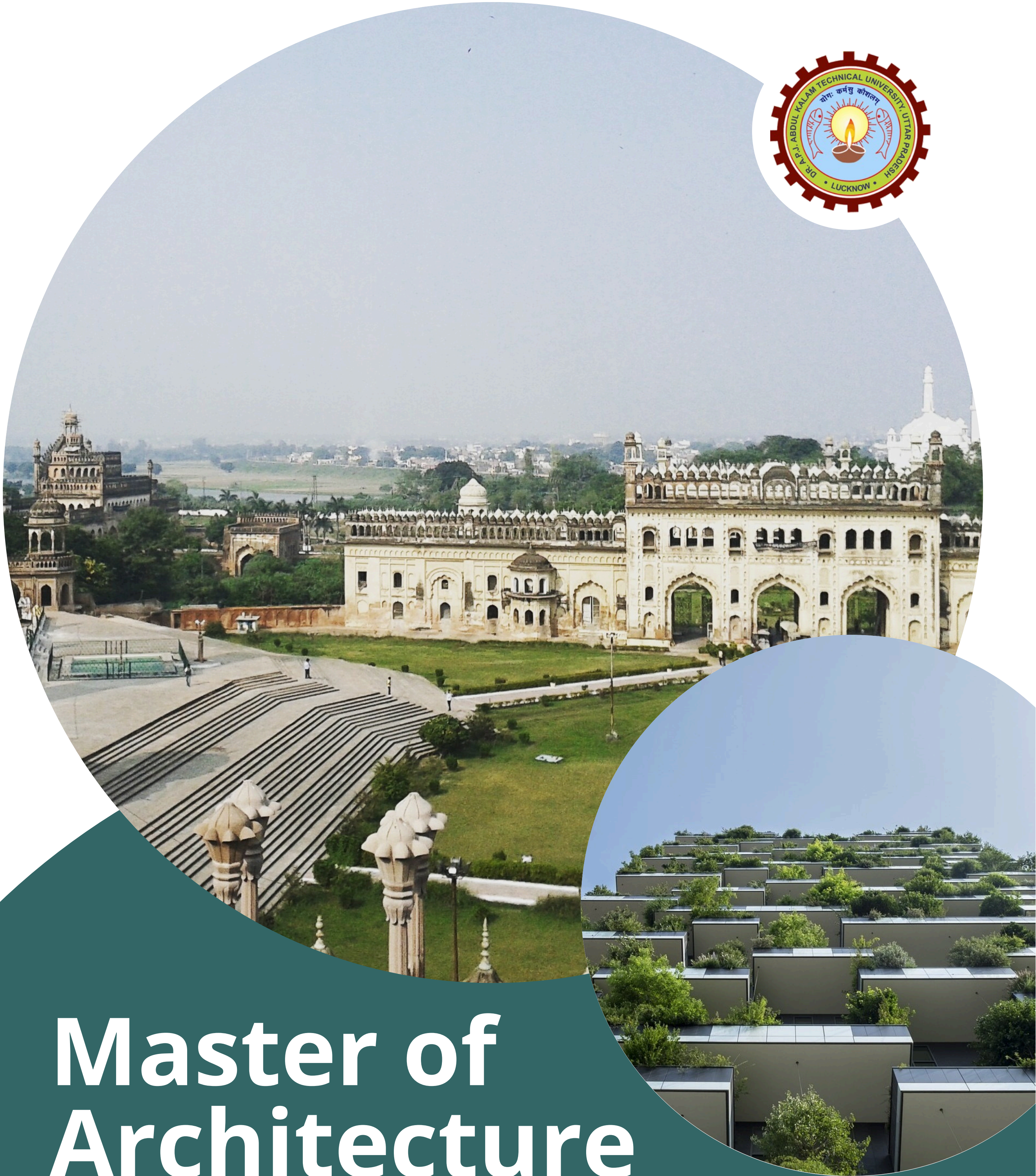


Master of Architecture Environmental Design

Faculty of Architecture and Planning
Tagore Marg, Lucknow, Uttar Pradesh -226007

2022-2024

MENTORS

The Team

Dr Vandana Sehgal
Dean / Principal

Sr. Asst. Prof. Dr Farheen Bano
(Specialized in Energy Efficiency and Sustainable Architecture)
Coordinator

Asst. Prof. Akshay Gupta
(Specialized in Energy Efficiency and Sustainable Architecture)
Co-Coordinator

CORE FACULTY

Dr Ritu Gulati
(Specialized in Building Services)
Professor, Head of Department

Ishwar Chandra Vidya Sagar
(Specialized in Building Services)
Sr. Assistant Professor

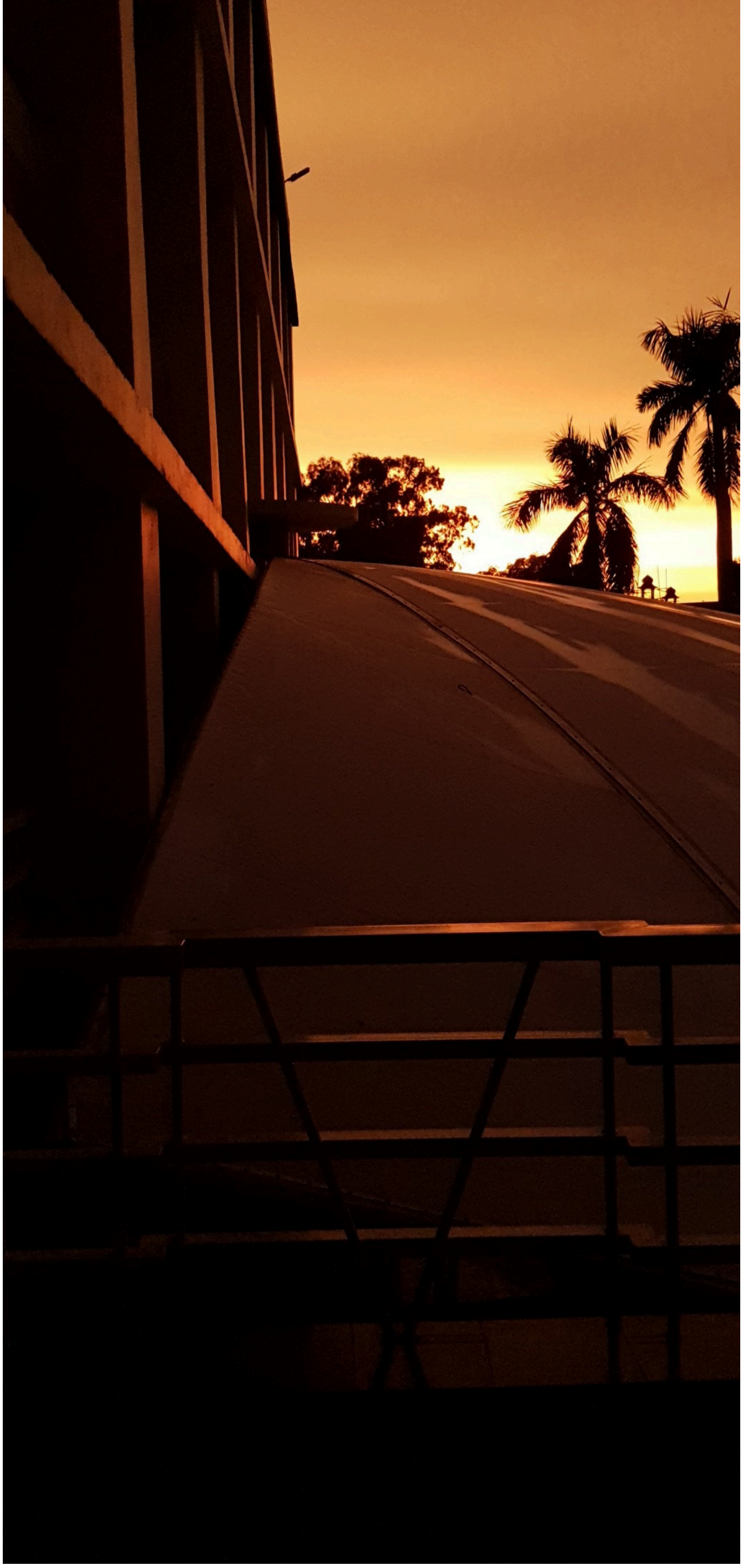
Shadab Saifi
(Environmental Planner)
Assistant Professor

