Enhanced the soil strength using Pine tree needles

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Abstract - **This Soil stabilisation is a broad topic, but it is especially important when it comes to sandy soil. It aims to increase the strength of soil and escalate the confrontation to softening by tying the soil particles together. The paper's main goal was to investigate the use of pine needles to stabilise sandy soil. The index qualities of both the parent soil and the pine needle-treated soil were discovered. The addition of pine needles results in an increase in OMC and a decrease in MDD. As a result, the strength of this combination does not suffer from the reduction in MDD when compared to virgin soil. In comparison to UCS test findings of virgin soil, UCS increased with pine needle.**

keywords - **Soil Stabilization, Pine needles, UCS, OMC, MDD.**

I. Introduction

Soil stabilisation is a method of enhancing soil engineering performance. Stabilization is limited to methods that alter the soil material itself in order to improve its properties. The soil at the construction site will not always be completely adequate for supporting structures; for example, granular soil may be very loose and imply large elastic settlement; therefore, the soil must be recognised in order to enhance its unit weight and hence shear strength. Civil Engineers are sometimes required to build a construction on a site chosen for reasons apart from soil characteristics. As a result, it is becoming increasingly vital for the engineers to understand the extent to which the soil's technical properties may enhance or other options for the construction of the identifying the factors at the given location. If inappropriate soil conditions are found at the proposed structure's location, the inappropriate soil can be circumvented by extending a deep foundation to an adequate bearing material, the poor material can be phased out and replaced with a good material, or the soil in should be treated with any suitable ground improvement methods (soil stabilisation) to achieve better its geotechnical properties. As a result, in order to puzzle out at the chosen location, we must have a thorough understanding of their characteristics and factors that influence their behaviour.As a result, the requirement of boosting soil qualities has become apparent since the start of construction work, and the procedure of soil stabilisation aids us in achieving the result supported in a soil for construction works. India is a growing nation where villages are home to the vast bulk of the inhabitants. Construction must be conducted out using locally accessible materials and traditional ways to connect villagers to cities and improve their living standards. By employing locally sourced materials, such as local soils, for the building of lower levels of pavement, retaining walls, and soil stabilisation, the construction budget can be greatly reduced. So, in this study, soil stabilisation will be accomplished using locally available materials, such as Pine Needles, which are available for free.

II. Experimental Study

The soil was collected from the Jote village under Papumpare district of Arunachal Pradesh as shown in figure 1. The soil shows cohesion less properties when came in contact with water. The sandy soil is light yellow in colour. According to IS soil classification system, the soil was classified as poorly graded sand(SP).The index properties of soil are determined as per Indian standard test procedure and tabulated in Table 1. Pines are evergreen, coniferous, resinous trees endemic to the Northern Hemisphere, belonging to the genus Pinus of the Pinaceae family. They can also be found in south-east Asia and India's Himalayan area. Pine needles are the needle-shaped, green-colored adult pine leaves found in clusters. In Shillong town, a large number of fibres are discarded and burned in an inefficient manner, therefore these materials are readily available (Raina and Alam, 2014; Shawl et.al 2015; Raina and Anjum; 2015; Aslam et.al, 2015). There are various bridges and aqueducts that benefit irrigation development in terms of civil engineering structures (Raina et.al; 2016). Pine needles were collected from a nearby forest at the NEHU college in Shillong. Pine needles were separated and the fibres were cut into lengths ranging from 10 to 20 millimetres. The pine needles are brown color in the dry condition.

III. Experimental investigation

An attempt has been made in this study to use pine needles for sandy soil stabilisation through extensive laboratory experimentation. The physical properties of the soil samples were tested, such as the Liquid Limit and Plastic Limit. Using the Modified Proctor's Compaction Test, the soil's Maximum Dry Density and Optimum Moisture Content were determined. After examining the physical properties of sandy soil, UCS values were calculated by mixing the soil with various percentages of pine needles. The main goal of this study was to conduct systematic research on the effect of pine needles on sandy soil stabilisation in order to develop new methods of application.

Table.1.Physical Properties of soil

Characteristics	VALUE
Water Content (%)	2.88
Type of soil as per IS: 1498	SP
Liquid limit, LL (%)	18.4
Plastic limit, PL (%)	NP
Specific gravity(Gs)	2.65
Coefficient of uniformity (Cu)	2.31
Coefficient of curvature (Cc)	1.354
Maximum Dry Density ,γd (kN/m3)	1.837
Optimum Moisture content (%)	12.18
Unconfined Compressive Strength(kPa)	84.35

Fig.1 Collected soil sample of jote village.

