Development of Sports infrastructure in terms of Energy and Water Conservation

:A case of international Level cricket stadium cum cricket academy Ghaziabad

A Thesis Submitted in

Partial Fulfillment of the Requirements

for the Degree of MASTER OF ARCHITECTURE

by

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June, 2022

CERTIFICATE

It is certified that the work contained in this thesis entitled **"Development of sports infrastrure in terms of energy and water conservation : a case of international cricket stadium Ghaziabad"** by **Mukesh Singh** (Roll No1190109011), for the award of **Master of Architecture** that is from Babu Banarasi Das University has been carried out under my/our supervision and that this work has not been submitted elsewhere for a degree.

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ABSTRACT

Cricket is one of the most popular sports in india.it requires more energy and water. As cricket stadiums are powered by generators and not off of direct gird because that would cause a national outage, the total carbon footprint is about 3% of India's entire carbon score.

This dissertation is focused on the energy and water conservation of a international cricket stadium. It includes roof top pv panels, water harvesting and water filteration by appropriate methods for eco friendly enviroinment. and it give contribution to the society for the future. This concept was brought in our country through the developed nations United States and Europe. This research investigates the factors, related to urban sport infrastructure development, that act as a catalyst for subsequent local urban renewal. It also examines the economic and social benefits resulting from sport infrastructure induced urban real estate renewal. The benefits analysed are derived from the changes in the local real estate markets that may be connected to the sport infrastructure construction.

The city of Ghaziabad in Uttar Pradesh will be proud to have a new world-class International cricket stadium. UP Cricket Association has key role in developing a international cricket stadium. The stadium site is proposed on recreational zone of Raj Nagar Extension Ghaziabad as per Ghaziabad Master plan-2021. The proposed stadium will have an open area of parking for cars and the stadium will also have a sports academy and players accommodation etc. The stadium will be accessible directly through the Hindon elevated road which is connecting UP-Gate (DelhiGhaziabad border) to Raj Nagar Extension, Morti village, Ghaziabad 201003.

ACKNOWLEDGEMENT

A few words to express the gratitude I feel for the assistance rendered by many individual and source for the completion of this dissertation, is a very difficult job. However, I take this opportunity to acknowledge those who have given their valuable suggestions in shaping this study into a cogent form. I am highly indebted to my guide Prof. Anshu Rastogi Department of Architecture Babu Banarasi Das University Lucknow for his great efforts in the completion of this dissertation and his tremendous help and support without which it would have been difficult for me to complete it

Thank You

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Declaration

I, Mukesh Singh hereby declare that the dissertation entitled, **Development of sports infrastructure in term of energy and water conservation: a case of proposed international level cricket stadium cum cricket academy Ghaziabad**. Submitted in the partial fulfillment of completion of M.ARCH. is my research work and that the information taken from secondary sources is given due citations and references.

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CHAPTER -1

1.0 INTRODUCTION:

A stadium is one of those building typologies which have the ability to shape a town or city. A stadium is able to put community on the map, establishing an identity and providing a focal point in the landscape. They represent a nation's pride and aspiration. A stadium is essentially a huge theatre for presentation of heroic feats. Basically, it is the output of the rise in the popularity of sport.it also role in the city-financial, political, geographical and spiritual.

In cricket stadium more lights are required, and bigger screens are used because of the size of a cricket pitch. These grounds swallow up energy on an industrial level. Any cricket club of India can be faced with a sizable bill given that there are on average 8 lighting towers. These feed off a staggering energy supply that is approximately 11kV (kilovolts). This massive size of power needs a transformer to reduce the load to approximately 1800Kilowatts.

Because cricket is the national sport, there are more games which adds to the ever-growing rise in energy being used. As a result, more consumption leads to a recorded 620,000kWh over 12 months. As cricket stadiums are powered by generators and not off of direct gird because that would cause a national outage, the total carbon footprint is about 3% of India's entire carbon score.

There is a clear and present danger with the levels of power that is being drawn from fossil fuels. To address these, changes are being made – though still in testing phases. One of these is solar rooftop installation on a cricket stadium. Installing solar roofing panels in cricket stadium become more environmentally friendly. A solar-powered cricket stadium would massively reduce the cost spent on energy, with old methods creating bills at around 1 or 1.2 crores, which is an approximate cost of 18 lakh units of power. With solar intervention, the power is more than halved to 6 lakh units, which is now solar power.

Entertainment and sports are highly necessary and they have proved to be a pride to our nation. But, maybe it is time to find more eco-friendly and planetary ways to move forward with these games so we can enjoy a good game without raising alarm to our future. Water scarcity is a highly prevalent issue all over the world in current times and it is highly debated upon, as well. Although a number of measures are being taken by the authorities to enforce water saving and frugal use of water among the masses, the issue seems to grow to no extent. On an average, 75-85 cricket matches are played in India each year. In order to irrigate a cricket pitch of normal size (22 yards/20.12 m in length and 10 ft/3.05 m in width) need upto 2500 – 3000 Litres of water each day. Since cricket grounds aren't watered every single day, that translates into approximately 40,000 liters a month. This is equal to the amount of water consumed by two families of four per month, in India.

1.1 AIM AND OBJECTIVE:

The aim of research is development of sports infrastructure through energy and water conservation

• Understanding the environmental impact from water and energy conservation

• Analyzing the necessity of water and energy conservation for sports infrastructure

• Extracted, related data from case study and literature study

• Data analysis for implications

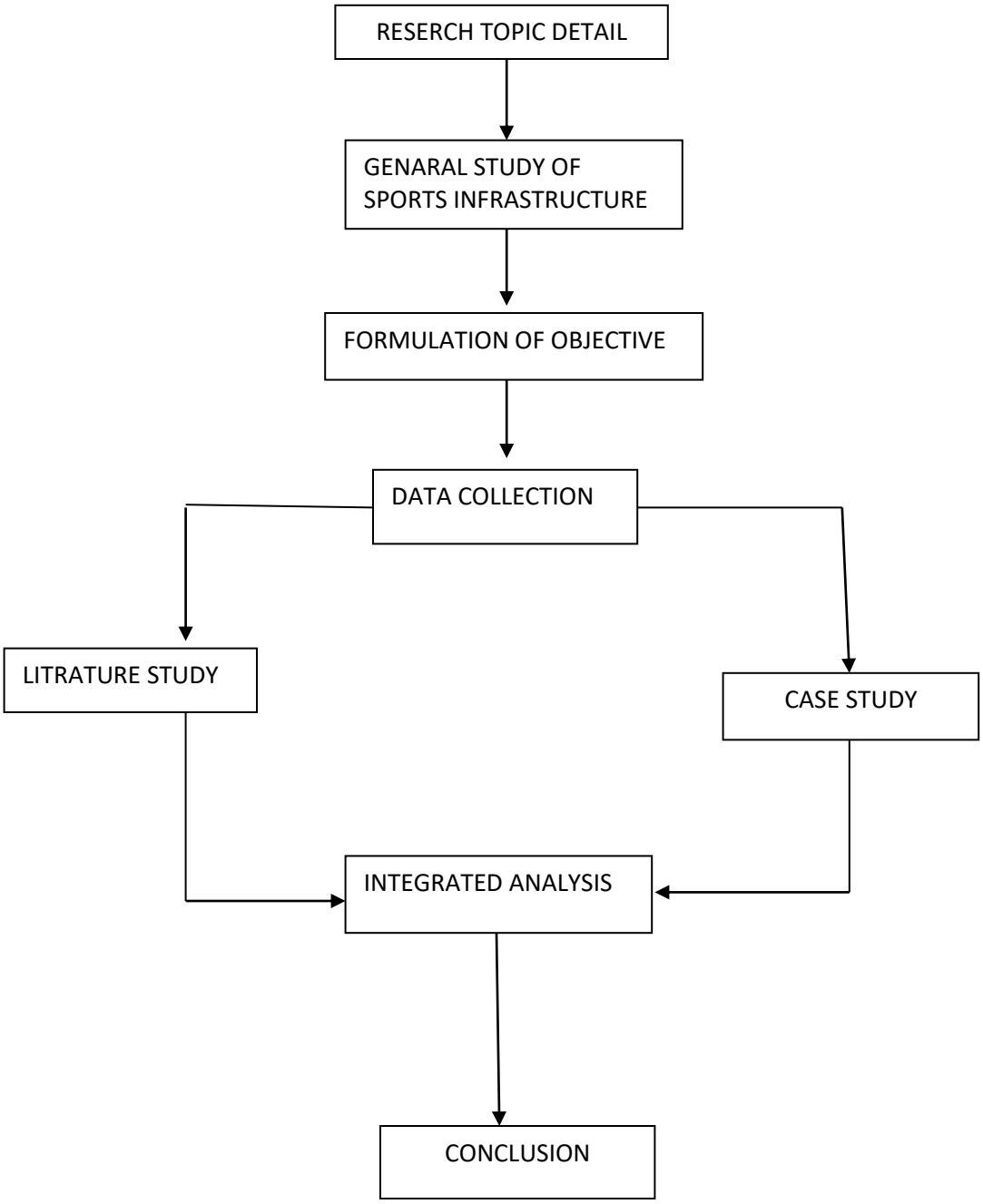
1.2 NEED OF SPORTS INFRASTRUCTURE:

Today sport emerges as an important component of socio-economic development of a country. The active participation in sports improves community health and productivity, reduces medical expenses, imbibes discipline in character and enhances social cohesion. However, sports like cricket, football, hockey, boxing, golf, kabaddi, shooting, and tennis etc. appears to have much potential in future.

1.3 SCOPE AND LIMITATIONS:

- Stadium is a key ingredient in the marketing of the cities and even nations.
- It has capability of creating interests and sports awareness amongst youth and citizens
- Stadium can be part and the memorable character to the cities. which in turn succeed in "getting their name on the world map"
- Introduction of new material in stadium construction in india
- To improve the user experience during the cricket matches
- There are huge gains to be made by upgrading technology.
- Reduction of carbon footprint by a sustainable approach In this dissertation only focused on sustainable approaches through energy and water conservation.

1.4 METHODLOGY:



CHAPTER -2

2.0 CASE STUDY:

2.1 Melbourne Cricket Ground, AustraliaMelbourne Cricket Ground, Australia:

Figure 2.1(a) Melbourne cricket ground and location source: author

INTRODUCTION :

- The Melbourne Cricket Ground is one of Australia's greatest assets.
- It is the busy venue accommodating international cricket, Australian Rules football, concerts, dinners and other major functions on its natural turf arena.
- More than three million people visit the ground annually.
- Melbourne Cricket Club manages the stadium and has progressively expanded the MCG's role as both an entertainment centre and a world-class tourist destination.

Ground Capacity:

- The total capacity of the MCG is 100,018.
- This includes 95,000 seats and approximately 5000 standing room spaces.

Spectator Facilities:

Figure 2.1(b) spectators facilities Source: Author

- This marvelous structure, accommodating 44,500 people and covering 45 per cent of the stadium's perimeter, brought state-of-the-art comfort, convenience and hospitality facilities to all levels of Melbourne's sporting society.
- Facilities and finishes are superior throughout. The male/female toilet ratio has been significantly improved and, for comfort and ease of access, individual plastic bucket seats are fixed on broader plats.
- Sightlines from all seats are uninterrupted and, because the new structure is much closer to the arena than the stands it replaced, spectators are also closer to the action.
- Seats are approximately 30% bigger than the previous northern stand and about 80% of seats are under roof cover.
- Large, deep rooms enable tenant sports and clubs to accommodate up to 500 guests.
- . Extensive landscaping and a new access road enhance the sense of arrival for visitors.
- Capping the new stand is a hybrid roof, part metal and part glass. This considerably increases the brightness of the seating areas.

A NATURAL TURF ARENA:

- After the Olympic Games much of the arena was reconstructed and red mountain soil laid to a depth of about 60cm.
- Compaction over the years gave this soil the consistency of clay and major drainage problems began to surface in the late 1980s

In the spring of 1992, the arena was completely reconstructed with a sand-based profile, giving the ground remarkable drainage characteristics and superior load-bearing ability

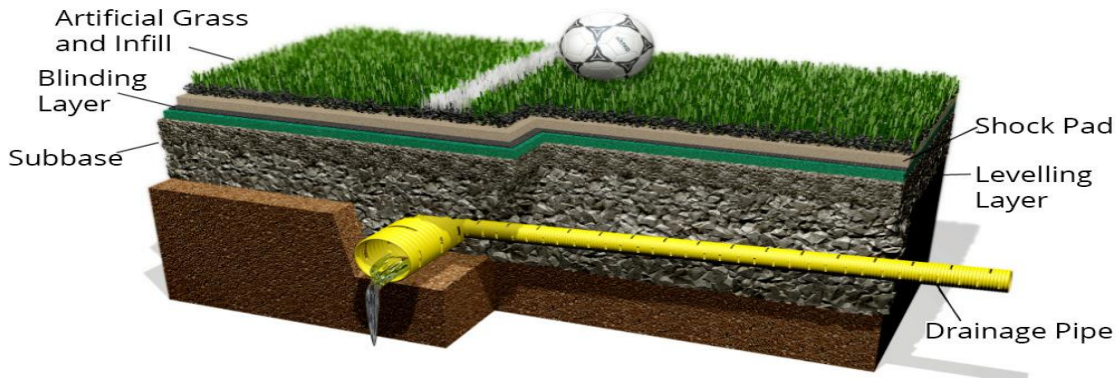


Figure 2.1 (c) Arena drainage system Source: Author

Dimensions:

- The MCG arena has a total of approximately 20,000 square meters in area and measures 171 x 146 meters in length, from fence to fence.
- The boundary line measures five meters from the fence.
- The volume of the MCG is 1,700,000 cubic meters, or 1.7 million cubic meters.
- The goal posts for AFL matches are 15 meters in height (point posts are 10 meters high) and the
- Length of the cricket pitch is 22 yards, which in metric terms is 20.12 metres.

Arena Grow Lights:

- As a result, the MCC procured a product called Stadium Grow Lighting, a mobile supplementary lighting unit
- The shipment, comprising 11 lighting rigs each measuring 12m x 2.5m x 2.5m and two smaller rigs.
- The lighting rigs are placed above the grass to provide light and heat, which stimulates turf growth.

This will enable to achieve year-round quality turf in all weather conditions.

LIGHT TOWERS:

Figure 2.1(d) light towers melborne cricket stadium Source : Author

- The light tower system comprises of six light towers which stand approximately 75 metres high (equivalent to a 24-story building) with the head frame a further 10 metres higher (85 metres overall).
- The foundations for the towers consist of four reinforced concrete piers which are set down in depth from seven to 12 metres depending on the sub surface structure.
- Each of the hollow tubular steel towers contains about 130 tonnes of steel.
- The diameter reduces from 4.2 metres at the base to two metres at the top.

There are between 12 and 14 landings connecting ladders inside each tower. The head frames of the towers are angled in at 15 Degrees in order to provide optimum levels of light

Waste Management:

- The MCC adheres to five key guiding principles to continually improve its performance in waste
- management:

  • Reduce unrecyclable waste

  • Reuse materials where possible

  • Promote recycling by providing appropriate infrastructure

  • Educate employees, patrons and contractors

  • Use landfill as a last resort.

Energy Conservation:

Working in tandem with Siemens, MCC has undertaken an energy efficiency upgrade that has converted the MCG into one of the most environmentally sustainable stadia in the world – and saved enough electricity to power the light towers for nearly six years.

The program of works have resulted in the MCG generating enough energy savings annually to power 835 houses.

Examples of the work involved include:

• Replacing the existing lighting systems with low-energy lighting technologies.
• Installing a new building management system.
• Implementing changes to heating and ventilation systems.
• Installing new chilled water systems and modernized room control systems.

Installation of 220 solar panels at the iconic Melbourne Cricket Ground.:

Great Southern Stand roof would not have been able to handle the added weight of the solar panels but EnergyAustralia discovered that certain sections of the northern stand would work, not only easing weight fears but ensuring there would be enough generation capacity to make the project feasible.

Figure 2.1 (e) solar panels in Melbourne stadium Source : Author

But Energy Australia, and Cherry Energy Solutions Installed 99.45 kW solar panels, system at the roofline of the Northern Stand, above the entry gate will be used to help power the stadium's innovative water recycling facility – resulting in a truly sustainable initiative.

It Consisting of 221 x 450W Trina Tallmax panels, 2 Solar Edge inverters and 112 Solar Edge optimizers, the new solar PV system will save the MCG 112,193 kWh and 114,436 kg CO2 per annum.

Water Conservation:

- The club, responsible for the maintenance of 20,000 square metres of MCG turf, has operated under a water conservation plan for some time.
- The sand profile on the ground has helped reduce water usage by more than one million liters annually without reducing turf quality.
- Despite its commitments to the upkeep of the MCG turf and stadium for the hosting of major events, MCC has operated under a water conservation plan for some time
- The sand profile on the ground has helped reduce water usage by more than one million litres annually without reducing turf quality.
- The MCC is conscious of its social and community responsibility towards the use of water. There are a number of measures either in place or being examined to ensure the MCC remains a responsible user of this precious resource.
- One of the most significant water saving projects in the club's history involved the installation of a water recycling plant in Yarra Park that has reduced consumption of potable water by up to 50 per cent.
- Other water-saving measures being used include the harvesting of rainwater from the northern stand roof (via a 1.5 million-liter storage tank) to clean the seating bowl and concourse, re-engineering the end of hose pipes to increase pressure, implementing toilet flush reduction techniques and the installation of water-saving shower heads and timer controlled taps.

Figure 2.1 (f) under ground water conservation Source: Author

The Yarra Park Water Recycling Facility is directly outside MCG was designed to meet the requirements of the Melbourne Cricket Club and the various regulators, with the *water* used to provide secure, long-term sustainable supply to the heritage listed Yarra Park, Punt Road Oval and the iconic Melbourne Cricket Ground.

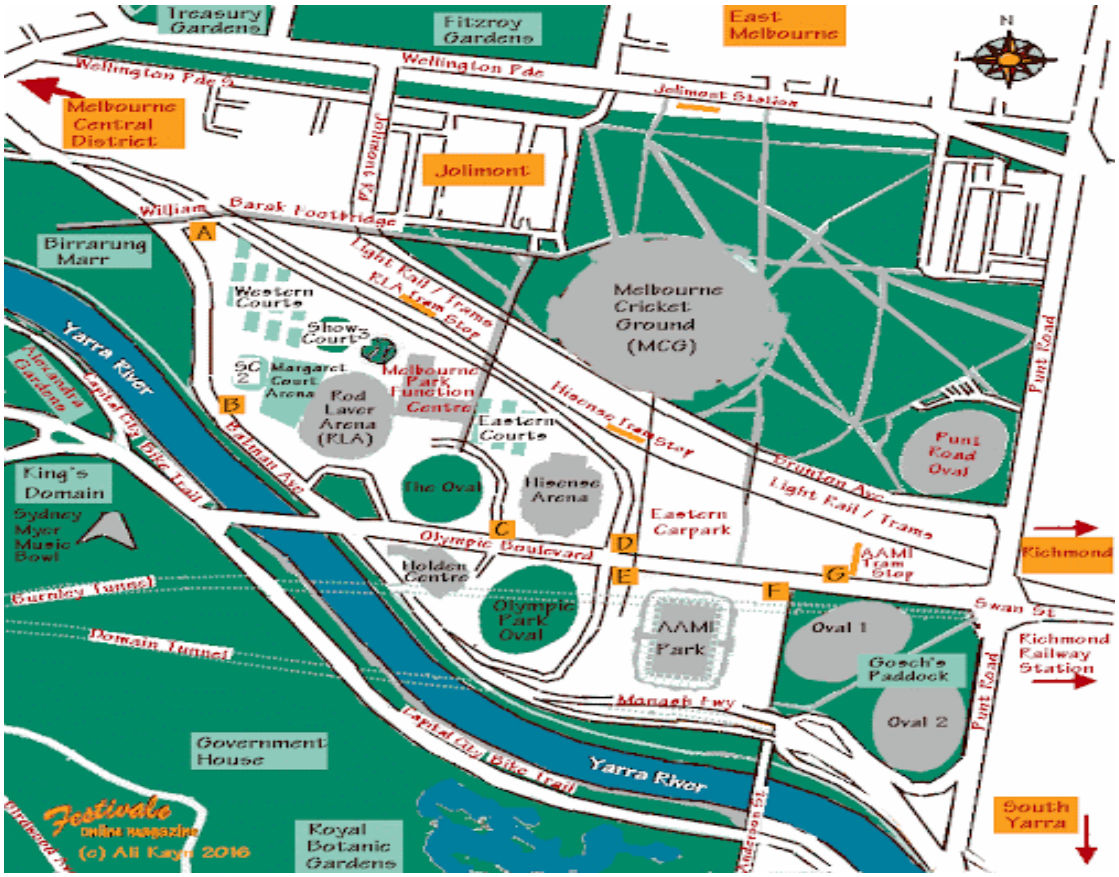


Figure 2.1 (g) yara river and MCG location Source :Author

- The water plant, funded by the MCC ($18 million) and Victorian Government ($6 million), treats sewage from the local sewerage network to Class A recycled water standards.
- Construction commenced on the 25x31 metre site in May, 2011 and was completed in October 2012, following a comprehensive testing regime to ensure the water quality meets EPA guidelines.
- More than 180 million litres of recycled water is produced each year, reducing the MCC's use of potable water by 50 per cent.
- The water is primarily re-used as irrigation in Yarra Park, as well as for cleaning and toilet flushing at the MCG and at nearby Punt Road Oval.
- As one of the first of its type in Victoria, the recycling facility has been built underground, out of public view, without taking away from valuable surface land use or park amenity.
- In 2012, the water recycling facility was recognised with the Infrastructure Project Innovation Award at the Australian Water Association Awards (Victorian Branch).
- For the technically minded, the water recycling process consists of screening and grit removal, biological treatment of the sewage and chemical addition for phosphate removal, filtration via membrane bioreactor and ultra-filtration membrane systems, before finally disinfection via ultraviolet and chlorination.

- The vast majority of the development associated with the water recycling facility to Yarra Park is located below ground, and is not visible within the Yarra Park landscape.
- The more visible elements are the two elevated stair entry/exit structures at the north and south ends of the water recycling facility.
- The water facility assists in providing a sustainable water supply for the future maintenance and upkeep of the park, enabling it to maintain its important role within the collection of inner urban public parks.