Julia Simlai
(Specialized in Environmental Science)

Oorvi Singh
(Specialized in Landscape architecture)
Assistant Professor

Ar. Arundhatee Mishra
(Planner)
Assistant Professor

Ar. Mohd. Aamir
(Specialized in Energy efficiency)
Research Scholar



CONTENT & COMPILATION

Asst. Prof. Akshay Gupta
Ar. Anugrah Singh
Ar. Sachin Sagar

STUDENTS

Aditi
Anant
Anushtha
Shashank

Faculty of Architecture and Planning
Tagore Marg, Lucknow, Uttar Pradesh 226007

Preamble

The Master of Architecture course in Environmental Design establishes cohesive relations amongst architecture, technology and sustainability, enabling graduates to respond effectively to the growing environmental challenges faced by the building industry and planet Earth.

This program offers an opportunity to expand students knowledge base for developing solutions for the environmental sustainability of the built environment, grounded in rigorous scientific research and analysis with a multidisciplinary approach to understanding issues related to energy efficiency and traditional wisdom of the built environment.

Aim

The FoAP, AKTU aims to play a key role in preparing future decision-makers to meet sustainable development challenges by offering this specialized course. The aim is to develop skills, knowledge and understanding related to environmental sustainability, construction and building technology, adopting the principles and practices of sustainable building design while responding to environmental challenges such as Climate change, environmental degradation, Pandemic, etc.

Message from the Coordinator

As we navigate an era of unprecedented environmental challenges, the demand for skilled professionals in sustainable design and environmental management has never been more critical. Our Master of Architecture in Environmental Design program at the Faculty of Architecture and Planning, AKTU, is dedicated to cultivating top-tier talent equipped with the expertise and ingenuity to address these pressing issues head-on. Our graduates are meticulously trained in cutting-edge environmental strategies, energy-efficient design principles, and innovative solutions for a sustainable built environment. By partnering with us, you gain access to a pool of highly qualified individuals poised to make meaningful contributions to your organization's sustainability initiatives. Together, let's build a greener, more resilient future. We invite you to join hands with us in shaping the next generation of environmental leaders.

Dr. Farheen Bano
Assistant Professor
(Env. Design
Course Coordinator)

Student profiles

Anant Pandey
Architect| Aligarh-UP

Qualification: B. Arch - Amity University, Lucknow 2015

Work Experience: 7 years in Architectural Practice-Aligarh smart city.

Internship Experience: Indian Institute of Sustainable Development [IISD | CMI] Research intern- Heat Mapping Survey for Ayodhya under VITO NY, Belgium

Contact: 7417430280
Email: ar.anantpandey@outlook.in
Area of interest: sustainability, environmental physics, GIS, waste management

Aditi Shrivastava
Architect | Lucknow-UP

Qualification: B.Arch-- Institute of Architecture and Town Planning, Jhansi 2017

Work Experience: 5 years Architectural practice

Internship Experience:
Research intern- Heat Mapping Survey for Ayodhya under VITO NY, Belgium

Contact: 6307792281
Email: archaditisrivastava@gmail.com

Area of interest: Solar passive design, earth bermed structures, green buildings

Shashank Singh
Architect| Lucknow-UP

Qualification: B.Arch-GL Bajaj, Mathura '2020

Work Experience: 2 years

Internship Experience:
Research intern- Heat Mapping Survey for Ayodhya under VITO NY, Belgium

Contact: 9838778814
Email: singhssashu24@gmail.com

Area of interest: Climate Responsive Building, IGBC/GRIHA Rated Building, Climate Resilient Infrastructure, GIS

Anushtha Dwivedi
Architect | Lucknow-UP

Qualification: B.Arch-GL Bajaj, Mathura '2021
Work Experience: 1 year
Internship Experience:
Research intern- Heat Mapping Survey for Ayodhya under VITO NY, Belgium

Contact: 8126114391
Email: arch.anushtha23@gmail.com

Area of interest: Climate Responsive Building, IGBC/GRIHA Rated Building, Climate Resilient Infrastructure, Urban Tree Cover, Urban Heat Island effect

Environmental Design Studio-I (Building Level)

The aim of Design Studio is to introduce the students to climate and surroundings as an important aspect of environmental design and to understand in depth, the environmental factors affecting human comfort and creation of comfort conditions along with the associated building physics.

Research Techniques and Application

The objective of Research Technique and Application is to formulate a research plan through application of research techniques, data collection, analysis and interpretation and to understand the methods of writing and presenting a research report.

Traditional Wisdom and Sustainability Concepts

The aim of Traditional wisdom and Sustainability Concept is to introduce the culture and knowledge systems of traditional community systems. It facilitate the application of learnings from traditional and vernacular strategies both at micro levels to mitigate the negative impacts of environment. The subject helps to analyse the viability of sustainable tactics in traditional knowledge and apply it in design of contemporary environment.

Environmental Physics and Application

To understand how to apply the basic thermodynamics to the human environment and to comprehend the basic composition, structure and dynamics of the atmosphere, the subject Environment Physics and Application is studied to facilitate the students to explore the working of hydrologic cycle and discuss the mechanisms of water transport in the atmosphere and in the ground and examine specific environmental problems such as noise pollution, ozone depletion and global warming in the context of an overall understanding of the dynamics of the atmosphere.

Environmental Modelling and Computer Applications

Environmental Modelling and Computer Applications introduces and gives an overview of methods for environmental modelling and its purpose. It imparts knowledge and experience in model construction and its evaluation. Training of software simulation tools for energy efficiency, noise, acoustic, air quality, fire, etc.

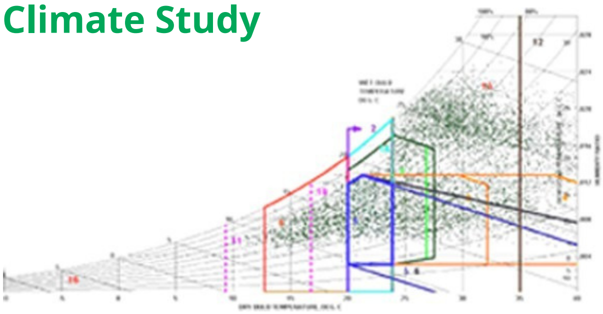
Elective

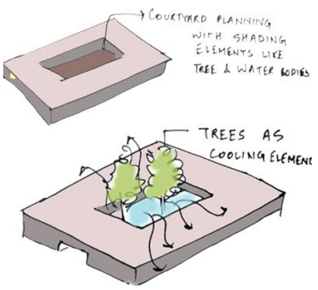
Facade design for Environment Responsiveness / Biommicry & Miomimetics / Landscape Design for Suitable Environment / Pollution Monitoring & Control / Sustainable Building Materials & Technologies

ENERGY EFFICIENT HOUSING

The aim was to design an energy efficient apartment building and to achieve thermal comfort in the building within a given climate context through understanding of passive architectural features in order to reduce the need for active energy

Climate Study



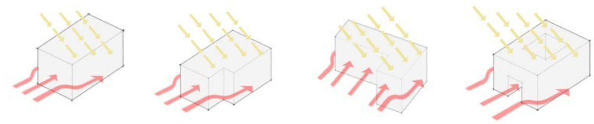


Charts show that Jan to Feb requires radiation at night while June to Oct require air circulation throughout the day. The Altitude angle has been used to identify the angle and length of overhangs and verticle fins.

