Pitch Analysis for Cricket Ground

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***Abstract*— It is stated that since the British colonial rulers introduced the game of cricket to India, the technique of creating a cricket pitch has been passed from one generation of grounds men to another. Pitch soil selecting, testing in the laboratories, arranging process, acclimated grass selection and planting, rolling techniques and schedules to achieve the maximum compaction, and the impact of micro-climatic factors (such as relative humidity, temperature, attainable moisture in the soil inside the pitch's background, wind velocity, evapo-transpiration rate, dew factors, and available soil moisture just to name a few) are all steps and conditions during the pitch making processes. This article aims to comprehend the various rational scientific explanations and pitch-making techniques by utilizing the knowledge and experience those curators and groundskeepers have accrued throughout the course of their careers.**

Index terms: Cricket ground pitch analysis, soil testing, site visiting, crease and pitch measurement.

I.INTRODUCTION

It is difficult to ignore the significance of cricket pitches since they frequently determine a team's future by having an impact on its performance. The cricket field occasionally benefits the bowling team and occasionally the batting eleven. When creating cricket pitches, it is necessary to adhere to specific regulations regarding the size and shape of the field. However, there are no restrictions on the size and form of the cricket ground, demonstrating that the pitch is the most important element in this game. The pitch is situated in the middle of the cricket field, between the wickets, and it is 22 yards (or 20.12 meters, or 2012 cm) long. It is 10 feet wide (3.05 meters, or 305 cm). Short grass may occasionally be covering it, however, it disappears at the very end of the game due to wear and tear. Contrary to other sports, the field is made on natural land using natural dirt, therefore the playing surface is not always level. Some pitches are firm and springy, others are cracked and dry, while yet others are lifeless and dusty. These attributes are all influenced by the location and method of construction of the field, the weather, etc.

A pitch soil's selection and layering principles have been traditional and customary for almost a century, but they only used the trial-and-error method used by groundskeepers who lacked the necessary scientific knowledge. The Board of Cricket for Control in India (BCCI) and the affiliated State Cricket Associations have started a specific campaign to investigate the discrepancy between the various scientific approaches based on research and development and the traditional style of pitch-building procedure. Through BCCI, the Indian Institute of Technology in Mumbai has examined virtually all of the physical and chemical characteristics of the pitch soils used in India's main cricket venues. Understanding the significant heterogeneity present throughout the numerous pitch soils of our country in various climatic zones requires physical as well as chemical studies of pitch soils, which are of utmost relevance. When the BCCI, related State Cricket Associations, and Central and State Agricultural/Engineering Colleges work together, they may improvise fantastic Indian pitches by knowing their characteristics and behavior.

Figure 1: Pitch observation

A. Problem Statement

A cricket pitch may have a number of issues, some of which include:

- Uneven bounce: Whenever the pitch hasn't been adequately maintained or prepared, the ball bounces in an unpredictable manner. The batter may find it challenging to determine how the ball will bounce which can potentially result in injury.
- Cracks: The pitch may develop cracks as a result of extreme dryness, an absence of moisture, or improper upkeep. The bounce from these breaks may be irregular, making it challenging for the bowlers to manage the balls they throw.
- Puddles: Due to poor drainage, puddles can collect on the field, delaying the match and making it challenging for players to move about.
- Excessive moisture: A too-wet or damp pitch might hinder the batsman's ability to perform strokes and slow down the velocity of the ball.
- An absence of grass covering can cause the pitch to become dry and dusty, which can cause an irregular bounce and make it harder for bowlers to hold the ball.
- Poor quality topsoil: Poor soil quality can cause the pitch to become overly tough or too supple, which can alter the ball's velocity and bounce.
- Poorly maintained field: A poorly maintained field can become uneven and have an unpredictable bounce, which makes it challenging for players to provide their best efforts.

These issues may result in player injuries as well as changes in the final result of a cricket match. The pitch must be periodically prepared and maintained to guarantee both sides have a level playing surface and that it is safe.