Environmental Benefits:

- Recycled water was provided for a number of uses including irrigation, toilet flushing and wash down
- There were benefits to the Yarra River from reducing pollutant loads from a catchment partially contaminated due to past use
- Heritage trees and other vegetation were retained.
- Carbon impacts are fully offset - The project sources part of its energy requirements from renewable sources and fully offsets the carbon impact of the project's operations. A Greenhouse Gas Assessment for the scheme's power usage has been conducted , indicating usage of 83332.6 kWh/per annum producing 101,666 kg CO2 -e. The Melbourne Olympic Parks Trust purchases carbon offsets from recognized sources in addition to any green power purchased.

  The project complements, and in many cases exceeds, existing government initiatives and policies regarding water reuse, urban water management and river health

2.2 CASESTUDY:2 : Chinnaswamy Cricket stadium Bangalore

About the stadium:

Figure 2.2(a) Chinnaswamy Cricket stadium Bangalore Source :Author

- The m. chinnaswamy stadium in bengaluru**,** karnataka, is one of the major cricket venues in india.
- It is located at the center of the city and has witnessed almost all formats of cricket i.e., test match, one day international, t-20 and all other forms of first-class cricket.
- It is the stamping ground of the karnataka stat**e** cricket team and the indian premier league franchise "royal challengers bangalore**".**
- Formerly known as karnataka state cricket association (ksca) stadium
- It has been renamed in the memory of mr. m. chinnaswamy who made significant contributions to **karnataka** state cricket association (ksca) for decades and was also the **president** of **bcci** from **1977-1980**.
- Although owned by the **government of karnataka**, it is leased by **ksca** for **99** years. the stadium is also used for several cultural and musical events.
- It can accommodate approximately 40000 spectators during a match and has two ends – pavilion end and BEML end.
- The ksca planned to increase the seating capacity to 70,000, as well as considered constructing a newer cricket stadium with seating capacity of 70,000–80,000.
- The stadium is spread over the 16.51 acres area.

Stadium Stands: Figure

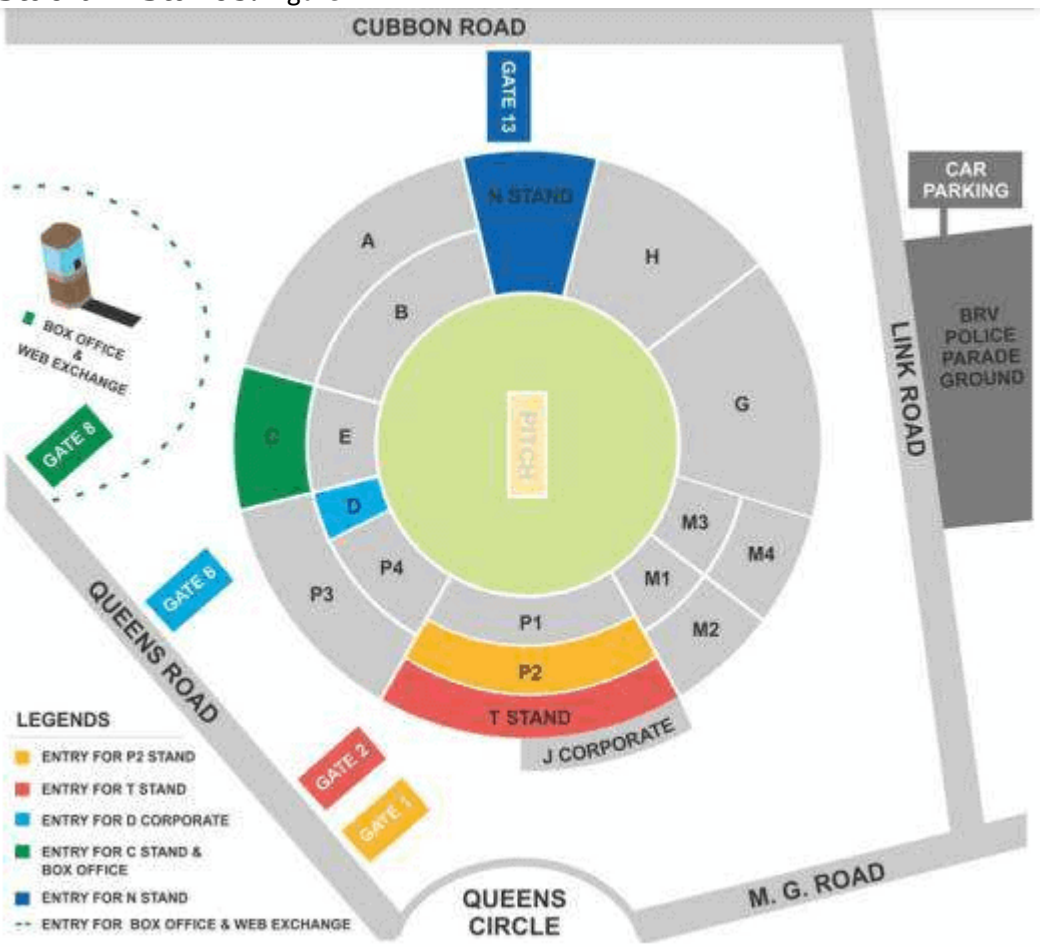


Figure 2.2(b) Chinnaswamy Cricket stadium linkage from road Source :Author

G upper, A upper, C upper, P3, P4, and terrace. These all will give the best match views. The **air-conditioned stands** of this stadium are **D stand**, **T** stand, **P2 stand**, and the **Box office** stand. Besides these all, there is a **Diamond Box** stand that is much costly but has a great view.

Renovation:

The renovation of the outfield is done according to the United States Golf Association standards. Under this system, there is also a sub-surface network of perforated pipes for aeration and drainage, in a closed-loop system and connected to the Sub Air Sports System. It helps in optimizing water usage in the stadium and also allows for Rain Water Harvesting.

Energy Consevation:

Figure 2.2(c) energy conservation by roof top pv panels Source :Author

- The Chinnaswamy Cricket Stadium in the city, which takes pride in being the first cricket stadium in the world to harness solar energy, has generated more than six lakh units of electricity in a year.
- A 400kW Grid Interactive Solar Power Plant has been installed on the roof of the stadium. As per the design, this grid can easily power the entire stadium lighting except the huge high-intensity floodlights.
- Each of these plates are 2 m x 1 m and occupy approximately 10,000 sq. m. It took about 45 days for the project right from installation to fabrication to the final test run,
- It has reduced the dependence on conventional sources of energy by 40 per cent.
- On an average, 16 lakh units of electricity was being used annually by stadium
- Considering the old structure of the stadium, the need of a detailed structural feasibility was felt and thus with the help of Lahmeyer International India a feasibility study of the stadium roof structure was carried out with regard to installation and long term operation of solar PV System. With slight modifications in the structure and roofing sheets, it is possible to install solar photovoltaic power plants with cumulative capacity of approximately 1.3 MW on the roof of east and west stands.
- Currently, the solar panels are installed on the roof of the east end of the stadium. The stadium will now get solar panels at its west end with upgraded technology that can generate more electricity. The stadium authorities now plan to install more solar panels on the west end.
- The first phase of the solar plant - 400 kW rooftop solar photovoltaic system is installed and running successfully
- The plant is installed by a Bangalore based company MRO-TEK and consists of 1422 modules that will generate approximately 1700 units / day which shall be consumed within the premises. Surplus electricity generated will be exported to Bangalore Electricity Supply Company Ltd. (BESCOM) at a price of Rs 9.56 /kWh under the Net

Metering Scheme promoted in the state. KSCA is looking forward to increase the capacity of the plant by adding another 850 kW in the second phase.

- Once finished, the entire project is expected to reduce 600 tonnes of carbon emission annually.
- The modules have additional protection – toughened glass to avoid easy breakage due to ‘sixers
- Transmission cables to the transformers are completely cased – for safety reasons

Water Conservation:

Chinnaswamy Stadium has recently installed a **sewage treatment plant** with the help of the local body BWSSB (Bangalore Water Supply and Sewage Board). The entire system outsources the sewage water flowing along the lines of Queens Road and uses the same after the treatment to water the turf, for gardening and landscaping mostly. This project rounded of the overall budget to about Rs 1 crore, which was self-funded by KSCA alone.

Figure 2.2 (d) STP installed at Chinnaswamy stadium Source : Author

The sewage water from the sewer manhole is laid through trenchless system through a nine-inch diameter pipe to a collection tank in the stadium. Once the water, is collected it goes through a three-stage filtration process.

Stage 1- Physical process

The system predominantly removes huge chunks of garbage collected in the sewage water. The water is collected in a collection tank with a buffer capacity of 16 hours, which is then transferred through a pump for further treatment.

Stage 2-Biological process (MBBR system)

The moving-bed, bio-reactor system is a specially engineered PU carrier media that is kept in a fully mixed condition together with the sewage. After a series of aerobic processes, where microorganisms are supplied with oxygen, the excess sludge is removed and the rest is passed on to the next stage.

Stage 3- Tertiary process (Sedimentation)

Though the above two cycles predominately treat the water, the sedimentation process adds huge value to the system. When the water from Stage 2 is left for sedimentation, a huge mass of sludge settles down leaving behind a comparatively decent quality of water.

Figure 2.2 (e) filteration plant at Chinnaswamy stadium Source : Author

If we thought that, efficient solar rooftop and sewage treatment plant was the only two initiatives Patel has led, wait till you hear about the **rain water harvesting system**. The area outside the main turf are built around 20 different water tanks that are at the ground level. As and when the stadium experiences rain, this water is collected and sent back to the ground through smaller inlets. This helps in retaining the surface moisture.

Calling for a mass movement of water conservation and the efficient utilisation of natural resources, the Bombay High Court had asked the Board of Control for Cricket in India

(BCCI) to use sewage water for ground maintenance for the Indian Premier League (IPL) across the drought hit areas. Though this order came in at the right time to fill in few dents, the gap is too huge to be monitored. But with organisations like the KSCA putting their heart into converting places like the Chinnaswamy Stadium into a green spot, it is definitely leaving behind a legacy for others to follow and to implement at a larger scale.

Rain Water Harvesting:

- Rain water harvesting system (35 million litres of rainwater every year)
- Rainwater Harvesting – 6 months pay back period achieved as KSCA could reduce the BWSSB consumption by 50%

Particulars	Area (Sq Mts)	Coefficient factor	Effective area in Sq Mts	RWH potential in ML Per annum
Stadium roof	20059	1	20059	17
Stadium field	16215	0.35	5675	5
Sitting area	9270	0.65	6026	5
Practice area + Lawn	11206	0.35	3922	3.3
Building	2007	0.65	1305	1
Swimming pool	278	0.1	28	0.028
Open area	17821	0.3	5346	4.5
Total			**42,360**	**36**

Table 2.2 Rain Water Harvesting at Chinnaswamy stadium Source : Author

1. Artificial recharge systems:

a. Recharge pit ,

b. Recharge Trench

2. Direct collection systems: Sumps with silt trap

- Waste water recycling plant/ STP – 200 KLD

Drainage system:

The Chinnaswamy Stadium now boasts of a new drainage system, which will efficiently tackle the problem of rain delays. The Karnataka State Cricket Association (KSCA) unveiled sub-surface aeration and vacuum-powered drainage system, built by Sub Air Systems, at the stadium.

M.Chinnaswamy Stadium will be using water from a sewage treatment plant for the ongoing IPL season on account of the water crisis in many parts of India. The testing for the water from the plant is underway and it should be ready for use in a week's time

Sub Air drainage system:

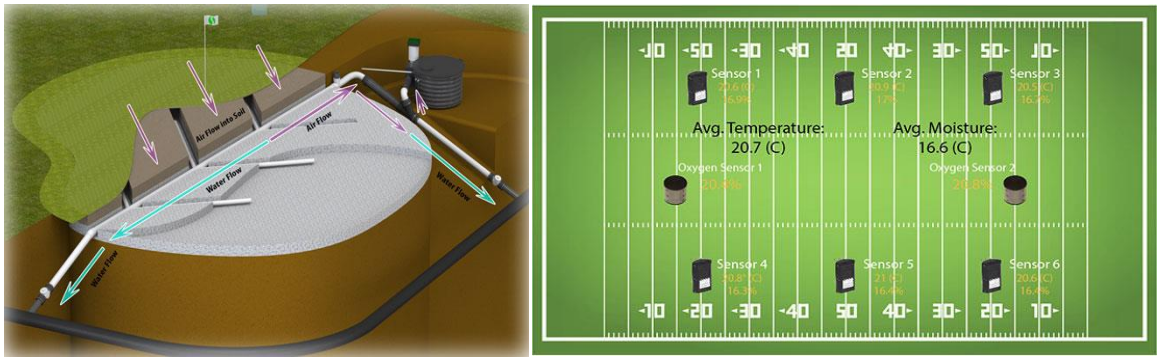


Figure 2.2 (f) sub air drainage system Source : Author

One of the most unique additions under the Green Wicket framework has been the sub air drainage system that sucks water off the surface of the ground at over 30 times the speed of gravity. "It is especially a boon when rain interrupts a match. Even 10 minutes of solid rainfall gets sucked into the ground within eight to nine minute. without the use of any other mechanism or manpower. Sub-Air was installed at a cost of Rs 4 crore by digging the up the ground and installing the pipe line in a sand-based drainage system connected to a vacuum that sucks the water out and stores it. Not just in terms of time, it benefits all the stakeholders in reducing the time spent to dry the ground

2.3 CASE STUDY -3

Indira Paryavaran Bhawan New Delhi:

Figure 2.3 (a) Indira Paryavaran Bhawan New Delhi Source : Author

Indira Paryavaran Bhawan in New Delhi is the first zero net energy building constructed in India with passive solar power generation. Due to inadequacy of roof-top area, additional area was provided through cantilever structural arrangement. Net zero energy building is the outcome of energy efficient architectural, structural, material, electrical and air-conditioning design

Energy efficiency:

The building has been made energy efficient through onsite solar power generation, reduction of conventional lighting load by enabling 75% day light use, generation of energy by deploying thin film transparent PV modules on space frame over the terrace and central courtyard, use of high efficiency lighting fixtures, astronomical/time switches and occupancy sensors.

- About 40% energy saving achieved
- About 55% saving in use of water
- Against the conventional energy demand of 22 lakh units per year, actual energy demand was brought down to only 14 lakh units per year
- Entire energy demand of 14 lakh units generated through highest efficiency mono crystalline SPV panels
- Energy generation started from 19.11.2013

- Energy generated fed to NDMC grid from where supply is taken, thereby offsetting total energy demand
- Thus, annual electricity bill is zero or negative i.e. net revenue on account of excess solar power generation.

Structural concept for solar panels:

Figure 2.3(b) Solar panels Indira Paryavaran Bhawan New Delhi Source : Author

To create total required area of 6000 sqm for supporting solar panels, the entire central courtyard was covered with a space frame. Additionally, MS supporting structure over the terrace was extended by providing cantilever, including at the fourth floor level on the southern side. In view of the high maintenance required for the solar panels, an adequate number of catwalks were provided in the entire supporting structure, with perforated bottom for easy draining of rain water. Out of the total area of 6000 m^2, the area covered by panels is 4600 m^2 and by catwalks it is 1400 m^2.
to generate 100% onsite power of the required capacity, covering of open to sky area in the central courtyard was designed to support the solar panels. For this, a space frame was provided at a height of 35 m. Complete fabrication was carried out in the factory by using stainless steel sections. Sizes of tubes used in the work are 48, 73, 114 and 168 mm diameter with thickness varying from 3.68 mm to 11.24 mm.

Since the area of covering of the central courtyard was inadequate for the required solar panels, the terrace of 2200 sqm was covered with MS box section with 6m cantilevers all around the building and 12m at the corners. Additionally, a 6m cantilever was provided at the 4th floor level on the south face of the building. Box sections measuring 250mm x 450mm to 250mm x 850 mm (depending on the span) were used for supporting the solar panels.

Net zero energy concept:

this building is the first ever zero net energy multi storeyed building with 100% onsite renewable solar power generation. It has the highest green rating by GRIHA as 5 star and Platinum rating by LEED India. With a solar power system of installed capacity 930 KWp, it has the largest rooftop solar system in multi story building in india

Brief details of solar power are given in the following;

- Capacity of power generation : 930KWp
- Annual power demand : 14 lakh units (KWh)
- Annual power generation : 14 lakh units (KWh)
- Total area of solar panels : 4600 sqm
- Total area of the system including catwalks : 6000 m^2
- Photo voltaic panels : mono crystalline, 20% efficiency

Eco friendly feature:

- Chilled beam system of HVAC
- Geothermal heat exchange system
- Regenerative lifts
- Fully automated car parking in basements
- Building orientation in E-W direction
- Blocks connected with corridors and central courtyard
- Building envelope designed to ensure daylight in 75% occupied areas
- Plantation and grassing in more than 50% area
- Grass pavers in circulation areas
- Terrace garden
- Energy efficient air conditioning system and lighting
- Conversion of braking energy into electricity in lifts
- Chillers and AHUs with VFDs, heat recovery wheels and thermostat controls for HVAC
- LED lights, occupancy and Lux level sensors
- 930 KWp rooftop solar power plant
- Low discharge water fixtures
- Landscaping with no hard paving eliminating heat island effect
- Fly ash-based products in construction
- Sewage treatment plant of 30 kLD capacity.

Passive Design stategies:

Orientation:

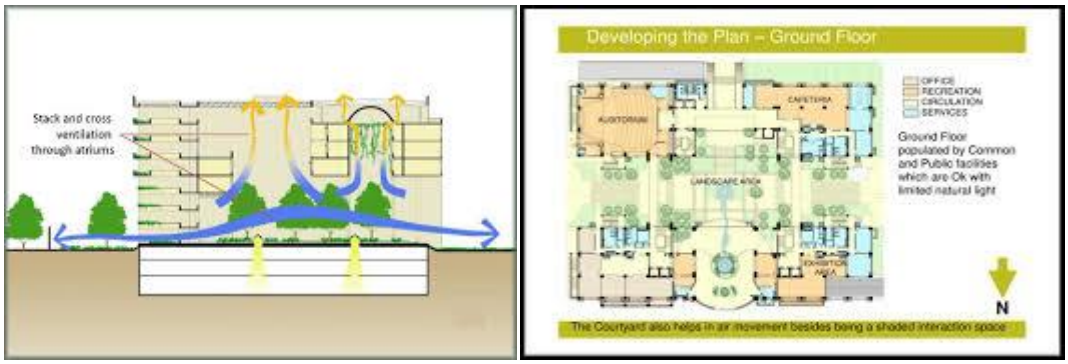


Figure 2.3(c) Passive Design strategies Source : Author

The orientation of the building was set towards north south direction with two separate blocks connected through corridors. A huge central court yard was placed for natural sky light and air movement in the building. It creates a landscaped connection with rest of the vegetation, provides cross ventilation within the building. The hot air escapes easily and the cool air is preserved. It minimizes the heat ingress in to the building. The optimal window to wall ratio is provided

Landscaping:

Greater than 50% area outside the building is covered with plantation especially native plants that have been planted to reduce water consumption. Circulation roads and pathways are softly paved to enable groundwater recharge

Ventilation:

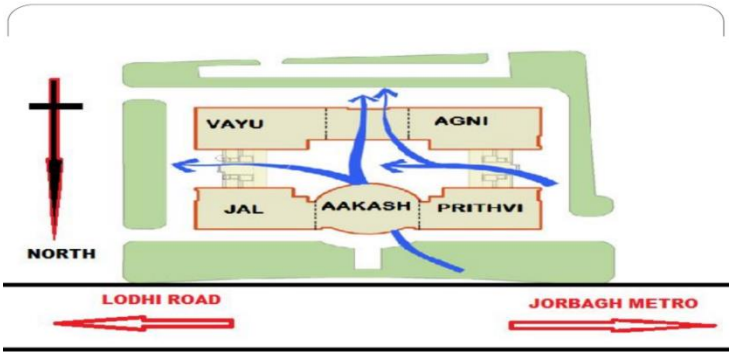


Figure 2.3(d) effective ventilation courtyard planning Source : Author

Courtyard in the center of the building helps in air movement as natural ventilation happens due to the stack effect. Windows and jaalis add to cross ventilation

Daylighting:

The courtyard provided with skylight which provides indoor natural sunlight. 75% of building floor space is provided with adequate daylight, consequently reducing dependence on artificial sources for lighting. • Building Envelope and Fenestration: Building Envelope Optimized, rock wool insulation used. The window uses high-efficiency low heat transmittance index double glazed glass of U-Value 0.049 W/m2K, VLT 0.59, SHGC 0.32. The hermetically sealed uPVC windows reduce incoming heat. Use of high reflectance terrace tiles (Cool roofs) or heat ingress, high strength, hardwearing

Active Design Strategies:

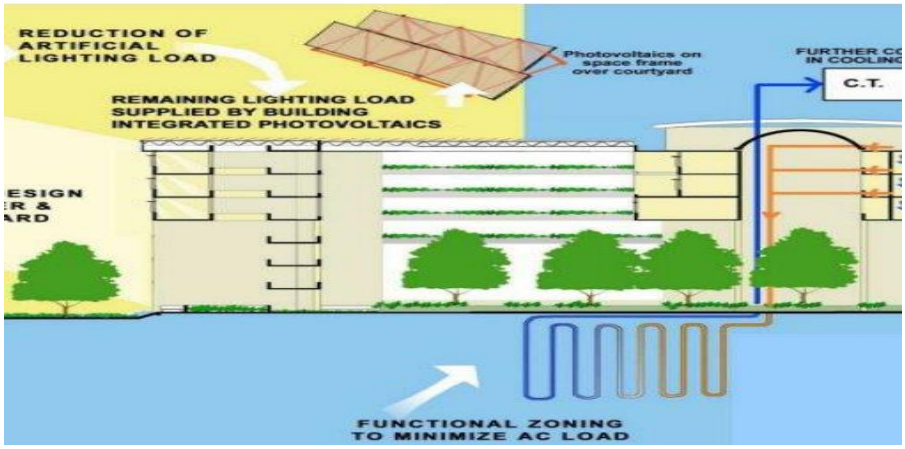


Figure 2.3(e) Active design strategies Source : Author

The active design uses appliances and technologies to modify the state of the building, create comfort and energy, ie. Fans, pumps, etc. This is the main part where much of the energy conservation can be done.

• Lighting Design: Building provided with an energyefficient lighting system that uses a lux level sensor to optimize the operation of artificial lighting. The total lighting power density of the building is LPD = 5 W/m2 which is much more efficient than Energy Conservation Building Code benchmarks. Installed integrated photovoltaic (BIPV) provides energy to the remaining lighting load.