Design Intent

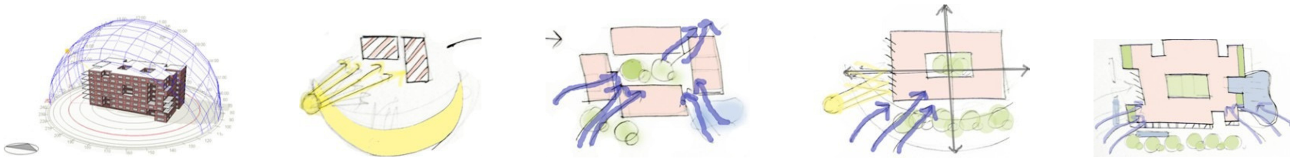
The studio works through an understanding of passive architectural features and material studies. This will be further strengthened through climate analysis and thermal simulation software, to resolve efficient spaces and building envelopes.

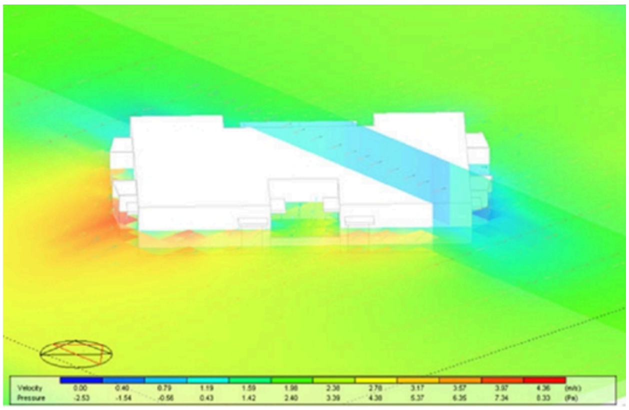
Concept and Strategies



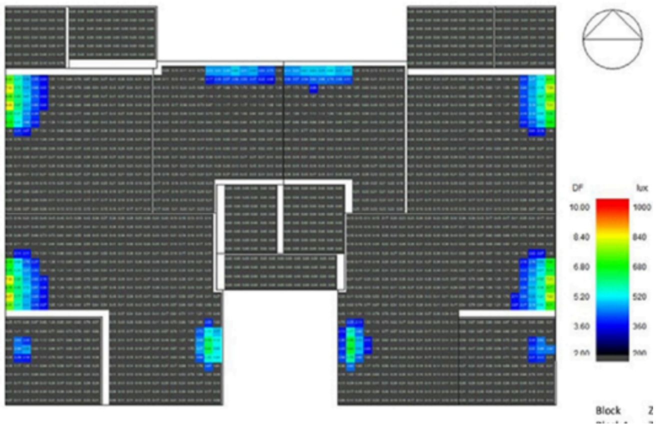
A compact shape and form of the building is recommended in hot and dry climate to reduce the direct solar radiations and increase the thermal mass.

BUILDING FORM AND SIMULATION ANALYSIS

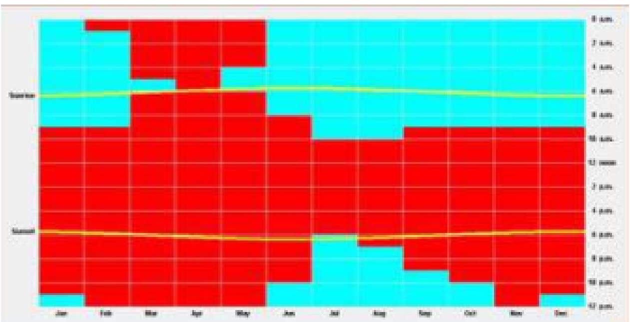


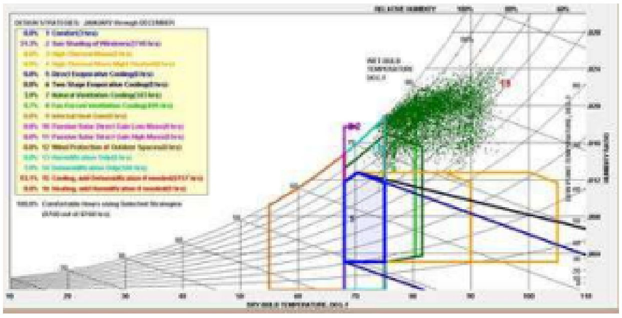


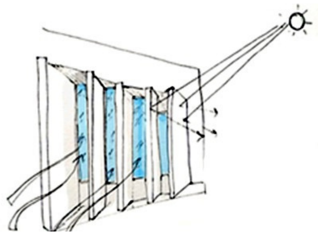
Daylight simulation was done using Designbuilder. The ideal amount of daylight between 150 lux to 700 lux is reduced indoors. Placement of balconies reduces amount of direct solar radiation entering the building.



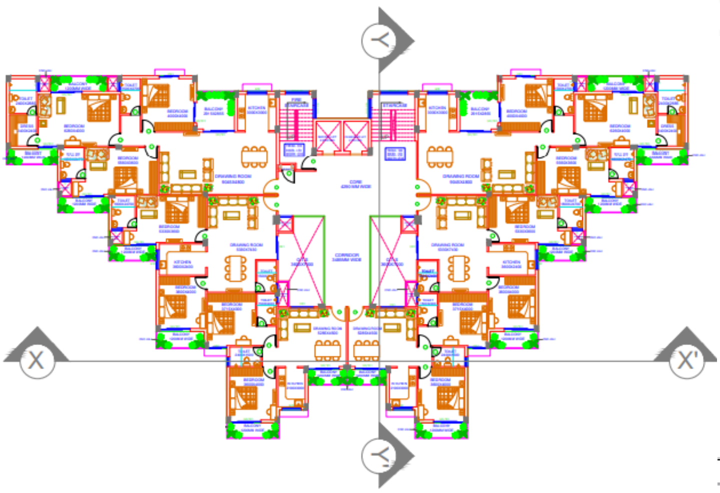
ENERGY EFFICIENT HOUSING, Varanasi







Vertical fins have been designed with the help of calculated VSA for west side elevation.