B. Objectives

There are a number of steps that may be implemented to address the issues with a cricket ground's pitch, including:

• Pitch renovation: If the pitch has grown old or damaged over time, renovating it might assist to increase its quality and uniformity. This can entail reseeding the field, adding fresh soil, or leveling the surface with specialized machinery.

• Pitch monitoring. By keeping an eye on the pitch on a regular basis, any issues may be found and fixed before they get worse. To monitor the ball's behavior on the field, technologies like cameras or pitch sensors may be used.

• Determining regions of the surface that need enhancement: Based on the study, it can be feasible to pinpoint problematic sections of the pitch, including those with an uneven bounce or too much spin. This may assist in guiding focused maintenance and improvement activities.

• Statistics on pitch traits: The study may produce information on the length, breadth, and slope of the pitch. To guarantee that the pitch satisfies the necessary criteria, this information may be utilized to guide maintenance and repair operations.

• Information on the pitch's composition, including the type of grass or soil used: The analysis may offer details on the pitch's composition. This can aid in maintenance planning and guarantee that the pitch is appropriate for cricket matches.

• Evaluating the pitch's quality: One of the main goals of a pitch analysis is to evaluate the pitch's quality and see if it satisfies the requirements necessary for cricket matches.

The results of a pitch analysis may be used to guide targeted maintenance and improvement projects and make sure that the field offers a level playing surface for all players. Overall, the pitch study is a crucial initial step in enhancing its quality and making sure that it offers a level playing field for all players.

II.LITERATURE SURVEY

[1] The study's main objective is to assess how adding sodium hydroxide to soil affects its strength, compressibility, and shear resistance. The authors carried out several lab tests, including unrestrained studies using varying sodium hydroxide concentrations on samples of clayey soil, including compression, consolidation, and direct shear tests. The findings demonstrate that the geotechnical characteristics of clayey soil are significantly impacted by the addition of sodium hydroxide. With an increase in sodium hydroxide content, the soil becomes stronger while becoming less compressible. With the addition of sodium hydroxide, the soil's shear resistance also rises. The results of this study have important ramifications for the building sector since they provide light on the prospective application of sodium hydroxide in construction.

[2] It is frequently devastating when expansive soils' volume becomes unstable owing to moisture changes,

leading to serious damage and distortions in the supporting buildings. Therefore, it is essential to sufficiently enhance such soils' capabilities so that they can successfully meet the needs for post-construction stability. Chemical stabilization utilizing additions like lime, cement, and fly ash can accomplish this. The applicability of these additions under various circumstances and their processes are explored in detail in this research. It has been noted that hydration, cat ion exchange, flocculation, and pozzolanic reactions are the main components of the stabilizing process.

[3] This article discusses the findings of an experimental investigation that was done to determine how ammonia-soda residue (ASR) behaves mechanically. The former Solvay Sodium Plant plant site in Krakow, Poland is where the calcareous sludge was dumped. It is an alkaline waste product created during the production of soda ash. The full saturation with water, the completion of the consolidation, and the selection of the loading/strain rate are all factors in isotopically consolidation drained (CID) triaxial tests and constant rate of strain (CRS) consolidation tests. ASR undisturbed samples were taken from the ground for this purpose and put through tests in the lab. The initial bulk density, first compaction level, initial void ratio, and initial water content of these samples all varied noticeably.

[4] Commonly, chemical stabilization is utilized to enhance the engineering qualities of difficult soils. The goal of this research is to determine whether clays' engineering qualities may be improved by utilizing calcium carbide residue (CCR), a by-product of the acetylene manufacturing process. The strength and compressibility of the stabilized clays were evaluated for this purpose using a variety of unconfined compressive strength (UCS) and consolidation tests on green bentonite (with a mineralogy predominately composed of montmorillonite) and white kaolin (with a mineralogy predominately composed of kaolinite). To further shed light on the mechanism of strength growth, a series of micro-level tests were used to evaluate the micro structural characteristics of the stabilized clay matrices.

