

BIOCLIMATIC INTERNATIONAL SCHOOL

THESIS

Submitted in partial fulfilment of the requirements for the award of
Bachelor of Architecture degree

By

KARTHIKEYAN C

3621040



**DEPARTMENT OF ARCHITECTURE
SCHOOL OF BUILDING AND ENVIRONMENT**

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with Grade "A" by NAAC

**JEPPIAAR NAGAR, RAJIV GANDHI SALAI,
CHENNAI - 600 119**

JUNE 2021



DEPARTMENT OF ARCHITECTURE
BONAFIDE CERTIFICATE

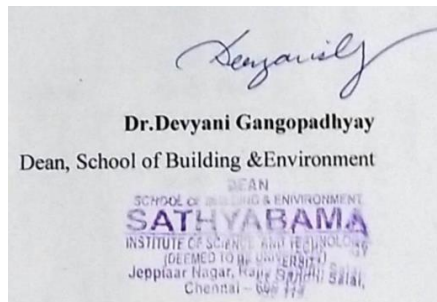
This is to certify that this Project Report is the bonafide work of Karthikeyan.C (3621040) who carried out the project entitled "Bioclimatic international school" under our supervision from January 2021 to June 2021.

Internal Guide
(Ar. Kavitha)

Internal Review Member
(Ar. Sukrith Suresh)

External Guide
(Ar.)

Dean and Head of the Department
Dr. DEVYANI GANGOPADHYAY



Submitted for Viva voce Examination held on _____

Internal Examiner

External Examiner

DECLARATION

I, **Karthikeyan.C** hereby declare that the Project Report entitled "**Bioclimatic International School**" done by me under the guidance of **Ar. Kavitha** (Internal Guide), **Ar. Sukritha Suresh** (Internal Review Member) and _____(External Guide). Sathyabama Institute of Science and Technology is submitted in partial fulfilment of the requirements for the award of Bachelor of Architecture Degree.

DATE:

PLACE: Chennai

SIGNATURE OF THE CANDIDATE

ACKNOWLEDGEMENT

I am pleased to acknowledge my sincere thanks to Board of Management of **Sathyabama Institute of Science and Technology** for their kind encouragement in doing this project and for completing it successfully. I am grateful to them.

I convey my thanks to **Dr. Devyani Gangopadhyay**, Dean and Head of the Department, **Dr. Suresh Kuppuswamy**, Design Chair of School of Building and Environment, Department of Architecture and providing me necessary support and details at the right time during the progressive reviews.

I would like to express my sincere and deep sense of gratitude to my Project Internal Guide **Ar. Kavitha** , Internal Review member **Ar. Sukritha Suresh** and External Guide _____their guidance, suggestions and constant encouragement which paved the way for the successful completion of my project work.

I wish to express my thanks to all Teaching and Non-teaching staff members of the **Department of Architecture** who were helpful in many ways for the completion of the project.

ABSTRACT

BIOCLIMATIC SCHOOL

School should be a place where teachers and students can learn and play, and be motivated. An image of children exploring space with no barriers, where they can touch and feel materials and react to them, can be very inspiring when designing for children.

When It comes to the school environment, most schools are single structures, long corridors, and classrooms where the students are uninterested and restricted by many rules.so, when it comes to school design, architecture provides enormous opportunity and freedom. Still, it must be followed by knowledge and observations about how children use and experience space through the years.

In adopting bioclimatic approaches, we can create comfortable buildings by understanding the microclimate and resulting design strategies that include natural ventilation, daylighting, and passive heating and cooling. It utilizes solar energy and other related environmental resources to provide indoor and outdoor human thermal comfort. Our design intends to create a climate-responsive design for a school to provide thermal and visual comfort.

Table of contents

CHAPTER 1	1
1.1 INTRODUCTION.....	1
1.2 AIM.....	1
1.3 OBJECTIVES.....	1
1.4 METHODOLOGY	2
1.5 DESIGN APPROACH	2
CHAPTER 2 LITERATURE STUDY	3
1.1 SCHOOL STANDARDS	3
2.2 CIRCULATION AREAS.....	4
2.3 BIOCLIMATIC APPROACH	5
2.3.1 Courtyards	5
2.3.2 Solar shading devices.....	5
2.3.3 Landscape and vegetation.....	6
2.3.4 Openings and voids consideration.....	7
2.3.5 Orientation	8
CHAPTER 3 CASE STUDY.....	13
3.1 THE BRITISH SCHOOL, New Delhi.....	13
3.1.1 Site Plan and Zoning	13
3.1.2 Building orientation	14
3.1.3 Passive strategies.....	14
3.2 THE RAJASTHAN SCHOOL, Nagaur	16
3.2.1 Site Plan and Zoning	16
3.2.2 Building Orientation	17
3.2.3 Passive Strategies	17
3.3 CMR EKYA SCHOOL, Bangalore	18
3.3.1 Site Plan and Zoning	18
3.3.2 Building Orientation	19
3.3.3 Passive Strategies	19
3.4 Vidhya Mandir, Chennai	21
3.4.1 Site approach and Orientation	21
3.4.2 Walls, roof, and openings	21

3.4.3	Natural ventilation and Daylighting	22
3.5	FOSHAN MEISHA BILINGUAL SCHOOL, China	23
3.5.1	Site Factor and Zoning	23
3.5.2	Building Orientation	24
CHAPTER 4	SITE ANALYSIS	28
4.1	SITE CONTEXT	28
4.2	Neighborhood Context	29
4.3	Demography.....	29
4.4	Proximity and Transport	30
4.5	Climatic Factors	30
4.6	SITE VIEWS.....	31
CHAPTER 6	CONCEPT	35
6.1	BIOCLIMATIC ARCHITECTURE :	35
6.2	BASIC PRINCIPLES OF A BIOCLIMATIC DESIGN:	35
6.3	DESIGN PARAMETERS:.....	36
6.3.1	<i>DAYLIGHT FACTOR</i>	36
6.3.2	VENTILATION	36
6.3.3	WIND	36
6.3.4	THE FAÇADE	36
6.3.5	SHADING	36
6.3.6	GREENERY.....	36
6.4	RESPONSE TO HUMAN SENSES TO PROVIDE COMFORT:.....	37
6.5	CONCEPTUAL SKETCHES :	37
CHAPTER 7	ZONING.....	39
CHAPTER 8	DRAWINGS.....	40
8.1	MASTER PLAN.....	40
8.2	ACADEMIC BLOCK:	41
8.2.1	Ground floor	41
8.2.2	First floor	41
8.2.3	Section	42
8.3	KINDERGARTEN BLOCK.....	42
8.4	DORMITORY BLOCK	43
8.4.1	Ground floor	43

8.4.2 First floor	43
8.4.3 Section	44
8.5 AUDITORIUM	44
8.6 CAFETERIA	45
8.7 LIBRARY	45
8.8 ADMIN BLOCK	46
8.9 PAVILLION.....	46

List of Figures

FIGURE	TITLE	PAGE NO.
CHAPTER 2 LITERATURE STUDY		
2.1	Typical illustration of primary classroom	3
2.2	Different type of courtyard effect	5
2.3	vertical and horizontal Shading with HSA and VSA	6
2.4	Shading by landscape trees and creeper plants.	7
2.5	Size of trees are noted for the Shading	7
2.6	Size of the opening controls the airspeed and airflow	8
CHAPTER -3 CASE STUDY		
THE BRITISH SCHOOL		
3.1	Site plan of the school	13
3.2	view of the school	14
3.3	Passive design strategies	15
3.4	Section with the wind flow	15
THE RAJASTHAN SCHOOL		
3.5	Site plan of the school	16
3.6	Design approach	17
3.7	View of the school	17
CMR EKYA SCHOOL		

3.8	Top view of the school	18
3.9	view of the school	19
3.10	Wind Circulation inside class rooms	19
3.11	Section with wind circulation	20
3.12	Section of the school with wind circulation	20

VIDHYA MANDHIR, CHENNAI

3.13	Orientation based on the sun path	21
3.14	Perforated double skin facade	22
3.15	Courtyard for ventilation	22
3.16	Skylight in the corridors	22

FOSHAN MEISHA BILINGUAL SCHOOL

3.17	<i>isometric view of campus</i>	23
3.18	Orientation based on the sun path	24
3.19	Corridor view	25
3.20	Courtyard space	25

CHAPTER 1

1.1 INTRODUCTION

School is not only about the study; it's all about learning life's standards, starting from kids' educational journey to the 12th standard. The main thing in designing a school is not only about the building; it should have equal concentration to the campus, green spaces, and the learning spaces. In this design, we design a school in a developing area with a bioclimatic approach to the design to provide comfort for the users.

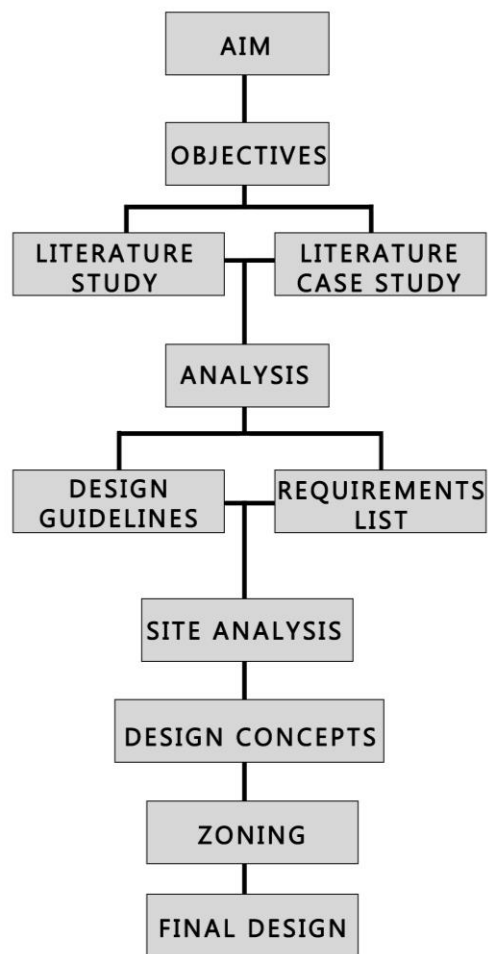
1.2 AIM

To create an environmentally friendly school and provide thermal comfort for the user with limited use of mechanical energy.

1.3 OBJECTIVES

- To create a climate-responsive school to provide comfort for the students.
- To provide all the required infrastructure and human resources with compulsory, relevant, and quality education
- To create a walkable design for the students with lots of green spaces.
- To create a space that is child-centered, activity-based, and joyful learning process.

1.4 METHODOLOGY



1.5 DESIGN APPROACH

The approach of the design will be with the concept of bioclimatic architecture, where the structure acts as a climate-responsive building that utilizes the maximum amount of use of daylighting and ventilation into the structure.