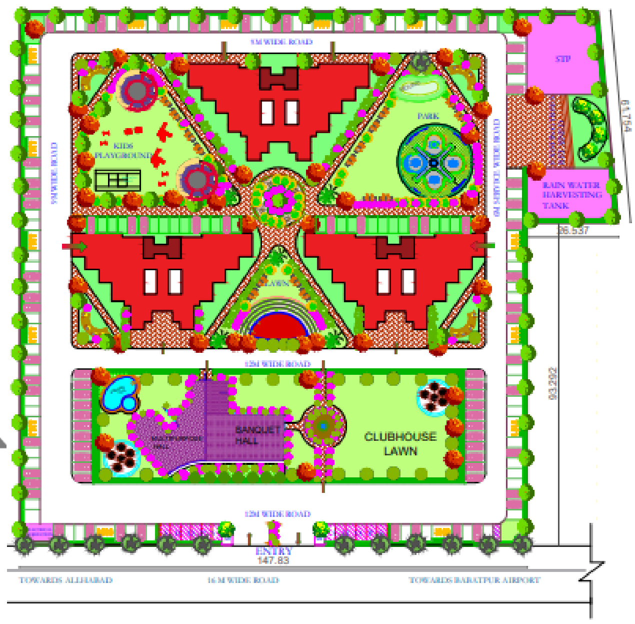


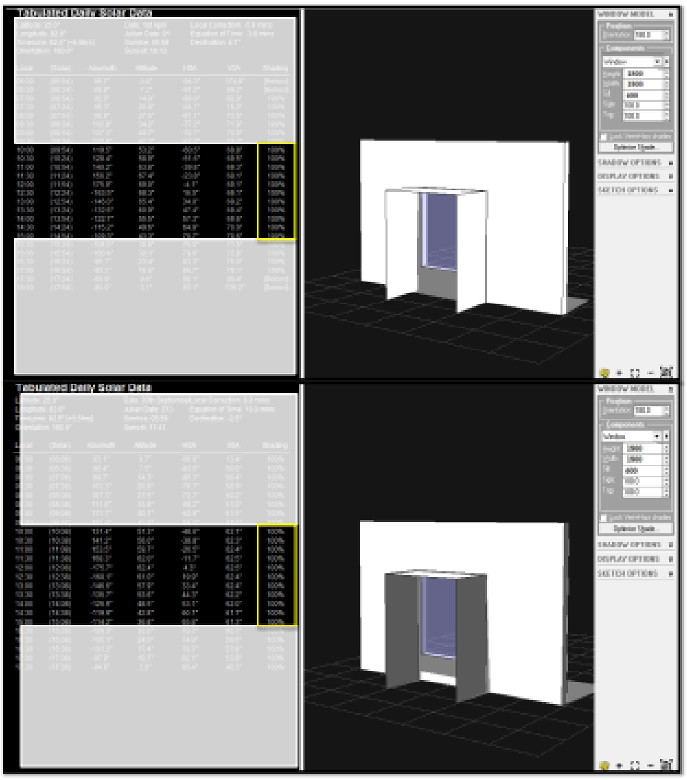
Climate Responsive Buildings

- The main objective to design this hotel was to reduce the overall impact of built environment on human health and natural environment by in depth climate analysis of the site and by designing a building envelope that provide thermal comfort and ventilation inside the building.
- Assuring the visitor's well - being while also striving to be in harmony with nature,
- A detailed climated study was conducted with daylighting analysis.

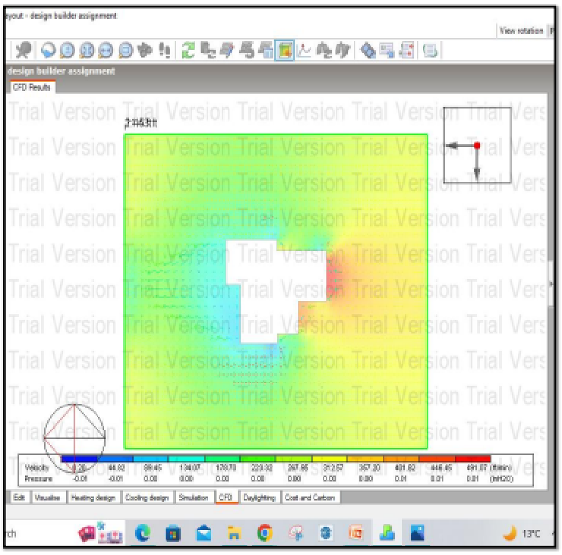
Objectives

- To apply the design principles for green building and energy efficiency in buildings.
- Follow the rating systems, IGBC, GRIHA, standards NBC 2016, codes ECBC and byelaws while designing Green building.
- Study and the application of environmental design solution at building level covering aspects of energy efficiency through passive and active techniques, resource conservation, use of renewable energy, innovation in design, etc.





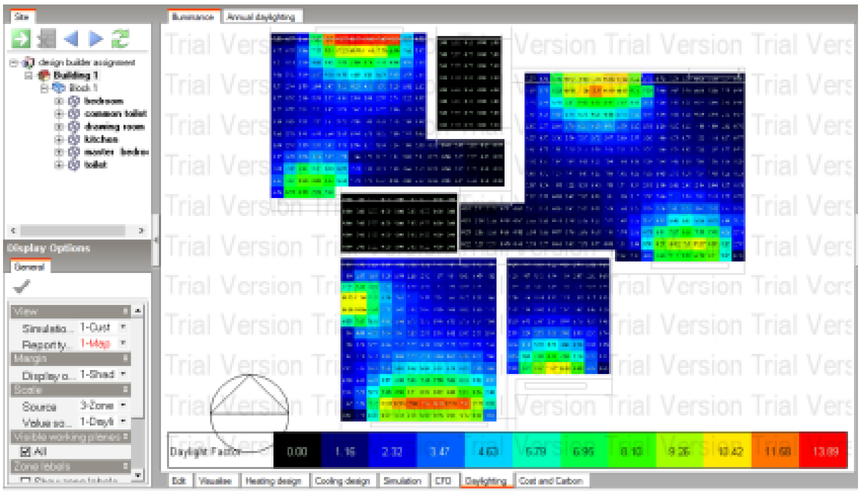
Sun tool was used to design horizontal and vertical shading devices to shade the windows between 0900 hours on March 15 to 1500 hours on September 15 as per GRIHA to minimize heat gain.

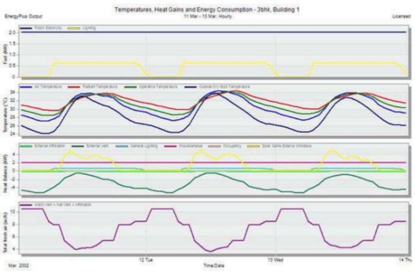


Sun tool was used to design horizontal and vertical shading devices to shade the windows between 0900 hours on March 15 to 1500 hours on September 15 as per GRIHA to minimize heat gain.

Daylight simulation done on Designbuilder.

Natural ventilation and CFD simulation for wind movement.



