

INTERRELATIONSHIP BETWEEN OPEN SPACE AND BUILT ENVIRONMENT IN RESIDENTIAL COMMUNITY

A THESIS

Submitted in partial fulfillment of the requirements for the award of
Master of Architecture degree in Sustainable Architecture

By

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INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

Accredited With Grade “A++” by NAAC
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DATE: 18-05-2024

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THESIS SYNOPSIS

The interplay between open space and built environment within residential communities has garnered increasing attention in urban planning and design disciplines. This thesis examines the multifaceted relationship between open spaces and built structures, considering their impacts on residents' well-being, social interactions, environmental sustainability, and overall community livability. Through a comprehensive review of existing literature, this study explores the diverse functions and qualities of open spaces, ranging from parks and green belts to plazas and recreational areas, and their integration with the built environment.

The research delves into various theoretical frameworks and empirical studies to elucidate the dynamic interactions between open spaces and built forms, including their influence on urban morphology, microclimate regulation, and aesthetic appeal. The paper examines the socio-cultural dimensions of open space utilization, addressing issues of inclusivity, accessibility, and community engagement. Moreover, it investigates the role of design interventions, such as mixed land use, pedestrian-friendly layouts, and green infrastructure, in fostering synergistic relationships between open spaces and built structures to enhance the quality of residential environments.

The thesis aims to understand the importance of adopting an integrated approach to urban development that emphasizes the symbiotic relationship between open space provision and built environment design. By recognizing the reciprocal influences between these elements, policymakers, planners, and designers can formulate more effective strategies for creating sustainable, resilient, and socially cohesive residential environments that cater to the diverse needs and aspirations of inhabitants.

Keywords: Open space, Built environment, Residential community, Thermal comfort, Sustainability

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF THE PROJECT

In the intricate tapestry of urban development, the balance between open space and built-up space in residential communities emerges as a critical determinant of livability, sustainability, and social cohesion. As cities around the world face the challenges of rapid urbanization, understanding the relationship between these two facets becomes increasingly important.

Built-up spaces encompass residential dwellings, commercial establishments, transportation networks, and civic amenities, constituting the built environment where people live, work, and engage in daily activities. While built-up spaces provide essential infrastructure and support economic vitality, their design, density, and distribution profoundly impact the accessibility, functionality, and aesthetic appeal of open spaces within residential communities. Open spaces, like parks, green belts, and communal areas, offer breathing room amidst the structures.

Moreover, the configuration of built-up areas influences environmental factors such as heat island effects, air quality, and ecological sustainability, further underscoring the interconnectedness of these two spatial dimensions. Understanding the symbiosis between these elements is pivotal for crafting neighbourhoods that nurture both human connection and environmental sustainability.

1.2 NEED OF THE PROJECT

With the increasing urbanization and environmental challenges facing cities, there is a pressing need for sustainable urban development strategies. This thesis can shed light on the role of open spaces in mitigating environmental impacts, improving residents' quality of life, and fostering community resilience.

Access to open spaces within residential communities significantly contributes to residents' quality of life. These spaces provide opportunities for recreation, physical activity, social interaction, and mental well-being. The design and distribution of open and built-up spaces have a direct impact on public health outcomes. Well-designed open spaces can encourage physical activity, reduce stress, and improve air quality, thus promoting community health and well-being. By studying the interrelationship between open and built-up spaces, the thesis identifies ways to enhance the accessibility, usability, and attractiveness of open spaces, thereby improving residents' overall quality of life

1.3 RESEARCH QUESTIONS

- a) How do open spaces impact the neighbourhood?
- b) What factors to consider when designing residences with respect to open space in improving thermal comfort?
- c) What are its impact on human health and well-being?
- d) How does the open space prioritize equity and social inclusion in a residential community?

1.4 AIM OF THE STUDY

To explore the relationship between open space and built-up space in residential communities to create active and sustainable public spaces.

1.5 OBJECTIVES OF THE STUDY

The main objective of the research scope is

- a) To integrate an active open space in an urban neighborhood.
- b) To explore different iterations of built-up and open spaces with the goal of creating thermally pleasant, sustainable open spaces.
- c) To provide passive design strategies that creates livable breathing urban space.

