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A Study on Laterite Soil to Form An Bouncy Cricket Pitch

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Abstract:

Soil characteristic for pitches may varies from country to country and pitches in kerala are regarded as slow and dusty. This study involves research on behaviour of soil for cricket pitches in Kerala according to BCCI guidelines .The main purpose is to make use of laterite soil to improve its strength thereby developing a fast and bouncy pitch. For this purpose different percentage of Bentonite clay is added to the laterite soil inorder to yield hardness to the pitch. The clayey property of Bentonite clay makes the soil stiffer. All the steps like soil selection , laboratory tests like compaction, specific gravity, sieve analysis etc are conducted to attain maximum compaction,and properties of soils do have proved scientific reasons And have the direct correlation with outcome and performances of pitch .This project aims at investigating the possibility of improving the characteristics of laterite soil for a fast and bouncy pitch.

Keywords — **Shear Strength, Compaction, Board of Control for Cricket in India**

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I. INTRODUCTION

Cricket is one of the most popular sports in the world. Weather, playing surface, ground conditions and many other variables play a part. Especially important among these is the playing surface known as Cricket Pitch. Here a model pitch is generated to observe charateristics of soil. Process of improving strength , durability of soils for an efficient pitch. A relation is generated between Compaction and Vertical Bounce test. A ball is allowed to fall under gravity on model pitch from a height of about 2m inorder to measure the bouncing height made by the ball. The bouncing height is measured by Enguage Digitilizer recommended by BCCI.

Different percentages of bentonite clay is added to the available soils to improve its physical characteristics. The liquid consistency state plays an important role in pitch preparation. Transformation between solid and plastic consistency is used in pitch preparation. The model pitch is wetted to make it plastic so it gets smoothened and then allowed to dry so it move to solid consistency where it becomes hard as well as bouncy character get improved. According to BCCI rule the plastic limit of soil varies from 13.8 -28% and L.L between 22.5% to 49.6%

II. LITERATURE REVIEW

Simon Parsons (2012) studied the effect on aeration of clay soils in cricket pitches . In this study effect of aeration processess on soils was analysed so he came to a conclusion that the the areation process can change physical properties and biological health of soil based sports surfaces. Thus he proposed guidelines for conducting aeration treatment on soil pitches, thereby providing best solutions to overcome ground problems.

John Shannon (2010) made a basic guide on pitch preparation for cricket on soils inorder to make a fast and bouncy pitch. He mentioned guidelines for developing pitches on soils and also renovation of old pitches for better performances. He also suggested that the process of compaction and closely mown truf could develop perfect pitches on ground.

Nawagamuwa U. P et al (2014)made a study on the improvement of local soils inorder to make fast and bouncy cricket pitches. In this study he mainly focussed on the possibilities of improving characteristic of soils for producing fast and bouncy pitches by focussing on different soil properties .he concluded that from the tests conducted ,the results showed that the plasticity characteristic of soil improved by the introduction of Bentonite clay on the local soils.

S.B Singh (2014) made a study on Cricket pitches- science behind the art of pitch making. In this study he mainly focused on different methods to develop a perfect bouncy pitch by conducting different experiments at different percentages. And he came to a conclusion that on soils with some desirable amount of clay content are considered as a perfect pitch soil.

D.M.James et al (2015) made a study on predicting the playing character of cricket pitches. In this study , he determined the soil properties and a correlations were drawn between pitch performance and soil compaction . He concluded by finding different properties of the soil and the amount of percentage of clay content required for an efficient bouncy pitch was also determined.

S.J .Haake (2015) made a study on the playing performance of countries cricket pitches. In this study he determined the different soil properties by conducting different experiments and conditions required for producing a fast and bouncy pitch. He concluded by finding different Soil properties and the amount of bentonite clay required to produce a fast and bouncy pitch was identified.

Hashir usman et al (2016) made a study on improvement of geotechnical properties of cricket pitches. In this study,he determined the properties of soil for developing bouncy pitches by conducting experiments. He came to conclusion that the Results obtained from different tests showed that the soil along with proper clay content and techniques have improved property as well as developed a bouncy pitch and also concluded that the Black soil also proved to be effective for pitch making.

III. MATERIALS

A. Bentonite Clay

Bentonite is a form of clay which comprises of montmorillonite. Bentonite used in this study mainly comprises of sodium ions as their major constituent. The material was collected from English India Private Ltd, Veli. A clayey material which enhances the properties of soil by its addition in varying percentages proves an efficient way in increasing the strength parameters of the soil. The bentonite property is mainly exploited to produce green molding sand. In this application, bentonite with a suitable moisture content covers quartz sand grains and acts as a connective tissue to the entire mass. Under this homogenous coating, even at maximum compression, water will remain in a highly “rigid” state, binding the sand grains and lending maximum resistance to the sand mould. Bentonite vitrification temperature is higher than other clays.Therefore, when used as an additive, it makes green sand more durable, and, in particular, more resistant to heat stress.