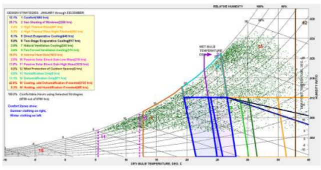


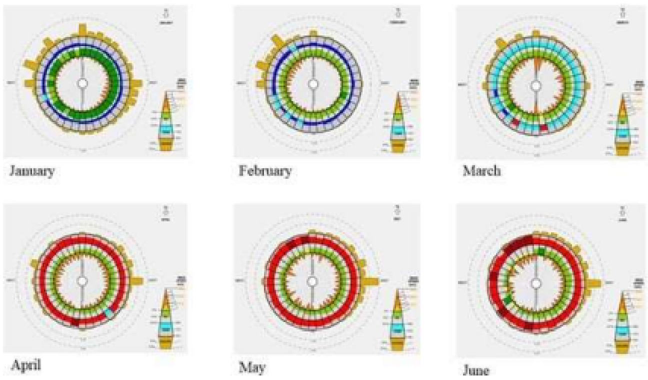
Illuminance | Annual daylighting

Block	Zone	Floor Area (I...	Floor Area ...	Floor Area ...	Average Da...	Minimum Da...	
Block 1	common toilet	47.718	0.000	0.000	0.000	0.000	
Block 1	toilet	48.975	0.000	0.000	0.000	0.000	
Block 1	kitchen	90.509	38.466	42.500	2.831	0.806	COMPLIANCE
Block 1	bedroom	179.126	143.941	80.357	4.596	0.508	COMPLIANCE
Block 1	master bed...	202.781	123.861	61.081	3.372	0.166	COMPLIANCE
Block 1	drawing room	295.222	129.483	43.860	2.795	0.205	COMPLIANCE
Total		864.330	435.751	50.415	2.995	0.000	

INSTITUTE CAMPUS

Lucknow, Uttar Pradesh





The project site is located in Lucknow, which was analyzed for its environmental, social, and contextual factors. The site had unique features and challenges that were addressed in the design, while ensuring alignment with GRIHA and IGBC guidelines.

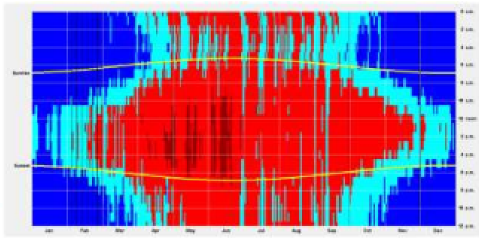
Focus was given on sustainable site planning