1.6 SCOPE & LIMITATIONS OF THE STUDY

The purpose of this study is to gain a deeper understanding on relationship between open space and built-up space in residential communities. The research focuses on studying user analysis, variables affecting thermal comfort and the relationship between them.

User analysis and climate data collection has been studied by question surveys, interviews, observation and measurement of climate affecting variables.

The study is limited to apartment case studies that have been done only on weekends in the month of February and March.

1.7 RESEARCH METHODOLOGY

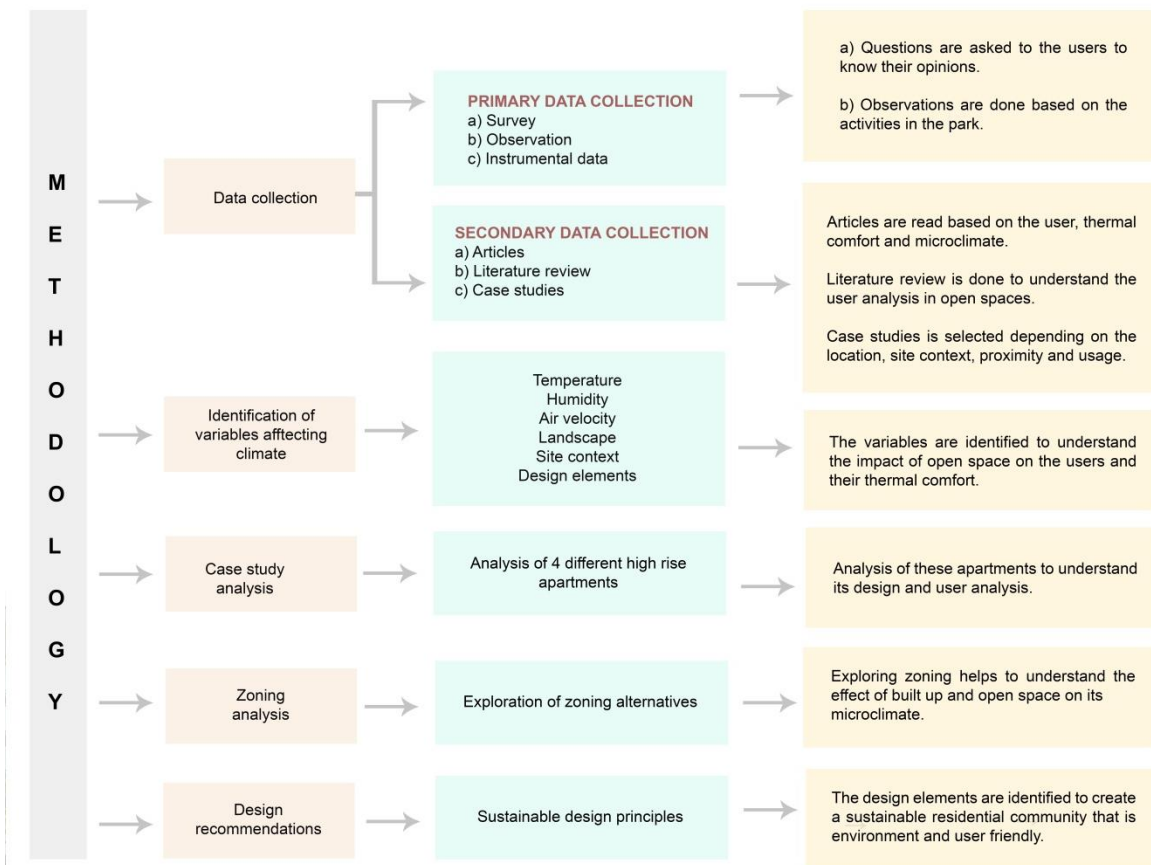


Figure - 1 Research Methodology

CHAPTER 2

LITERATURE REVIEW

2.1 LITERATURE REVIEW ON JOURNALS

2.1.1 Review of open space rules and regulations and identification of specificities for plot-level open spaces to facilitate sustainable development: an indian case

- *Ritu gulati*

The study intends to understand the open space dynamics at the plot level. It conducts a detailed literature review of planning implementation tools, including the City Development Plan (CDP), which incorporates the Master Plan and the Development Control Rules (DCR).