The school design is based on the Indian School Standards IS 8827:1978

CHAPTER 2

LITERATURE STUDY

1.1 SCHOOL STANDARDS

The school design is based on the Indian School Standards IS 8827:1978

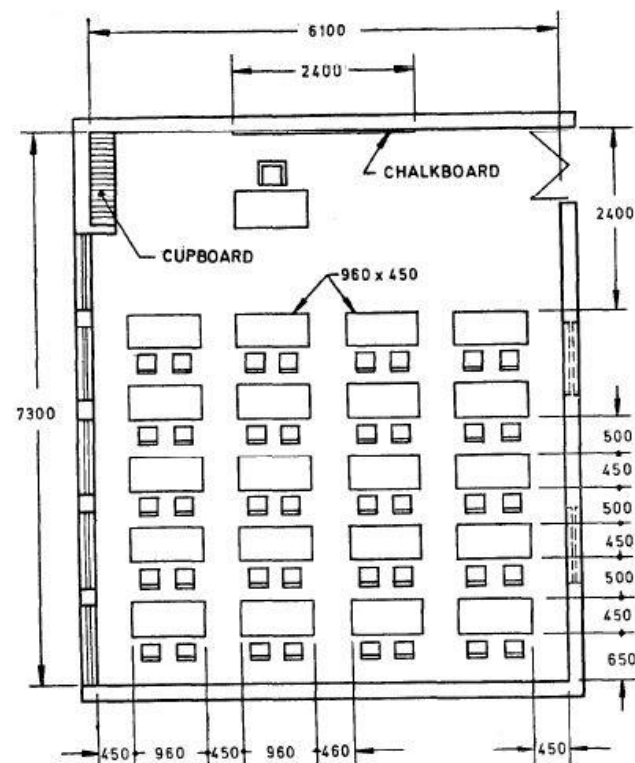
The number of classrooms in a school' and the number of sections

per class should depend upon the size and level of school and use efficiency

of spaces. The classroom should be designed for the following number of student

Table 2.1 USABLE FLOOR AREA OF CLASSROOMS

Sr. No.	CATEGORY	NO. OF STUDENT PLACES PER CLASSROOM	GROSS AREA OF CLASSROOM IN m ² PER STUDENT PLACE, Min
(1)	(2)	(3)	(4)
i)	Pre-school	20/25	2.00
ii)	Primary/Junior		
i)	With furniture	40	1.11
ii)	With squatting	40	0.74
iii)	Secondary/Higher Secondary	40	1.26



All dimensions in millimetres.

Fig. 2.1 TYPICAL ILLUSTRATION OF A PRIMARY CLASSROOM

2.2 CIRCULATION AREAS

Circulation areas such as corridors, entrance halls, staircases, etc., in the school buildings with double-loaded and single-loaded corridors & all not be more than 18 percent and 24 percent of the total covered area of the building respectively.

Table 2.2 RECOMMENDED ADMINISTRATIVE AREAS FOR SECONDARY/HIGHER SECONDARY SCHOOLS

SL No.	ENROLMENT NUMBER	PRINCIPAL'S ROOM	VICE-PRINCIPAL'S ROOM	GENERAL OFFICE	STORAGE AREA	TEACHING STAFF AREA INCLUDING STAFF COMMON ROOM
(1)	(2)	(3) m ² Min	(4) m ² Min	(5) m ² Min	(6) m ² Min	(7) m ² Min
1.	Up to 960	19	29	29	50	1.8 m ² per teacher (for 60% of teaching staff)
2.	From 960 to 1920	19	33	45	65	1.8 m ² per teacher (for 60% of teaching staff)

Table 2.3 INDOOR AREAS FOR VARIOUS STUDENTS' ACTIVITIES

SL No.	Room	AREA (3) m ²	REMARKS (4)
i)	Common Rooms	0.1 per student (Min 25 m ² , Max 100 m ²)	Boys common room should contain arrangements for sitting or squatting and it may be combined or be a part of canteen itself. Girls common room should contain in addition a bench or a couch for lying down
ii)	Canteen	0.1 per student (Min 25 m ² , Max 100 m ²)	—
iii)	NCC/ACC/Scout/Guide	One room for each, 11.0 m ² area	—
iv)	Medical Inspection Room	20 to 30	It should contain facilities such as a table, a chair, an examination bed, a medicine chest and a wash basin
v)	Book/Stationery Shop	30 to 50	—
vi)	Library	0.1 per student (Min 50 m ² , Max 150 m ²)	Regarding primary elements in the design of school library buildings, IS: 8338-1976* may be referred
vii)	Students' Club and House Offices	30 to 50	—
viii)	PET Room (Physical Education and Teaching Room)	45	—
ix)	Toilets	0.2 per student	Regarding provision of various fittings in toilets, Table 9 may be referred.
x)	Multiuse Hall (Optional)	0.65 per student for 50% of the strength (excluding stages) (Min: 14 m × 28 m × 5.5 m) (Max: 18 m × 36 m × 6 m)	Without stage

*Recommendations for primary elements in the design of school library buildings.

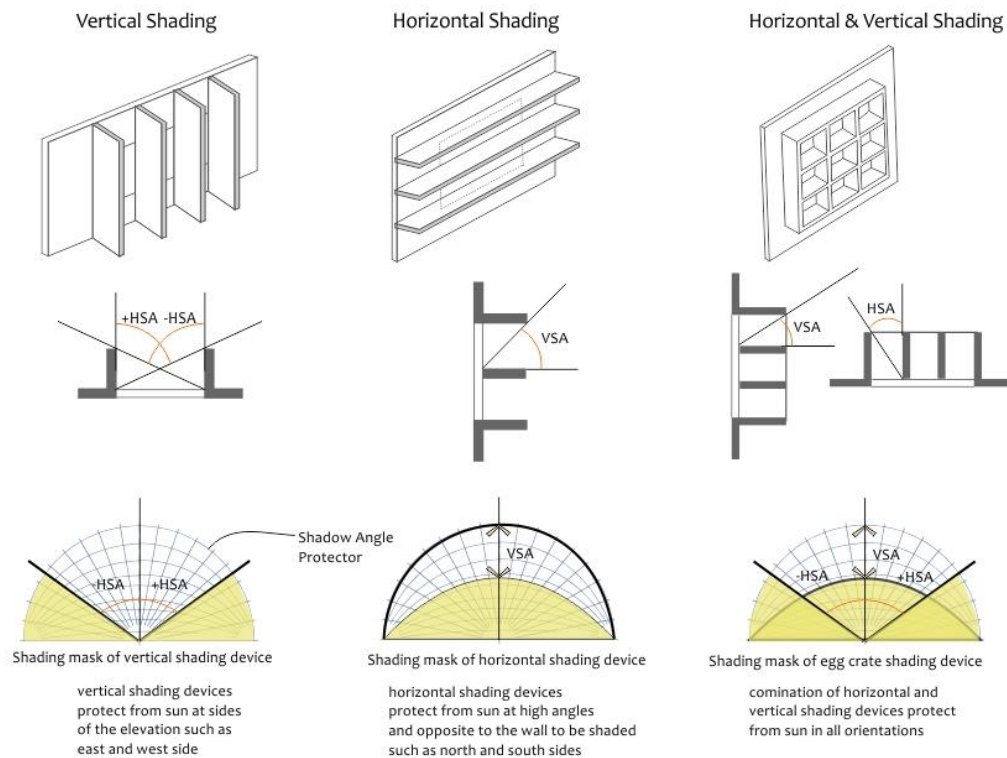


Fig 2.3 vertical and horizontal shading with HSA and VSA

2.3.3 Landscape and vegetation

Vegetative Shading also works efficiently with the shoulder heating and cooling seasons. Deciduous trees can also play a role in providing shade to the facade when heat avoidance is desired. It can also permit solar penetration where passive solar gain is sought. During the fall season, when continued warm days may suggest cooling, the leaves will not have been shed. If natural ventilation is also desired, it becomes important to allow sufficient wind penetration around the exterior plantings, or else potential natural cooling with being affected or blocked. The natural surroundings can also be used to shade low-rise buildings.

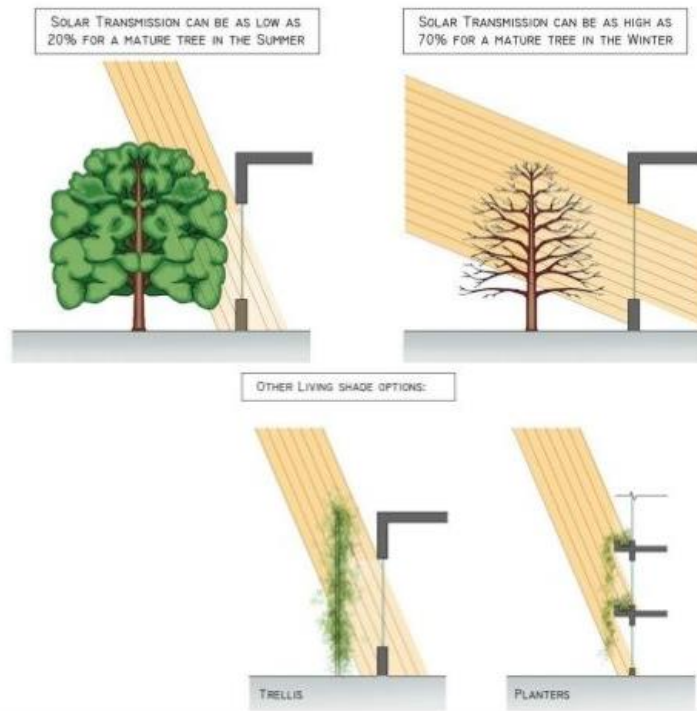


Fig2.4 Shading by landscape trees and creeper plants.

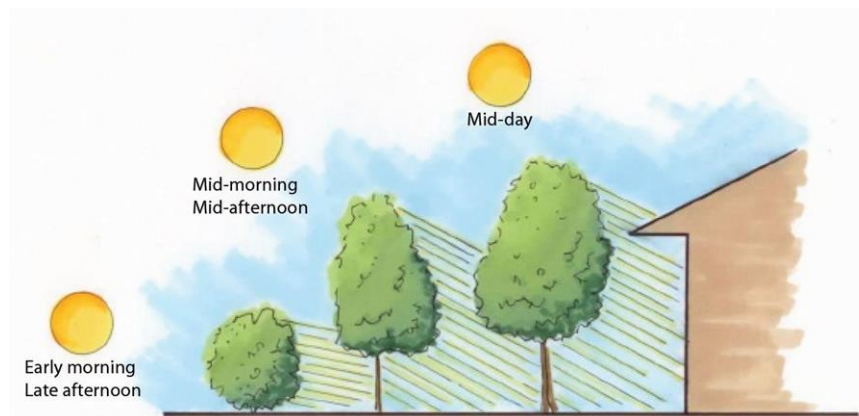


Fig 2.5 Size of trees are noted for the Shading

2.3.4 Openings and voids consideration

Building openings define the transition from warm to cold, from introverted to exposed, from dark to light, from artificial to natural, from enclosed to open space. Having a direct connection with the outdoors is essential to a building's users. Structures should use an opening area appropriate to their Orientation and

courtyards for light and ventilation. These should be noted as it plays a vital role in the climatic responsive design. Based on the form and space of the wind flow, the amount of light to comfort the user. The size of the openings also matters as it allows solar radiation as wells as wind flow.

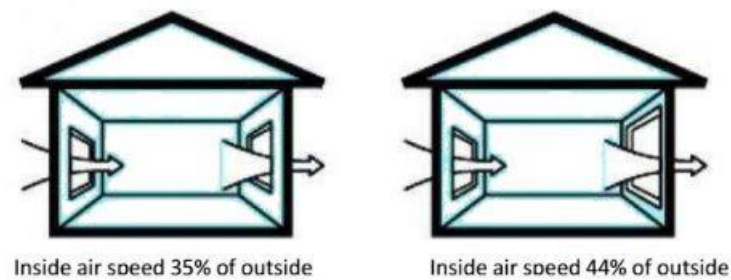


Fig 2.6 Size of the opening controls the airspeed and airflow

2.3.5 Orientation

Orientation is planned in such a way as to make maximum use of the daily and seasonal variation of the sun's radiation. The optimum Orientation of a building is a compromise between its function, location, and the present environmental factors such as heat, light, humidity, and wind. The building orientation is generally used to refer to solar Orientation while planning concerning the sun path.

