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Drainage System of a Cricket Stadium

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***Abstract*— A cricket stadium's drainage system is an essential part of making sure the playing surface is dry and safe for players during bad weather. This system is often made to drain extra water from the pitch and outfield, eliminating water logging and lowering the possibility of player injury. In order to transfer water away from the playing surface, a well-designed drainage system may incorporate elements like sub-surface drains, trenches, and sumps in addition to a network of pipes and pumps. The drainage system must be properly maintained to be functional, and any concerns that do occur may call for routine inspections and repairs. Overall, a solid drainage system is necessary to maintain a top-notch playing field and guarantee the security of both players and spectators. The objective of this paper's comparative analysis is to lower installation and maintenance costs. To keep the stadium dry and make the field playable within 30 minutes of rain, an underground ventilated drainage system is used. Manual labor is no longer necessary. The technology completes the task with the least amount of expense and environmental impact, assisting the authorities in boosting the stadium's local economy.**

***Index Terms*—Stadium drainage pattern, Infiltration of soil, Delayed matches.**

I. INTRODUCTION

Cricket is a manner of lifestyle for many of people in India, not simply a sport. It is perhaps the most popular playing sports in the entire nation, with a huge fan base that spans all ages and socioeconomic levels. Sport has played an important part in establishing the country's sense of culture, bringing people from all areas and cultures together. Cricket has been a source of Indian pride, with India creating many of the world's top players. A cricket ground is a specialized athletic venue built specifically to hold cricket matches. The stadium normally has a big, oval-shaped playing field surrounded by spectator seating spaces. To achieve best performing circumstances for cricket matches, the field typically comprises of genuine grass and is kept to stringent standards. Overall, cricket stadiums are important in the sport of cricket because they provide a specialized venue wherein teams are competing and fans can gather to experience the thrill as well as grandeur of live cricket matches.

A cricket stadium's drainage system is an important part of its layout, ensuring that rainfall is adequately and efficiently evacuated from the playing field and surrounding regions. The drainage system is crucial to preserving the field's condition, reducing the danger of player injuries, & allowing matches to continue despite instances of severe rain. A well-constructed drainage scheme needs to be adept at handling enormous amounts of rainwater in a brief span of time without causing field damage or jeopardizing player safety. Surface and underground drainage systems, such as gutters, channels, and subterranean pipes, are normally used to gather and discharge precipitation as fast and effectively as feasible. Regular maintenance and upkeep, alongside to the overall appearance of the drainage system, are required to maintain its long-term function. This involves cleaning and inspecting drainage channels and pipelines on a regular basis, as well as monitoring soil moisture levels to spot possible problems ahead of time. Overall, a cricket stadium's drainage system is an essential part of the complete design, ensuring that matches may continue even in poor weather conditions, while also assuring the safety and comfort of both players and spectators.

Careful planning and consideration of many elements are necessary when designing a drainage system for a cricket stadium. Conducting a site study is the first stage in constructing a drainage system for a cricket stadium. The next stage is to ascertain the drainage needs when the site survey is finished. Different types of drainage materials may be required depending on the site characteristics and drainage requirements. The drainage pattern should be created to guarantee that the whole playing area is suitably covered based on the site assessment and drainage needs. The drainage system needs to be created with maintenance in mind. Before establishing the drainage system, it could be essential to get approvals or permits from the local authorities, depending on where the cricket stadium will be located.

A. Objectives

- Prevent water logging: The major goal of a stadium's drainage infrastructure is to keep water out of the stadium during heavy rains. This keeps the playing field dry, which is essential for the safeguarding of those playing and the standard of the game.
- Preserve the stadium's structural integrity: Water logging can also harm the stadium's construction, causing deterioration, cracking, and sinking. The drainage system aids with this prevention by diverting rainwater past the stadium & its base.
- Increase the stadium's economy: A well-drained stadium may save drying time and have the stadium ready to play faster, avoiding match cancellations.
- Extend the playing surface's lifespan: The accumulation of water may lead the field of play to degrade fast, necessitating repeated repairs or replacements. A robust drainage structure helps to increase the usefulness of the playing field, lowering long-term maintenance expenditures.
- Improve overall game quality: A adequately drained playing surface provides for greater control of the ball, smoother play, and more constant playing conditions, enhancing overall game quality for both players and spectators.

II. LITERATURE REVIEW

[1] Drainage systems include all landscape components through which or over which water flows. The hydrology of an area is defined by these systems for collecting, moving, and storing water through drainage basins. Natural drainage basins' features may change as a result of forestation, agriculture, or urbanization, with serious ramifications for life and property. Despite the fact that few studies of these systems have been conducted, the causes and impacts of urban-induced alterations are explained, and remedies for a Pacific Northwest county are studied. The resulting model may be utilized in the public sphere to make resource preservation choices.