Under the **QUANTITATIVE ANALYSIS**, identified examples were examined for density parameters such as the total number of dwelling units, plot areas, built-up areas, building ground coverage, utilized FSI, and recreational open space to derive the resultant per capita open space.

The **QUALITATIVE ANALYSIS** looked at the aspects of open spaces that contribute to the overall sustainability of the development.



Fig 2.1.1.1 Open space

STUDY OF OPEN SPACE RULES AND REGULATIONS IN INDIA

There is a tiered legislative framework for India's planning and implementation of rules and regulations for urban planning; at the top is the Central or Union Government, followed by the State government and the local administrative body.

The State Act allows the local executive body to formulate Regional Plans (RP) and City Development Plan (CDP). If the city does not have a designated Regional Plan, it can develop its CDP directly.

The Union Ministry of Housing and Urban Affairs (MoHUA) has promulgated the Urban and Regional Development Plans Formulation & Implementation (URDPFI) guidelines for formulating the RP and CDP.

Later, the local body frames appropriate DCR or Building Bye-laws to facilitate the implementation of the CDP. Like URDPFI guidelines, the Bureau of Indian Standards (BIS) formulates the National Building Code (NBC) to enable the local bodies to draft the DCR.

There is constant review and amendments of the State Acts and the DCRs from time to time. For this, the local body updates the CDP after every ten years and must be strictly followed.

Though all the local bodies and development authorities within the State follow the same State Act, they have the freedom to make a few alterations or additions to these rules as per the city's geographic, social and climatic requirements.

RULES FOR OPEN SPACES

The CDP categorizes the open spaces as,

- 1) Recreational Space
- 2) Organized Green Space (OG)
- 3) Other Open Spaces (such as vacant lands / open spaces including flood plains, forest cover, etc. in plain areas)

The guidelines mention that a CDP should provide a desirable 10-12 sq. m. per person open space, which includes all the above categories for the whole city.

Sr. No.	Planning Unit	OG space		
		Number of OG	Population Served per OG	Min. Area of each OG
1	Housing Cluster	3-4	5000	0.5 ha
2	Neighborhood	3-4	10500	1.0 ha
3	Community	2-3	1 Lakh	5.0 ha
4	District/ Zone	1	5 Lakh	25.0 ha
5	Sub-city center	1	10 Lakh	100.0 ha

Table 2.1.1.1. Hierarchy and norms for green areas

The DCR categorizes open spaces as,

1. Mandatory Open Spaces
2. Interior Open Spaces (Chowks)
3. Amenity Open Spaces
4. Layout / Recreational Open Spaces (LOS)