[5] In India, expansive soils cover more than 20% of the country's land. These soils experience shrinkage and expansion in response to changes in the soil's water content, respectively. In order to investigate the impact of combining potassium chloride on various soil parameters, experimental experiments on an expansive soil were carried out in this study. With the addition of potassium chloride, it was discovered that the liquid limit, swelling potential, and plasticity index considerably decreased. Plastic limit was first decreased for potassium chloride concentrations of 6-8%, but later it was increased to reflect the rise in potassium chloride concentration.

[6] By hydration, cat ion exchange, flocculation, pozzolanic reaction, and carbonation, calcium-based stabilizer materials (CSMs) enhance the characteristics of clayey soils. The mechanistic literature of extensive soil stabilization by adding CSMs is provided by evaluating 183 published research publications in this thorough study, which spans the previous three decades from 1990 to 2019. Both the benefits and drawbacks of using CSMs as a ground stabilizing agent are briefly reviewed, and the main consequences of physicochemical changes on soil parameters are covered in depth.

[7] The impact of sodium chloride on a few geotechnical characteristics of expansive soil for highway pavement (subgrade) works was examined in this research. In this study, the laboratory determination of engineering properties, such as natural water content, Atterberg limits, specific gravity, compaction, free swell index, unconfined compressive strength, soaked and unsoaked California bearing ratio, and their behavior when stabilizing with different percentages of sodium chloride (0, 0.5, 1.0, 1.5, 2.0, and 2.5), was investigated. According to the study, the stabilized soil's values for plastic limit, liquid limit, plasticity index, linear shrinkage, specific gravity, free swell index, and optimal water content decreased, while its values for maximum dry density, California bearing ratio, and unconfined compressive strength rose. The largest percentage reductions were 42.86% (50.00 to 28.57%), 60.42% (131 to 51.85%).

[8] This study examines bio-cementation utilizing microbial-induced calcite precipitation (MICP), a new and promising technique for soil stabilization. By using bacteria to hydrolyze urea, MICP produces carbonate ions that combine with calcium chloride to create calcium carbonate (calcite), which binds soil particles

together and increases soil strength and stiffness. The efficiency of bio-cementing silica sand under various environmental and physical variables, such as starting soil density, temperature, and pH, was examined in this work. The assessment of calcium carbonate content, soil permeability, and unconfined compression strength were among the laboratory studies that were carried out. According to the findings, bio-cementation works better with sand that has a higher starting density.

III. PROPOSED METHODOLOGY

We went to the ABBR Ground, spoke with the staff there about the pitch conditions, and conducted a number of surveys and observations. We are performing a site visit for a cricket pitch study, and there are a number of things to take into account. It is crucial to evaluate the state and playability of a cricket pitch, which is a strip of ground created especially for the game of cricket.

Figure 2: Pitch analysis procedure

A. *Crease Measurement Metrics*

When doing a site visit for a pitch study, it's crucial to record the pitch's state and features using precise measurements, notes, photos, and videos. To acquire fresh viewpoints and thoughts, it could also be beneficial to speak with regional specialists or seasoned cricket players.

Figure 3: Crease Measurements

- Type of Soil: The pitch's performance is highly dependent on the type of soil that was used to create it. It is customary to use a clay-based soil since it can hold onto moisture and offer a sturdy surface for the ball to bounce on.
- Pitch Dimensions: The International Cricket Council's (ICC) rules on pitch dimensions must be followed. The pitch's dimensions must be 22 yards long by 10 feet broad, with the "wicket" in the center.
- Pitch Conditions: How the pitch is set up can make a big difference in how the game turns out. Bowlers and batsmen might struggle on a pitch that is too dry or too wet, thus it's critical to evaluate the moisture level and overall firmness of the pitch.
- Grass Cover: The grass cover on the field can have an influence on how the ball moves and bounces during play. Too much grass may make a pitch slower and lower, while too little grass can make a pitch faster and springier.
- Environment: It's crucial to take into account the pitch's surrounds, including the land's slope and any potential obstacles, since they might also affect games.