• Optimized Energy Systems / HVAC system: Building used chilled beam system to meet 160 TR of air conditioning load. The use of a chilled beam system lessens energy use by 50 % in comparison to a conventional system by saving AHU/FCU fan power consumption by approximately 50 kW. Chilled water is supplied at 16° C and the return temperature is 20° C. This system is used from second to the sixth floor in the building. Water-cooled chillers and double skin air handling units fitted equipped with variable frequency drivers (VFD) which reduces energy consumption on variable load. Chilled water pumping system, cooling tower fans, and AHUs use VFD. All HVAC equipment controlled & monitored through an integrated building management system. Sensible & latent heat energy recovery wheel used to precool fresh supply air from toilet exhaust air. Room temperature is maintained at 26 ±1 ° C which is again a brilliant step towards energy conservation. more efficient than ECBC requirements.

Water management:

Onsite STP with FAB/MBBR technology constructed to recycle the total water amount to create zero wastewater. Water consumption has been reduced by 64% by providing water-efficient fixtures

CHAPTER -3

3.0 LITURATURE STUDY:

3.1 **Solar panels installation:**

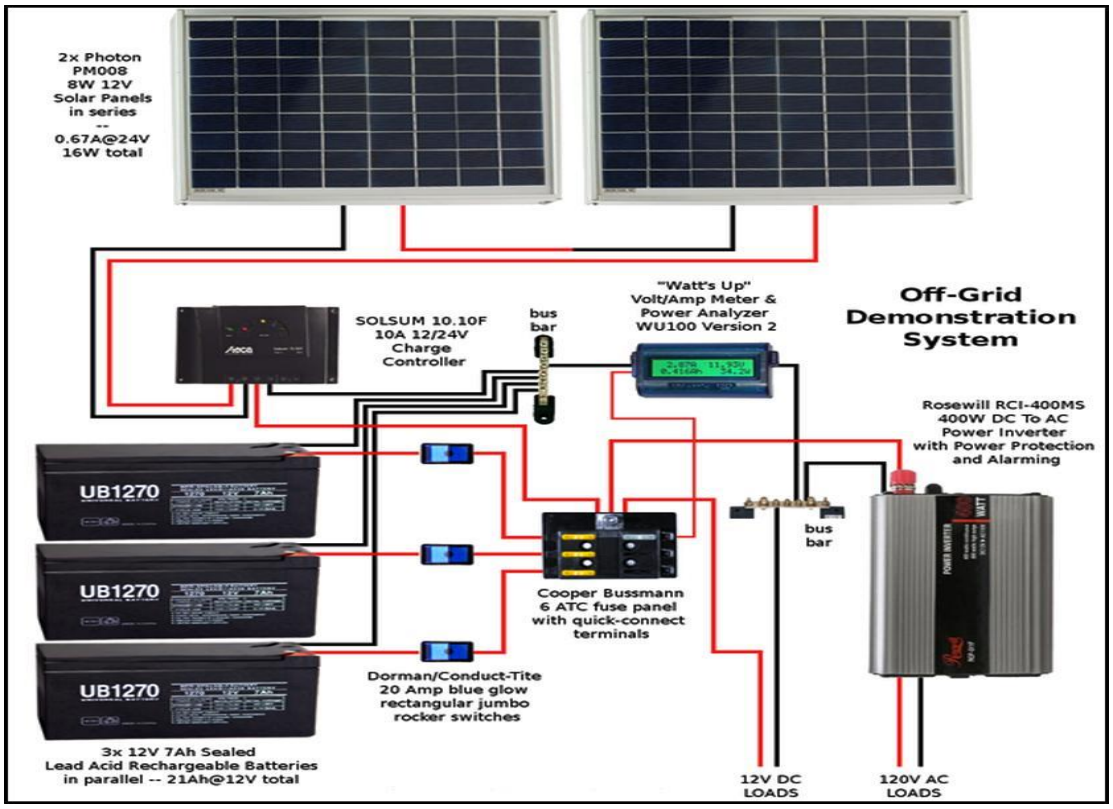


Figure 3.1(a) Solar panels installation Source : Author

3.2 Direction of PV panels:

The mounting structure provides the base for the entire solar system so make sure it is sturdy and properly fastened to the rooftops of your house or commercial establishment. A typical mounting structure is made up of aluminium. The performance of the solar panels depends upon the direction in which these panels are placed. The best direction to face solar panels is south, since here they receive the maximum sunlight. East and West directions also

work well. North is the only direction that we should not want to put our panels on. Since India lies in Northern Hemisphere, south direction works best here . Rooftop Solar Mounting Structure is used to fix solar panel with it. You can fix both monocrystalline and polycrystalline

panel with it. This is ready to use structure of 1 kw, offered by loomsolar.com. You can connect 4 panel of 270 watt.

3.3 Angle for installing PV panels:

The Solar panel tilt angle (the angle between the horizontal ground and the solar module) should be decided according to the latitude of your location anywhere in the world. It is generally believed that the modules placed at a tilt angle equivalent to the latitude of the place, would generate the maximum energy output. You can also use a solar tracker to increase the conversion efficiency

3.4 Assemble Solar Panels:

Once the solar structure is fixed accurately, we will connect it with solar modules. We should ensure that all nuts and bolts of solar modules are fixed with solar structure so that it is properly secured and lasts long.

3.5 Electrical Wiring:

MC4 connectors are used to connect solar panels. These are universal connectors and can be connected with any type of solar panels. The solar array wiring becomes simpler and faster using MC4 connectors.

Figure 3.1(b) Electrical Wiring: Source : Author

Few modern solar modules come with wire leads that have MC4 connectors on the ends, else they have a built-in junction box at the back with wires jotting out. In a series connection you will have to connect the positive wire from one module to the negative wire of another module. In a parallel connection, you connect the positive to positive and negative to negative leads. A parallel connection maintains the voltage of each panel while a series connection increases the voltage in order to match it with the battery bank.

3.6 Connection between Solar Panel and Solar Inverter:

In the picture given below, the backside of an inverter is shown where solar panel wire is connected. Connect the positive wire from the solar panel with the positive inverter terminal and the negative wire with negative terminal of the inverter.

Figure 3.1(c) Connection between Solar Panel and Solar Inverter Source : Author

There are other connections too like battery wire connection and output wire connection with the inverter. In all, Solar panel, Solar Battery and Grid input are connected with the solar inverter to produce electricity. The output of a series string of solar modules is connected to the input of the inverter. Make sure the inverter is turned off while the connections are being done.

3.7 Connection between Solar Inverter and Solar Battery:

In an off grid solar system, Battery is mandatory where it is used to store power backup. This battery is connected with solar inverter to recharge it with solar panel and grid. The positive terminal of the battery is connected with the positive of the inverter and vice versa.

Figure 3.1(d) Connection between Solar Inverter and Solar Battery Source : Author

3.8 Connection between Solar Inverter and Grid:

In order to connect the inverter to the grid simply plug it in in the main power switch board, so that it gets power from the grid. The output wire is also connected with board that is supplying electricity in home.

Figure 3.1(e) Connection between Solar Inverter and Solar Battery Source : Author

In order to calculate the excess energy generated from the solar system we need to install a metering device. We need to connect the positive wire from the metering device with the line terminal and the negative wire to the neutral terminal of the inverter**.**

3.9 Start solar inverter through solar panel and grid:

After all the connections are done, we switch on the mains. There is a digital display which shows the total solar unit generated during the day, what is supply volt and current (amp) from solar panel etc. In the picture below is shown the front side of Microtek solar inverte

Figure 3.1(f) Start solar inverter through solar panel and grid Source : Author

3.10 Project plan of 2kw off grid roof top solar PV system:

1.Specifications: No of panels required for 2 Kw Solar PV system

If one solar panel rates about 325 Watts,

then No. of panels required for 2kw, = 2 * 1000/325 = 6.153 ,

approx 6 solar PV panels

2.Area :

Area requirement for 1 Kw power generation by solar PV system = 100 Sq ft (shadow free area)

Area required for 2 Kw power generation by solar PV system = 100*2 = 200 sq ft (shadow free area)

3. Number of units generated by 1kw solar PV system assuming 5 Hrs of bright sun in a day,

(Energy = Power * time = Kw*Hr) = 1Kw * 5hrs = 5Kwh = 5 Units/day

For 2kw solar PV system, = 2kw * 5hrs = 10 Kwh = 10 Units/day

4. Amount of electricity bill saved using 2 kw solar PV system Assuming cost of 1 unit electricity = 7 Rs Electricity bill saved/day = units generated in a day * cost of 1 kwh (unit) = 10 kwh * 7 Rs = 70 Rs Monthly electricity bill saved , = 70 Rs * 30days = 2100 Rs Yearly electricity bill saved, = 2100 Rs * 12months = 25,200 Rs

5. Return of investment of solar panel/Payback calculations If cost required for 1Kw of Solar PV system installation is 62000 Rs,

then cost required for 2 Kw of Solar PV system installation = 62000 * 2Kw =1,24,000 Rs

As per CREST (Chandigarh renewable energy and Science & technology), 30% subsidy is allowed on solar PV system installation After 30% subsidy,

the total cost of 2Kw solar PV system installation comes to :

= 30/100 * 124000 Rs = 37,200 Rs (subsidy discount)

Net initial cost of The System = 1,24,000 – 37,200 = 86,800 Rs

6. Payback period = net cost of the system / yearly savings = 86,800/25,200 Rs = 3.44 (3 yrs & 4 months) – RECOVERY PERIOD

3.11 INFERENCES FROM CASE STUDY :

- Stadium is running like a factory so much power needed for its working, roof top solar pv panels installation are the best option for its environmental sustaining. we can use these energy for stadium lighting ,water filtration plant stadium flud lighting after replacing to LED
- Sand profile turf construction reduces water demand of the pitch
- Watering of pitches done in night time because evaporation of water in day time goes maximum.
- Use sub air vacuumed drainage system for sucking of rainy water in short time
- Store storm water from different catchment area and roof top to irrigating pitches, flushing toilets, cleaning different area and watering for plantation. Excess water can be used for water harvesting.
- Re-use waste water
- Installing waste water treatment plant for non potable water demand

CHAPTER -4

4.0 SITE STUDY:

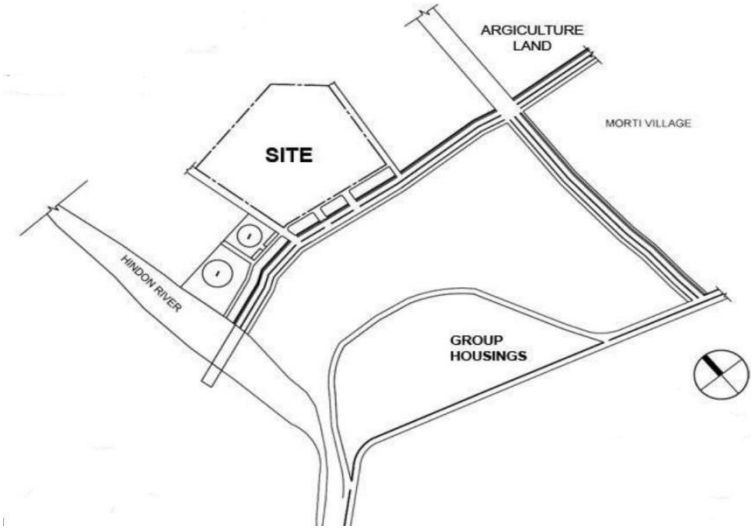


Figure 4.1 site location

4.1 LOCATION OF SITE:

- The site is located in morti village on the meerut by pass raj nagar extension
- The site is close proximity to hindon river
- The site is located on 45 meter wide road
- GCA ground and a private cricket academy is running near the proposed site
- 45 meter approch road has been newly developed by the gda for proposed BCCI international cricket stadium

4.2 ABOUT THE SITE:

The Ghaziabad Development Authority has allotted 59.14Acres (2,39,341.43Sqm.) land in Morti Village, Raj Nagar extension to UPCA (Uttar Pradesh Cricket Stadium) for proposed international cricket stadium. The plot is in master plan-2021 acquired for recreational purpose. The project managed by UPCA and governed by BCCI.

• The site is approx. 20 km. away from Delhi border and close to the NH-58.

• The proposed 45.0 MT. wide highway is abutting the site on southern side.

• 30.0 meter and 21.0 meter. wide road proposed for development on both side of the stadium.

• 45.0 mt. wide green belt proposed on South - East side of the site.

• Group housing projects are proposed near by the site.

• The proposed site more or less regular in shape of a polygon.

• The ground is hard with sandy soil.

• The site is south facing.

OWNERSHIP:

The ownership of the plot is upca and project is financed by BCCI and the main governing body is BCCI

SITE TOPOGRAPHY:

Figure 4.2 site topography

- The site almost plain due to natural terrain
- The site shows a general gradient of slope towards the south east side which has main approch road
- Front side which will allow natural drainage
- The formation of road level is 2.0 meter above from the natural ground level

GEOGRAPHICAL DATA:

- Latitude : 28.7071 n
- Longitude : 77.3981 e
- Elevation: 212 meter

- Ground water level: 10.0 meter
- Soil condition : loose
- Deep foundation refers

SITE SURROUNDING:

- Site is aproximately trapezium shaped facing to south east direction
- North – river hindon flood plain area 1.0 km.
- West – gca cricket stadium and 2.0 km. distance hindon air force station
- East – agriculture land and about 1.5 km. morti village
- South – stp 0.5 km. and raj nagar group housing 1.5 km.

4.3 SITE CONNECTIVITY BY ROAD, RAIL, METRO AND AIRPORT:

Site is well connected with Delhi, Meerut, Noida and Ghaziabad. Elevated road and Noida link road are specially planned for Raj Nagar extension connectivity. The site 5 km. Away from the G.T. road and 4 km. Away from nh-58. Site is located on Raj Nagar Extension Meerut bypass road.

• Ghaziabad Railway Station: 12 Km.

• Anand Vihar Railway station:25 Km.

• New Delhi Railway Station:42 Km.

• Nearest Metro station (Hindon Vihar):5.0 Km.

• Nearest Bus stand (New Ghaziabad Bus stand): 6.0 Km.

• ISBT Anand Vihar Bus stand: 25 Km

• Proposed RRTS station (Guldhar Meerut Road): 6.0 Km

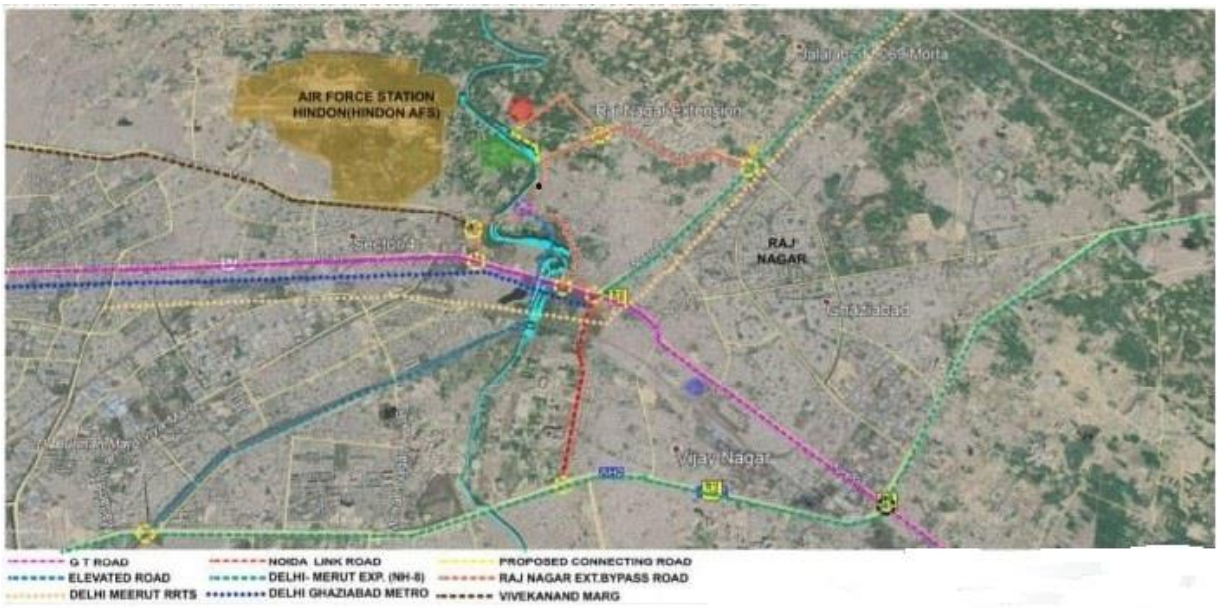


Figure 4.3 site connectivity source :Author

AIRPORT CONNECTIVITY:

The site is well connected with the IGI international airport and regional Hindon airport. Proposed Jewar airport is also very well connected with site. Spectator, VIPs, Players can easily reach to the site. The site is very close proximity to the Delhi, so hotels and other facilities are easily available for the visitors.

THREE MORE TRACKS ARE LIKELY TO BE CONSTRUCTED

- Delhi ghaziabad meerut RRTS corridore may be linked to khurja and hapur in the future
- NCRTC to construct three tracks at ghaziabad rrts station for future extension of project
- An additional plateform will also be constructed at Ghaziabad RRTS station

OPPORTUNITY AND CONSTRAINT OF THE SITE:
OPPORTUNITY:

- The site has easy access through the approach road.
- The site has already been selected by the UPCA and approved by BCCI for the construction of cricket stadium.
- The site is located on outskirts of the city which helps in easy management of traffic & during its use.

- The natural slope of the site towards south - east direction of the site creates a solution of the waste / sewage disposal from the premises.
- The main approach road is 45mt. wide in south- east, it helps to manage the future traffic and crowd.
- Ghaziabad Cricket Association playground and one private cricket academy is close vicinity of the site.
- The site is located in recreational zone so other parks and recreational projects may be come around the site.
- Nearby resident is come for walk and inhale the fresh air.

CONSTRAINT:

- The site being in close vicinity of river Hindon hence formation level shall be decided for precautions and protection against flood on site.
- Hindon AFS and Hindon airport is in close proximity, the air traffic may create disturbance in game. • Due to Hindon AFS the stadium structure height cannot be more than 45 mt.
- The soil of the site is loose hence having low soil bearing capacity so deep foundation will be needed for the structure.
- 33000-volt high tension line is passing from the site. Authority is trying to shift this line from the site. While this high voltage electric line will not align with the green belt area the construction of stadium will not be started.
- 6.0 mt. Wide open drain is passing from front edge of the site. The drain is carrying waste water of raj Nagar extension area.

CHAPTER -5

5.0 PROJECT REQUIREMENTS:

5.1 GENERAL REQUIREMENTS IN A STADIUM:

- **LOCATION:**

- The area should have sufficient for future expansion
- It should be in core city area
- Must fit well with local topography
- Should be designed with the good transport link facilities like bus, train, airoplane, lorge parking etc on other hand it should easily accessible by motorways and other private vehicle.
- It should not be sited close to the industrial area where smoke , odors and noise might create uncomfortable conditions**.**

PARKING:

- Capacity for 50000 spectatores parking should be provided for 10000 cars and approximately 500 buses
- Where onsite sufficient parking not posible parking should be provided no further than 1500 meter from the stadium.
- There should be sufficient parking space for the buses and cars for vip's preferably , these vehicle should be parked inside the stadium
- Parking space for at least 2 buses and 8 cars should be available for team, match officials, and stadium staff.

SEATING:

- Seating surrounds the center pitch with each row positioned at a slightly higher level than the one in front it, proving an unobstructed view and ample leg room. seats are generaly installed on to a stepped floor surface, which also serves a s stairs in the aisles
- The limitations of normal visual acuity make any seating falling outside a radius of 200 feet from the center of field increaseingly marginal

- For major international maches a stadium should seat at least 30,000 people

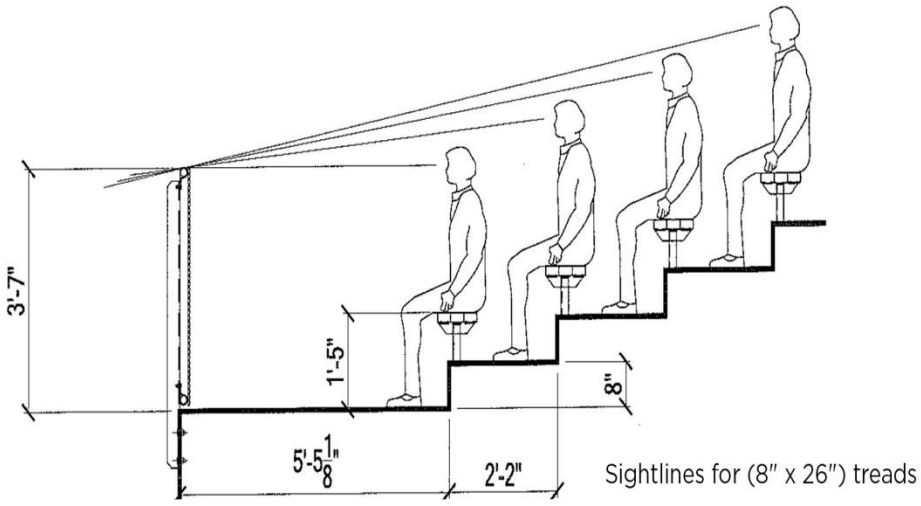


Figure 5.1(a) Seating in stadium Source :Author

5.2 CIRCULATION OF SPECTATORES WITHIN THE STANDS:

CONCOURSE:

A concourse is defind as a circulation area that provide direct access to and from viewing accomodation to which it may be linked by vormitories, passageways, stairs or ramps. it is recommended that all new sports ground concourses should be designed to allow at least 0.5 sq.m.per person (a density of 20 persons/ 10 sq.m.) expected to occupy the concourse at peak times

VORMITORIES:

A vormitories is an access route built in to a gradient of a stand which directely links spectatores accomodation to concourses, and/or routes for ingress, igress and emergency evaculation ,passage, through a vomitory can be either level or transverse to the row of terraces or seats

VERTICAL CIRCULATION OF SPECTATORES WITHIN THE STANDS:

STAIRCASE:

- The stairway width should be uniform
- All goings and risers on each stairway should be uniform between floors
- Winders (that is tapered treads) should not be used

- Iindividual flights should consist of no more than 12 risers
- Minimum riser height 150 mm and maximum 170 mm.
- Minimum width of stair : 1.20m.