[2] The authors of this project created a drainage system for an Indian cricket stadium. They employed a combination of surface and subsurface drainage measures to keep the field dry even under heavy rain. The authors stated that the drainage systems design was important to the stadium's success and urged frequent maintenance to guarantee its optimal function.

[3] The performance of drainage systems for sporting grounds, including stadiums, was investigated in this study. The authors found that a well-designed drainage system was crucial to a sports field's effectiveness and suggested a combination of surface and subsurface drainage systems. The scientists also suggested routine maintenance and monitoring to guarantee peak performance.

[4] This paper gives an overview of athletic field and facility drainage systems, including stadiums. It emphasizes the significance of good drainage system design and management, as well as the relevance of various drainage approaches, such as surface and subsurface drainage. The paper also examines the significance of soil type and slope in deciding the design of a drainage system.

[5] In this "Main Drainage Systems" lecture series; we will go through how to construct a major drainage system. After a brief introduction to the importance of drainage in agricultural areas (Chapter 2), the components of a drainage system are examined (Chapter 3), with a focus on the main drainage system. Finally, in Chapter 4, drainage practices from the Netherlands (representing the temperate humid area), Egypt (representing the desert and semi-arid regions), and Malaysia (representing the humid tropics) are given.

[6] This article gives an overview of the design concerns and management techniques for agricultural subsurface drainage systems, with an emphasis on drain water quality. The article emphasizes the value of subsurface drainage systems in controlling surplus water in agricultural fields, noting that these systems can boost crop development and output by minimizing water logging and lowering soil salinity. The drainage water generated by these systems, on the other hand, can include high amounts of nutrients and contaminants, which can have a severe influence on downstream water quality and ecosystem health. Grismer highlights various design concerns for subsurface drainage systems, such as the usage of appropriate drainage outlet structures and the selection of acceptable drainage pipe materials.[7] The development of sustainable urban drainage systems (SUDS) in two locations of Glasgow, Scotland, is

investigated in this research. The authors address the application of SUDS approaches to regulate storm water runoff in the Belvidere hospital and Celtic FC stadium sites, such as rain gardens, infiltration trenches, and permeable pavement. They state that these strategies were chosen for their capacity to minimize runoff and increase the quality of storm water released into receiving bodies. The report includes thorough case studies of SUDS implementation in these two locations, including the design and building of the SUDS systems, monitoring and evaluating their performance, and community involvement activities to promote the benefits of SUDS. [8] Soft ground is typically connected with significant issues since these soils are vulnerable to deformation and have relatively low shear strength, which can lead to structural damage. Stone columns are the best option for constructions with wide spread loads and greater permitted settlements among the many solutions available for upgrading the soft clay stratum. The benefits of installing stone columns in weak deposits include increased load carrying capacity, a significant reduction in total and differential settlements, accelerating the consolidation process, reducing liquefaction risks, and improving the slope stability of embankments and natural slopes. In the current investigation, it was decided to use certain locally accessible waste materials for the formation in order to protect the naturally available resources.

III. PROPOSED METHODOLOGY

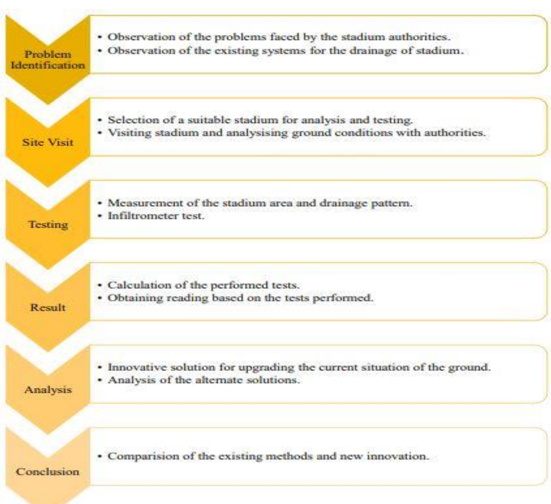

Figure 1: Methodology

A. *Problem Identification*

- Matches that are delayed or interrupted: When the pitch becomes wet owing to rain, matches may be delayed or halted, resulting in a loss of money for the stadium and discomfort for the spectators.

Figure 2: IPL match interrupted due to rain

- Damage to the fields: Excessive water can harm the field, causing soil compaction, decreased infiltration rates, and nutrient loss. This can have an impact on the field's playability and raise maintenance expenses.