Fig.1 Bentonite Clay

TABLE 1
Properties of Bentonite Clay

Properties	RESULT
Liquid Limit %	336
Plastic Limit %	47
Shrinkage Limit %	12.4
Plasticity Index %	289
Soil Classification	CH
Percentage of Clay %	82
Specific Gravity	2.59
Differential free swell index %	120
ucc strength kN/m^2	112.7
Coefficient of permeability m/s	$3.2*10^{-10}$
Optimum Moisture %	40
Maximum Dry Density kN/m^3	1.19

B. Laterite Soil

Laterite is a soil and rock type rich in iron and aluminium and is abundantly distributed soil along south India. The mineralogical composition of the lateritic soil has an influence on the geotechnical parameters such as specific gravity, shear strength, Atterberg limits, bearing capacity etc. Nearly all laterites are of rusty-red coloration, because of high iron oxide content. They develop by intensive and prolonged weathering of the underlying parent rock. Tropical weathering (laterization) is a prolonged process of chemical weathering which produces a wide variety in the thickness, grade, chemistry and ore mineralogy of the resulting soils. The majority of the land area containing laterites is between the tropics of Cancer and Capricorn. Laterite has commonly been referred to as a soil type as well as being a rock type. Laterites are a source of aluminum ore; the ore exists largely in clay minerals and the hydroxides, gibbsite, boehmite, and diaspore, which resembles the composition of bauxite. Soil for this study is collected from Armachillo, Trivandrum.

Fig.2 Laterite Soil

TABLE 2
Properties of Laterite Soil

Properties	RESULT
Liquid Limit %	32.5
Plastic Limit %	19
Soil Classification	MI
Clay %	23
Silt %	60
Sand %	17
Specific Gravity	2.41
ucc strength kN/m^2	90.742
Optimum Moisture %	24
Maximum Dry Density kN/m^3	6.174

IV. METHODOLOGY

Laboratory tests were conducted to determine the engineering properties and strength characteristics of soil samples with and without addition of bentonite. The main materials characterized in the present study are laterite soil, bentonite. A brief introduction about these materials and methodology are explained in this chapter. The soil considered for this study were tested first for engineering properties and the samples were tested for determination of strength parameter that is Compaction. Tests were conducted on varying percentages of bentonite to both the samples – 0%, 5%, 10%, 15%, 20%, and 25% by weight respectively and optimum is found out.

V. RESULTS AND DISCUSSIONS

A. Liquid Limit

The experiments was conducted for laterite soil with varying percentages of bentonite from 0%, 5%, 10%, 15%, 20%, 25% of bentonite along with the red soil . The variation of liquid limit for Laterite soil with varying percentages of bentonite is shown below.

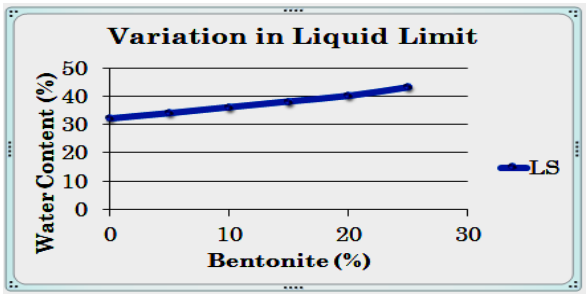

Chart -1:Variation in liquid limit for Laterite soil with varying percentages of bentonite

There is increase in the liquid limit value with increase in percentage of bentonite clay content. The liquid limit increased up to 25% (Nawagamuwa U. P

et al (2014) .The values obtained is with in the limits and is considered suitable for remaining experiments.

B. Plastic Limit

The experiments was conducted for Laterite soil with varying percentages of bentonite from 0%, 5%, 10%, 15%, 20%, 25% of bentonite along with the Laterite soil. The variation of plastic limit for Laterite soil with varying percentages of bentonite is shown below.

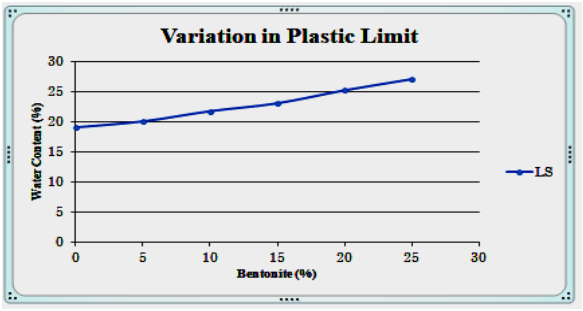

Chart -2:Variation in plastic limit for Laterite soil with varying percentages of bentonite.

Laterite soil showed an increase in plastic limit with increase in percentage of bentonite clay content .The values obtained is with in the limits and is considered suitable for remaining experiments (Nawagamuwa U. P et al (2014)).