FLOW IF SPECTATORES BY ESCALATORES:

step width	600	800	1000
A	605-620	805-820	1005-1020
B	1170-1220	1320-1420	1570-1620
C	1280	1480	1680
transportation capacity/h	5000-6000 persons	7000-8000 persons	8000-10000 persons

Figure 5.2 Different widh of escalatores Source : Author

5.3 ROOFING OF THE SPECTATORES STANDS:

- Structure with span lorger than 20m. can be regarded as long span structure for this span is usually unable to be achieved by ordinary rc structure
- Long span unobstructed, column free spaces are needed in the stand
- Canvas framed roofing
- Truss franed roofing
- Portal frame precost roofing
- Pneumatic structural roofing: pneumatic structure is a membrane which carries load developed from the tensile stresses

- Pneumatic structure have a wide range of possible materials.
- Pneumatic structure works on tensile are composed of strechable materials that are binded togather by the help of cables

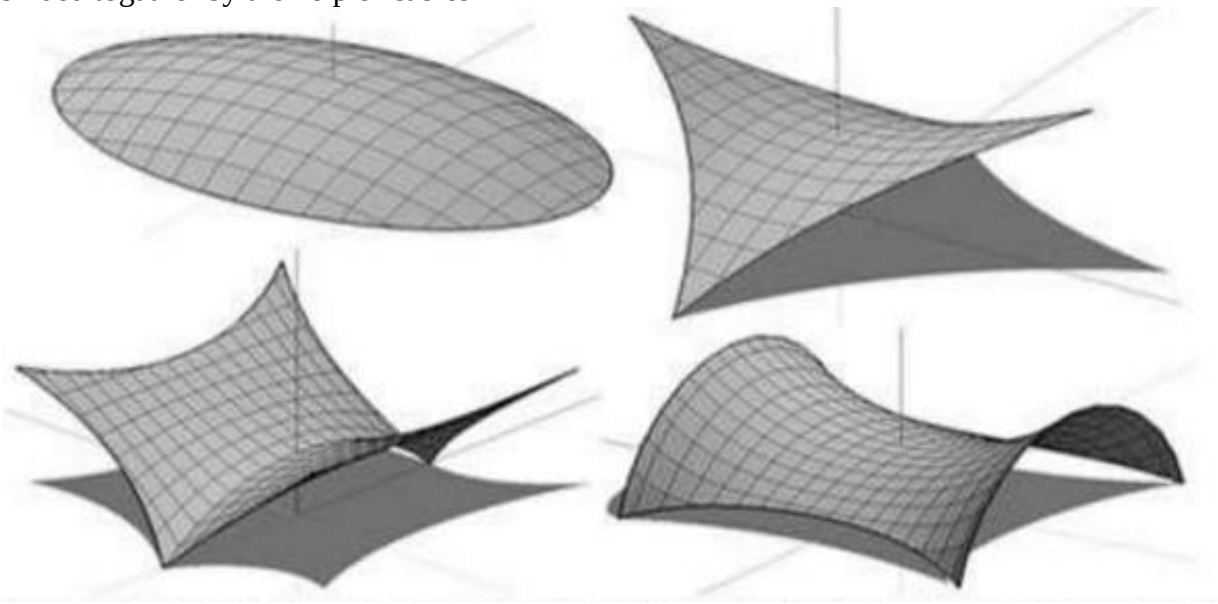


Figure 5.3 ROOFING OF THE SPECTATORES STANDS Source : Author

5.4 LIGHTING FIXTURES AT THE STADIUM:

- The height of the lighting tower and the dimensions of the field should be in proportion to receive right amount of light evenely through out the field
- An angle of not less than 25 degree should be maintaind between the top of the light tower and the field so get optimum amount of light on the field.
- There should be no obstruction from the sports or other stadium fittings between the path of the light to the pitch

5.5 CROWDS CONTROL:

control of crowds and separation of spectators from participants has been a great challenge for designer. a group of people coming togather to enjoy an event it is a crowd and must be carefully managed . from the moment they enter the zone of infiuence of the stadium . some time very little encouragement is needed for that crowd to become a mob and eventually that mob to become a ‘riot’. the managing of people must be considerd from the very beginning of a stadium of a project if this adverse encouragement is to be minimized.

5.6 **DESIGN CONSIDERATIONS FOR CRICKET ACADEMY:**

WARM-UP/ PRACTICE AREA:

- Outdoor practice nets
- These areas should have a grass surface (artificial turf is acceptable) and be surrounded by plain walls with no protrusions, outdoor areas should be sufficiently lit to enable their use in night.
- Turf practice wicket
- 20.12m x 2.5 m. per wicket
- Synthatic practice wicket
- 20.12 m.x 3.0 m. per wicket
- The length of overall practice net area is to be a minimum of 50 m. and height is generaly 5 m.

CRICKET PITCH:

It is 20.12 m. long and 3.05 m. wide. the surface is flat and normally covered with extremely short grass

Figure 5.6(a) cricket pitch Source : Author

DIMENSIONS OF THE PLAY FIELD:

there are no dimensions for playing field but its diameter usually varies between 137 m. to 150 m.

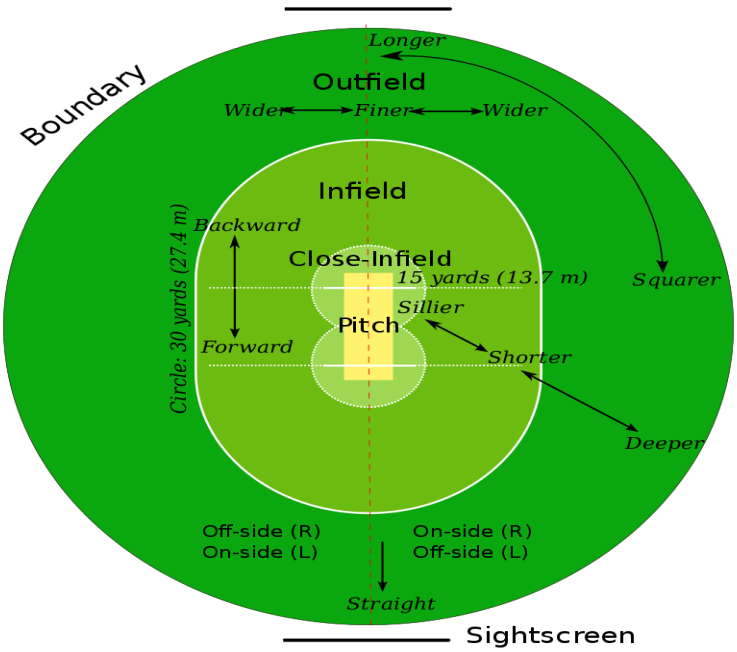


Figure 5.6(b) dimensions of the play field Source : Author

CHAPTER -6

6.0 CONCEPT PLAN

6.1 Concept (site plan)

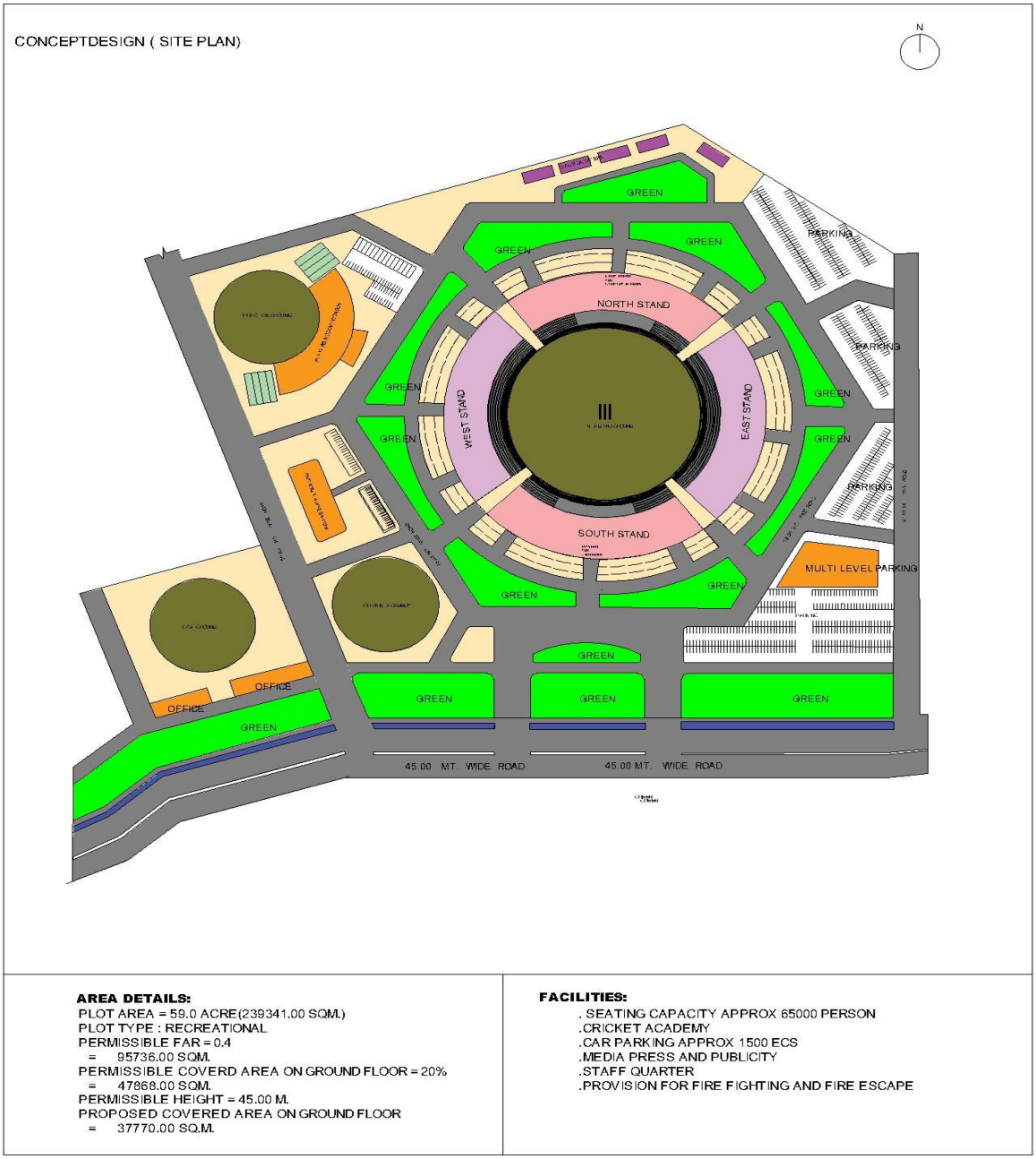


Figure: 6.1 concept plan (site)

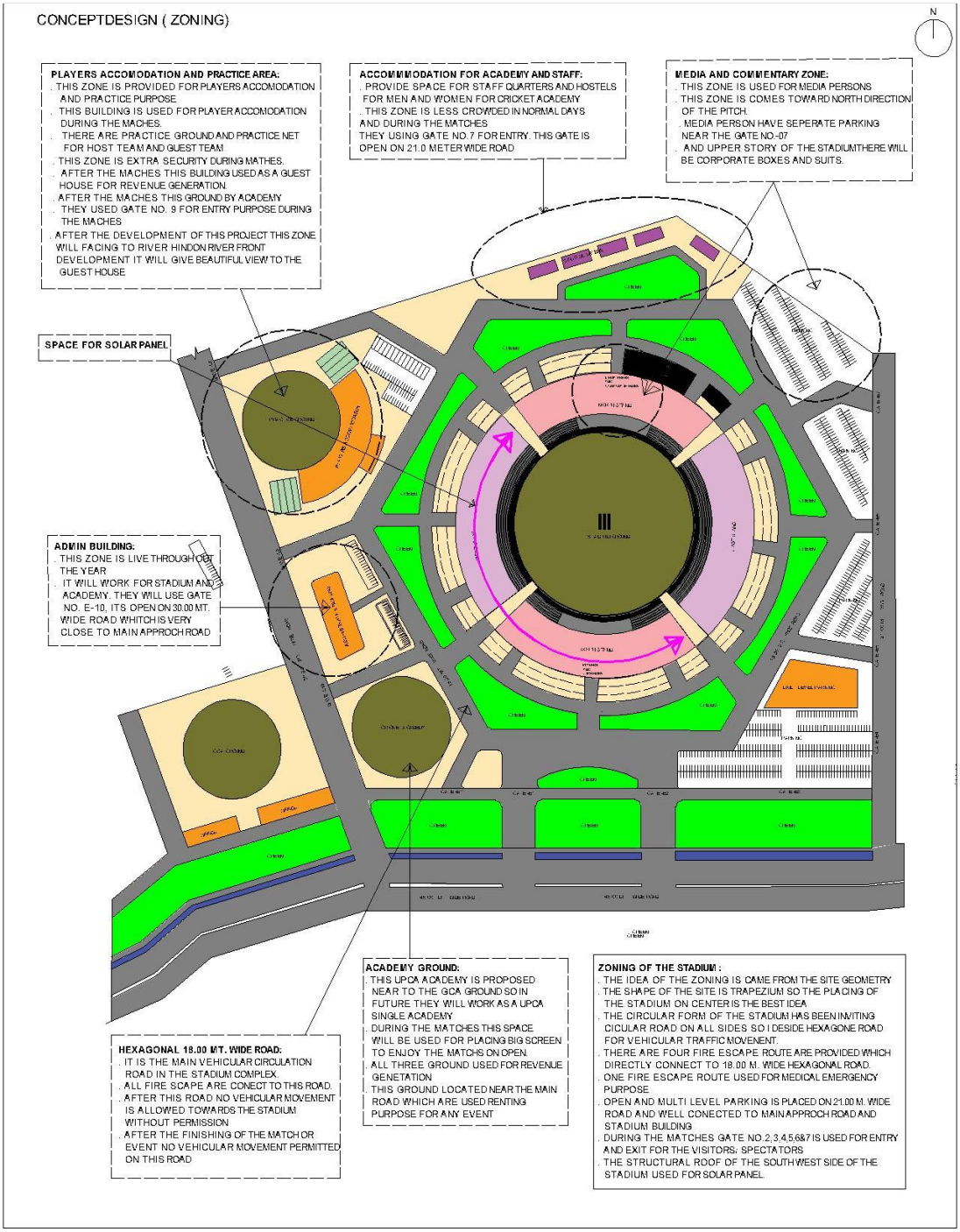


Figure: 6.2 concept plan (site)

6.3 **Concept Design (Circulation)**

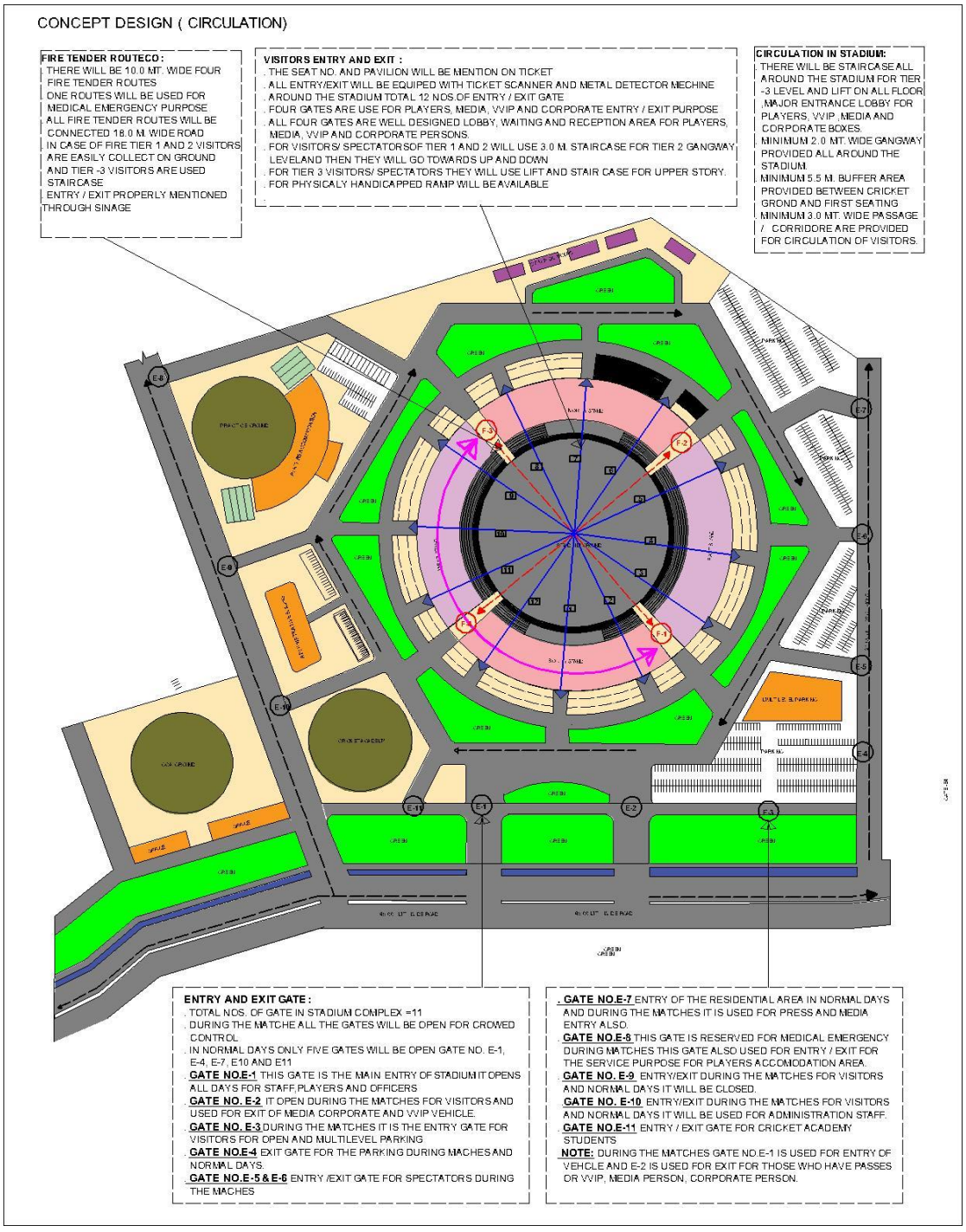


Figure: 6.3 concept design (Circulation)

CHAPTER -7

7.0 DRAWINGS

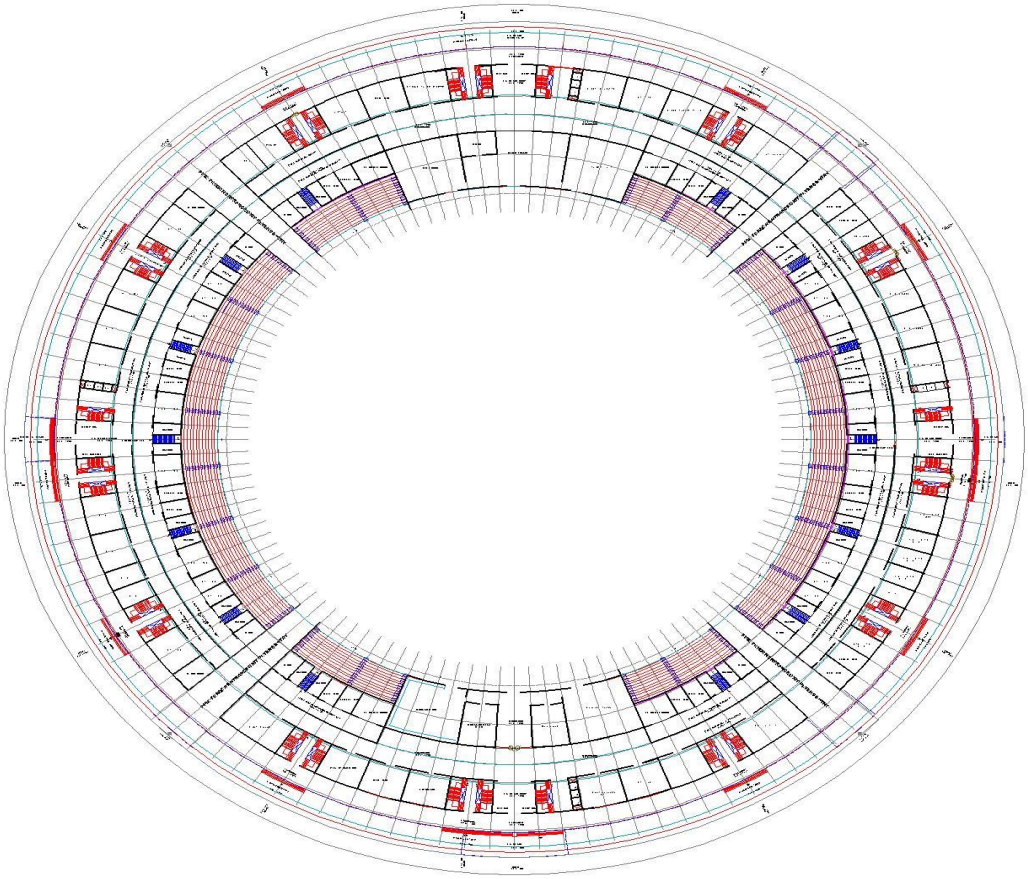
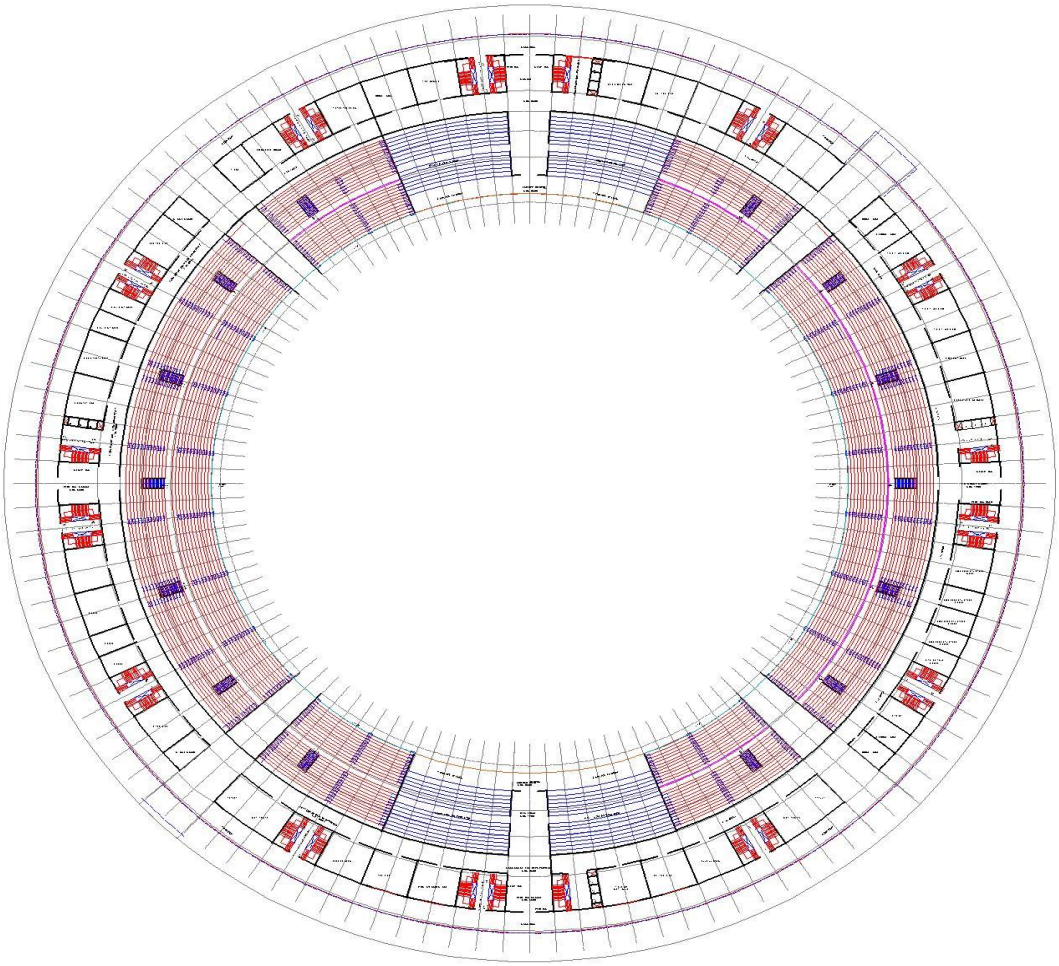
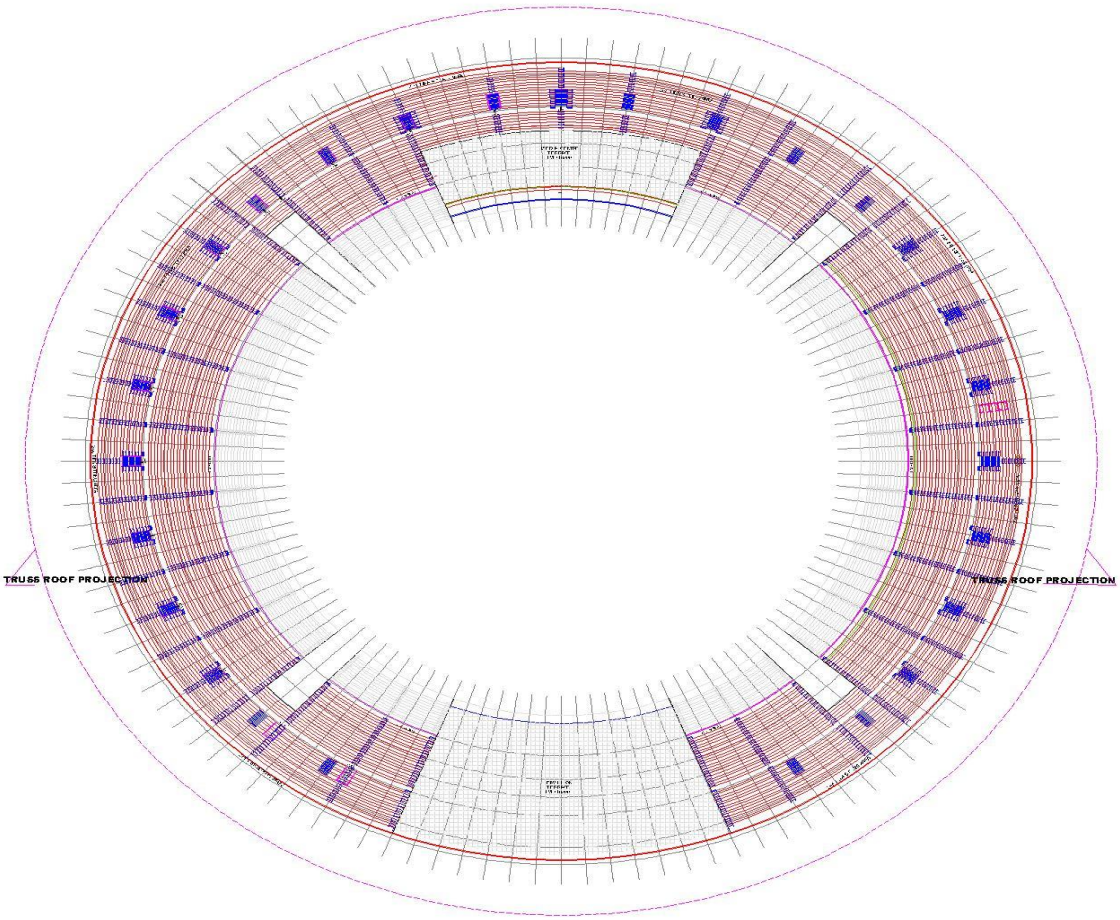