Fig.2 Pine tree needles from Shillong.

1) Standard Proctor Test for determination of O.M.C and MDD

The MDD and OMC of sandy soil samples reinforced with pine needles were determined using the Modified Proctor Test at various moisture content levels. The results are illustrated as below.

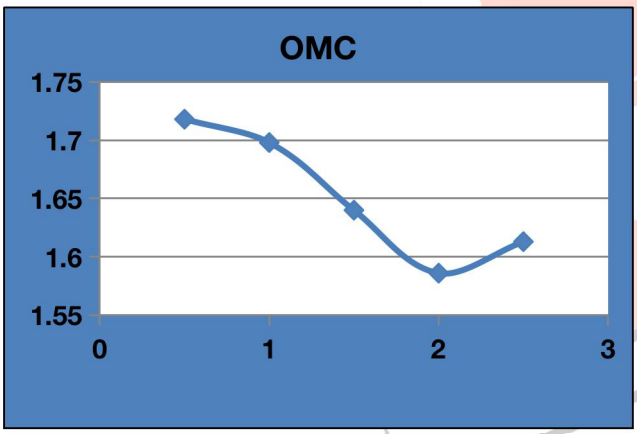

Fig.3 OMC of Soil with Pine needles.

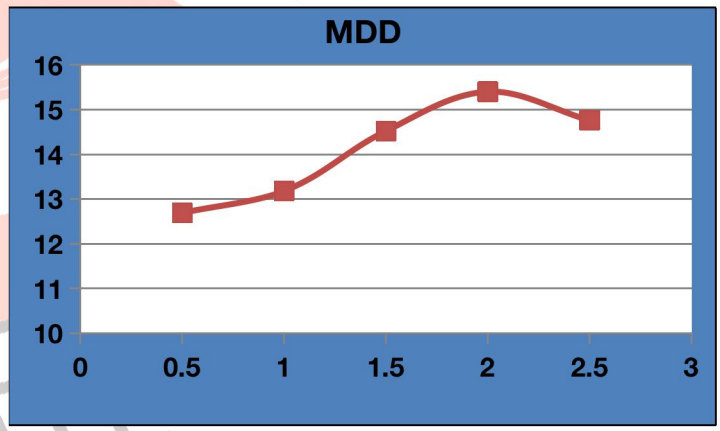

Fig.4 MDD of Soil with Pine needles.

2) UNCONFINED COMPRESSIVE STRENGTH OF THE REINFORCED SOIL

The UCS test of soil and pine needles with the increment percentage of 0.5% to 2.0% in 0 ,3,7 and 28 days. It is observed that addition of pine needles increases the unconfined compressive strength of soil. The stress strain curve is plotted below with different percentage of pine needles which is tested in 0 day and with curing in 3 days, 7 days and 28 days.

Soil Properties	0days (kPa)	3days (kPa)	7 days (kPa)	28 days (kPa)
Normal soil	84.350	104.930	127.540	163.251
0.5%PN + soil	91.492	145.490	203.549	249.945
1%PN + soil	130.547	167.537	230.191	263.994
1.5%PN + soil	163.378	211.631	253.631	358.812
2.0% PN + soil	143.986	183.863	267.170	314.944

