Selection and application has to be done with great care to meet performance, environment requirements and safety [7].

Depending upon the carrier solvents, bamboo preservatives are divided into 2 different categories: Non-fixing and fixing type preservatives. Non-fixing preservatives will percolate out the bamboo when exposed to rain. In other words non-fixing type preservatives are NOT suited for outdoor use [7].

Non-fixing bamboo preservatives mainly consist of boron salts, which are effective again termites and fungi. These boron salts are dissolved in water. After treatment, the water evaporates leaving the salts inside the bamboo. They are not toxic and can be used for treating bamboo products like baskets, dry containers, etc. which come in contact with food products [7].

FIG 2: Bamboo treatment[6]

BORIC ACID BORAX - Curing bamboo with borax and boric acid is the most popular bamboo preservation method (for indoor use) around the world because it is effective and more environmentally friendly than other wood preservatives [7].

The combination of boric acid and borax in a ratio of 1:1.5 is an alkaline salt called: Disodium octaborate tetrahydrate ($Na_2B_8O_{13}$ x $4H_2O$).Disodium octaborate tetrahydrate is a white, odourless, powdered substance that is not flammable, cumbustible, or explosive and has acute low oral and dermal toxicity. The product itself is fire retardent and shows no hazardous decomposition [7].

FORMULA (1):
boric acid / borax
ratio 1:1.5

FORMULA (2):
boric acid / borax / sodium dichromate
ratio 2:2:0.5

FIG 3: Bamboo treatment [7]

CONCLUSION

According review survey of above papers, we have concluded that using of Bamboo as a soil stabilizer material directly or indirectly, improves the stabilized value of soil. Also using of bamboo for stabilization is cheaper and easier technique. But Bamboo should be chemically treated before instalment to enhance durability of bamboo.

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