Figure : 7.0 (a) Ground floor plan



SECOND FLOOR PLAN
PLAN AT + 9500 LVL

Figure : 7.0(b) second floor plan



SECOND TIER PLAN
PLAN AT + 33950 LVL

Figure : 7.0(c) second tier plan

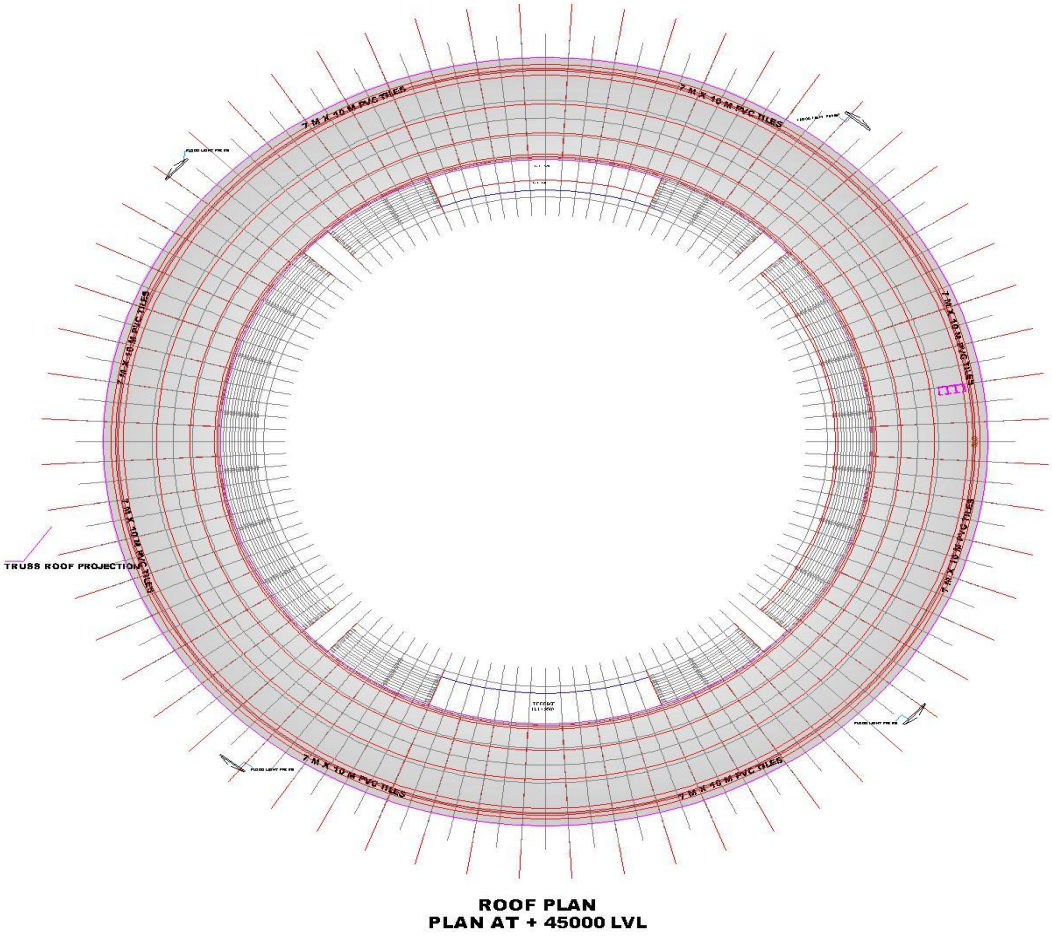


Figure : 7.0(d) roof plan

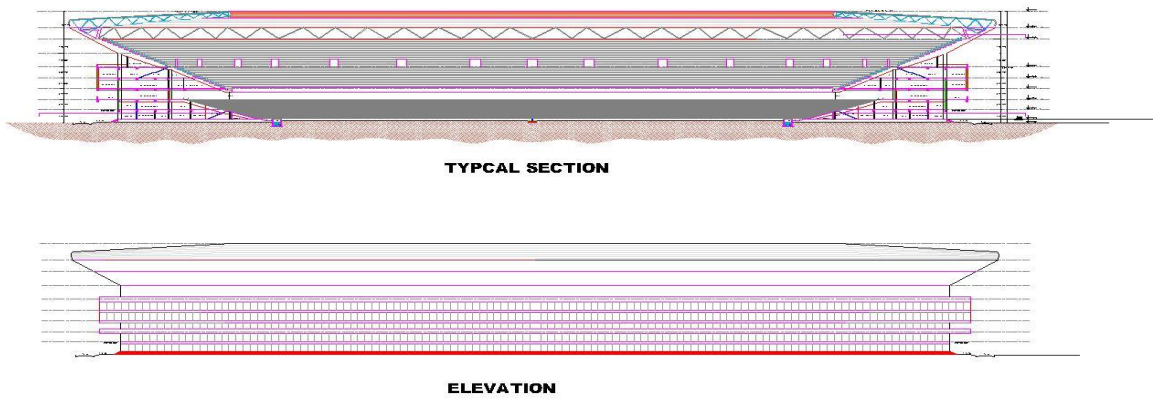


Figure : 7.0(e) Elevation and Section

8.0 CONCLUSION:

Ghaziabad, is fast growing city of NCR. The upcoming international cricket stadium and cricket academy will act as a catalyst for the whole region. it will create various opportunity for the people of city. After the development of this recreational zone, this area is benefited to all nearby people for morning walk, evening recreational purpose and social interaction. transportation improvement, and other infrastructure promotions. It will also improve economic and intangible benefits from sports event But there is a need to concentrate more on the tangible and long-term benefits that cricket has the potential to deliver. This is due to requirement of huge money for construction, maintenance, and ancillary construction. However, in the recent years, sustainability has assumed increasing importance. Mostely cricket stadium in india are not environmental friendly stadium consume more energy during the day night maches and running like a factory so corbon foot print increases their surrounding area.only solar pv panels are best solution to reduce to energy consumptions. In second hand stadium pitch and playing field need more water for soil settlement to avoid un-even bounce for ball we can say that cricket stadium are driking water monster. Its only solution rain water harvesting ,filteration of waste water . if we make eco friendly cricket stadium and they run smoothly then this will be example for others.and existing cricket stadium also renovate according to sustainability standerd.

9.0 REFERENCES:

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DEVELOPMENT OF SPORTS INFRASTRUCTURE IN TERMS OF ENERGY AND WATER CONSERVATION:

A CASE OF PROPOSED INTERNATIOINAL LEVEL CRICKET STADIUM CUM CRICKET ACADEMY GHAZIABAD

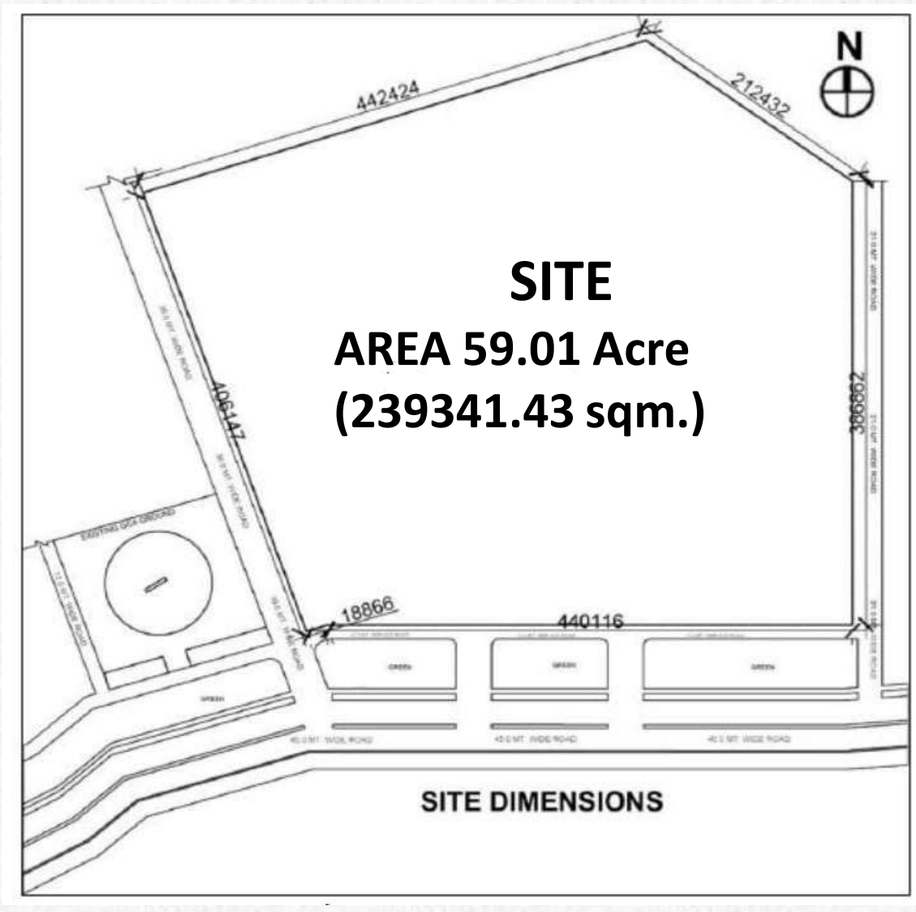
SITE STUDY

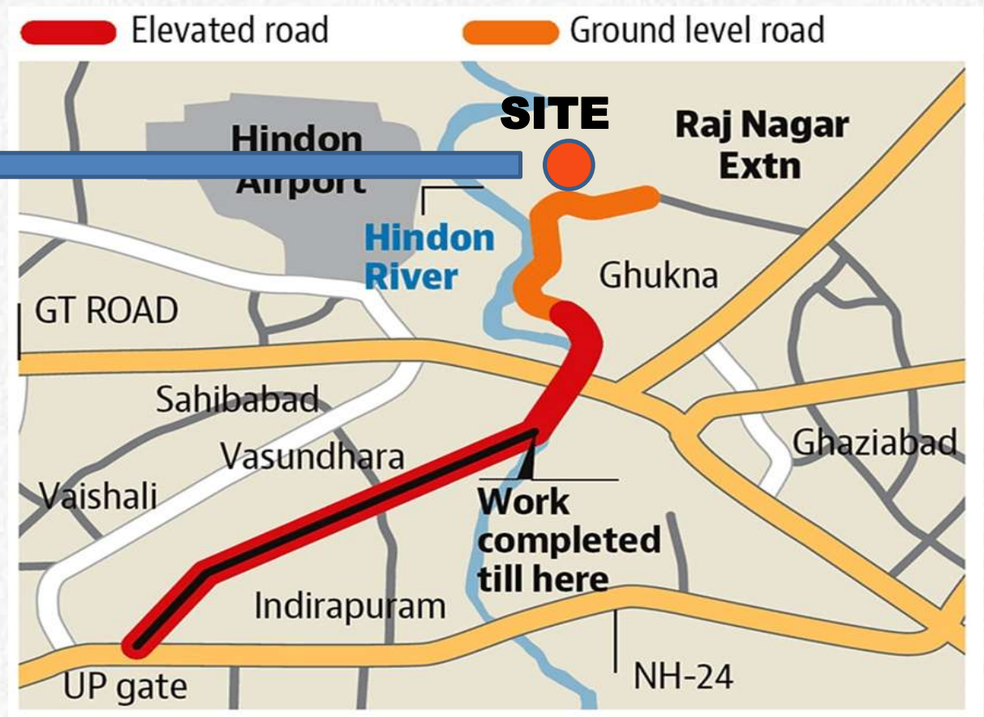
RAJ NAGAR EXTENSION MORTI VILLAGE GHAZIABAD

LOCATION OF NCR IN INDIA

LOCATION OF GHAZIABAD IN NCR

MASTER PLAN 2021 OF GHAZIABAD





PROPOSED SITE LOCATION IN GHAZIABAD

GHAZIABAD:

THE GATEWAY OF UTTAR PRADESH:

from the historical cultural, mythological and archeological point of view ghaziabad is a prosperous city. this has been proved from the resarch work and excavations done in the district. the excavation carried out at the mound of kaseri suitated on the bank of river hindon, 2 km north from mohan nagar shows that civilization was developed here in 2500 b.c.

garhmukteshwar which provides salavation to the people and the pooth village situated on the banks of river ganaga are associated with the mahabharat period. nearby is the ahar region which was supposed to be the capital of pandava's and janamejay's nag yagya site. the loni fort is associated with lavanasura of the ramayana period. as per the gazetteer the fort was named after lavanasura (from lavana it changed to loni). on the eastern border of the district is situated the village "kot" which is associated with the famous emperor samundragupta, who performed the aswamedha yagya here after destroying the fort and "kot kuljam" (princes of the kot dynasty), which was an incident of great historical importance at that time.

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CONSTITUENT AREA OF NCR:

the contituent area of national capital region are as under

A) national capital teritory of delhi(1483 sq.kms
this accounts for 4.41% of the total area of the ncr

B) haryana sub-region comprising of faridabad , gurugram,rohtak, sonipat rewari, jhajjar, mewat and panipat districts this accounts for 30.33% (13413 sq.kms) area of the state and 39.95% of the area of ncr

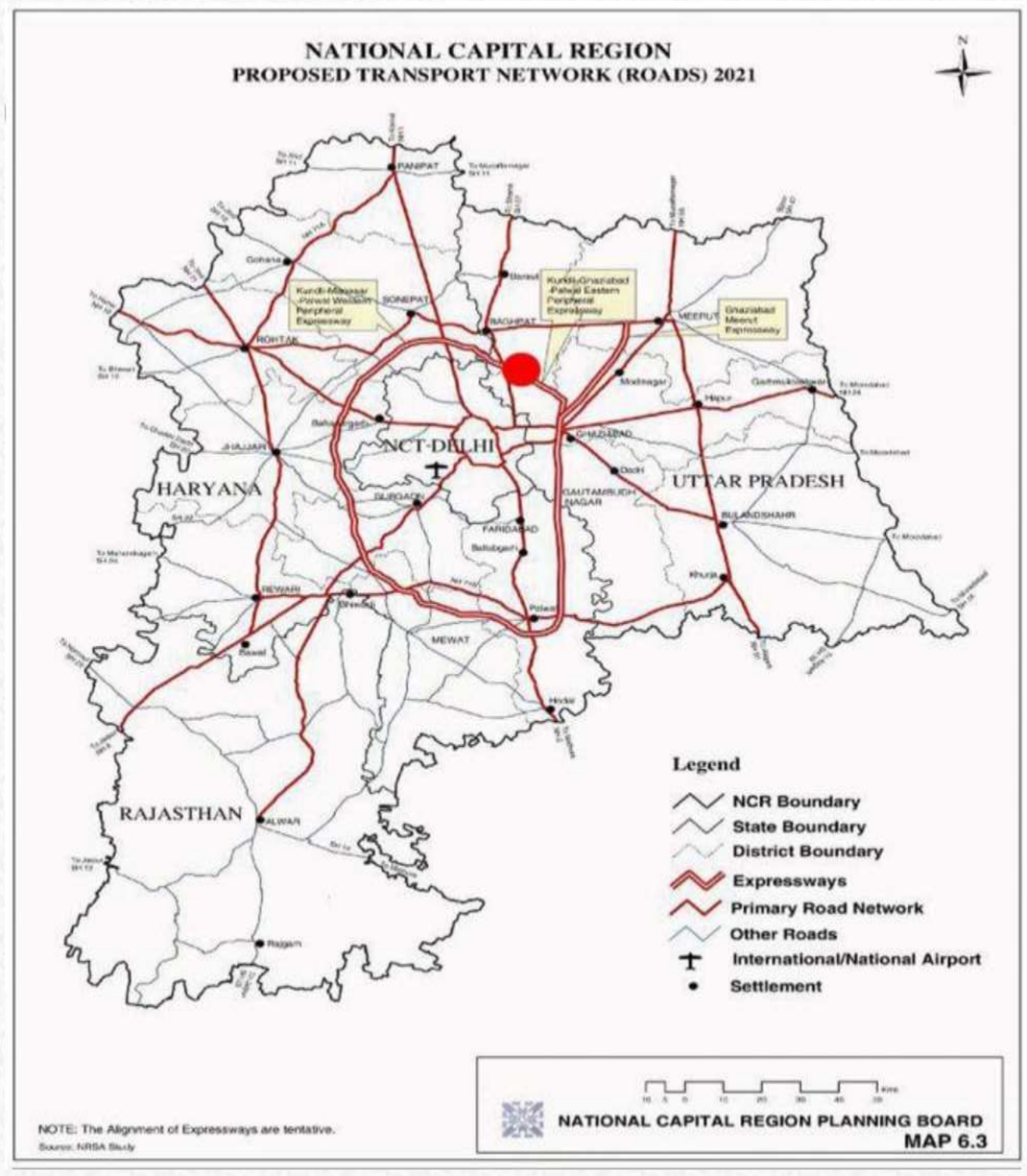
C) rajasthan sub-region comprises of alwar, district. the area is 2.29% (7829 sq.kms.)of the total area of the state and 23.32% of the total area of ncr

D) uttar pradesh sub-region comprising of five districts namely meerut, ghaziabad, gautam buddha nagar, buland sahar and baghpat. this accounts for 4.50% (10853 sq.kms.) of the area of state and 32.32% of the area of ncr

thus the total area of ncr is 33578 sq.kms.as indicate in the map

EASTERN PERIPHERAL EXPRESSWAY OR **KUNDALI – GHAZIABAD –PALWAL (KGP)** expressway is a **135 km**. long six lane expressway(three lane in each direction) passing through state of haryana and uttar pradesh the expressway starts from the western peripheral expressway at kundli sonipat passing through bagpat , ghaziabad and noida districts in up and faridabad district in haryanabefore rejoining western peripheralexpressway near palwal eastern peripheral expressway along with western peripheral expressway completes the largest ring road around delhi

the expressway consists of two sections, 86 km long palwal ghaziabad section also known as **faridabad-ghaziabad -noida expressway** and the 49 km long ghaziabad sonipat section to relieve traffic congestion in the faridabad –ghaziabad strech and also to prevent pollution causing commercial vehicles from entering delhi