B. *Pitch Measurement Metrics*

The majority of the action happens on the cricket pitch, a rectangular space in the center of the cricket field. The Laws of Cricket standardize the dimensions of a cricket pitch, which are as follows:

Figure 4: Pitch Measurements

Pitch length: The pitch measures 22 yards (20.12 meters) in length. The distance is measured between the two sets of wooden stumps that are positioned at either end.

• Pitch width: The pitch measures 10 feet (3.05 meters) in width. It is measured perpendicular to the length, across the pitch.

• Crease markings: At either end of the field, there are two sets of crease markings. The batting and bowling regions are indicated by these marks.

- The popping crease is a white line that stretches 4 feet (1.22 meters) in front of the stumps on either end. It is often painted with paint or whitewash. To ascertain if a batsman is outside of his area of responsibility.
- Return crease: The return crease is a white line that extends at a right angle from the popping crease towards the edges of the pitch. It is also drawn in front of the stumps.
- Bowling crease: The bowling crease is an 8 feet 8 inch (2.64 meter) wide white line that is drawn on both ends of the wicket. It establishes the acceptable region for the bowler to release the ball while running parallel to the popping crease.
- Stumps: There are three vertical wooden poles called "stumps," each of which is 28 inches (71.1 centimeters) tall. With the central stump placed in the centre, they are placed at either end of the pitch.

IV.EXPERIMENTAL RESULTS

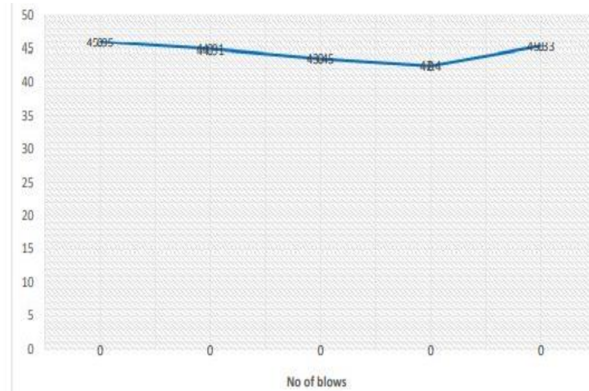

Figure 5: Line graph of Liquid Limit

The liquid limit calculated from the graph is 45.91.

Table 1: Values of liquid limit

Sample no.	1	2	3	4	5
Mass of empty can (gms)	15.34	13.56	14.53	11.26	14.96
Mass of can + wet soil in (gms)	54.72	53.62	53.46	45.45	54.96
Mass of can + dry soil in (gms)	43.00	40.70	42.96	36.45	37.69
Mass of soil solids	29.76	27.12	28.75	21.53	23.69
Mass of pore water	13.96	13.34	12.78	19.33	10.83
Water content (%)	45.95	44.91	43.45	42.40	45.33
No. of blows	19	24	31	36	22

Table 2: Values of direct shear test using normal soil

Test no.	Normal stress (kPa)	Area of shear surface (cm^2)	Shear Displacement (mm)	Shear force (N)	Shear Strength (kPa)
1.	25	10	0.5	50	50
2.	50	20	1.0	120	60
3.	100	30	1.5	270	90

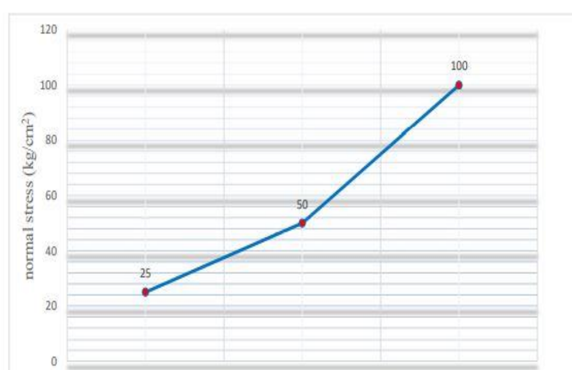

Figure 6: Line Graph of Direct Shear Values by Using Normal Soil Computing from graph,