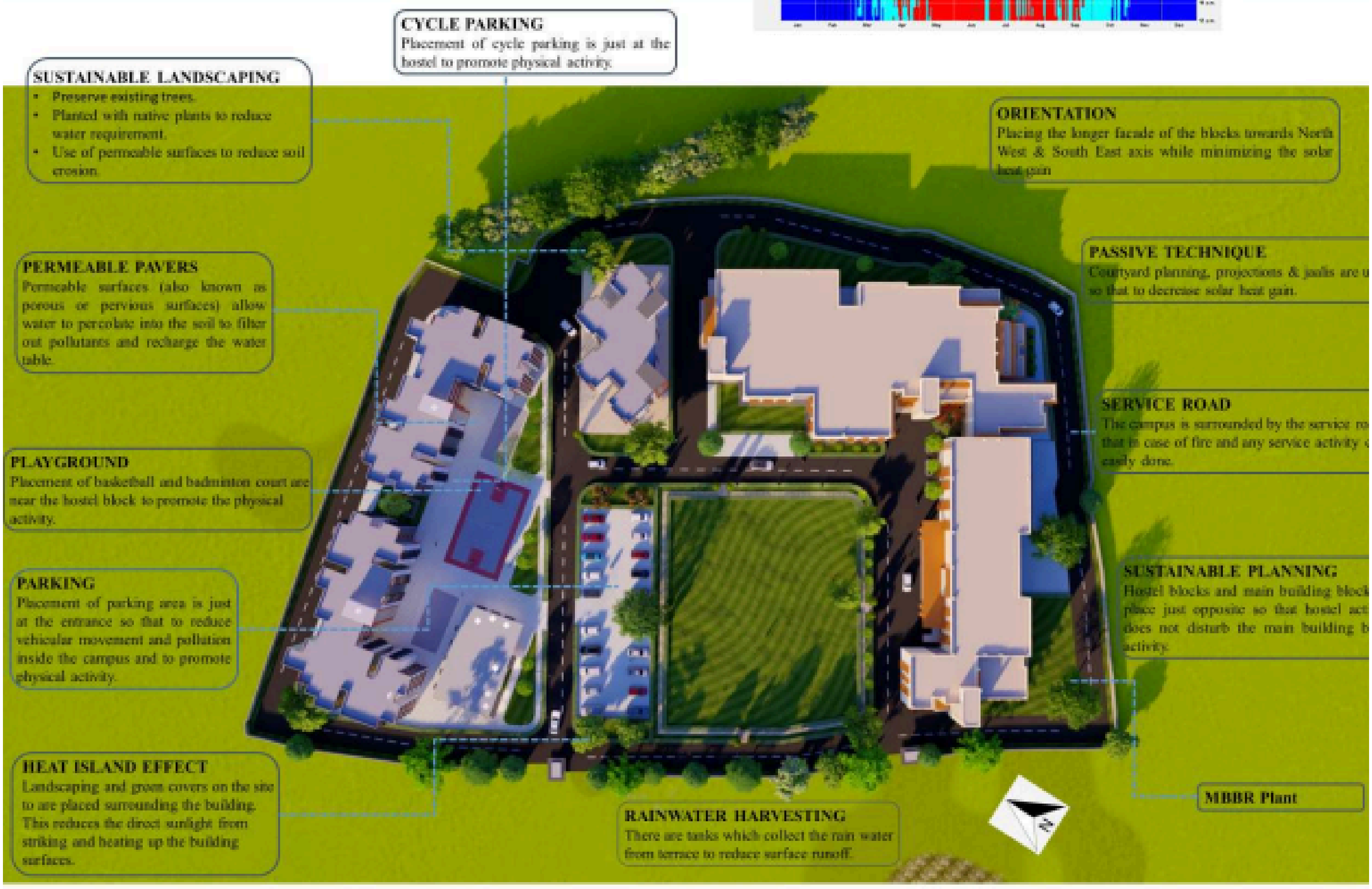
Solid and waste waste management

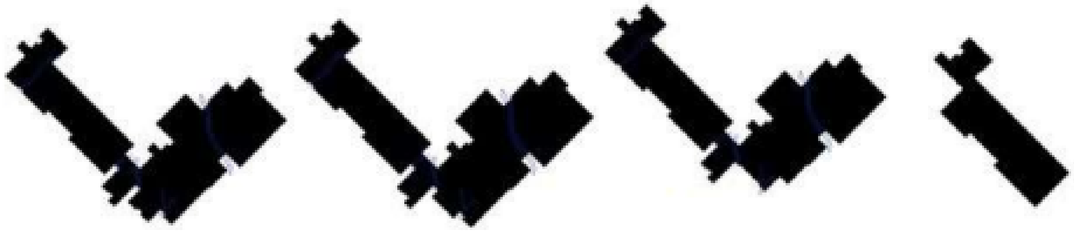
Minimizing urban heat island effect

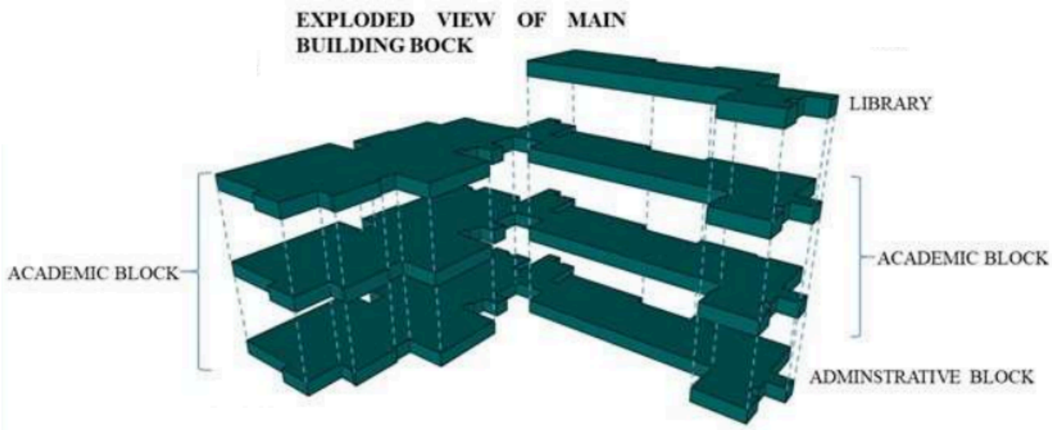
Enabling ground waster recharge

Creating an energy efficient building envelope

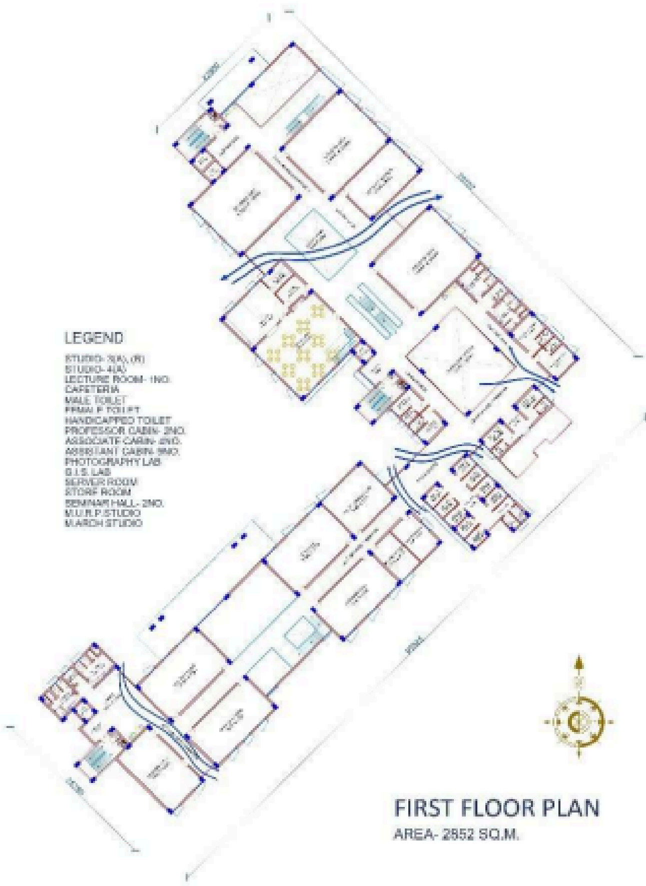







EXPLODED VIEW OF MAIN BUILDING BOCK
LIBRARY
ACADEMIC BLOCK
ACADEMIC BLOCK
ADMINSTRATIVE BLOCK


LEGEND
LECTURE ROOM- 2NO.
EXHIBITION AREA
MALE TOILET
HANDICAPPED TOILET
PROFESSOR CABIN- 2NO.
CONSTRUCTION LAB
VISITING FACULTY
EXAMINATION CELL
SURVEYING LAB
STATIONARY SHOP
RECEPTION/ WAITING LOBBY
OFFICE CELL
PRINCIPAL CABIN+ STENO
CONFERENCE ROOM
GROUND FLOOR PLAN
AREA- 2892 SQ.M.


LEGEND
LECTURE ROOM- 1NO.
CAFETERIA
MALE TOILET
HANDICAPPED TOILET
PROFESSOR CABIN- 2NO.
PHOTOGRAPHY LAB
G.I.S. LAB
SERVER ROOM
STORE ROOM
SEMINAR HALL- 2NO.
M.U.R.P. STUDIO
M.ARCH STUDIO
FIRST FLOOR PLAN
AREA- 2852 SQ.M.

Vertical Louvres

Passive louver shading systems are defined as a series of fixed, horizontal or vertical extensions of a building's façade, used to reflect direct insolation away from a building's interior. A louver shading system affects many of the interior environmental systems of a building, as well as the aesthetic of a building's façade.

Courtyard

Buildings with courtyards have been considered to offer a substantial potential for utilizing passive strategies for indoor thermal comfort. A courtyard is a design element in most of the vernacular buildings and Agreement between building geometry, enclosure, orientation, density of the building context and access to wind flow can carry considerable architectural implications in modifying the microclimate of the courtyards.

Geo-thermal Energy

Geothermal energy utilizes the relatively stable temperature of the earth that is buried and stored a few feet under its surface. Geothermal energy can potentially be harnessed in the front or back yard of your home.

Wind Energy

Using wind catchers is an effective measure to improve indoor air quality in Hot and Arid regions. Wind towers can save the electrical energy used to provide thermal comfort during the warm months of the year, especially during the peak hours.

Models- Passive Techniques

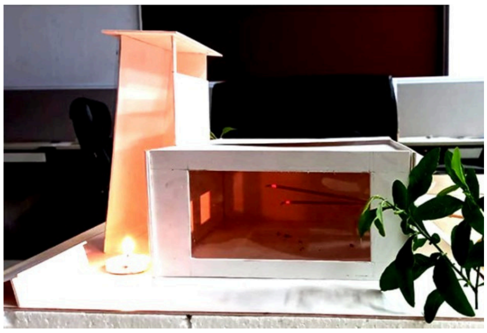
To increase the energy efficiency of a building, a variety of active and passive design strategies can be incorporated.
Active strategies usually consist of heating and cooling systems, while passive design measures include building orientation, air sealing, continuous insulation, windows and daylighting, and designing a building to take advantage of natural ventilation opportunities.

Passive measures find ways to reduce the size of the heating and cooling system by keeping the heat (or cooled air) inside the building, Passive design strategies take advantage of natural energy opportunities as they relate to the location of the building's site, the local climate (and the site's microclimate, if relevant), and the properties of building materials.

Passive design can include consideration of:

- **Location**
- **Landscape**
- **Orientation**
- **Massing**
- **Shading**
- **Material selection**
- **Thermal mass**
- **Insulation**
- **Internal layout**

The positioning of openings to allow the penetration of solar radiation, visible light and for ventilation.



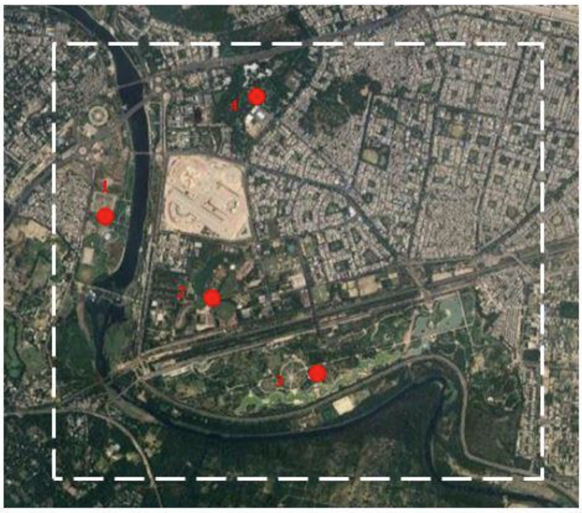
Solar Energy

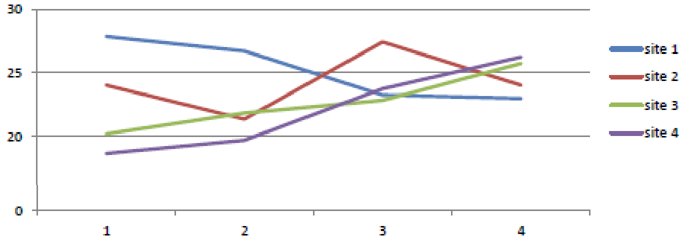
A type of passive solar heating and cooling system that can be used to regulate the temperature of a building as well as providing ventilation. solar chimneys are a way to achieve energy efficient building design. Essentially, solar chimneys are hollow containers that connect the inside part of the building to the outside part of the building