Figure 3: Cracks due to excess water in pitch

- **Failure of the drainage system:** If the drainage system is not properly built, implemented, or maintained, it may fail to adequately drain water from the field, compounding all of the difficulties listed above.

Figure 4: Failure of drainage system

B. *Site Visit*

The drainage systems design will be influenced by the site's topography. Take note of the field's slope, the position of any high or low spots, and the direction of surface runoff.

Figure 5: Aerial view of ABRR cricket ground located at Balapur, Hyderabad

Another key thing to consider is the kind of soil. The kind of soil influences the pace at which water can be absorbed, the amount of water the soil can store, and the total drainage capacity of the soil. Examine the present drainage system, including the type of system utilized, the system's condition, the placement and size of catch basins and channels, and the type and condition of pipes. Identify any local water sources, such as rivers, lakes, or groundwater that may impact the field's drainage. Take note of any landscaping elements, such as trees or bushes, as these might affect the field's drainage patterns.

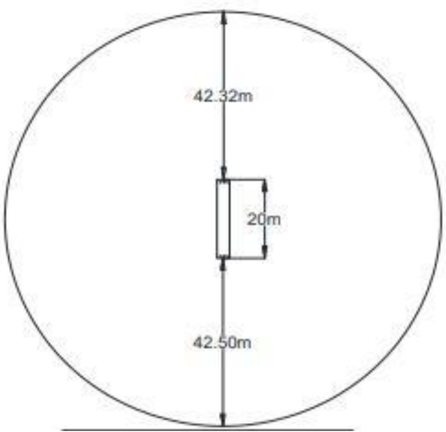

Figure 6: Dimensions of the stadium

Examine the area's regular weather patterns, such as the quantity and frequency of rainfall, and if the area is prone to flooding. This data may be utilized to build a suitable drainage system for the stadium. Examine the frequency and intensity with which the field is used, as well as the sorts of sports performed and the number of events hosted each year. This data may be used to assess the drainage system's capacity and the requirement for new drainage infrastructure. Examine the location and condition of any plumbing and utility infrastructure in the field. Make certain that drainage channels and catch basins do not obstruct any subterranean services, such as electrical or plumbing lines.

Table 1: Details of the stadium

Name of the Stadium	ABRR Cricket Stadium
Location	Balapur, Hyderabad
Climate	Semi-arid
Type of soil	Red Laterite
Annual Rainfall	136 mm
Radius	52.4m
Diameter	104.8m
Total area of the ground	$10000m^2$
Playing area	$8691.90m^2$
Drainage pattern	Circular pattern
Total matches held	265
Matches delayed	36
Types of matches	College and State level matches

C. Measurement of Ground Dimension

Determining the measurements of a ground normally entails using tape to measure the length and breadth of a ground. The diameter of the circular ground is measured, and its area is computed.

Figure 7: Ranging and measuring the diameter of the stadium using Tape

Figure 8: Measuring the length of the Pitch

IV. EXPERIMENTAL TESTS AND RESULTS

A. Single Ring Infiltrometer Test:

A quick test to determine how quickly water can permeate the soil is the single-ring infiltrometer test. This test is frequently used in agricultural, hydrological, and environmental investigations to ascertain the hydraulic parameters of the soil and calculate how much water the soil can hold.

Figure 9: Digging the soil for setting up Infiltrometer

The rate of water infiltration into soil in a limited area is measured using a single-ring infiltrometer. It consists of a single metal ring that is driven into the soil's surface to form a circle, usually having a diameter of 30 to 60 cm. The base of the ring is flat and smooth, which makes it easier for water to be distributed evenly throughout the soil.

The single-ring infiltrometer measures the amount of time it takes for water to infiltrate into the soil when a specific volume of water is put into the ring. The amount of water injected, the size of the ring, and the amount of time it takes for the water to infiltrate into the system are used to compute the infiltration rate.

Figure 10: Filling the water in Infiltrometer

Table 2: Infiltration Test Results

Time in minutes	Δt in hours	Cumulative vol. of water added in cm³ v	Cumulative Infiltration depth in cm F=V/A	Incremental Infiltration ΔF in cm	Infiltration rate in cm/h f=ΔF/Δt
0	0	0	0	0	0
2	0.033	150	0.123	0.213	6.46
5	0.050	200	0.283	0.07	1.40
10	0.083	260	0.368	0.085	1.03
20	0.167	285	0.404	0.036	0.22
30	0.167	350	0.496	0.092	0.56
60	0.500	820	1.170	0.674	1.35
90	0.500	905	1.281	0.111	0.23
150	1.000	1045	1.479	0.198	0.20
210	1.000	1165	1.649	0.17	0.18
240	0.500	1220	1.726	0.077	0.16

The bare minimum infiltration rate is 0.16 cm per hour.