Cohesion (C) = 0.3982 kg/cm2

Angle of internal friction (φ) = 48.10°

Table 3: Values of Direct Shear Values by Adding 0.5 % Chemical to Soil

Test no.	Normal stress (kPa)	Area of shear surface (cm^2)	Shear Displacement (mm)	Shear force (N)	Shear Strength (kPa)
1	0.5	56	208.58	20.80	60
2	1.0	86	331.35	33.76	89
3	1.5	108	422.31	42.34	119

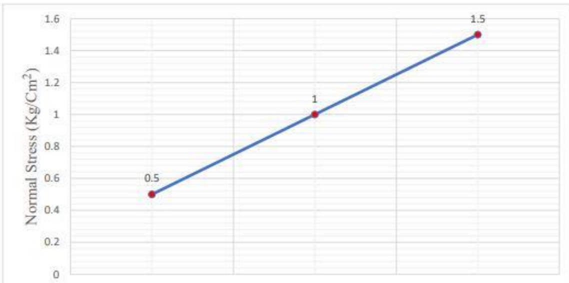

Figure 7: Line Graph of Direct Shear Values by adding 0.5% Chemical to Normal Soil

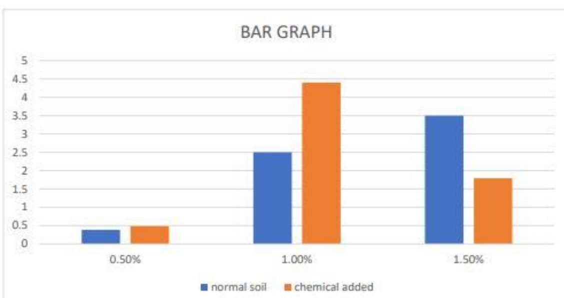

Figure 8: Bar graph

Computing from graph,

Cohesion (C) = 0.3575 kg/cm2

Angle of internal friction (φ) =51.101

V.CONCLUSION

Investigated and discussed were the findings of a geotechnical investigation done on dirt from the ABBR Ground. Experiments were carried out using soil that had chemicals added in weight amounts ranging from 0.5% to 1.5% to 2.5%. The geotechnical characteristics of soil were formed into a relationship. The investigation also looked at the influence and impact on soil that happened. The investigation yielded the following findings about soil compaction tests. The study's findings indicate that maximum dry density increases in trend and depends less on chemical additive levels as they rise, moreover, the black soil compaction test.

REFERENCE

[1] N. K. Subuddhi and S. K. Pradhan, (2019), "Effect of Sodium Hydroxide on Geotechnical Properties of Clayey Soil".

[2] N. Kumar and R. K. Sharma (2019). "Stabilization of Expansive Soil with Magnesium Chloride and Fly Ash".

[3] A. J. Khajuria and S. Kumar (2018). "Effect of Sodium Carbonate on the Engineering Properties of Cohesive Soil".

[4] M. S. Rawat et al. (2019)."Improvement of Soil Strength and Compressibility Using Calcium Carbide Residue".

[5] R. K. Sharma et al. (2016), "Effect of Potassium Chloride on Geotechnical Properties of Expansive Soil".

[6] A. K. Gupta and R. K. Sharma (2017),"Effect of Sodium Silicate on Geotechnical Properties of Expansive Soil".

[7] P. M. Attard and S. B. Kulkarni (2015), "Stabilization of Clay Soil with Sodium Chloride".

[8] Baral, A., and Das, S. (2021),"Soil stabilization using microbial-induced carbonate precipitation (MICP).

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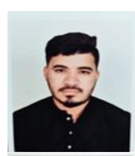

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