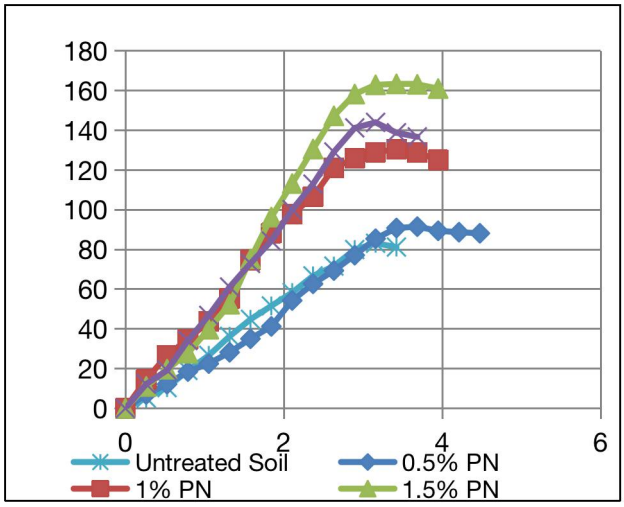

Fig.5 UCS test of Soil with Pine needle in 0 DAYS

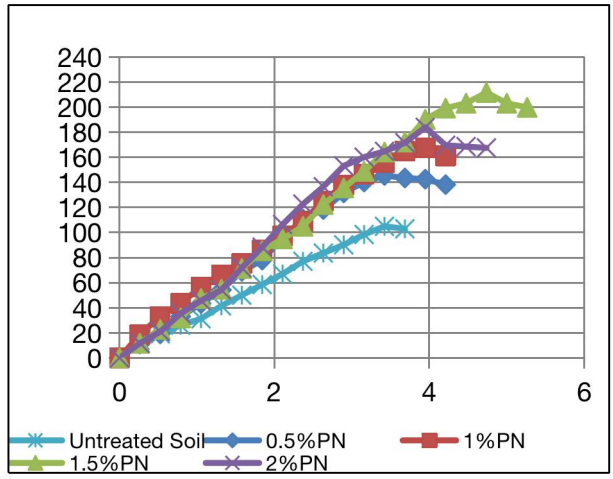

Fig.6 UCS test of Soil with Pine needle in 3 DAYS

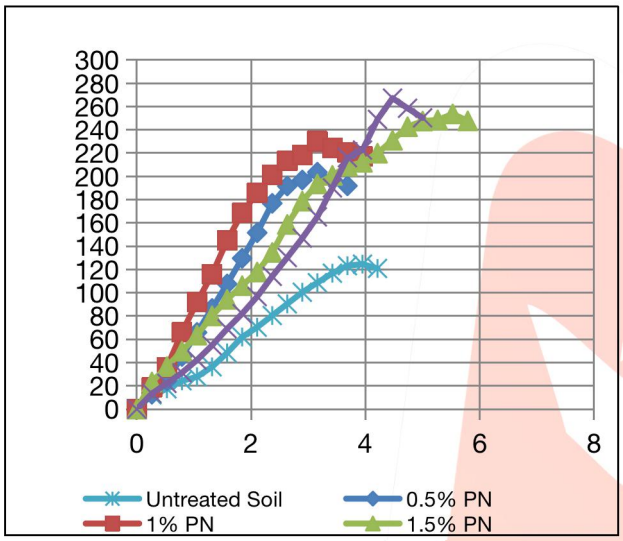

Fig.7 UCS test of Soil with Pine needle in 7 DAYS

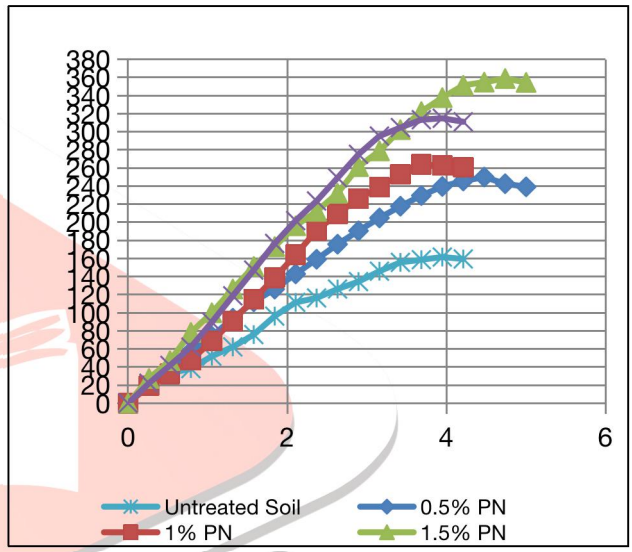

Fig.8 UCS test of Soil with Pine needle in 28 DAYS

It was observed that the UCS value is increased much in 7 and 28 days of curing condition .

IV. CONCLUSIONS

On the basis of analysis and interpretation of results obtained from the experimental investigations carried out in the present research work following conclusion are drawn. There is increase in OMC and decrease in MDD with addition of pine needles of 0.5% to 2%.The UCS test performed with soil mixed with pine needles increased the strength of soil with curing of 3, 7 and 28 days .The goal of this study is to improve the engineering qualities of sandy soil (SP) by employing pine needles as a reinforcement for compressibility (MDD) and unconfined compressive strength (UCS). There is a lot of room for more research in this area in the future. Additional types of soils could be studied to determine the impact of adding pine needles on engineering qualities of the soil, and other engineering properties of the soil, such as Direct Shear Strength, could be evaluated using pine needles in the future. Although dry pine needles were employed in this study, green pine needles can also be used to improve soil qualities.

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