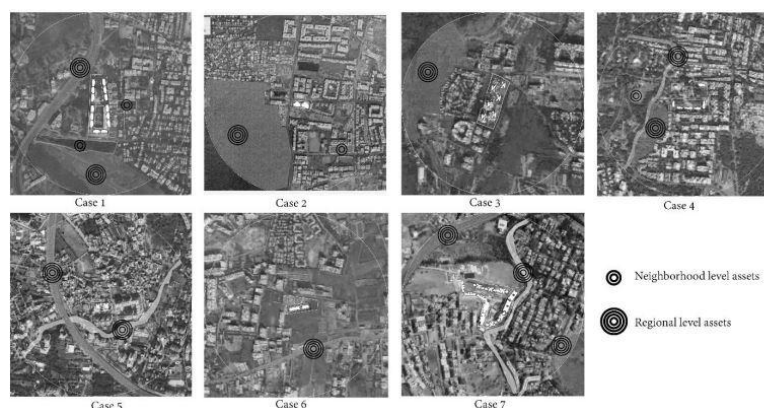


Fig 2.1.1.2. Neighbourhood and regional level assets

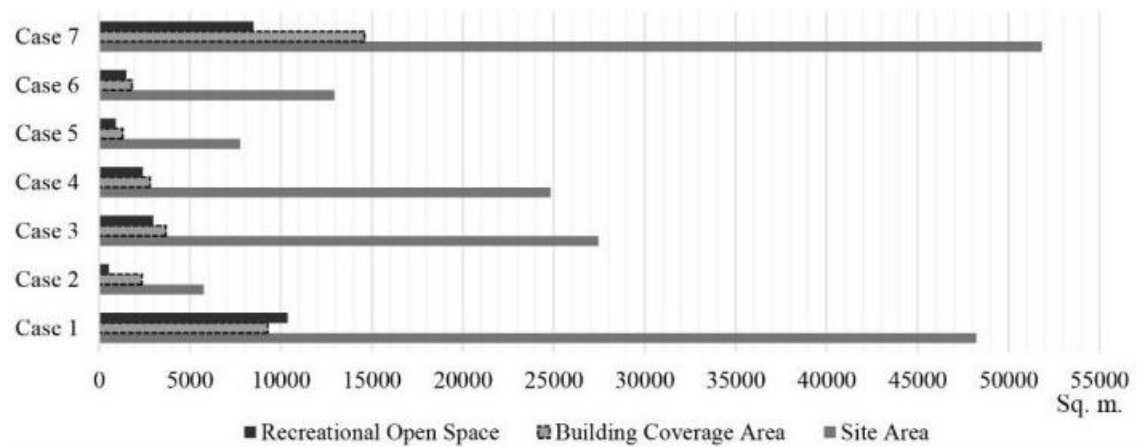


Fig 2.1.1.3. Area configuration comparison

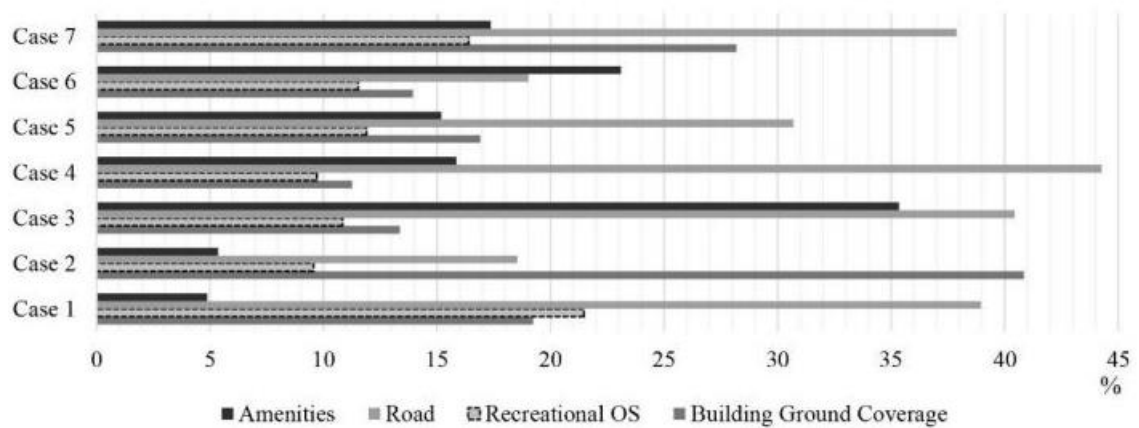


Fig 2.1.1.4 Ground coverage comparison

RESIDENTIAL OPEN SPACE

Residential open space as a setting of dwelling is related to form, shape, plan, structure, and functions of the built environment and has a positive impact on residential environment quality.

Open space can be categorized into four groups:



Private space is specific to an individual residential building, and semi-public areas such as streets within the neighborhood are the buffer zones between dwellings and public spaces. Some spaces are preserved by elements such as signs and boundaries and some others are enclosed by fences, walls, and gates.

Open space is a vital component of residential layout including balconies, gardens, and communal areas. These areas provide a private space for residents to play, relax, communicate, and enjoy natural elements such as trees and vegetation, which make the atmosphere more attractive. They can also be used to define the borders between dwellings and the separation between neighboring houses.

Allowing the penetration of sunlight and fresh air is another environmental function of open space. The definition of open spaces within a residential environment in this research includes private open spaces (yards, gardens etc.), roads, and public open spaces in selected areas.