ORIENTATION BASED ON FACTORS

1. **SOLAR RADIATION-** The building orientation is generally used to refer to solar Orientation while planning of house concerning the sun path. The Orientation can refer to a particular space or, most importantly, the building facade.
2. **WIND DIRECTION-** The wind direction and velocity should be studied at your site for the whole year. The building should be oriented so that the wind flow should be more in the building during the humid season than in other seasons.

3. **HUMIDITY** - Humidity does not affect the Orientation of a building directly, but adequately planning according to wind orientation, which will ventilate your home naturally, will give you relief from the humid heat, even when there is a little natural breeze.
4. The structure's Orientation decides the positioning of the windows and the size of openings for the light and ventilation to enter the building.

Table 2.4 Orientation and Effective Shading

Orientation	Effective Shading
South	Fixed horizontal device or window recessing
West and East	Vertical device /louvers (possibly moveable). As the sun is very low, East / West faces are difficult to shade with fixed shades. So only small size windows are recommended. External moveable shades / rollable blinds are more effective than fixed shades. These also help preserve the view from the windows.
Northside	Generally not required except low evening sun in peak summer when the sun path is long and hits the North from the side. Cutting this out can be achieved by vertical shades.

Table 2.5 Performance of these design strategies(Gupta, 2017)

1.	Indirect gain	The heating load may be reduced by 25 %.
2.	Evaporative cooling	• A reduction of about 9.6 °C may be achieved. • With the use of a fountain, indoor temperature was found to fall within the comfortable zone of 20 °C for hot arid regions. • For a hot, humid climate, a 2- 6.2 °C drop in the room temperature may be achieved. • Water retaining material (porous roof) laid over the roof may reduce surface temperature by 4-6 °C. • Indirect evaporative cooling may lead to a reduction of 1 °C in mean daily temperature for regions with daily mean temperatures ranging between 26.5 °C- 27.6 °C. It may also reduce the thermal discomfort due to heat in about 95- 100 % of the year. • The energy demand by the HVAC system by 20% in the next 20 years may be reduced by Indirect evaporative cooling
3.	Natural ventilation	• More than 30 % of energy savings may be achieved. • The recommended value of air movement is 0.2 m/s for winters and 0.4 m/s for summers. • For living rooms, dining areas, the mean window to wall ratio should be 0.34. The same for the bedroom should be 0.27 in high-rise buildings. • With air movement of 2-3 m/s, Comfortable indoor thermal conditions may be achieved.
4.	Natural Daylight	• Window to wall and window to ground ratios (0.33-0.58) have a massive contribution to the effectiveness of natural ventilation and daylight

		• 10 % of additional energy savings may be achieved by changing the size of the windows. • Skylights may lead to a reduction in energy savings by 77 %. • With the integration of semi-transparent photovoltaic systems with buildings, about 7150 W daylight savings may be achieved for cold climatic conditions • Annual daylight savings of 11233.79 kWh may be achieved by building integrated semi-transparent photovoltaic systems.
5.	Solar shading techniques	• With proper shading techniques, Energy demand for south exposing facades may be reduced by about 9 %. • With the additional provision of insulation, about a 4.4-6.8 °C decrease in the indoor temperature may be achieved. • Using locally available materials such as hay, inverted earthen pots, plants, insulation, terracotta tiles, etc., for the roof cover, the indoor temperature may be reduced since the roof has the maximum exposed area for solar gains.
6.	Landscaping	• The presence of a park can reduce the surrounding temperature by two °C. • The surrounding temperature may be reduced by 2- 5 °C due to the shading effect and evapotranspiration offered by trees. • Evergreen trees towards the west and south side of the building, whereas Deciduous trees should be planted on the southwest and south of the buildings. • Due to the presence of green space, the indoor temperature may be reduced by 2°C. • A comparison of shaded (tree buffering) and the non-shaded area was conducted, and it was observed that the peak solar irradiation at the same time was 100 W/m₂ and 600 W/m₂, respectively, for a southeast-oriented building located in Athens.

7.	Courtyard planning	This planning at tropical climate has the potential to save up to 25% power consumption.

CHAPTER 3

CASE STUDY

3.1 THE BRITISH SCHOOL, New Delhi

3.1.1 Site Plan and Zoning

The ground floor of the structure consists of the primary classroom in which the users are at the age of less than 8, which helps in safety measures. It is provided with facilities such as a swimming pool, medical room, play area, library, etc. Taking inspiration from traditional chaupals (outdoor gathering spaces) in India, some congregation spaces are designed to sit in the shade of mature trees. Protecting old trees, creating bioswales, rain gardens, and a visible rainwater harvesting system consciously illustrate demonstrative sustainability. Care has been taken to protect all existing trees, and the student community has played an active role in the transplantation process.



Fig 3.1 Site plan of the school

3.1.2 Building orientation

Most of the classrooms are on the opposite side of the direct sunlight. The spaces in which the usage is less such as auditorium, swimming pool, etc., are exposed to direct sunlight and have a double skin facade.



Fig 3.2 view of the school

Possible to have more window areas towards the NW and NE facades.

Requires greater care like solar Shading and other strategies

3.1.3 Passive strategies

Double skin façade - The result of using a double skin facade is that the temperature of the inner skin is kept much lower, and less heat is transferred from the building's exterior to its interior. Ultimately, the ventilation properties of a double-skin facade act to keep the building and its occupants cooler and reduce the need to run air conditioning

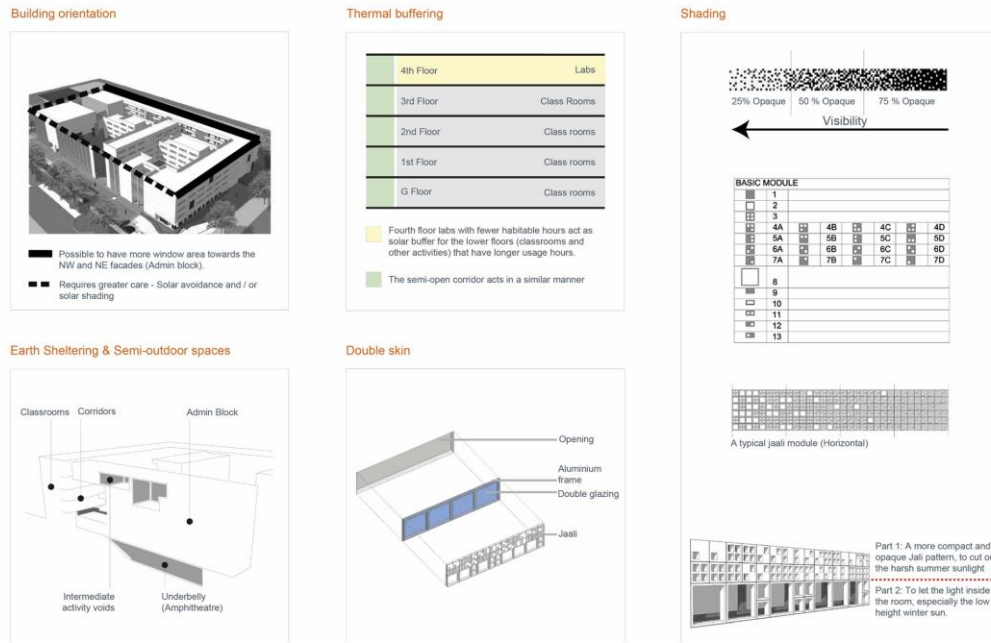


Fig 3.3 Passive design strategies

Thermal Buffering - fourth-floor lab with fewer habitable hours acts as a solar buffer for the lower floors (classrooms and other activities) that have longer usage hours.

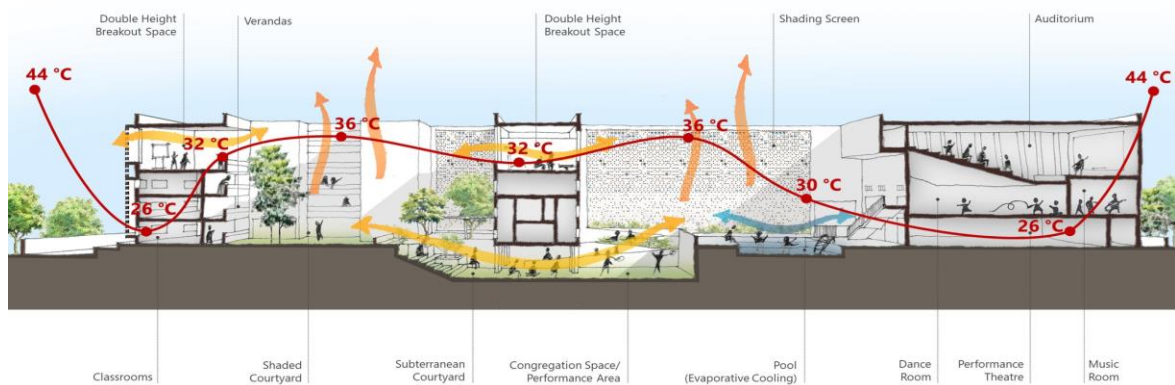


Fig 3.4 Section with the wind flow

The courtyards are designed in a way that the majority of the courtyard space is at shade throughout the year, thus making them effective not only as transition spaces but as extended learning environments. Internal courtyards, chajjas (deep overhangs), and verandahs provide opportunities for students to interact with the environment and nature.

3.2 THE RAJASTHAN SCHOOL, Nagaur

3.2.1 Site Plan and Zoning

The school has multiple entrances to access certain facilities. There is the main entrance, auditorium entrance, entrance for the auditorium green room, and a direct entrance for the admin office. The ground floor consists of facilities such as an auditorium, a Dining area for both the teachers and students, an admin office, and classrooms. The central courtyard acts as circulation between both blocks, and the landscape acts as an interactive space and play area for the students.

FIRST FLOOR - The first floor consists of all the labs, staff room, admin office, library, and other facilities along with the classroom. The entire circulation is through open naturally ventilated corridors traversing & skirting the focal semi-sheltered landscaped court in the center.

SECOND FLOOR - The second floor has only the classrooms and only on the entrance block. Every classroom is faced the northern side, which has a view of the multipurpose playground and the basketball court.

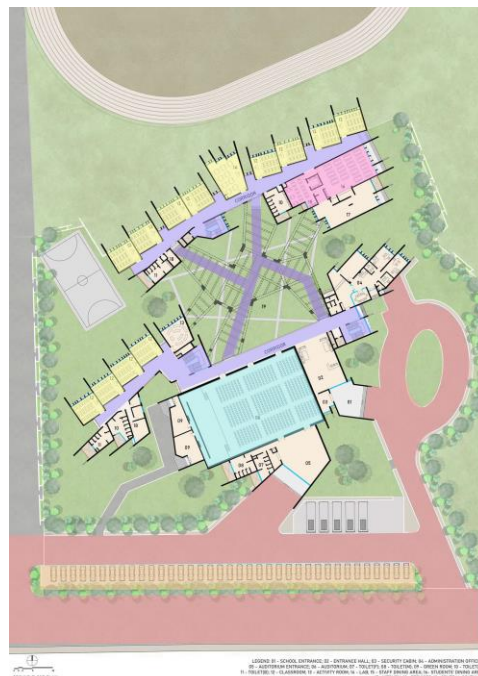


Fig 3.5 Site plan of the school

3.2.2 Building Orientation

Taking cognizance of the desert climate of its location with temperatures in excess of 35°C for most of the year, each of the classrooms is north-oriented to derive indirect sunlight. Space is organized around a central courtyard protected by a patio structure consisting of frames and sun-breakers, where you can watch the shadows often change their pattern. In the southern part of the site are distributed auditorium, primary school, and offices, while on the northern side are the secondary school, library, and cafeteria, with a total built-up area of 8,639 square meters.