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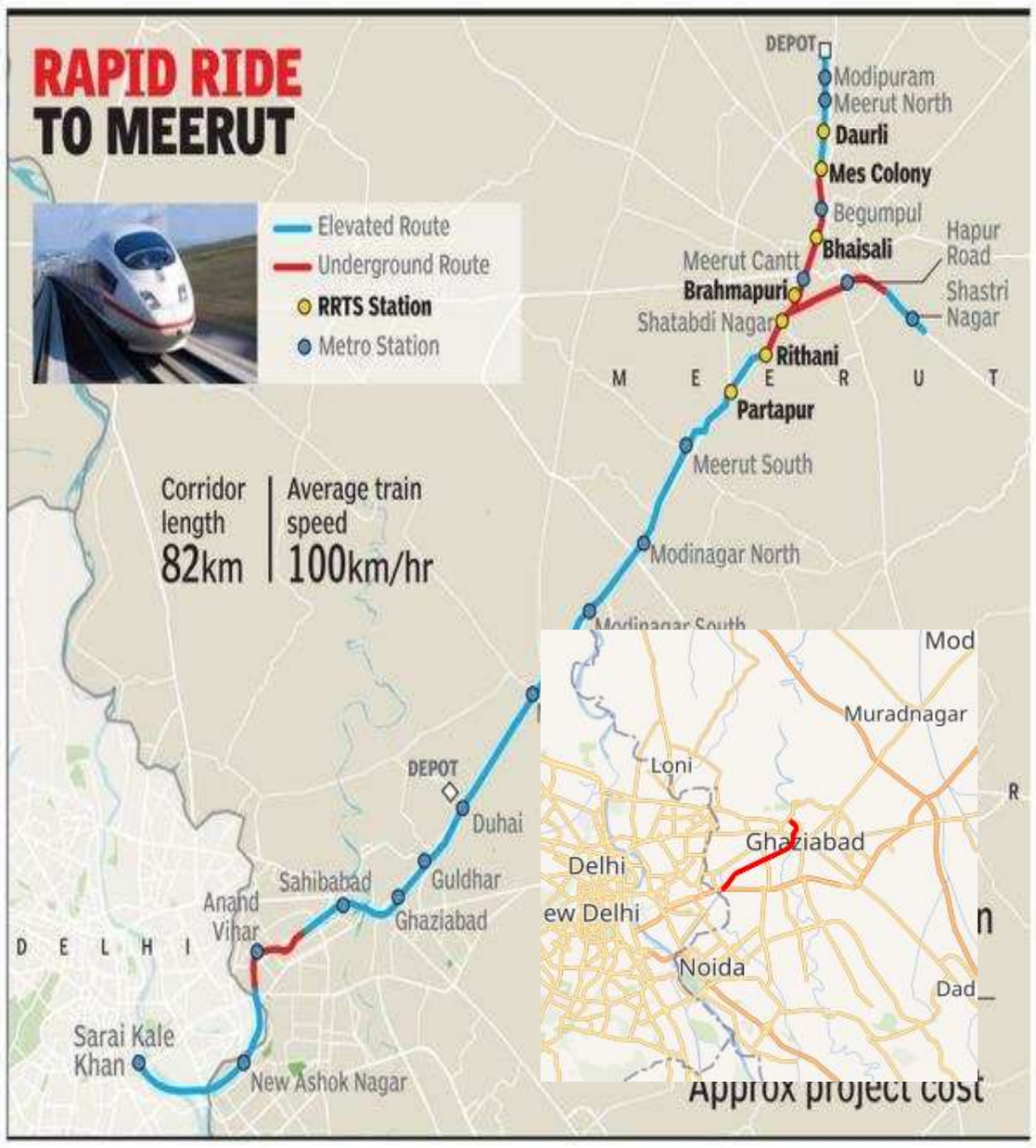
DELHI –MEERUT REGIONAL RAPID TRANSIT SYSTEM (DELHI –MEERUT RRTS) is an **82 km.** long under construction semi high speed rail corridor connecting delhi ghaziabad meerut it is one of the three rapid rail corridors planned under phase–I of regional rapid transport system (RRTS) project of national capital region transport corporation (NCRTC) with maximum speed of 160 km/h the distance between delhi to meerut will be covered around 55 minuted only

the corridor would be beneficial for the development of region and help connect the lorge number of townships and centers of economic activity that are already planned along this corridor

LENGTH – 82 KMS.

NOS. OF RRTS STATIONS – 16

NOS. OF ADDITIONAL STATION FOR MEERUT -6



HINDON ELEVATED ROAD PROJECT:

• 10.3 km. long elevated road making it longest elevated road in the country

•hindon elevated road project faced sevaral central agencies clearence, ministry of envirоinment, forest and climate change gave it final node &gave envirоinment clearence on 11 th march

•conecting raj nagar extension in ghaziabad to up gate journey in just 18 minutes

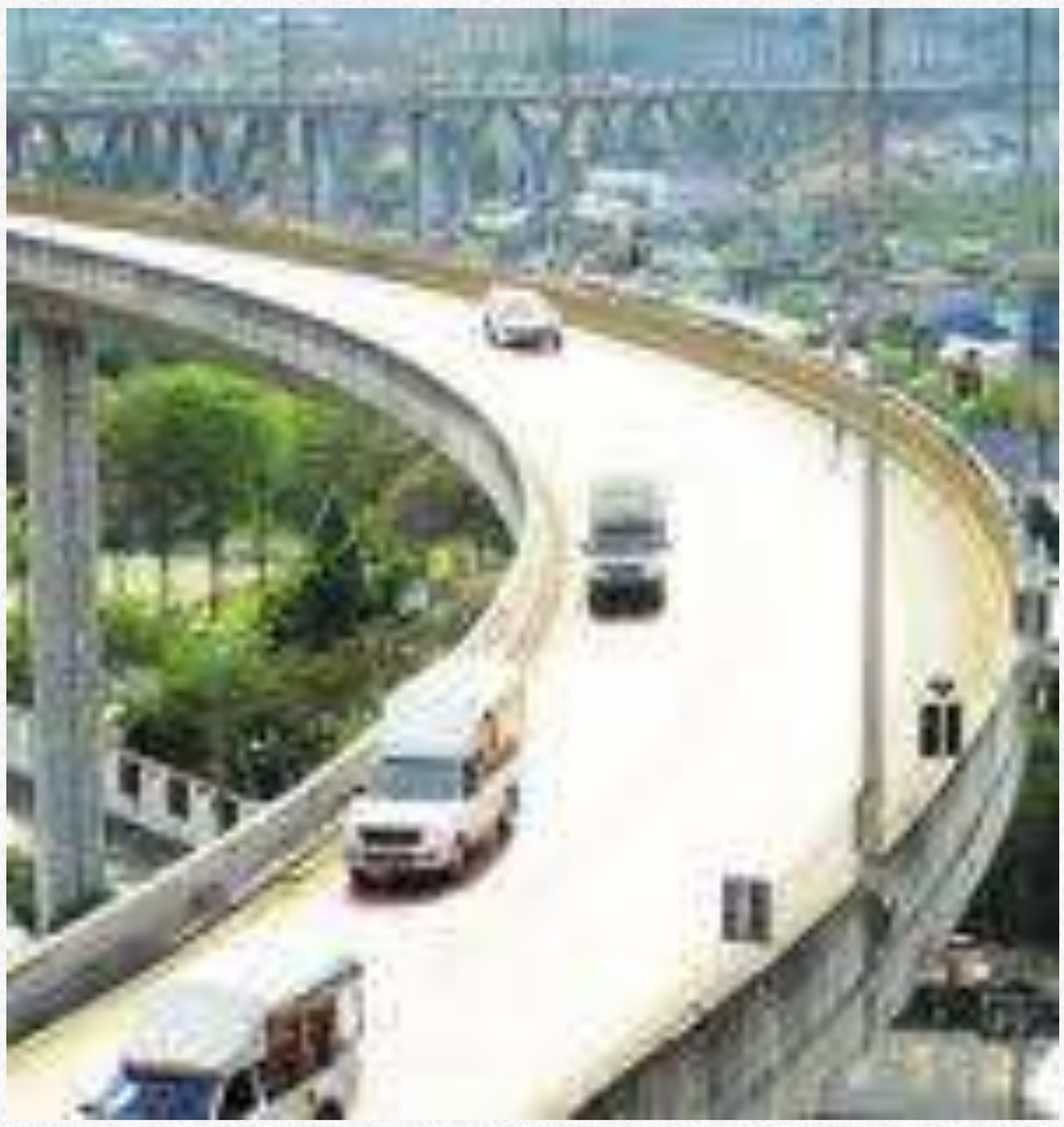
• entire strech of elevated road built on 228 single pier pillars

•it will connects commuters to nh-24 , delhi meerut expressway making journey till delhi akshardham signal free

•it will helps commuters and travellers to reach hindon airbase which is distance of 1.5 km. from toll gate

•the total cost of this project is 1147 cr.

•vehicle using elevated road will be allowed to drive at average speed limit of 80 km/h



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the regional plan-2021 for ncr has proposed a six tier settlement system consisting of metro centres, regional centres, sub-regional centres, service centres, central villages and basic villages. the urban agglomerates selected consist of 7 metro centres/complexes outside nct of delhi with a population of one million and above consisting of gurgaon-manesar, faridabad-ballabhgarh, ghaziabad-loni, noida, greater noida, meerut and sonepat-kundli; and 11 regional centres/complexes namely bahadurgarh, panipat, rohtak, palwal, rewari-dharuhera-bawal, hapur-pilakhua, bulandshahr-khurja, baghpat-baraut, alwar, greater bhiwadi & shahjahanpur-neemrana-behror.

the ncr regional plan-2021 has identified three types of infrastructure requirements –first, regional level large investments in power, highways, railways etc, second, inter-state connectivity and the environment investments and third, city level urban investments. the plan estimates that the development of quality infrastructure in the ncr will require investment of about rs. 193752 crore in transport, power, water, sewerage and sanitation by 2021; this excludes investments in land development for residential/ commercial/ industrial/ institutional projects.

Year	NCR Total	NCT-Delhi		Haryana		Rajasthan		Uttar Pradesh	
		Population	% to total	Population	% to total	Population	% to total	Population	% to total
1	2	3	4	5	6	7	8	9	10
2001	371.00	138.50	37.33	86.87	23.42	29.92	8.06	115.70	31.19
2021	641.38	225.00	35.08	163.50	25.49	49.38	7.70	203.50	31.73

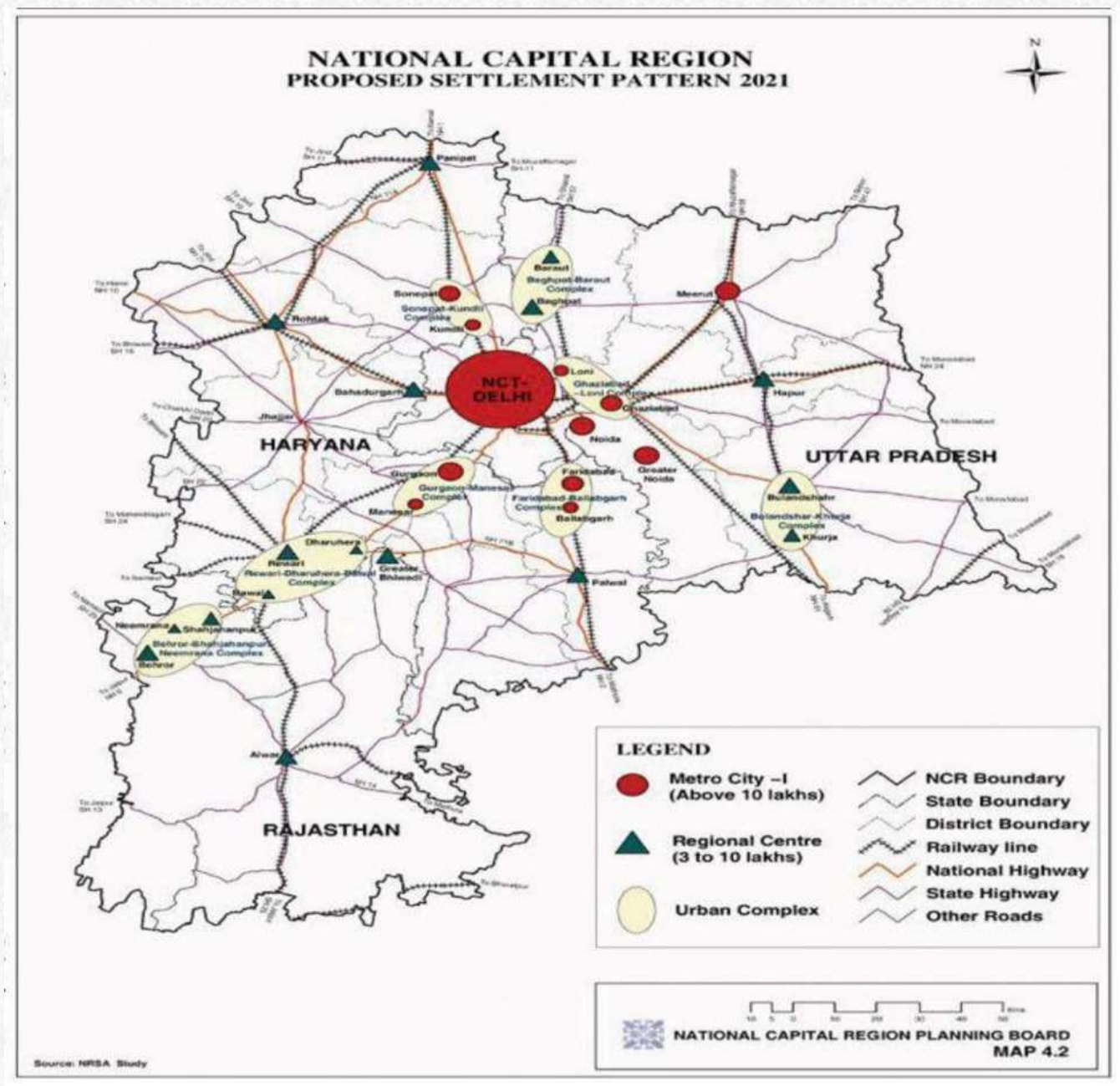
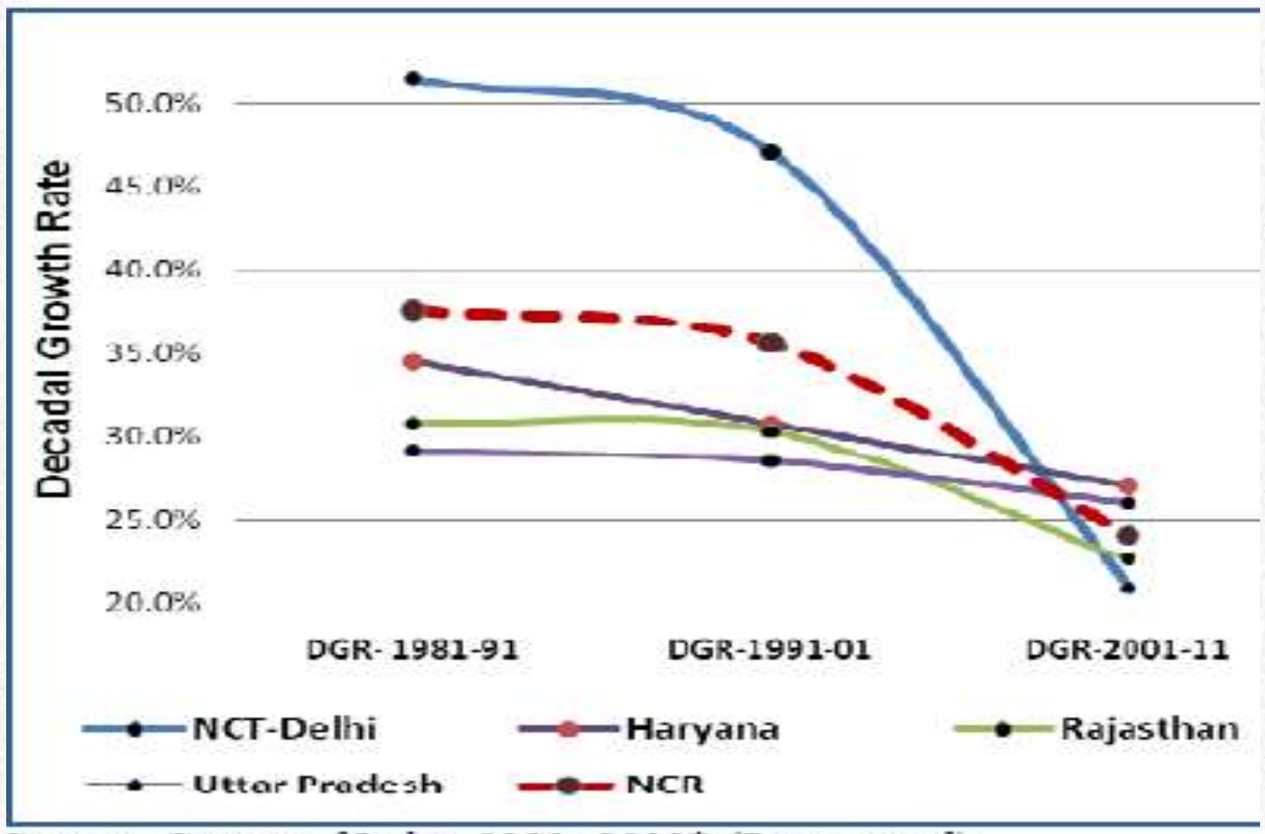


Figure 4.5: Growth Rate of Population in NCR



Source- Census of India, 1981- 2011 (Provisional)*

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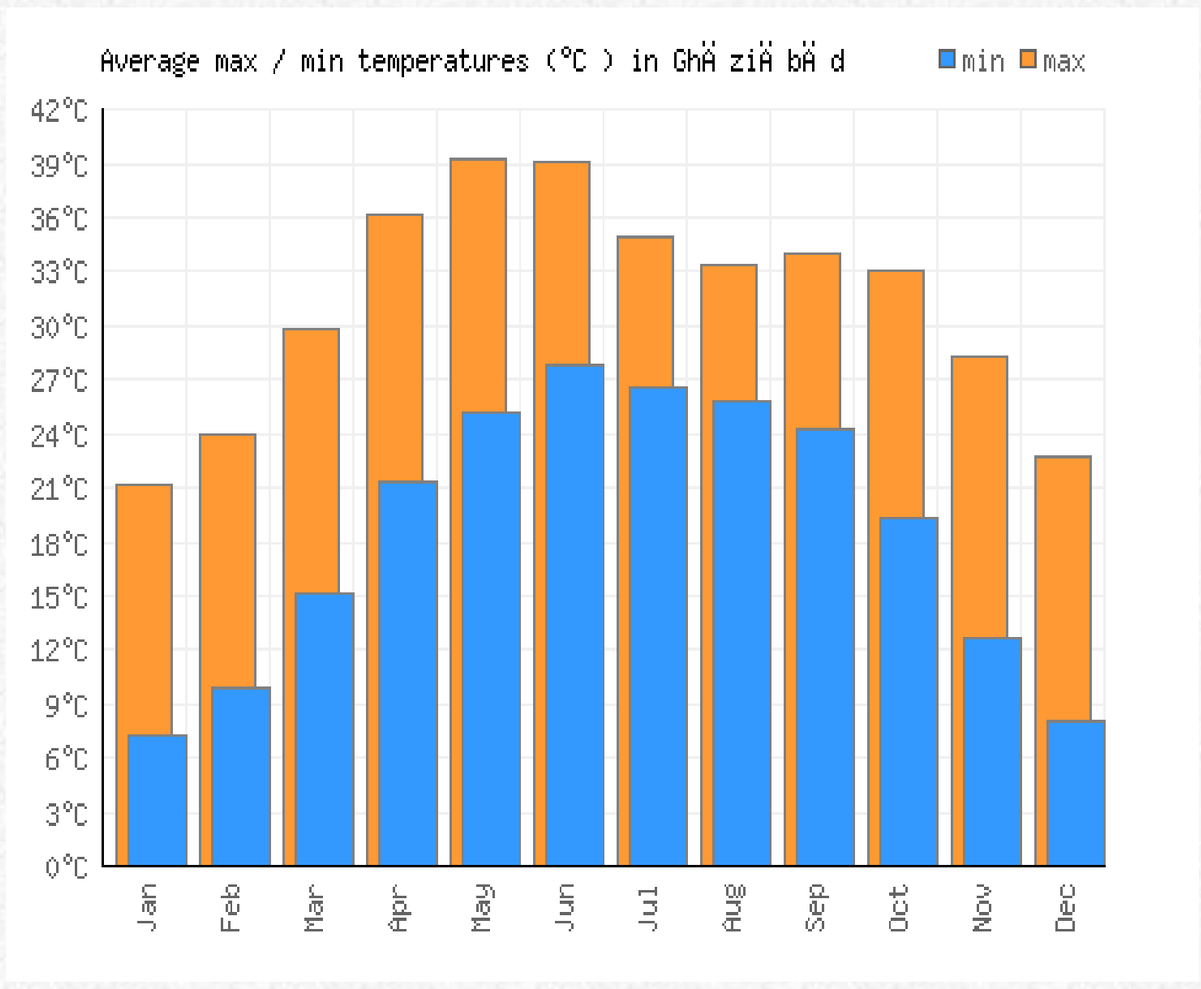
CLIMATE:

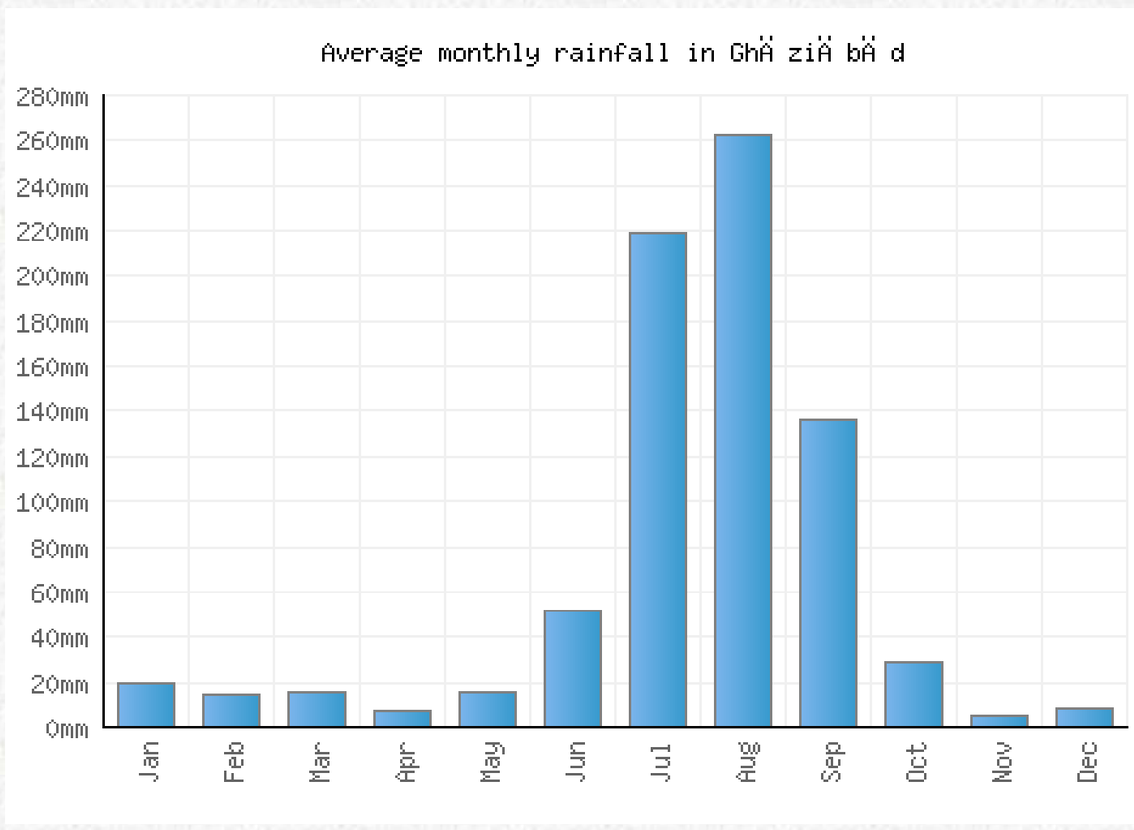
Ghaziabad has composite climate, hot summer and cold winter. four seasons can be named as under:

1. summer (march – june)
2. monsoon (july – september)
3. post monsoon (september – october)
4. winter (november – february)

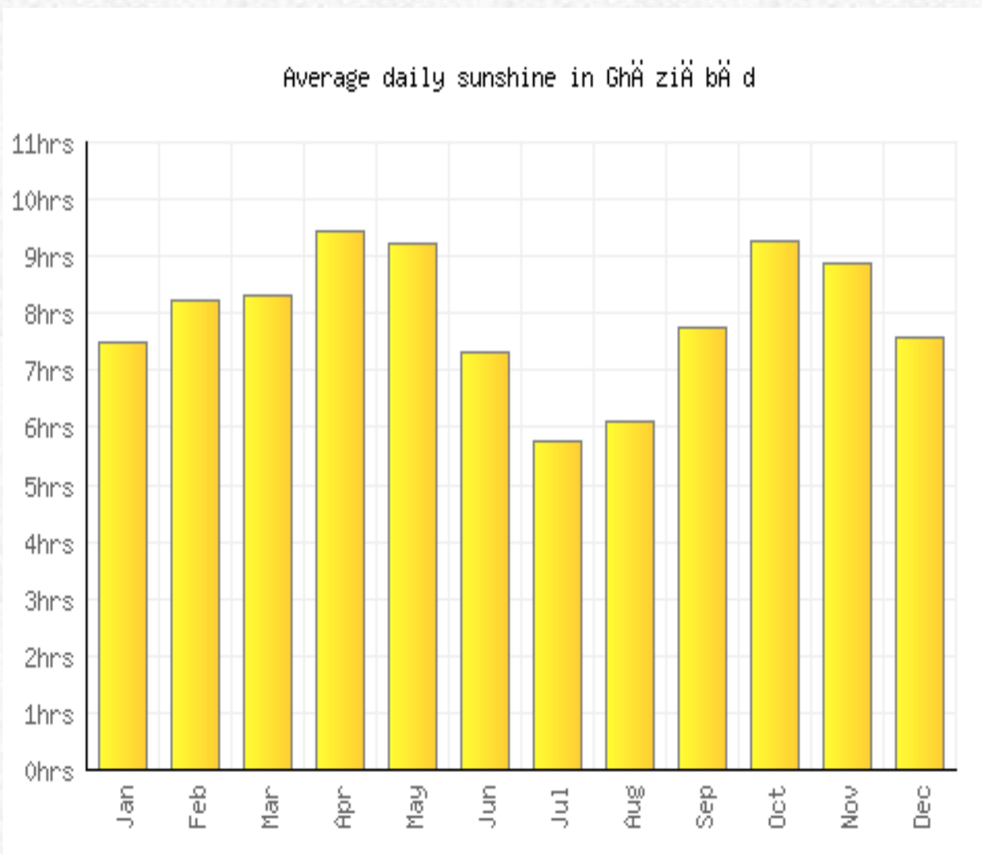


TEMPRATURE:

from about the beginning of march, temperatures begin to increase rapidly. may and june are the hottest months when the average maximum temperature is about 39° c. while days are little hotter in may than in june, nights are warmer in june than in may. from april onwards, hot dust – laden winds locally known as “loo” blows and weather is unpleasant. the average maximum temperature in january is about 21° c and the minimum average temperature is about 7° c.



AVERAGE RAIN FALL



AVERAGE DAILY SUN SHINE

RAINFALL:

the annual rainfall in the district is 764.00mm. the average monthly rainfall in november month 5 mm and maximum rainfall in month august 260 mm.

WINDS:

- winds are generally light but gain force in the summer and monsoon seasons.
- the wind direction in summer is nw to se.
- in winters the wind direction is se to nw

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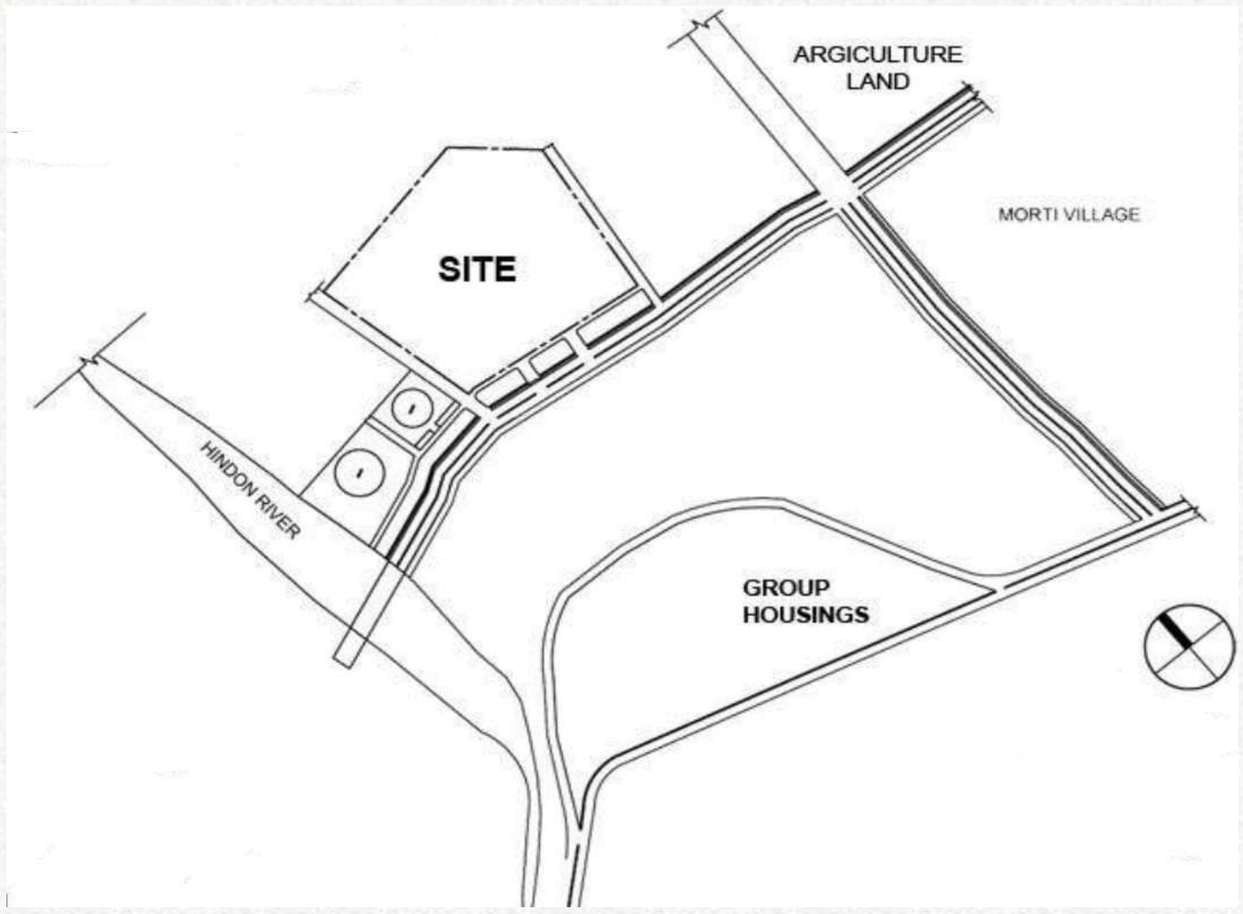
LOCATION OF SITE:

- the site is located in morti village on the meerut by pass raj nagar extension
- the site is close proximity to hindon river
- the site is located on 45 meter wide road
- gca ground and a private cricket academy is running near the proposed site
- 45 meter approch road has been newly developed by the gda for proposed bcci international cricket stadium



ABOUT THE SITE:

- the area of site is 59.01 acre(239341.43) sqm
- the site is south east facing
- the site is trapezium in shape
- south east side 45 meter green belt proposed
- the site is in master plan -2021 aquired for recreational purpose
- the project managed by upca and governing body is bcci
- the site is located on the most developing region of ncr where several other projects of much larger scale are being proposed
- the site is well connected by rail, road, metro, rrts and airport.

OWNERSHIP:

the ownership of the plot is upca and project is financed by bcci and the main governing body is BCCI

SITE TOPOGRAPHY:

- the site almost plain due to natural terrain
- the site shows a general gradient of slope towards the south east side which has main approch road
- front side which will allow natural drainage
- the formation of road level is 2.0 meter above from the natural ground level

VEGITATION ON THE SITE

LEVEL DIFFERENCE BETWEEN ROAD AND GROUND LEVEL OF SITE

GEOGRAPHICAL DATA:

- latitude : 28.7071 n
- longitude : 77.3981 e
- elevation: 212 meter
- ground water level: 10.0 meter
- soil condition : loose
- deep foundation refers

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45.0 M. WIDE MEERUT BY PASS ROAD

MEERUT BY PASS AND SITE APPROCH JUNCTION

45.0 M. MAIN ACCESS ROAD

6.0 M. WIDE OPEN DRAIN ON SOUTH EAST DIRECTION

33000 VOLT HIGH TENSION ELECTRICITY LINE PASSING FROM THE SITE

45 M. WIDE GREEN BELT AND FENCING OF SITE

SITE SURROUNDING:

- site is aproximately trapezium shaped facing to south east direction
- north – river hindon flood plain area 1.0 km.
- west – gca cricket stadium and 2.0 km. distance hindon air force station
- east – agriculture land and about 1.5 km. morti village
- south – stp 0.5 km. and raj nagar group housing 1.5 km.

STP 500 M. AWAY FROM SITE

FILTERED WATER DROPING IN OPEN DRAIN

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RAJ NAGAR EXT. GROUP HOUSING

PRIVATE NURSERY NEAR SITE

GCA CRICKET GROUND

HINDON RIVER AND PRIVATE CRICKET ACADEMY

CITY FOREST GATE ABOUT 1.5 KM. FROM SITE

PROS:

•the site has easy access through the approch road
•the site is located on outskirts of the city which helps in easy management of traffic and during mathes.
•the natural slope of site is south east direction of the site create a solution of the waste/ sewage disposal from the premises
•the main approch road is 45 meter wide which helps to manage the future traffic and crowd
•the site is located in recreational zone so other recreationalprojects may be come around the site
•it creates a healthy enviroinment for near residents

CONS:

•the site being in close vicinity of river hindon hence formation level shall be decided for precaution and protection against flood on site

JUNCTION POINT METRO AND ELEVATED ROAD NEAR HINDON BRIDGE

•hindon airforce and airport is approximately 1.0 km. so air traffic may create disterbance during matches and struture hight restricted 45.0 meter
•soil of site is loose so deep foundation will be needed in design
•33000 volt high tention line passing through site. and it it not align through green belt area
•6.0 m. wide open drain is passing from front of site. the drain is carring waste water

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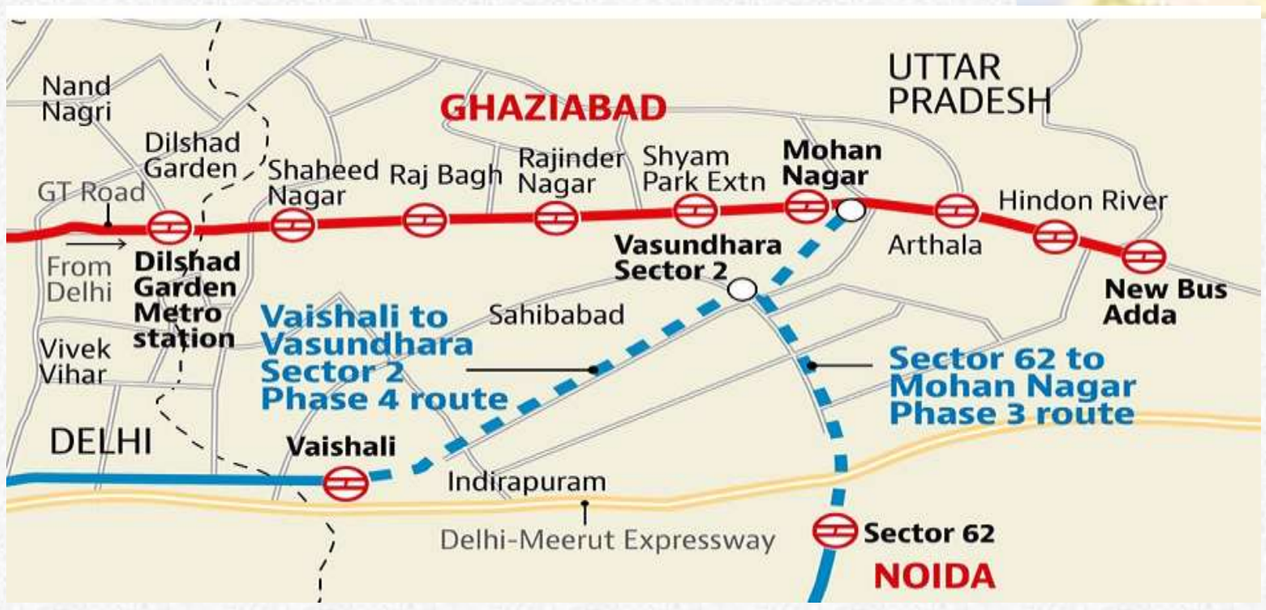
SITE CONNECTIVITY BY ROAD, METRO AND RRTS:

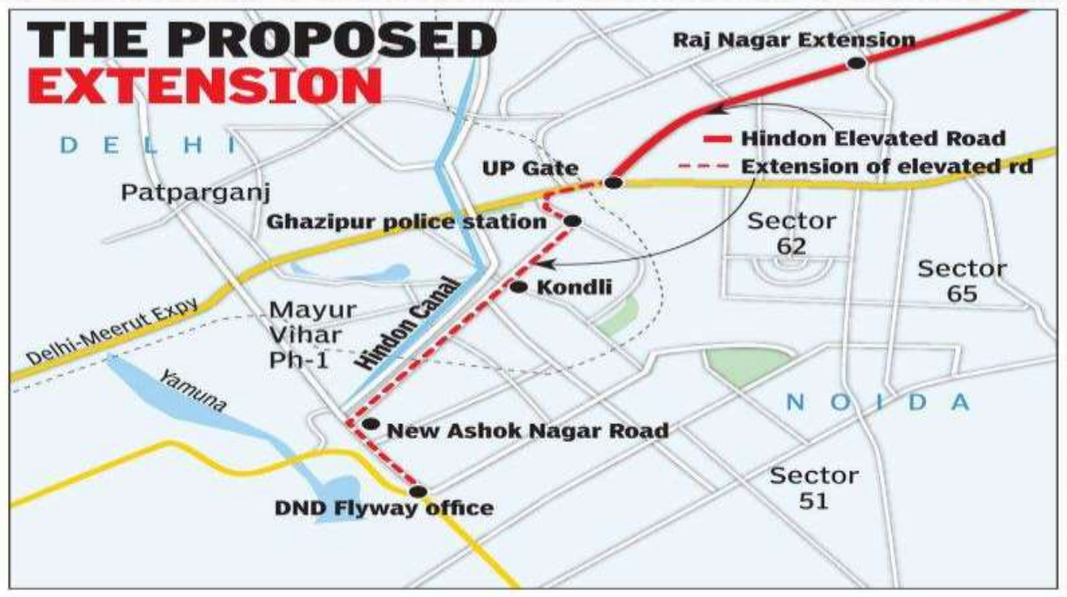
site is well connected with delhi, meerut,noida and ghaziabad elevated road and noida link road is specially planned for raj nagar extension connectivity. the site is away from 5.0 km. from g.t. road and 4.0 km away from nh-58 site is located on raj nagar extension by pass meerut road

THREE MORE TRACKS ARE LIKELY TO BE CONSTRUCTED

- delhi ghaziabad meerut rrts corridore may be linked to khurja and hapur in the future
- ncrtc to construct three tracks at ghaziabad rrts station for future extension of project
- an additional plateform will also be constructed at ghaziabad rrts station



METRO ROUTE FROM DELHI TO GHAZIABAD



PROPOSED EXTENSION OF ELEVATED ROAD

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PROJECT REQUIREMENTS:

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GENERAL REQUIREMENTS IN A STADIUM:

LOCATION:

•the area should have sufficient for future expansion
•it should be in core city area
•must fit well with local topography
•should be designed with the good transport link facilities like bus, train, airoplane, lorge parking etc on other hand it should easily accessible by motorways and other private vehicle.
•it should not be sited close to the industrial area where smoke , odors and noise might create uncomfortable conditions.

SEATING:

•seating surrounds the center pitch with each row positioned at a slightly higher level than the one in front it, proving an unobstructed view and ample leg room. seats are generaly installed on to a stepped floor surface, which also serves a s stairs in the aisles
•the limitations of normal visual acuity make any seating falling outside a radius of 200 feet from the center of field increaseingly marginal
•for major international maches a stadium should seat at least 30,000 people
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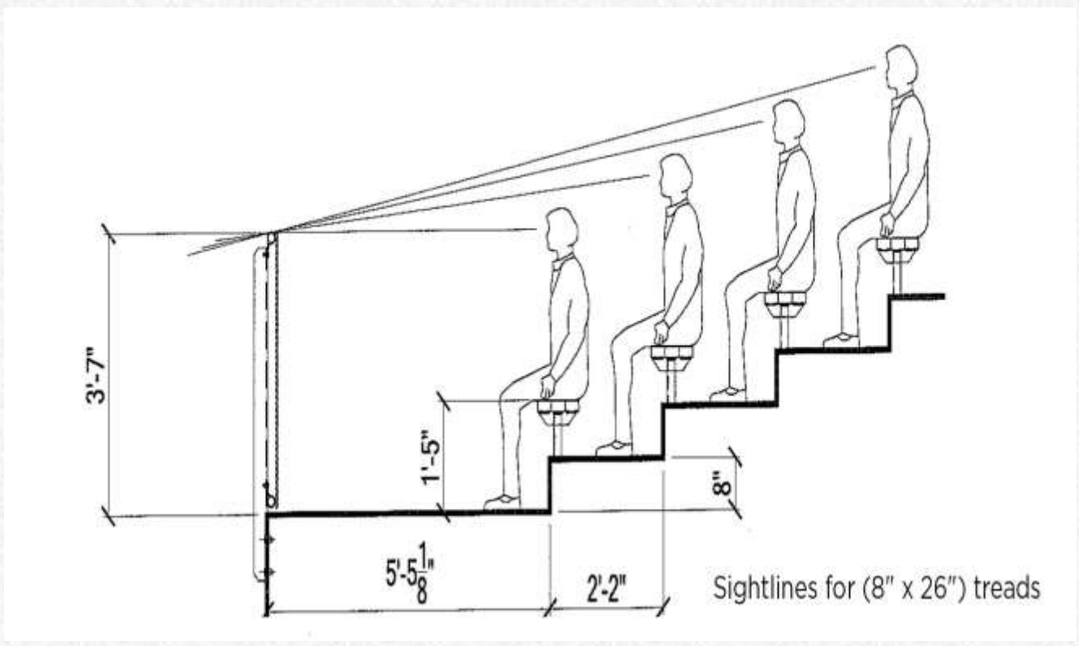
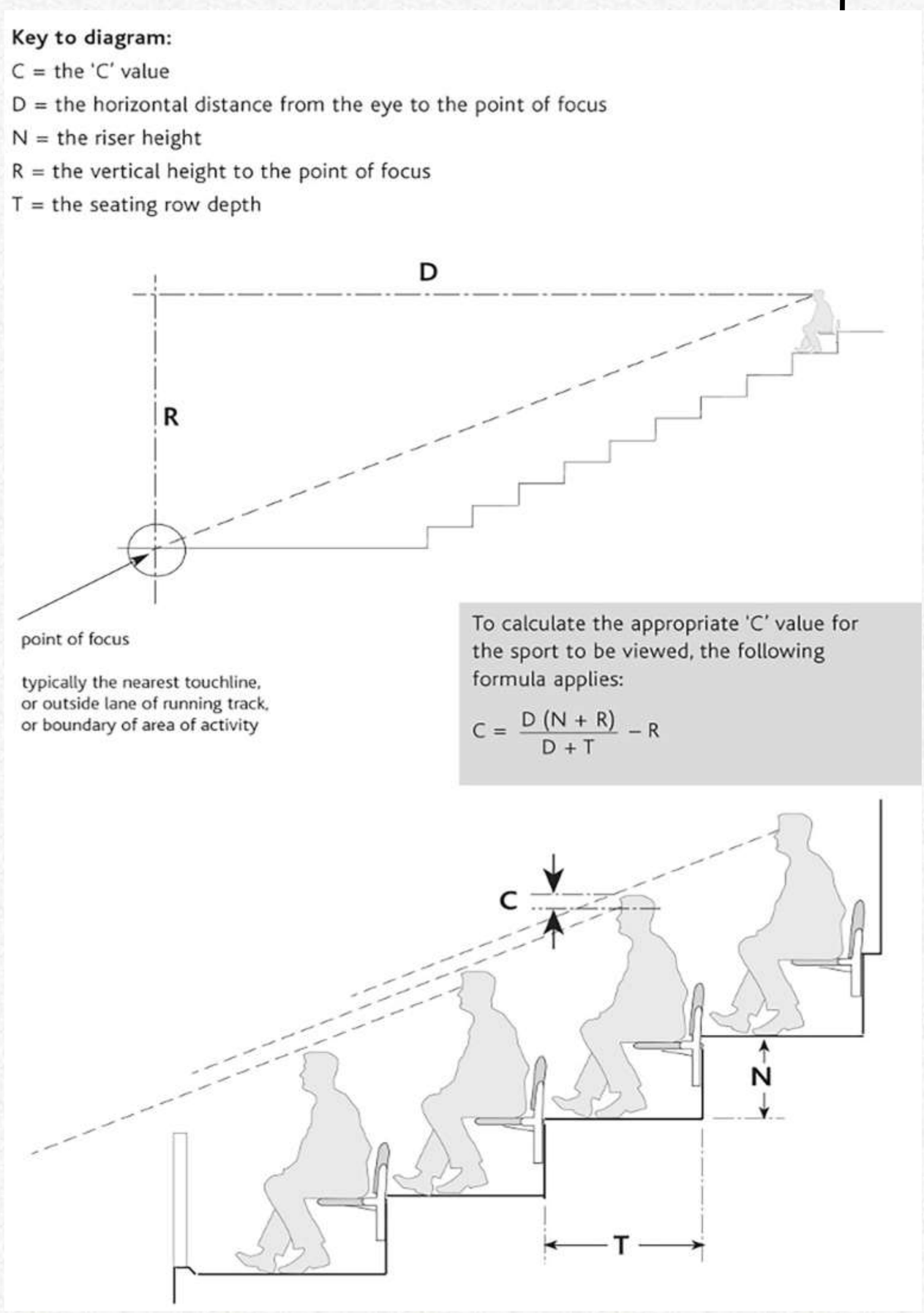


Sightlines for (8" x 26") treads

PARKING:

•capacity for 50000 spectatores parking should be provided for 10000 cars and approximately 500 buses
•where onsite sufficient parking not posible parking should be provided no further than 1500 meter from the stadium.
•there should be sufficient parking space for the buses and cars for vip's preferably , these vehicle should be parked inside the stadium
•parking space for at least 2 buses and 8 cars should be available for team, match officials, and stadium staff.