DISSERTATION

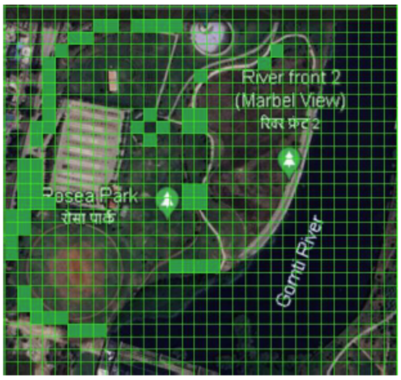
OPTIMUM PERCENTAGE OF TREE COVER TO ACHIEVE THERMAL COMFORT by Anushtha Diwedi

In this study four different sites with different percentage of tree cover were identified. In situ experiment was conducted using different instruments on various parameters like wet bulb temperature, air velocity, relative humidity, carbon dioxide concentration and sky-view factor.

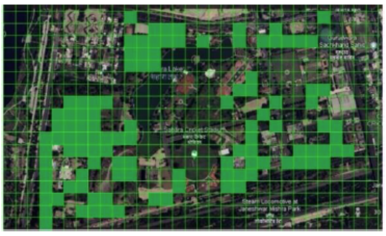




Average wet bulb temperature recorded on all the four sites using the Heat Index WBGT meter.

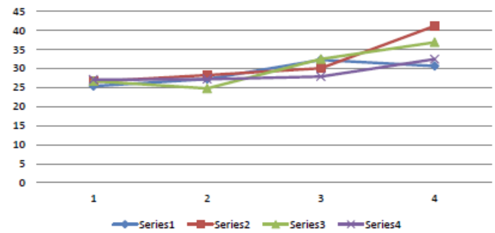


Site 1: With almost 30% of tree cover- Rosia Park, Gomti River Front

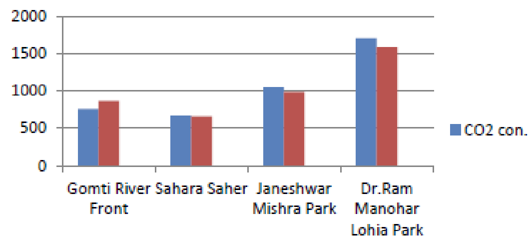


Site 2: With almost 50% of tree cover- Sahara Saher.

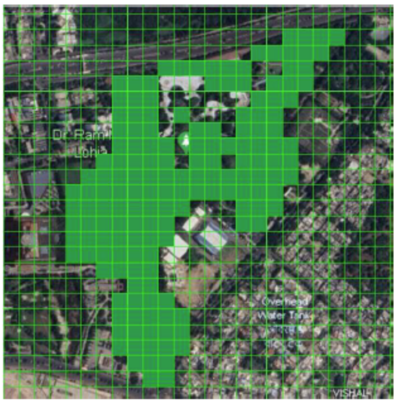
Humidity chart



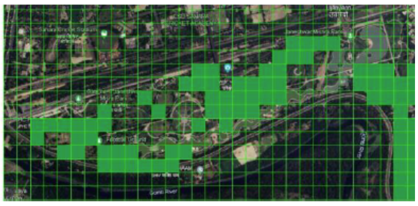
Average of the relative humidity recorded



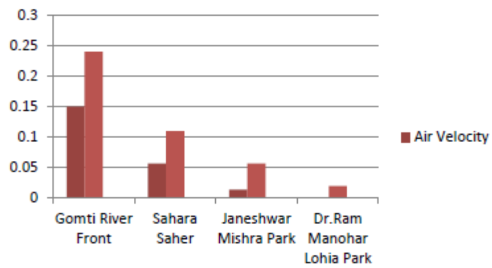
Average of the CO2 recorded



Site 4: With almost 90% of tree cover- Dr. Ram Manohar Lohia Park



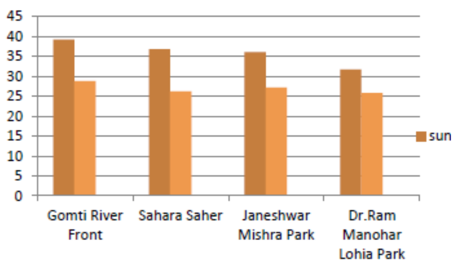
Site 3: With almost 70% of tree cover- Janeshwar Mishra Park



Average of the Air Velocity

From the above data collection and discussion, it can be seen that Sahara Saher which has approx. 50%of tree cover has the most thermally comfortable atmosphere as compared to the other sites with different percentage of tree covers. Therefore it can be concluded that:

1. 50% of tree cover is optimum to achieve thermal comfort.
2. Native trees should be planted to make a site more sustainable.
3. Trees should be planted at a specified distance to achieve more comfort.



Average of the Surface temperature

DISSERTATION

COMPARATIVE ANALYSIS OF BERMED HOUSE AND CONTEMPORARY HOUSE IN COMPOSITE CLIMATE

by Aditi Shrivastava

Parametric optimization study has been performed using Design Builder/ Energy Plus software to reach the optimal performance of the building with the best combination of design variables.

Design Variables were the combination of 4 aspects: -

• Natural ventilation and HVAC condition, resulting in 4 cases

WWR (all the 4 sides of wall)

Using 10% WWR in composite climate will give the best thermal performance for bermed structure in both HVAC and natural ventilation condition.

 Orientation of exposed facade in HVAC condition

Locating the exposed facade in north direction will be the optimum orientation in HVAC condition as it will give maximum annual energy saving than any other orientation.

 Orientation of exposed facade in natural ventilation condition

Locating the exposed facade in south direction will be the optimum orientation in natural ventilation condition as it will give minimum number of annual discomfort hours and near to neutral PMV than any other orientation.

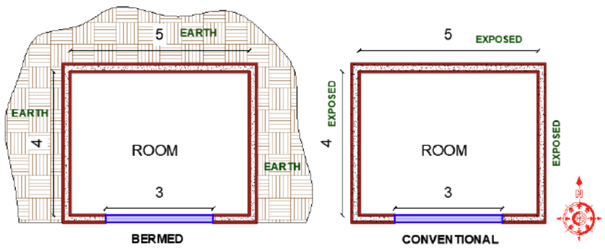
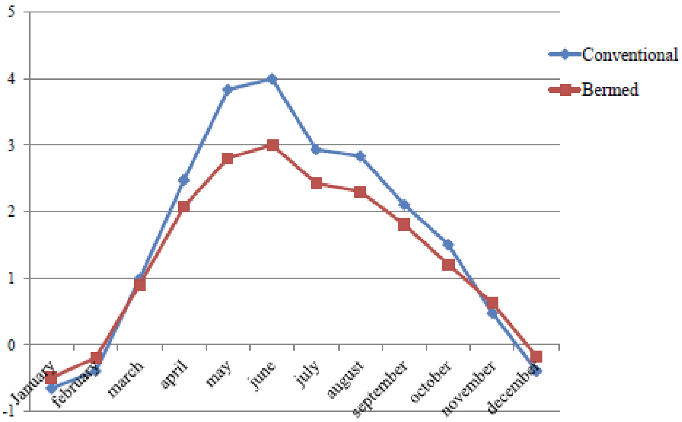
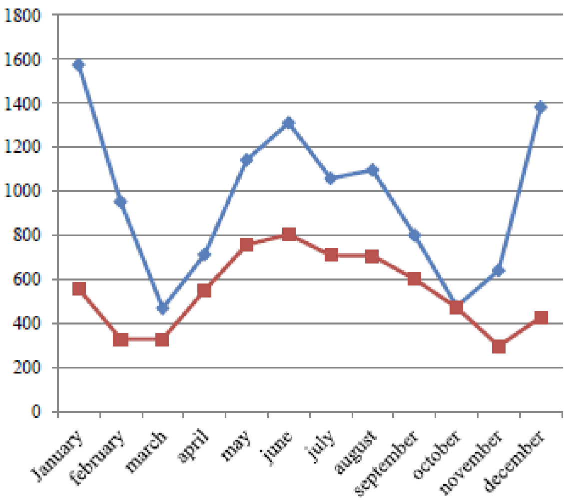