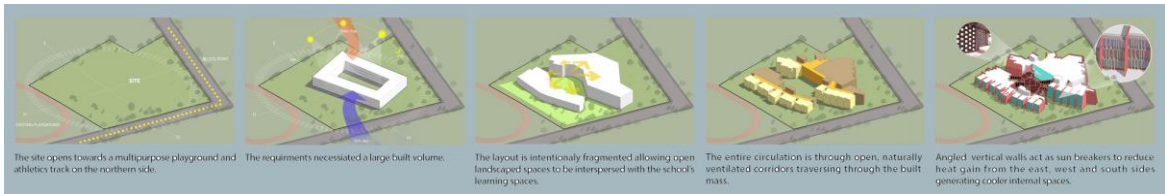


Fig 3.6 design approach

3.2.3 Passive Strategies

These semi-sheltered pathways cross through and skirt around the central courtyard. Angled, protruding vertical walls act as sunshades to reduce the impact of the sun and heat gain from the east, west, and south sides, thereby generating cooler interiors. Apart from these passive design aspects responding to the extreme climate of Rajasthan, the entire electricity needs for the school to operate come from the residual power generated by a cement factory in the vicinity, which is also the client that had the school built. And all the water used in the school is recycled and reused for the landscaped areas. Vertical panels protect the interior spaces from heat. The layout is deliberately fragmented to fit the open, landscaped spaces in between the learning zones, which improves the microclimate and comfort of the users and allows cross ventilation to occur.



Fig 3.7 View of the school

3.3CMR EKYA SCHOOL, Bangalore

3.3.1 Site Plan and Zoning

The ground floor is segregated into two zones - one for the kindergarten, which has its own drop-off and pick-up area, and the second for the administrative facilities, separated from the kindergarten to give the young children the required security and privacy. The rest of the ground floor area is kept open and becomes a part of the play area for students. The school has a play area consisting of a basketball court, volleyball and throw ball courts, two cricket practice pitches, a swimming pool, and a play area for kindergarten, in addition to other double and triple-height covered play areas for the children.

The first floor consists of classrooms, an art room, and a director's room. There are two layers of classrooms planned around the play area, with a corridor becoming a spine connecting the two layers. The corridors and bridges are staggered to have trees and plants and also to bring in light for the lower floors. The amphitheater at the ground floor provides a gradual transition between the ground and the first floor.

The second and third floor has the same floor with only classroom, staff room and laboratory. the corridors are well lit by the skylights

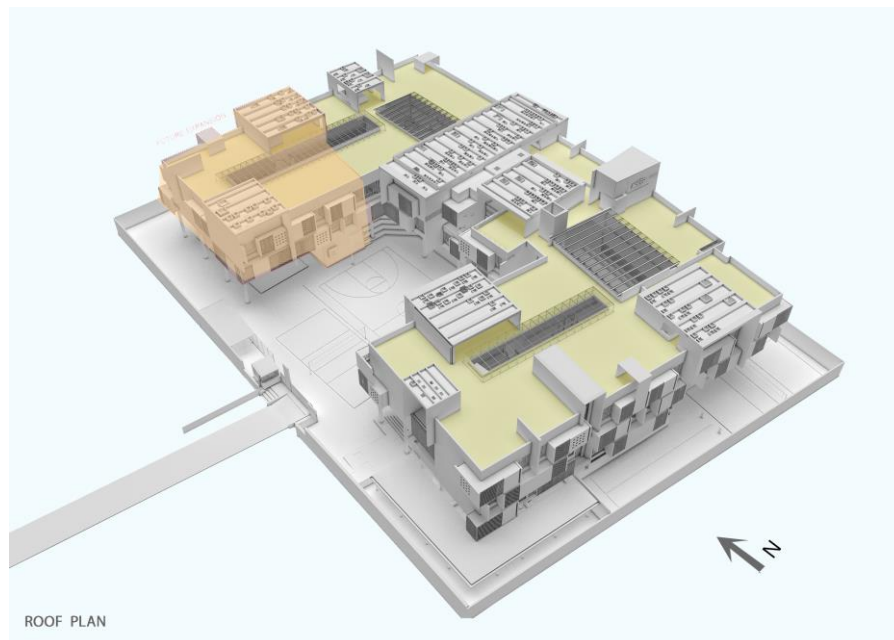


Fig 3.8 Top view of the school

3.3.2 Building Orientation

The structure is faced in the south, west, and north direction, where the southern direct sunlight is blocked by the nearby residential building. The structure itself acts as a shall for the central courtyard, which has a sports facility. The openings are in the windward direction where it provides natural ventilation. Most of the classrooms are at the exterior of the structure, which has visual points and allows diffused sunlight into the classroom.



Fig 3.9 view of the school

3.3.3 Passive Strategies

The predominant wind direction is used in designing the open spaces. The opening oriented in the wind direction brings the air inside to the central court area. Cross ventilation takes place in the classroom, which keeps the classroom cool. There is a play of volume and light along the corridor.



Fig 3.10 Wind Circulation inside class rooms

Wind tunnels are located after every two classrooms, which open into the corridor areas keeping the entire school campus, including all the classrooms, well ventilated and naturally lit, thus reducing energy consumption. The campus is made disabled-friendly by providing ramps and lifts to access all the levels. There are a lot of details in terms of railings, pin-up boards, doors –windows, use of colors specifically developed to deal with different age groups.



Fig3.11 Section with wind circulation

DAYLIGHTING: There are skylights provided into the structure, which provide enough lighting into the corridors. These openings in the roof also help in natural ventilation. Some of the classrooms are provided with small openings, which limits the direct sunlight and allows wind flow.



Fig 3.12 Section of the school with wind circulation

3.4 Vidhya Mandir, Chennai

3.4.1 Site approach and Orientation

Based on a thorough study on the sun path on the site, the Orientation of the structure is designed to use the sunlight at a particular time at a specific space, and it is also based on the timings of the activity of the student. It is also oriented in the windward direction as the cool air flows at the ground level.

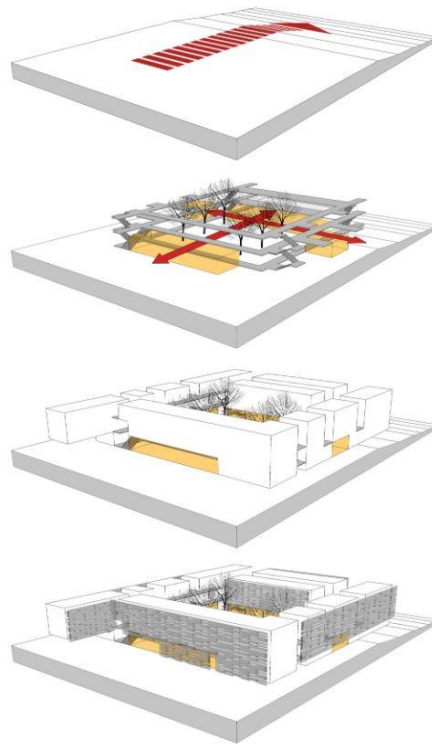


Fig 3.13 Orientation based on the sun path

3.4.2 Walls, roof, and openings

The structure's exterior wall is covered with a precast jaali concrete façade to limit the solar radiation into the corridor and classroom. These concrete facades are facing the south side as it has the maximum amount of solar radiation. The roofs are insulated with the standard insulation material. The classrooms have large opening windows for ventilation.



Fig.3.14 Perforated double skin facade

3.4.3 Natural ventilation and Daylighting

The structure has a large open courtyard at the center, which provides ventilation at ground level and corridors. The structure has a column-free corridor to have more cross-ventilation. Because of this openness, the corridors and the verandahs, and the central courtyard harness the ambient southern and eastern breeze. The corridors are provided with the skylights, and the wall adjacent to these skylights is provided with an opening at a lintel level where daylighting enters at a certain angle.



Fig. 3.15 Courtyard for ventilation



Fig.3.16 Skylight in the corridors

3.5 FOSHAN MEISHA BILINGUAL SCHOOL, China

3.5.1 Site Factor and Zoning

The "shared corridor" interconnects the "vitality cores" to install a campus roaming system, which sets up a link between the whole college from the lowest point to rooftops via roof platforms and courtyards of all scales. The "vitality cores" in various shapes and spatial preparations are embedded into primary functional areas, breaking the boundary of indoor and outdoor areas as activation points. The "shared corridor" works as the principal circulation space in the campus, which additionally connects the classrooms, dwelling areas, sports activities venues, and landscaped greenery to build a multi-leveled, all-around, and 3-dimensional location for occasions followed utilizing social and casual coaching areas with rich spatial experiences to stimulate the vitality on campus.

The school students can be molded through experiential explorations supplied with the aid of using the lecture room break-time activity terraces, pergola lounge, star-gazing platform, rooftop farm, recreational spaces, and rooftop basketball courts; At the same time, the artwork box, outdoor podium, open-air theater, and the notice board will decorate the social spaces with various enjoyments. Each courtyard has its nature by the character and academic desires of all age groups so that individual students will revel in the wealthy and colorful memories for the duration of the nine long years of campus life.



Fig.3.17 isometric view of campus

3.5.2 Building Orientation

The campus site is an irregularly shaped rectangular site which is located in a north-south direction with the track and field ground on its northeast nook, whereas the teaching blocks are located to the south side. The primary buildings are north-south oriented, and the often-used facilities such as the library, lecture hall, gym, and canteen are scattered on the lowest stage to provide multi-layered outdoor venues covered by traditional classrooms positioned on level two to level five. The multi-themed settlement-type learning and sharing areas are supplied through courtyards to inspire the students to conduct energetic exploration, and the semi-enclosed courtyard forms a visually open corridor. Passive Strategies

Foshan is present in a subtropical area that has a hot and wet climate. The design of the campus draws inspiration from the passive strategies which are celebrated in traditional Lingnan gardens with regards to the ventilation, insulation, rainproof nature, and moisture protection taking the help of spatial forms such as "cold lanes," "patios," "open halls," and "courtyards" to adapt to the climatical situation as well as respond to its regional context.

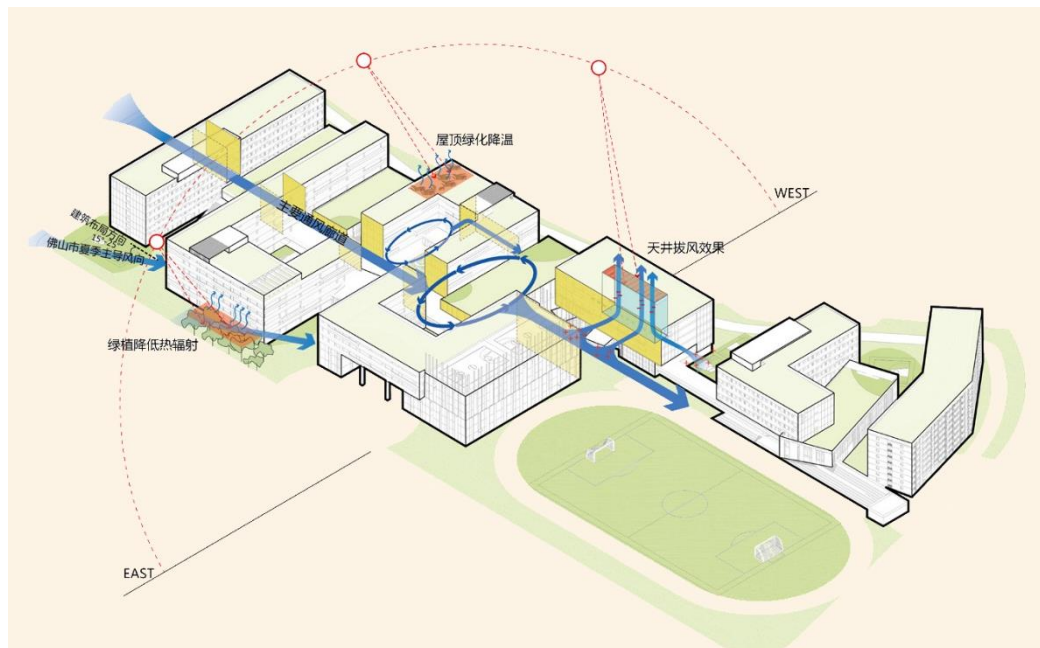


Fig.3.18 Orientation based on the sun path

The architectural layout is planned at an angle of 15-25 degrees with the dominant summer wind in Foshan to ensure good ventilation conditions for the middle school teaching buildings and science building downwind.