C. Plasticity index

The experiments was conducted for laterite soil with varying percentages of bentonite from 0%, 5%, 10%, 15%, 20%, 25% of bentonite along with the Laterite soil. The variation of plasticity index for laterite soil with varying percentages of bentonite is shown below

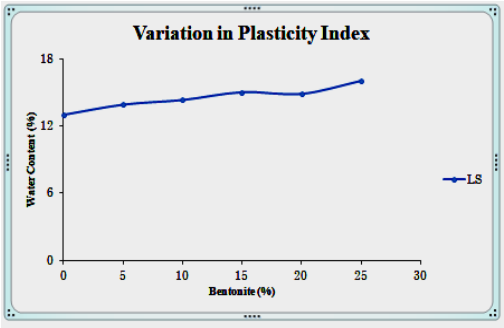

Chart -3 :Variation in plasticity index for Laterite soil with varying percentages of bentonite

Laterite soil showed an increase in the plasticity index with increase in percentage of bentonite clay content.

D. Compaction characteristics

The experiments was conducted for Laterite soil with varying percentages of bentonite from 0%, 5%, 10%, 15%, 20%, 25% of bentonite along with the Laterite soil. The variation of compaction for Laterite soil with varying percentages of bentonite is shown below.

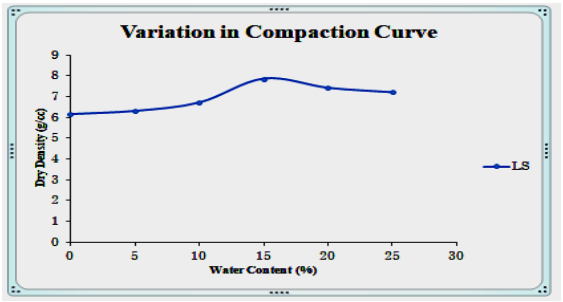

Chart -4: Compaction curve for Laterite soil with varying percentages of bentonite.

The compaction value of Laterite soil also increased with increase in percentage of bentonite clay content .as per the journal of Hashir usman et al (2016). The maximum value obtained for compaction was for 15% of clay content .

E. Image processing of vertical bounce test

The experiment was conducted by allowing the cricket ball to fall freely from a height of about 2m into the model pitch. By image processing the rebound height of ball is noted and it is found that upto 15 % of bentonite content ,bounce value increased and then it decreased. The variation of bounce height for Laterite soil with varying percentages of bentonite is shown below.

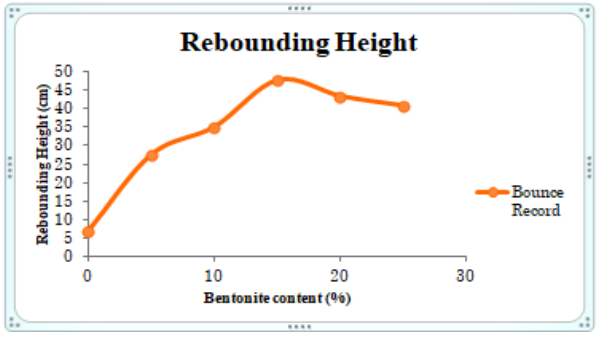

Chart -5: Variation of vertical bounce with varying percentages of bentonite clay.

The Laterite soil showed an increase in height upto

15% of bentonite content and then it decreased. The optimum value of bounce is found at 15% clay content.

VI. CONCLUSIONS

The Laterite soil were used in this study. Sodium Bentonite was added to the Laterite soil in varying percentages. A series of laboratory test were conducted and the following conclusions were obtained from the study.

- The initial properties of Bentonite clay, Laterite soil were found.
- Liquid Limit, Plastic Limit, Plasticity index were found with varying percentages of bentonite in Laterite soil.
- The Compaction curve was found with increase in percentage of bentonite in Laterite soil.
- For the optimum percentage of bentonite , the vertical bounce increased to 5.5 times than that of original state. The optimum value for bounce was observed at 15% of clay content for Laterite soil.
- The Liquid limit value was determined for Laterite soil with varying percentages of bentonite clay from 0% - 25%. The result showed an increase in value of liquid limit with increase in percentage of bentonite. clay.The value obtained for each percentage was within the limits that is between 22.5% to 49.6%. Which indicates that the soil can be utilised for the making of pitches .
- The plastic limit value was determined for Laterite soil with varying percentages of bentonite clay from 0% - 25%. The result showed an increase in value of plastic limit with increase in percentage of bentonite clay.
- The value obtained for each percentage was within the limits that is between 13.8 - 34%. It indicates the binding effect of bentonite on soil. The compaction values were also determined for Laterite soil with varying percentages of bentonite clay from 0 % - 25%. The maximum dry density (MDD) and OMC was obtained at 15% of bentonite clay content on Laterite soil.

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