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PROJECT REQUIREMENTS:

CIRCULATION OF SPECTATORES WITHIN THE STANDS:

CONCOURSE: a concourse is defind as a circulation area that provide direct access to and from viewing accomodation to which it may be linked by vormitories, passageways, stairs or ramps.

it is recommended that all new sports ground concourses should be designed to allow at least 0.5 sq.m.per person
(a density of 20 persons/ 10 sq.m.) expected to occupy the concourse at peak times

VORMITORIES: a vormitories is an access route built in to a gradient of a stand which directely links spectatores accomodation to concourses, and/or routes for ingress, igress and emergency evaculation ,passage, through a vomitory can be either level or transverse to the row of terraces or seats

VERTICAL CIRCULATION OF SPECTATORES WITHIN THE STANDS:

STAIRCASE:

- the stairway width should be uniform
- all goings and risers on each stairway should be uniform between floors
- winders (that is tapered treads) should not be used
- individual flights should consist of no more than 12 risers
- minimum riser height 150 mm and maximum 170 mm.
- minimum width of stair : 1.20m.

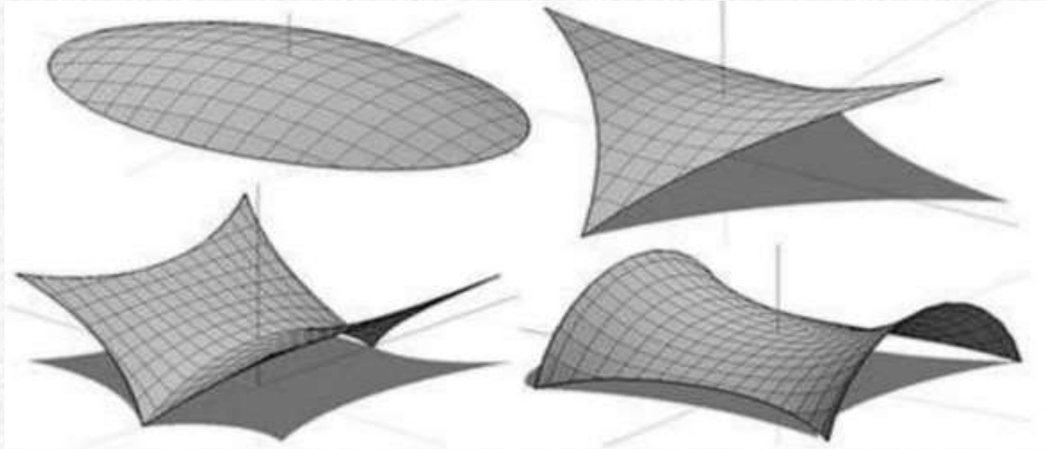
FLOW IF SPECTATORES BY ESCALATORES:

step width	600	800	1000
A	605-620	805-820	1005-1020
B	1170-1220	1320-1420	1570-1620
C	1280	1480	1680
transportation capacity/h	5000-6000 persons	7000-8000 persons	8000-10000 persons

DIFFERENT WIDH OF ESCALATORES

ROOFING OF THE SPECTATORES STANDS:

- structure with span lorger than 20m. can be regarded as long span structure for this span is usually unable to be achieved by ordinary rc structure
- long span unobstructed, column free spaces are needed in the stand
- canvas framed roofing
- truss franed roofing
- portal frame precost roofing
- pneumatic structural roofing: pneumatic structure is a membrane which carries load developed from the tensile stresses
- pneumatic structure have a wide range of possible materials.
- pneumatic structure works on tensile are composed of strechable materials that are binded togather by the help of cables



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DEVELOPMENT OF SPORTS INFRASTRUCTURE IN TERMS OF ENERGY AND WATER CONSERVATION:
A CASE OF PROPOSED INTERNATIOINAL LEVEL CRICKET STADIUM CUM CRICKET ACADEMY GHAZIABAD

PROJECT REQUIREMENTS:

LIGHTING FIXTURES AT THE STADIUM:

•the height of the lighting tower and the dimensions of the field should be in proportion to receive right amount of light evenely through out the field
•an angle of not less than 25 degree should be maintaind between the top of the light tower and the field so get optimum amount of light on the field.
•there should be no obstruction from the sports or other stadium fittings between the path of the light to the pitch

DESIGN CONSIDERATIONS FOR CRICKET ACADEMY:

warm-up/ practice area:
•outdoor practice nets
•these areas should have a grass surface (artificial turf is acceptable)
and be surrounded by plain walls with no protrusions, outdoor areas should be sufficiently lit to enable their use in night.
•turf practice wicket
•20.12m x 2.5 m. per wicket
•synthatic practice wicket
•20.12 m.x 3.0 m. per wicket
•the length of overall practice net area is to be a minimum of 50 m. and height is generaly 5 m.

CRICKET PITCH:

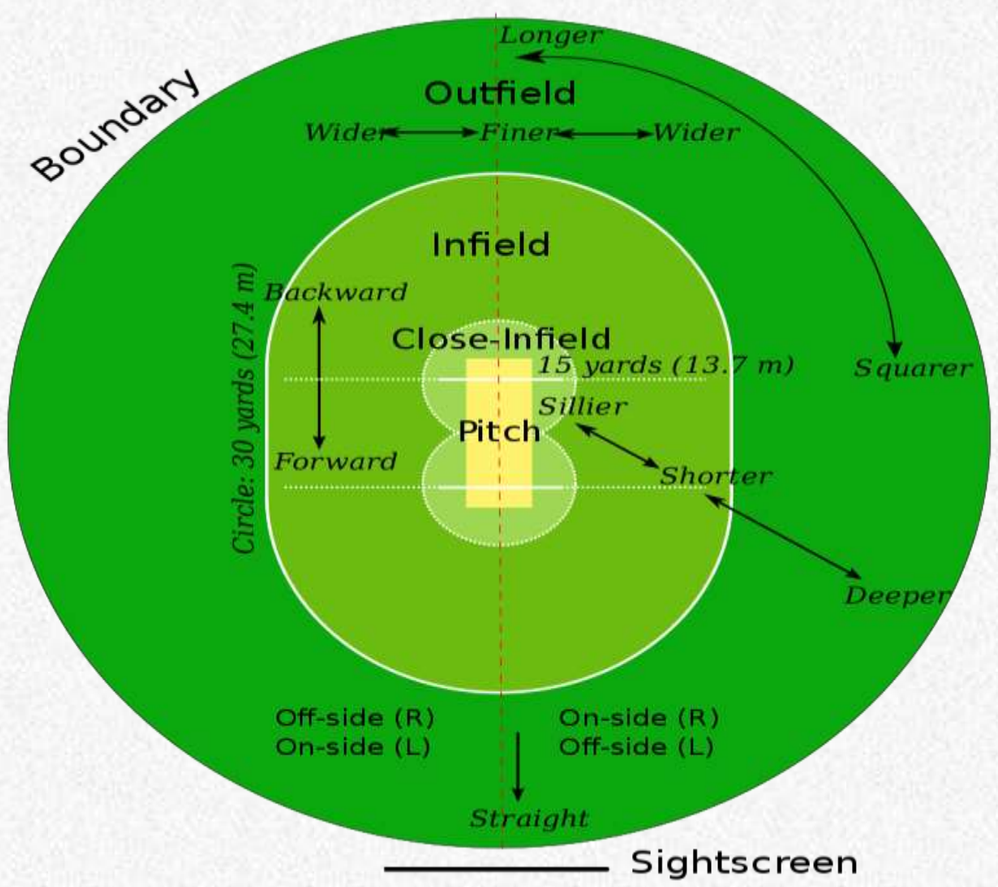
it is 20.12 m. long and 3.05 m. wide. the surface is flat and normally covered with extremely short grass

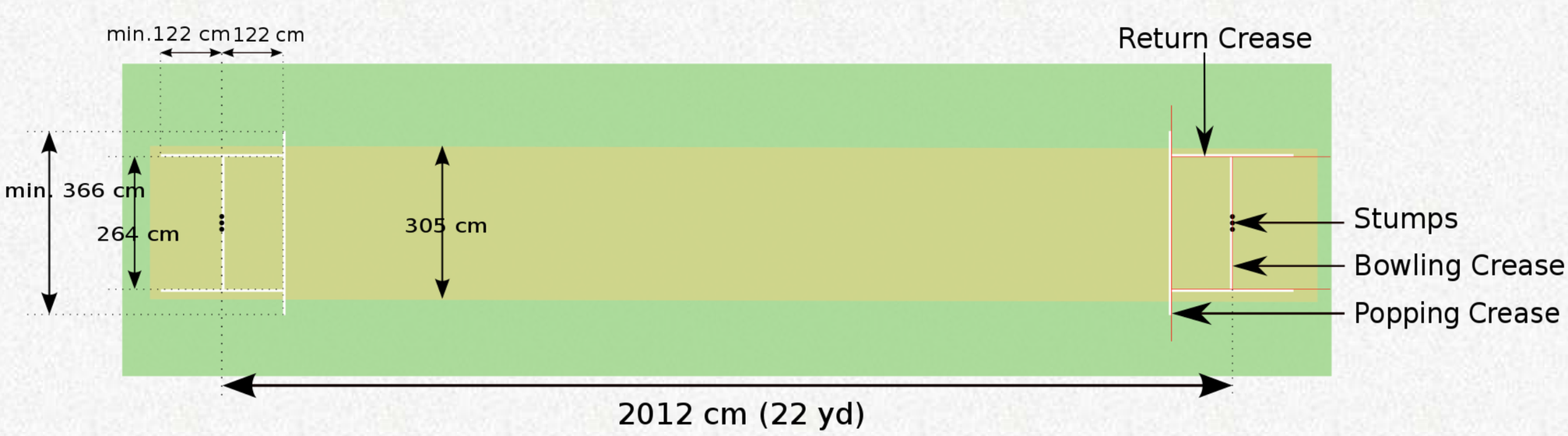
CROWDS CONTROL:

control of crowds and separation of spectators from participants has been a great challenge for designer. a group of people coming togather to enjoy an event it is a crowd and must be carefully managed . from the moment they enter the zone of infiuence of the stadium . some time very little encouragement is needed for that crowd to become a mob and eventually that mob to become a 'riot'. the managing of people must be considerd from the very beginning of a stadium of a project if this adverse encouragement is to be minimized.

DIMENSIONS OF THE PLAY FIELD:

there are no dimensions for playing field but its diameter usually varies between 137 m. to 150 m.





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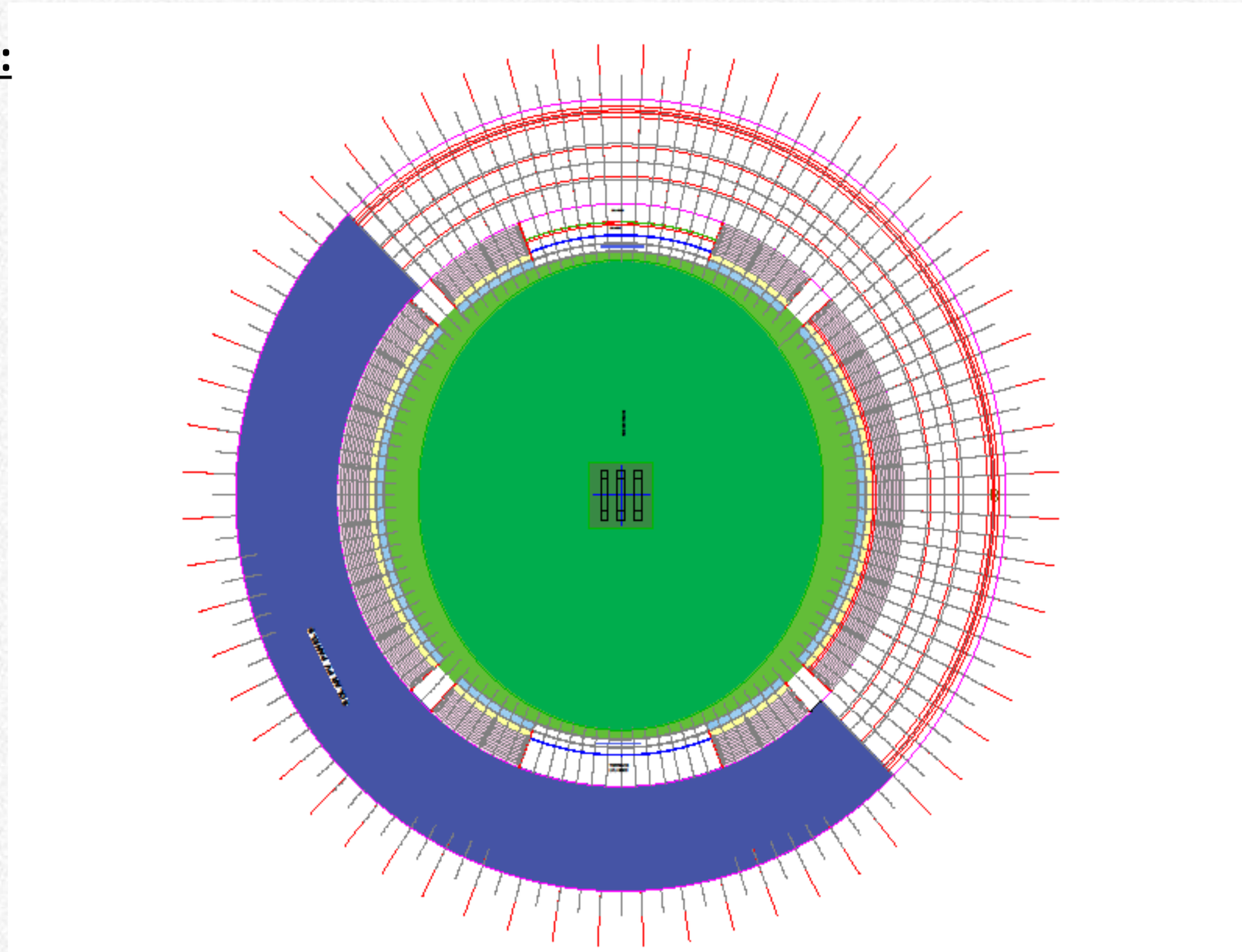
ENERGY CONSERVATION

•PV. PANELS:



Total shadow free area for solar PV panels = 13500 sqm.
For 1 kw power generation area needed 100 sqft (9.29 sqm.)
Nos of panels 500 watt = 13500/ 9.29 *2= **2910**
So total power generated by above area =13500/9.29
= **1455 kw/ h**
Average 5 houres briteness in a day
So tatal energy will produce in a day=1455*5 =7275 kw/day
So whole year energy saving 7275 *365 =**2655375 unit/year**

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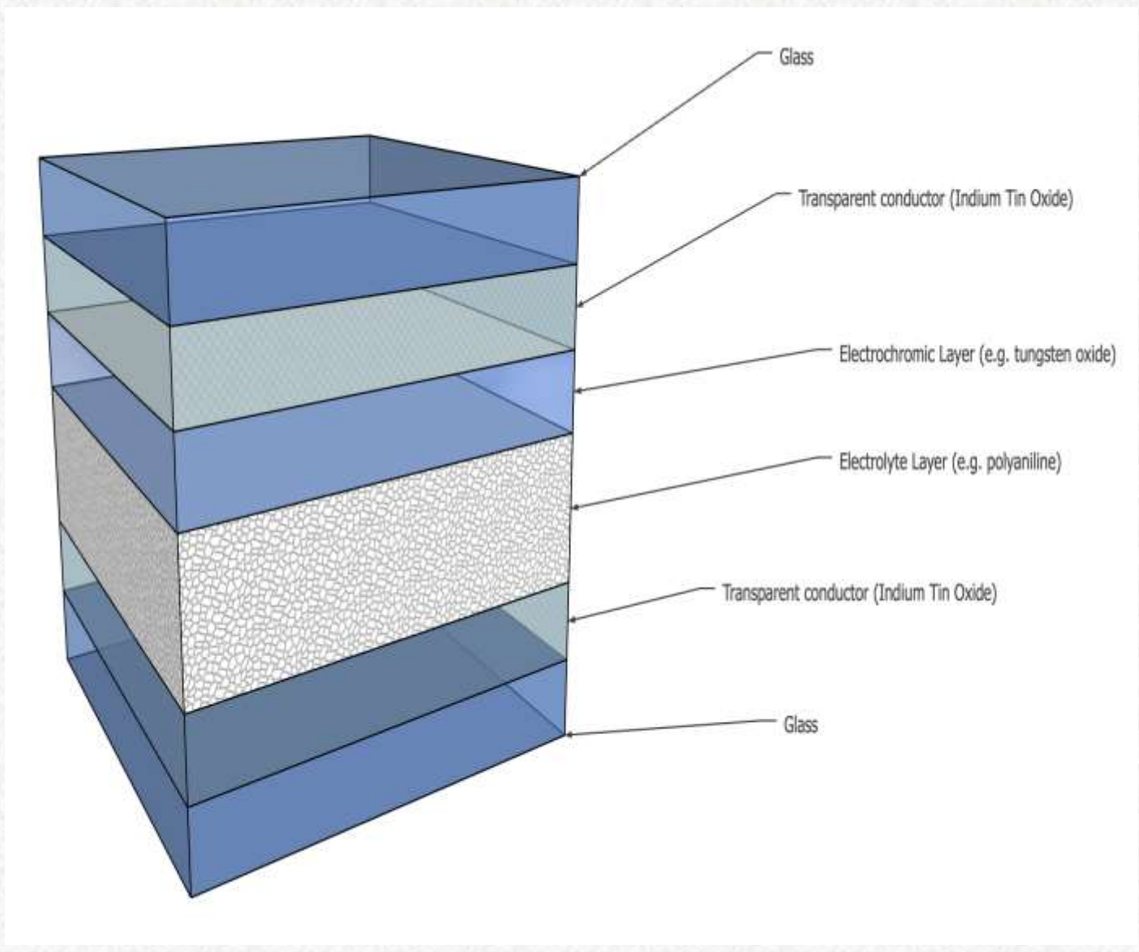
- **PROGRAMMABLE OR SMART THERMOSTAT:**

A programmable thermostate can be set to automatically turn off or reduce heating/ cooling during the time when no one there

- **ELECTROCHROMIC SMART GLASSES**:

Electrochromic smart glass changes its transmittance (i.e. how much light it passes) if stimulated by an electrical signal. This reversible change alters the state of the glass between transparent and opaque (or any state in between). Research work has also been underway recently to change the reflectance of electrochromic smart glass in the same way.



When a voltage is applied across the electrochromic stack, lithium ions will ‘intercalate’ (i.e. insert themselves into) the electrochromic layer.
The inserted lithium ions reduce the ‘band gap’ of tungsten oxide to roughly 2 electron-Volts (eVolts), which means that incident photons having at least that energy can be absorbed by the tungsten oxide, energising electrons into a higher energy state.
Since visible light photons do have at least this energy, they are absorbed by the intercalated electrochromic layer, and the solar radiation which reaches the human eye by passing through the glass can be seen to be missing those wavelengths, i.e. it lacks visible light and thus appears tinted

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WATER CONSERVATION

•RAIN WATER HARVESTING:

Particulars	Area (sq.m.)	Cofficient factor	Effective area (sqm.)	R.W.H. potential per annum(ML.)
Stadium roof	2700	1	2700	20.62
Stadium field	23224	0.35	8128	2.17
Sitting area	15694	0.65	10201	5.06
Practice area	12160	0.35	4256	1.14
Buildings	1200	0.65	4680	2.32
Open area	154063	0.30	46220	10.59
total	**239341**		**100485**	**41.90**

• Sub air drainage system:

This is the most unique additions under the green cricket that sucks surface water more than 30 times of natural gravity. Sub air installed by digging the ground and installed the pipes in a sand base drainage system with a vaccume which sucks water and stored in mention place.

•Water treatment plant:

the water collected in a tank from roof top rain water, surface water and sub air drainage. And it filterd in a underground water filteration plant by three process 1. physical process 2. biological process and sedimentation process

•Vaccume assisted toilets:

In this toilets have an inner tank that prevents condensation on the out side of the porcelain tank . When flushed this vacume helps pull waste out of the bowl

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