On the other hand, the upwind elementary school teaching buildings and the art building manage to ventilate the classrooms by partially elevating the structure, forming ground-floor corridors with devised open halls to utilize the wind pressure principles.

The ventilation sequence of the science building structure is composed of patios, open halls, loggias, and elevated floors, and natural ventilation is achieved through open spaces of different scales complemented by skylights with favourable ventilation properties. The grey spaces formed by overhanging eaves, elevated floors, and arcades can cope with the strong sunlight in southern China, keeping the wind and rain away to create a pleasant space for activities.



Fig 3.19 Corridor view



Fig 3.20 Courtyard space

CASE STUDIES	INFERENCE
THE BRITISH SCHOOL, New Delhi	• The structure has a large open courtyard, which provides ventilation at all floor levels and corridors. • Set on different levels, the staircases and platforms that articulate the courts are both aesthetically pleasing and socially functional • Outdoor spaces have also been designed to make open-air learning feasible in the New Delhi climate. • The perforated façade is used for multiple purposes ,for shade,indirect light,design pattern,wind movement etc.. • The pattern of the perforated walls, the landings running around the courts and the recessed terraces facilitate air circulation through the building and create shaded areas for students to gather. • The double skin facade helps in reducing the heat gain into the structure.
THE RAJASTHAN SCHOOL, Nagaur	• The semi-sheltered courtyard has multiple angular pathways, connecting the two parts of the school with landscaped play zones that stimulate the students to explore their environment and it allows natural ventilation between both the structures. • The corridors aligned along to the wind direction with an opening which ventilates the corridors. • The classroom has glazed windows with a large angled vertical wall which limits amount of light into the structure. • The air conditioned spaces such as auditorium , staff rooms and parking is at the southern side which blocks the sunlight and creates shade into the courtyard and classroom corridors.
CMR EKYA SCHOOL, Bangalore	• As this structure-function during the daytime, daylighting in the design is useful in reducing electric energy. The amount of daylight should be considered based upon space and activities happening in that space. Too much daylighting in a space can create discomfort for the user. • Shading devices has been considered in providing daylighting to limit the amount of light the enters into the structure.

	• Cross ventilation process takes place inside the structure which keeps the space cool.
Vidhya Mandir, Chennai	• With a better study of sun's path spaces can be created in a way that it creates shadows as well as allows light into the structure. • In this design the double skin façade helps a lot in reducing the amount of heat into the structure. • Open spaces are being well utilized for various purposes like assembly or even as play area for kids.
FOSHAN MEISHA BILINGUAL SCHOOL, China	• The overall design is based on climate adaptability, including the use of lanes that emphasize natural ventilation, materials that insulate sunlight and heat, and materials that are rain-proof, moisture-proof and heat-insulated, etc., to reduce energy consumption and achieve the goal of environmental protection. A multi-dimensional learning, living and interactive space is created. • The ventilation structure sequence utilizes the skylights to complement other open spaces of different scales to achieve natural ventilation. The design also emphasizes sustainability by adopting autoclaved lightweight concrete for both wall and roof, which provides good heat insulating to fulfill goal of energy saving.

CHAPTER 4

SITE ANALYSIS

4.1 SITE CONTEXT

SITE LOCATION: Kalavakkam, OMR, Near SSN College, Chennai

LATITUDE:12°45'22.0"N LONGITUDE :80°12'20.4"E



Kalavakkam is a residential neighborhood along the old Mahabalipuram Road (OMR) and is about 5 km from Siruseri it park and 12 km from sholinganallur junction. This site is located at the main of old Mahabalipuram road and its a corner plot where it can be useful for the accessibility of the school.

Why this Site?

There is no residential development till 2009 and less development near to the site under a 2 km radius in 2015. Due to rapid development, good water availability, and excellent road infrastructure with easy accessibility to all parts of Chennai, a lot of apartments and villas have come up in Kelambakkam, and they are below. Also, Kelambakkam has witnessed a lot of family migration in the past few years. Proximity to employment opportunities, good asset appreciation, good road infrastructure, proximity to beaches at ECR, and other entertainment venues continue to attract more residents to this suburb.

These are some of the upcoming residential development

- alliance- humming gardens --- 4km

- Advaita blossom --- 5.6km
- Akshaya today --- 3.5km
- Akshaya January --- 3km
- shanthiniketan atlair --- 5km
- Vijay Shanthi(lotus pond) --- 1km
- Pbel city --- 5km
- Puranvankara --- 6km
- Shobha Merita --- 8km
- Hiranandani Loftline (villa plots). --- 0.5km
- Jagannath orchid ---- 3.5km
- Savithanjali marg properties ltd -- 1.5km

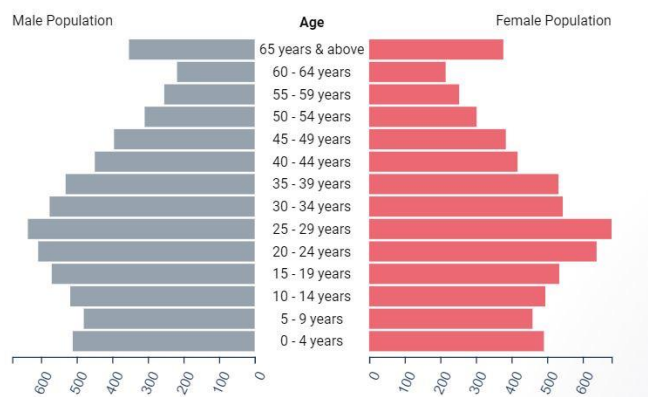
4.2 Neighborhood Context

The site is mostly surrounded by vegetation. The site is just adjacent to the SSN institute, and there are some residential apartments under construction near the site. A new highway is under construction which connects the OMR across Tiruporur to avoid traffic at Tiruporur.

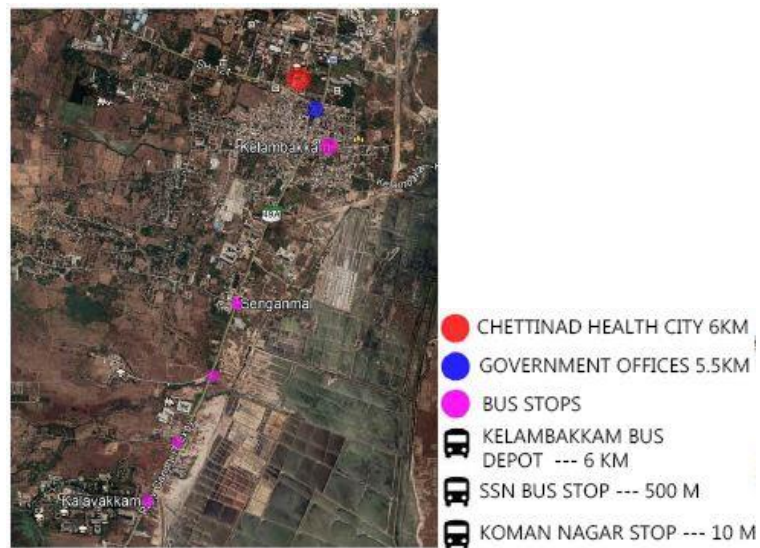
4.3 Demography



Population tree

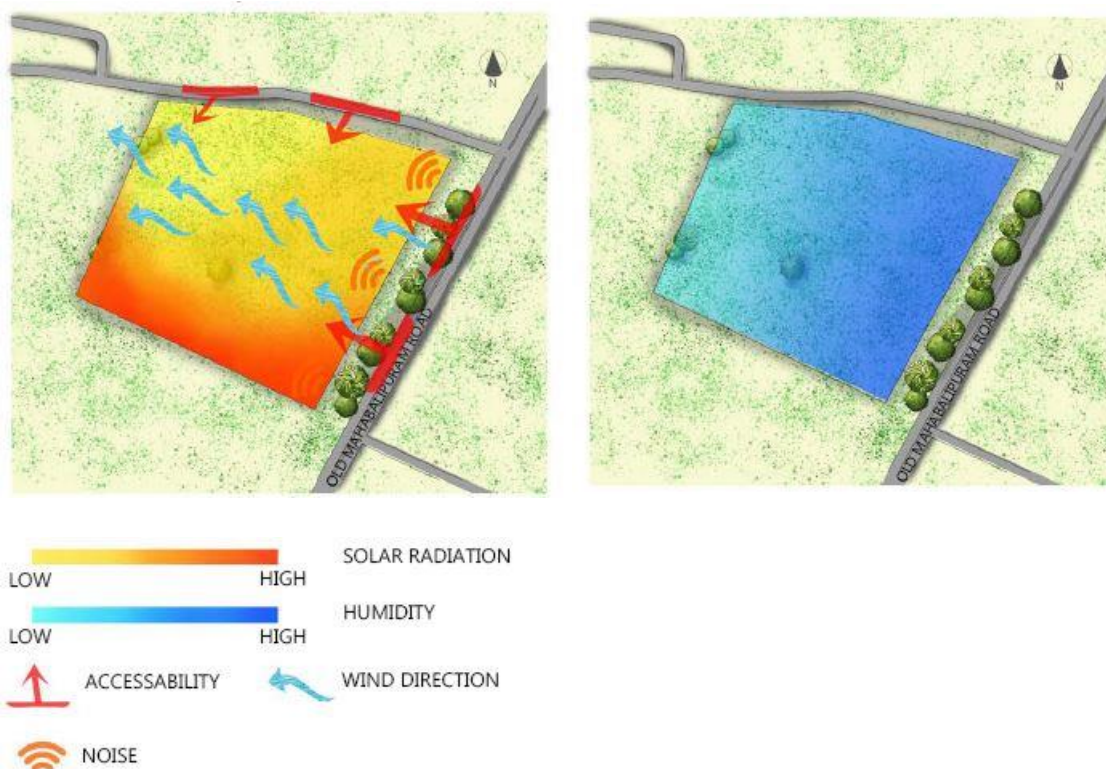


4.4 Proximity and Transport



Kelambakkam bus depot has a bus route to Koyambedu, Vandalloor, Tambaram, Ambattur, Broadway, Thiruvettriur, Saidapet, and T.nagar. Since it's a highway and at the outskirts of town /city there is no much traffic near the site.

4.5 Climatic Factors



Sun path and Solar radiation - The southern side of the site gets a higher amount of solar radiation.

Wind direction - As the site is near the beach, the predominant wind direction is east and southeast.

Accessibility - As it is a corner site, the North and eastern parts of the site can be accessible into the site.

Noise - As the east side of the site is near the highway; vehicular noise comes from that direction

Vegetation - There are trees of height 6m at the frontage of the site and a distance of 27m from the site, so it acts as a buffer for the noise. Based on the climatic factors, the built form and building orientation can be decided.