For the first 10 minutes, the average infiltration rate was 2.208 cm/h.

For the first 30 minutes, the average infiltration rate was 0.992 cm.

A. Comparative study with similar existing project

A new drainage system has been installed at the Chinnaswamy Stadium, thereby addressing the issue of rain delays. A drainage system with subsurface aeration and vacuum power was introduced by the Karnataka State Cricket Association (KSCA). According to Mruthyunjaya, the system was constructed at a total cost of about Rs. 4.25 crore. The length of the pipe, around 4.5 kilometers, has been utilized. The venue's rainwater collecting system will receive the water that is extracted from the earth via the pipes. Since the water is recycled, this initiative is "environmentally friendly," according to Mruthyunjaya.

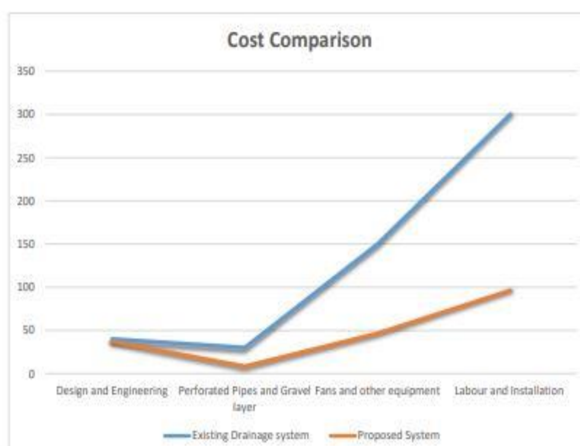

Figure 11: Graph chart showing the cost comparison

Table 3: Cost Comparison

Description of Quantities	Existing Drainage System (INR)	Proposed System (INR)
Design and Engineering	INR 37,50,000 - INR 75,00,000	INR 37,00,000
Perforated Pipes and Gravel Layer	INR 3,00,00,000 - INR 4,50,00,000	INR 8,31,256
Fans and Other Equipment	INR 1,50,00,000 - INR 3,75,00,000	INR 46,40,000
Computerized Monitoring System	INR 37,50,000 - INR 75,00,000	-
Labour and Installation	INR 3,75,00,000 – INR 7,50,00,000	INR 96,49,350
.Contingency	10% of total cost	10% of total cost

According to Kevin Crowe, senior vice president of SubAir, "The entire water evacuation procedure is automated because there are sensor locations on the ground. No manual intervention is necessary. The annual maintenance expense is estimated to be roughly Rs. 7 lakh.

V. CONCLUSION

When compared to other existing Drainage systems, the Drainage system's overall cost is about 60% lower. After a downpour, the field is ready for play in 30 minutes. A competent drainage system may draw more matches and events to the stadium, boosting attendance, income, and profitability. This is done by lowering the possibility of match cancellations and enhancing the overall condition of the playing field.

A good drainage system helps lessen soil erosion and other harm to the field of play, which can lower the stadium's long-term maintenance expenses. Match cancellations brought on by heavy rain or water logging can be upsetting for players, spectators, and stadium staff. A good drainage system can reduce the possibility of match postponements due to muddy fields. The quality of the game may be improved, and player safety can be increased, by maintaining a consistently dry and hard playing surface with the aid of a well-designed drainage system.

REFERENCE

[1] Derek B. Booth (1991), “Urbanization and Natural Drainage system – Impact, Solutions and Prognoses.”

[2] M. A. Rajput and S. A. Siddiqui (2016), “Design of a Drainage System for a Stadium”.

[3] J. R. Watson and J. L. Cisar (2017), “Performance of Drainage Systems for Sport Fields”

[4] The American Society of Agronomy (2014), “Drainage Systems for Athletic Fields and Facilities.”

[5] Dr. Henk Ritzima (2014), “Main Drainage System.”

[6] Mark E. Grismer's article, "Subsurface Drainage System Design and Drain Water Quality.”

[7] "The Glasgow Sustainable Urban Drainage System Management Project: Case Studies (Belvidere hospital and Celtic FC stadium areas)", Scholz et al. (2006)

[8] Mohd Furkhan (2017), “A Study on Load carrying capacity of Soft Clays provided with Granular piles of different materials.”

[9]. “Drainage Behavior of Sports Pitches–A Case Study Review”

[10] Will Adams (2007), “Practical Aspects of Sports field drainage”

[11] “Rainfall Simulator for Investigating Sports Field Drainage processes”.