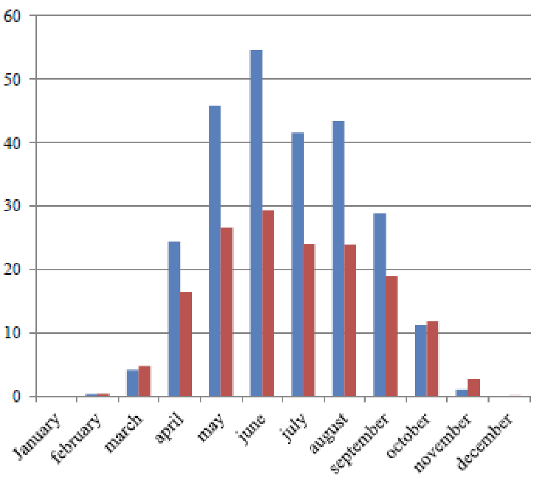
Figure 13 Plan of bermed and conventional house



Simulation results in the case of Natural ventilation for bermed and conventional house.

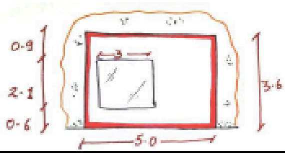
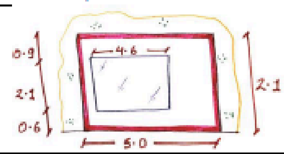
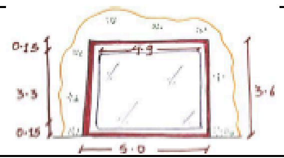


Energy consumption comparison for bermed and conventional house (monthly)

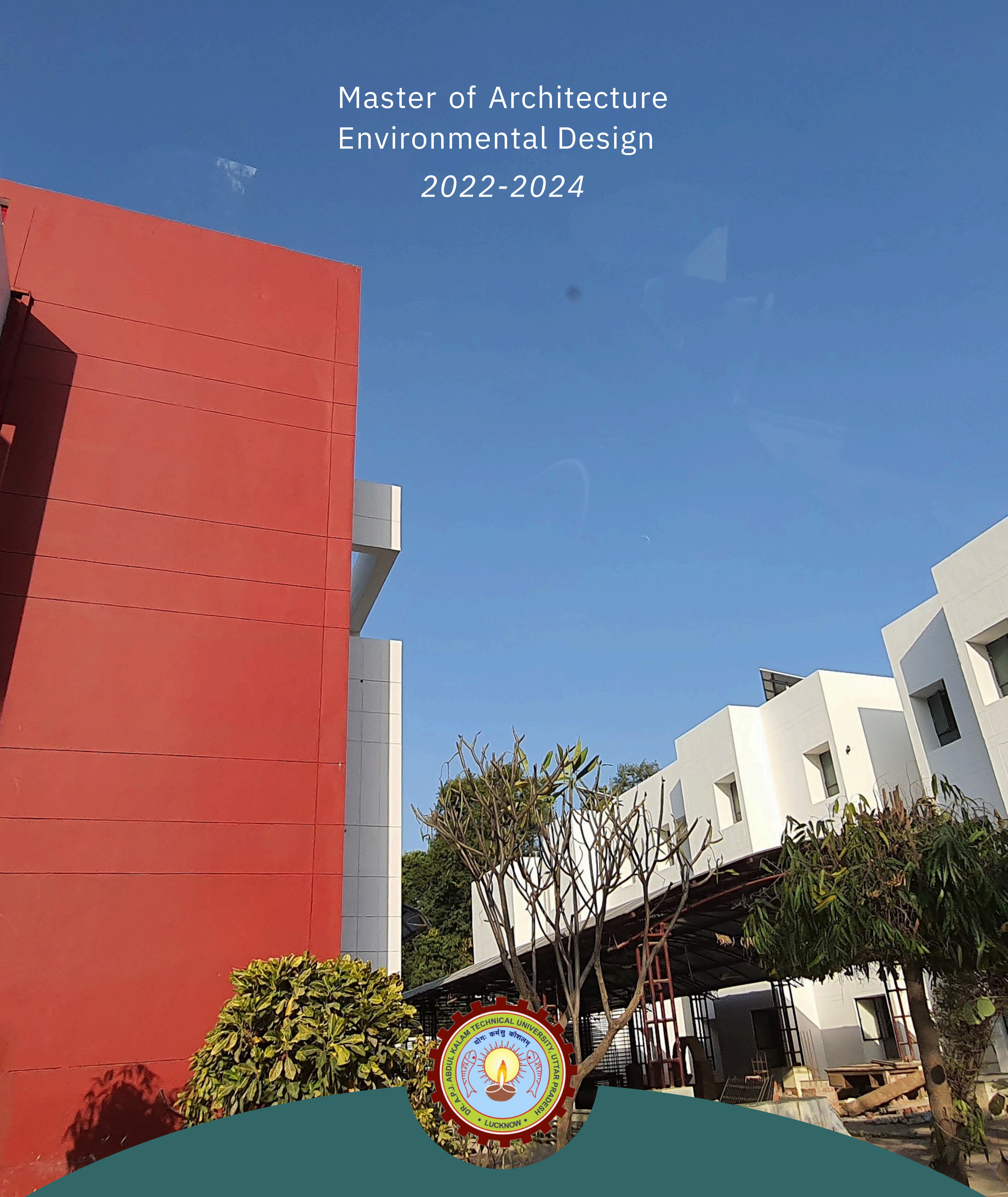


Cooling load comparison for conventional and bermed house (monthly)

Table 17 Variation in WWR and orientation for bermed house (Natural ventilation)

ELEVATION						
WWR (%)	10%		15%		25%	
DATA (YEARLY)	THERMAL COMFORT		THERMAL COMFORT		THERMAL COMFORT	
	DISCOMFORT HOURS	PMV	DISCOMFORT HOURS	PMV	DISCOMFORT HOURS	PMV
CONVENTIONAL	-	-	6559.33	2.04	-	-
NORTH	6272.66	1.76	6393.66	1.83	6668.00	2.03
SOUTH	6128.00	1.59	6239.5	1.62	6487.00	1.68
WEST	6186.5	1.79	6308.16	1.87	6569.66	2.06
EAST	6176	1.74	6285.83	1.80	6532.33	1.97

Master of Architecture
Environmental Design
2022-2024



Faculty of Architecture and Planning

Tagore Marg, Lucknow, Uttar Pradesh-226007