4.6 SITE VIEWS



CHAPTER 5

AREA STATEMENT

Curriculum of the school - IGCSE(International General Certificate of Secondary Education)

Total No. of Students = 820

Student Staff Ratio = 24:1

Total No. of staff = 35

PROGRAM	STANDARDS MIN.	NO. OF USERS	NO. OF UNITS	UNIT AREA	TOTAL AREA
ADMIN BLOCK					
Reception		2	1	12	12
Waiting Lounge		10	1	40	40
Office	min 45	6	1	50	50
Principal room	min.19	1	1	25	25
Toilet		1	1	5	5
Vice principal room	min. 29	1	1	35	35
Toilet		1	1	5	5
Correspondent room		1	1	35	35
Toilet		1	1	5	5
Directors Office		1	1	40	40
Toilet		1	1	5	5
Guest Room			1	30	30
Conferrance Hall			1	100	100
Medical room	20 to 30 sq.m		1	30	30
Cafeteria			1	100	100
Store room			1	20	20
Common Toilet	4 wc+ 3 handwash		1+1	25 + 25	50
total area					587
KG BLOCK					
Classroom	2 sq.m per student	25	4	50	200
Parents Waiting Space			1	60	60
Activity Room	65 sq.m	50	4	65	260
Play room			2	70	140
Staff Room	1.8 sq.m per teacher	4	1	15	15
Staff toilets	1 male and 1 female	2	1+1	30 + 30	60
Students toilet	4 wc+ 3 handwash		1+1	25 + 25	50
Store room			1	20	20
Play area			1	400	400
total area					1205
Primary and High School Block					
Primary classrooms	1.11 sq.m per student	30	10	35	350
High school classrooms	1.26 sq.m per student	30	14	40	560
Chemistry Lab			2	70	140
Store cum Preparation room			2	20	40
Physics Lab			2	70	140
Store cum Preparation room			2	20	40
Biology Lab			2	70	140
Store cum Preparation room			2	20	40
CSC lab			2	80	160
Server room			2	20	40

Activity Room					
Art Studio			1	100	100
Dance studio			1	100	100
Music Hall			1	100	100
Students Club Room			1	80	80
Exam cell			1	30	30
Meeting hall			1	250	250
HM room			2	20	40
Staff room	1.8 sq.m per teacher	5	7	30	210
Staff toilets	1 male and 1 female	5	1+1	75	150
	7 wc + 8 urinals+ 5				
Boys Toilets	handwash		2	40	80
Girls Toilets	14 wc+ 5 handwash		2	50	100
Toilets for disabled	1 in boys +1 in girls		2	5	10
Store room			2	15	30
Cleaners room			2	20	40
total area					2970
Auditorium					
Auditorium	700 seats		1	850	850
Reception			1	20	20
Waiting area			1	60	60
	9 wc + 10 urinals+ 5				
Mens Toilets	handwash		1	55	55
Ladies Toilet	20 wc+ 5 handwash		1	65	65
total area					1050
Cafeteria					
Students Dining Space			1	350	350
Teachers Dining space			1	100	100
Kitchen			1	40	40
Storage			1	20	20
HandWash			1	20	20
total area					530
Library					
Recepotion			1	20	20
Librarian Room			1	20	20
printing area			1	30	30
seating space			1	250	250
digital library			1	100	100
toilets	4 wc+ 3 handwash		2	30	60
total area					480
Dormitory					
Lobby			2	20	40
Dorms			2	1000	2000
Warden Room			2	40	80
Digital Library			2	65	130
Storage			2	20	40
Toilets			4	100	400
total area					2690

Outdoor Space				
Multi purpose playground		1	10000	10000
Seating Space at Playground		1	600	600
total area				10600
Parking				
car parking	25 sq.m per car	30	25	750
bike parking	3 sq.m per bike	60	3	180
bus parking	60 sq.m per bus	4	60	240
cycle	1.1 sq.m per cycle	250	1.1	275
total area				1445
Circulation 18%				2264 sq.m
total builtup area				10957 sq.m

CHAPTER 6

CONCEPT

6.1 BIOCLIMATIC ARCHITECTURE :

A Sustainable Design Approach in attempt to Connect with Nature while Maintaining Building Comfort based on Local Climate.

Bioclimatic relates to the interconnection between climate and the activities of living organisms, while architecture is the art or practice of designing and constructing buildings.

By merging them to form bioclimatic architecture, it articulates the idea of building design that takes account of its climate and environmental state to aid in attaining favourable thermal and visual comfort of users as it establishes bonds with nature.

6.2 BASIC PRINCIPLES OF A BIOCLIMATIC DESIGN:

A key elements of a bioclimatic design are Passive systems, which run without being over dependent on mechanical equipment.

Passive Production-Minimal Heat Gain	Solar Heat	Passive Cooling Technique - Minimal Heat Loss
It is achieved by, • Appropriate location • Orientation - Protecting from Sun • Design based on Sun path • Presence of trees & landscaping features • Treating the exposed facade - materials absorbing solar heat and radiation		It is achieved by, • Natural ventilation • Night flush cooling • Direct and indirect radiative cooling • Evaporative cooling • Earth coupling • Openings based on wind

6.3 DESIGN PARAMETERS:

6.3.1 DAYLIGHT FACTOR

The openings of the facade as well as the building geometry should be corresponding to the need of daylight inside the building to minimize the use of artificial light.

6.3.2 VENTILATION

Natural ventilation can be implemented as an active part of the design to minimize the energy use for obtaining good thermal conditions indoor.

6.3.3 WIND

Wind turbulence around the building is important to avoid. The shape of the design has to break down the wind to minimize uncomfortable wind at the street level.

6.3.4 THE FAÇADE

The facade of the building should reflect the outdoor environmental as a membrane with adjustable openings. The facade has to respond to very cold winters and hot summers and therefore have to provide both insulation and openness.

6.3.5 SHADING

To avoid overheating the shading of the windows have to be taken into consideration when designing the facade. The shading can prevent overheating in the summer and still allow daylight in the winter.

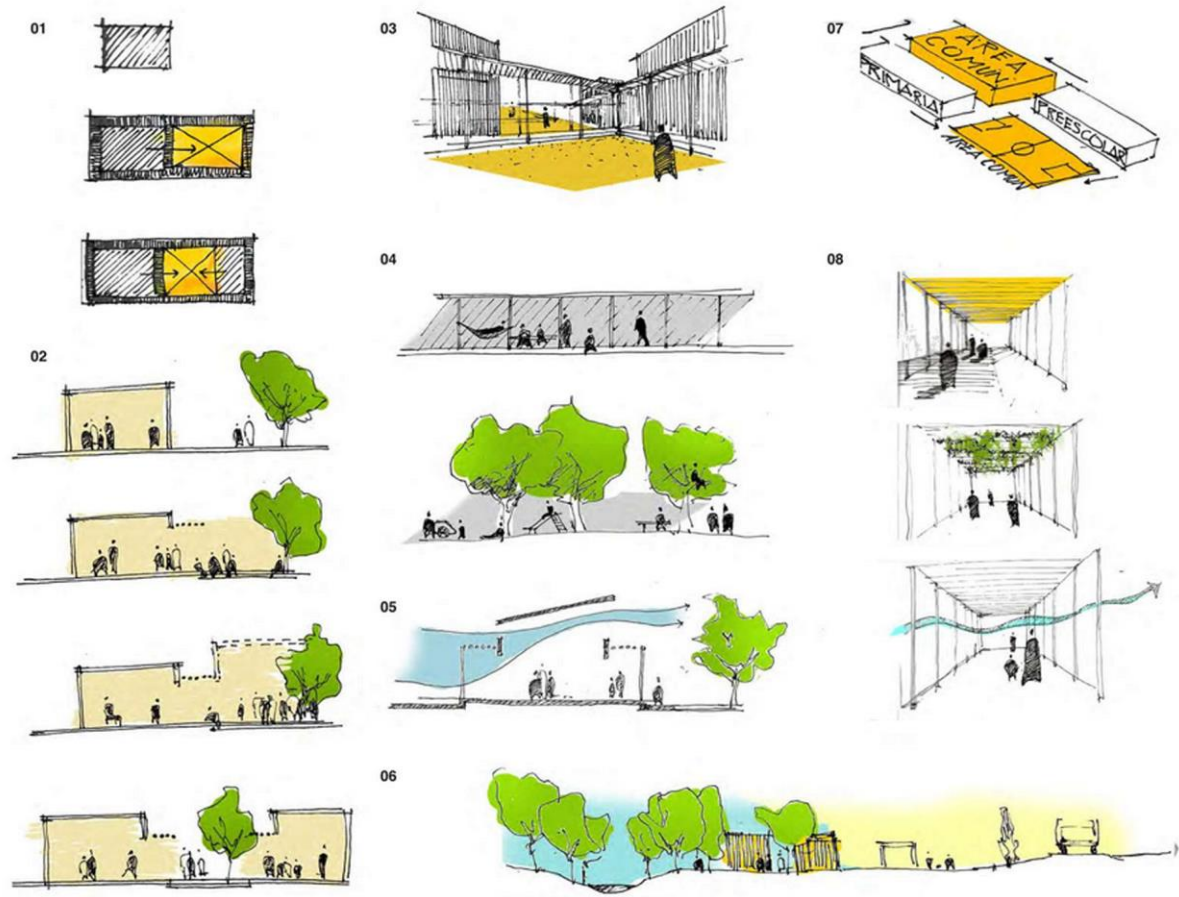
6.3.6 GREENERY

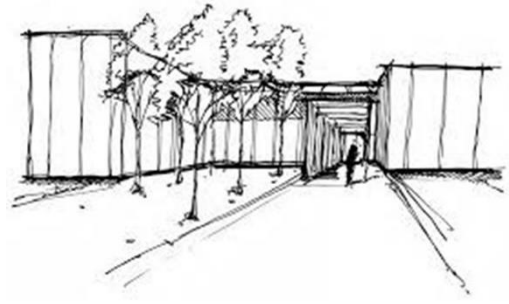
Greenery can be use for their ecological and aesthetic benefit its of the building and also improve the performance of the building and the indoor environments.

6.4 RESPONSE TO HUMAN SENSES TO PROVIDE COMFORT:

	VISUAL COMFORT Visual comfort ability to allow occupants to see clearly for carrying out their daily domestic/official tasks.	NATURALLY By using sun-light, natural winds, evaporation, trees, etc while saving energy.	VISUAL COMFORT Open courtyard, mutual shading, size of opening, light shelves, glare free glass, jali to let in diffused air.
	THERMAL COMFORT Thermal comfort is the ability to keep occupants cool in the summers and warm in the winters.	ARTIFICIALLY By using electric lighting, ACs, etc involving large-scale energy generation leading to pollution and green house gas emissions.	THERMAL COMFORT Orientation of the building, earth air tunnel, water body, chiller beam, canopy, green wall, solar panel, HVAC system.
	OLFACTORY COMFORT Olfactory comfort is the ability of the occupants to detect the odour in the air.	LOCAL CONDITIONS Since local conditions vary from place to place, it gives us lots of flexibility in designing local buildings.	OLFACTORY COMFORT Reduction of carbon dioxide emission, plantation of trees which provides more oxygen, creating green walls in the interior.
	AUDITORY COMFORT Auditory comfort is the ability to allow occupants to respond to sound in the surrounding.	GLOBAL CONDITIONS Which cater to international requirements which may drastically vary from our local conditions, and may require a lot of energy to provide/recreate	AUDITORY COMFORT Spacing between the road and the building, double wall facade, louvers to break sound, material of the building.

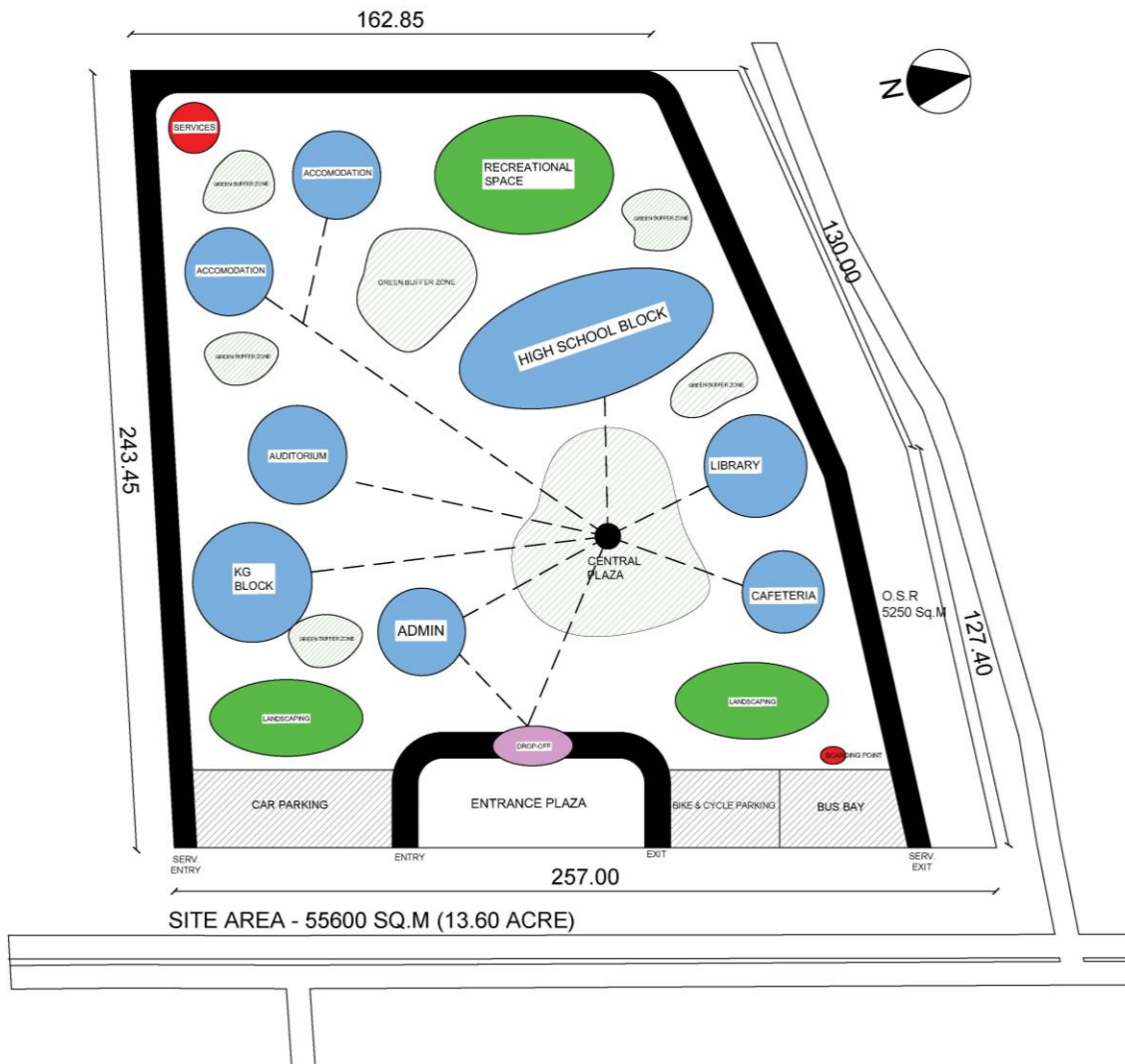
6.5 CONCEPTUAL SKETCHES :





CHAPTER 7

ZONING



CHAPTER 8

DRAWINGS

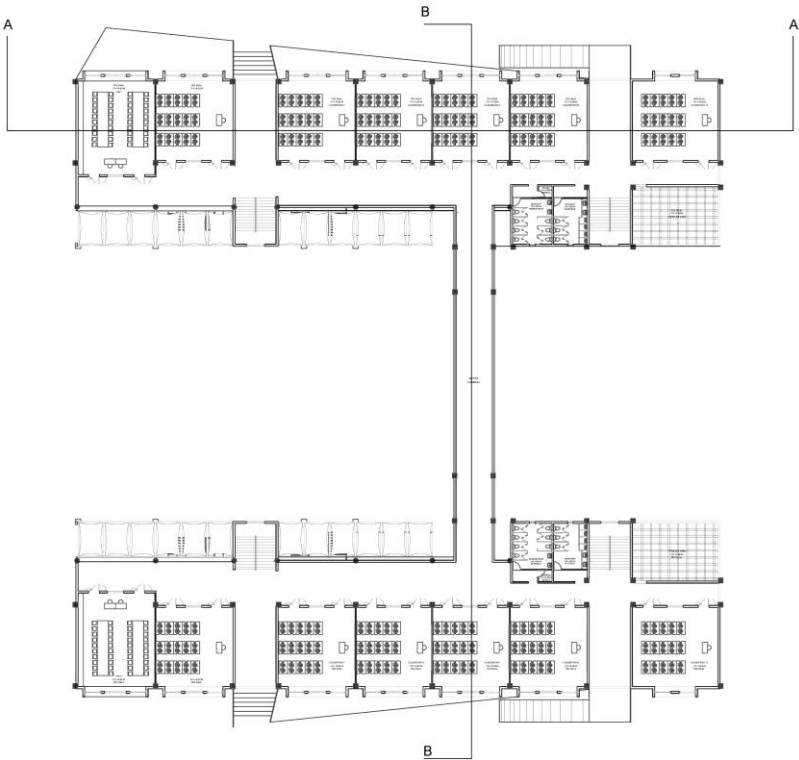
8.1 MASTER PLAN



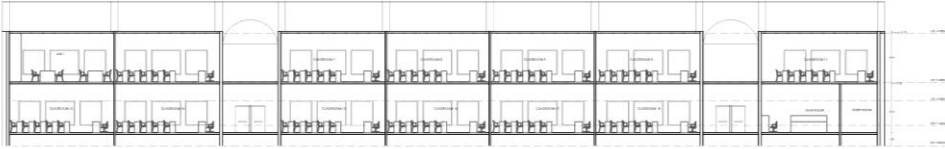
8.2 ACADEMIC BLOCK:
8.2.1 *Ground floor*



8.2.2 *First floor*



8.2.3 Section

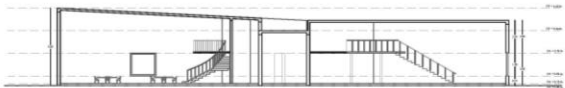
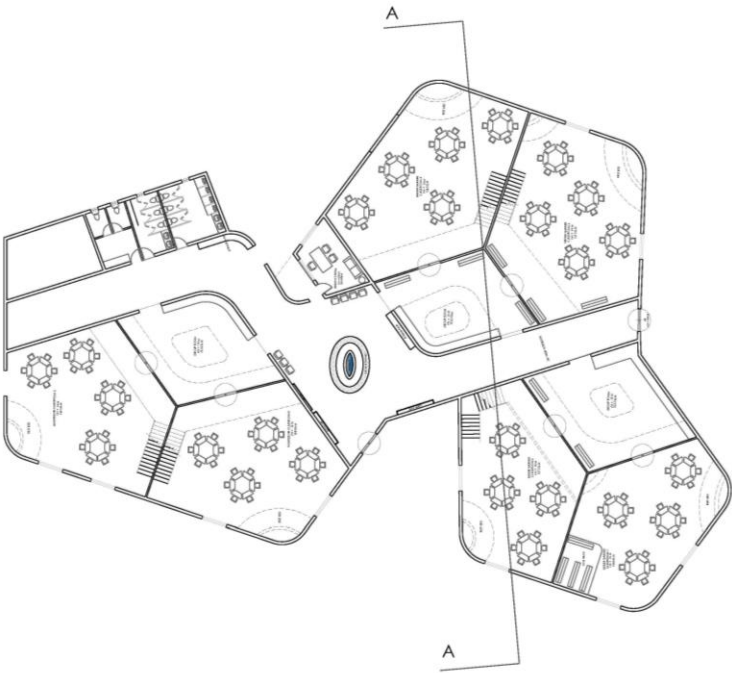


SECTION - A



SECTION - B

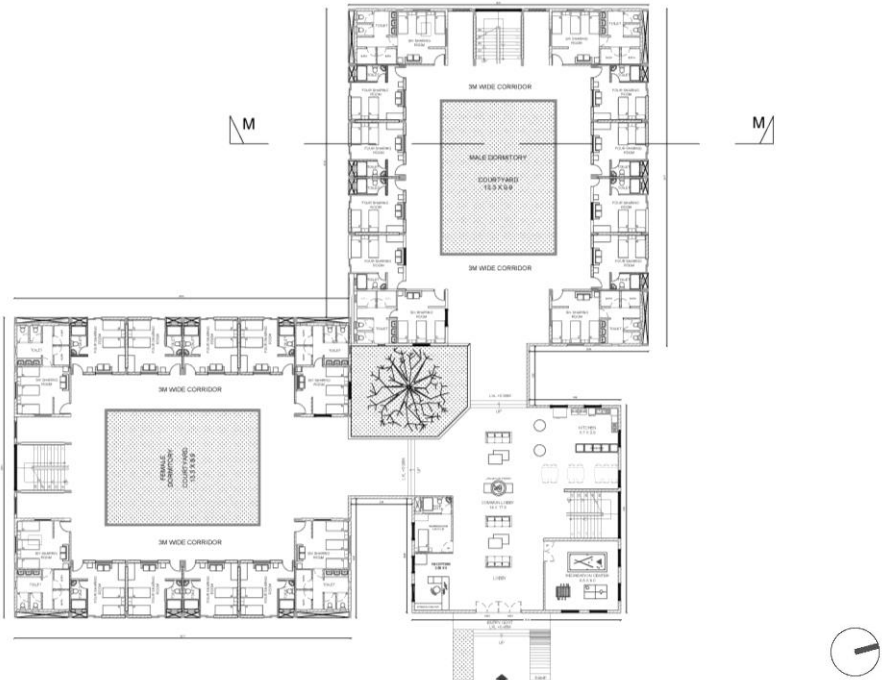
8.3 KINDERGARTEN BLOCK



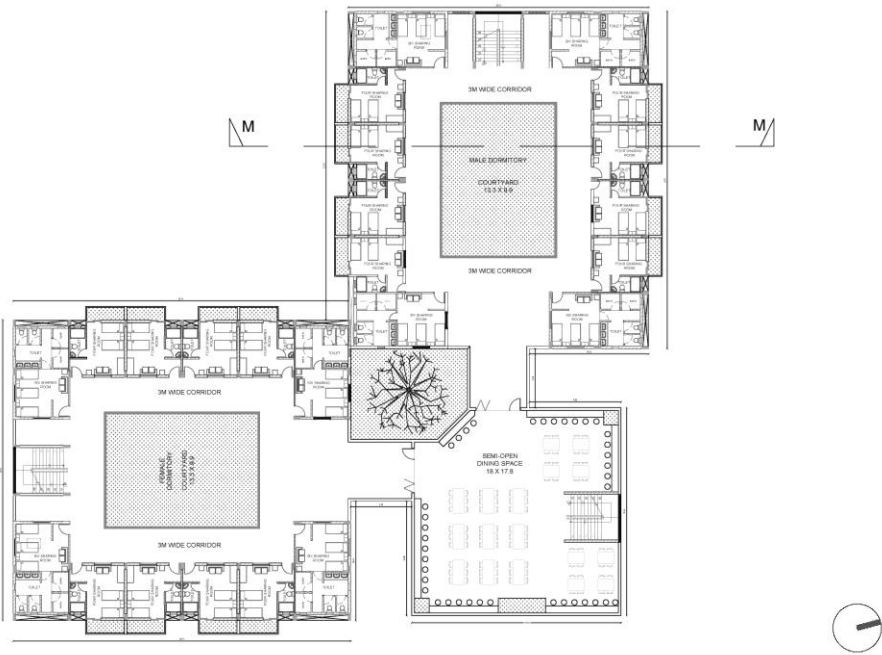
SECTION - A

8.4DORMITORY BLOCK

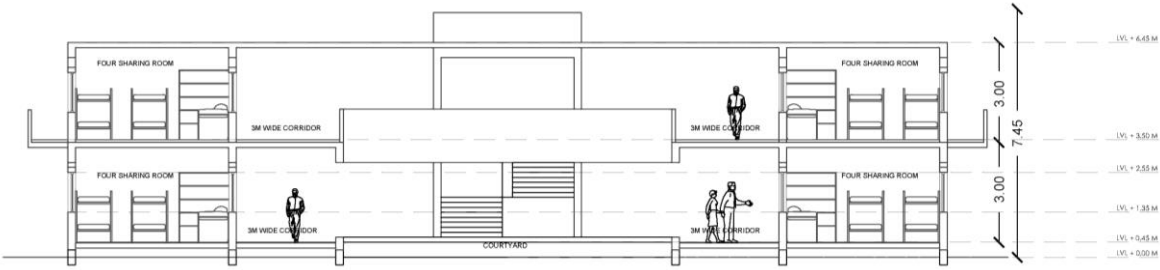
8.4.1 Ground floor



8.4.2 First floor

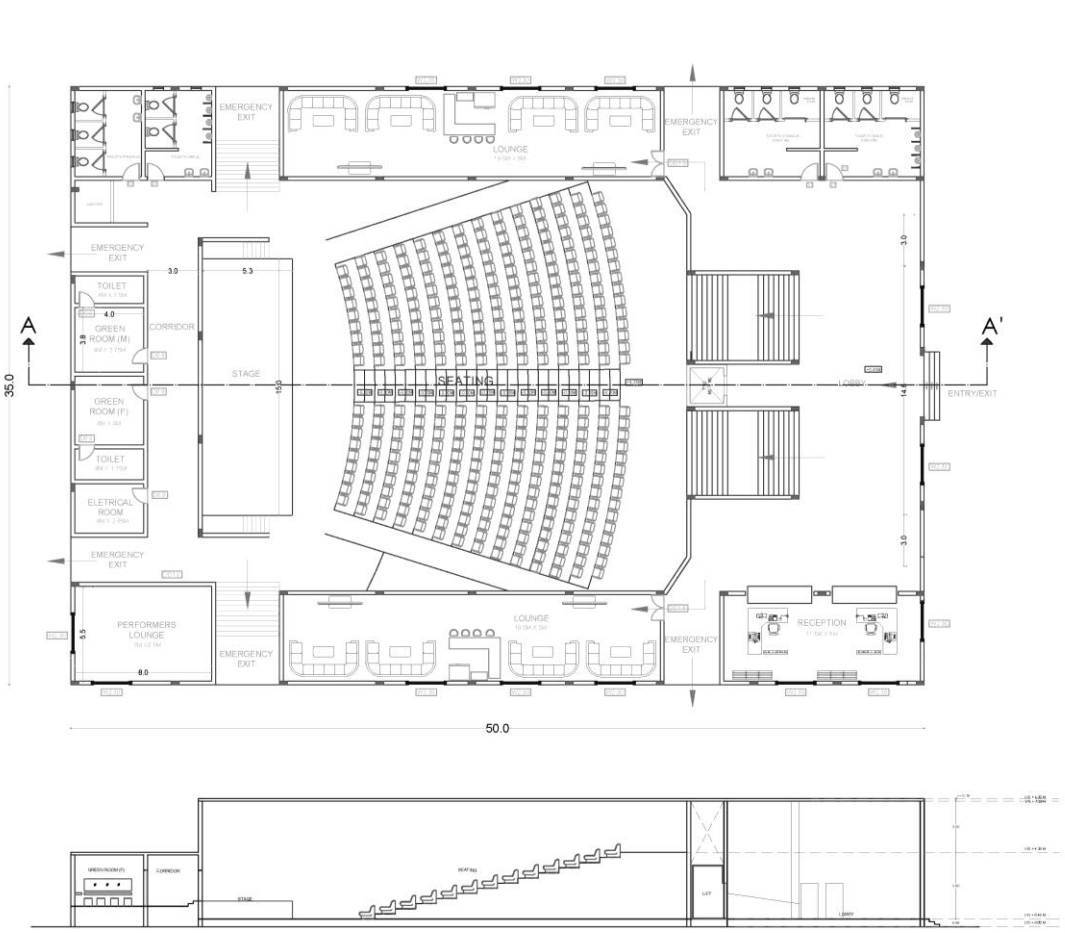


8.4.3 Section



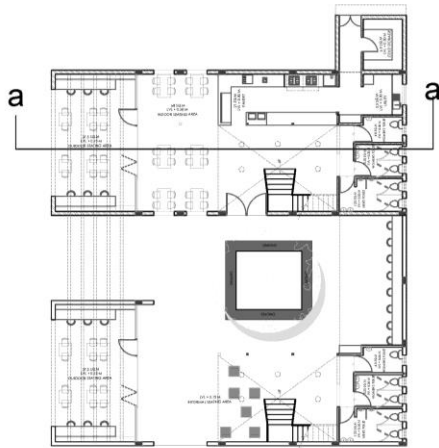
SECTION-MM

8.5 AUDITORIUM

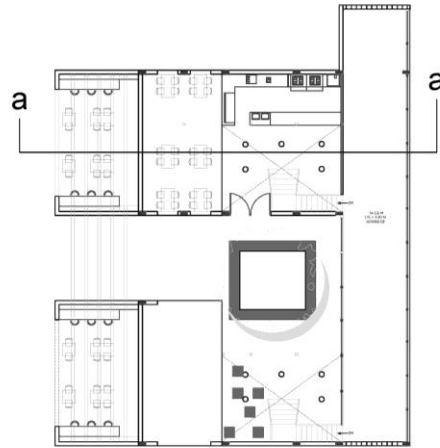


SECTION AA'

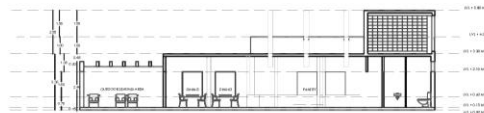
8.6 CAFETERIA



GROUND
FLOOR PLAN

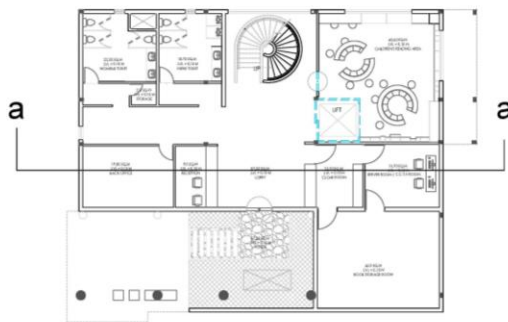


FIRST
FLOOR PLAN

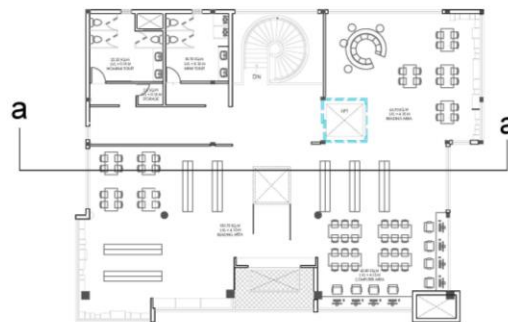


SECTION A

8.7 LIBRARY



GROUND FLOOR

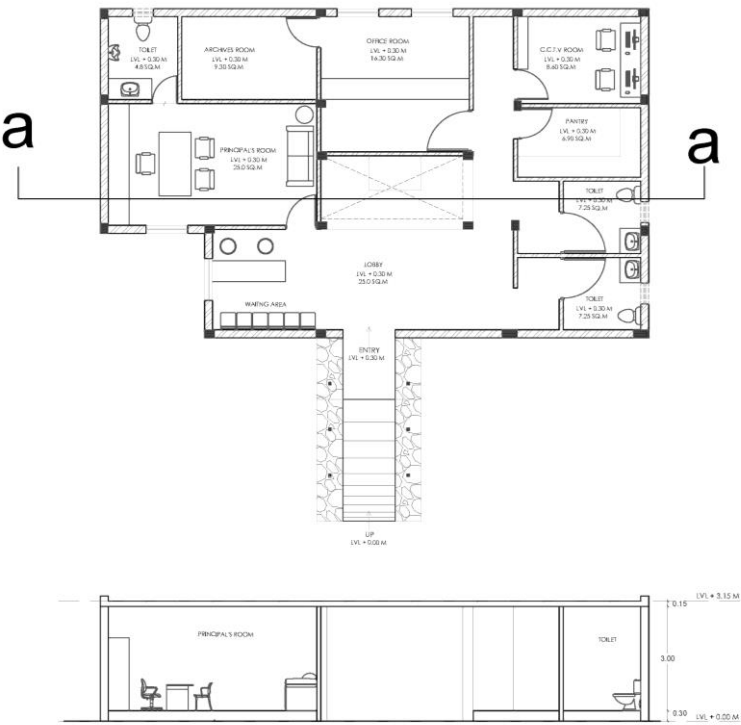


FIRST FLOOR



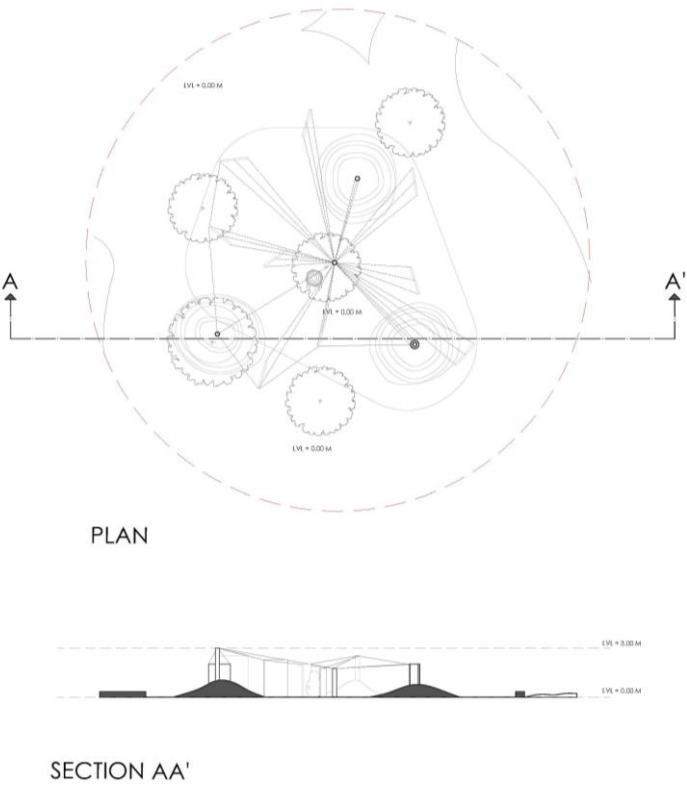
SECTION - A

8.8ADMIN BLOCK



SECTION-A (ADMIN)

8.9PAVILLION



SECTION AA'