CONCLUSION :

For Indian cities, as far as the open spaces are concerned, the study shows a stark disconnect between rules and regulations formulated by various statutory bodies.

Surrounding spatial structure, built unbuilt mass, the scheme's location, and orientation in its larger context. may directly guide the open space qualities at the plot level and thus need further study on it.



Fig 2.1.1.5 Public open space

2.1.2 OUTDOOR THERMAL COMFORT BY DIFFERENT HEAT MITIGATION STRATEGIES

- *Mohammad Taleghani*

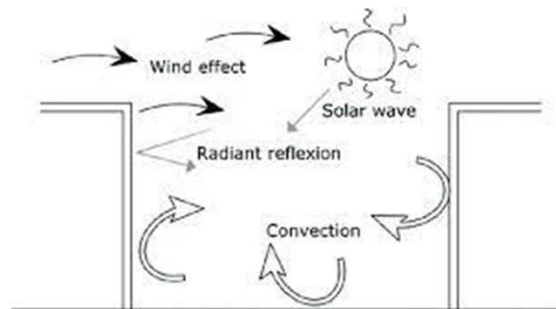


Fig 2.1.2.1 Courtyard effect

Focuses on

Vegetation
(in the form of
parks, street trees,
green roofs and

**Highly reflective
materials**
(on roof and on the
ground level)

Research finding:

Although highly reflective materials reduce air temperature in urban open spaces, they increase the re-radiation of sun to the pedestrians.

Therefore, vegetation is a better choice for improving thermal comfort in the pedestrian level.



Fig 2.1.2.2 Different form of vegetation

Vegetation reduces heat in three ways:

- a)by evapotranspiration,
- b)by reflecting the sun because of the higher albedo of the leaves compared to man-made dark materials;
- c)by blocking the solar radiation.

Vegetation has been used in various ways in cities. From a large to local scale, we can see vegetation in cities as parks, street trees, grass yards, and green roofs.

Apart the heat capacity of man-made materials, urban canyons reduce natural ventilation and therefore heat traps in cities.

The intensity of the UHI is also related to the size and population of the city. This shows with the increase of urban settlers, more people are prone to UHI.

Higher air temperature has direct and indirect effects. The most direct effect of UHI is lower thermal comfort of people in urban spaces

UHI indirectly increases energy consumption for cooling, reduces the air quality in cities and threatens the ecosystem by warmer water flowing from the cities.

Thermal comfort is associated with environmental (air temperature, radiant temperature, wind speed, and relative humidity) and personal (clothing and metabolism) factors.

Several studies have shown that radiation plays the greatest role on thermal comfort, the impact of urban morphology and different heat mitigation strategies on urban climate have been reviewed.



Fig 2.1.2.3 Urban heat island effect

BENEFITS OF VEGETATION

1. Improved health and quality of life
2. Reduced greenhouse gas emissions
3. Improved air quality
4. Decreased stormwater runoff
5. Reduced energy usage
6. Increased productivity
7. Rapid healing



Fig 2.1.2.4 Vegetation

2.1.3 OPEN SPACE BETWEEN RESIDENTIAL BUILDINGS AS A FACTOR OF SUSTAINABLE DEVELOPMENT - CASE STUDIES IN BRNO (CZECH REPUBLIC) AND VIENNA (AUSTRIA)

- *Pavla Kilnarová and Maxmilian Wittmann*

Two types of urban structures which appear in a large number in post-socialist cities of central Europe are:

- Open spaces surrounding houses in high-rise panel housing estates constructed under the socialism era in the 20th century.
- Courtyards in closed urban blocks from the 19th century.

RESEARCH QUESTIONS

1. How do the open spaces in housing estates affect the character of the environment?
2. Do the residents use these open spaces and consider them as important for their quality of life?
3. Can the importance of these open spaces compete with the significance of the closed courtyards in the centre of the city?

Specific indicators of sustainability within a range from 0 to 10 points. 5 points correspond to the general standard in the area, 0 points indicate degradation, and 10 points indicate the highest contribution to sustainable development.

Observation methods, questionnaire survey, statistical analyses, and methods of measurement were used to determine the values of the given indicators.

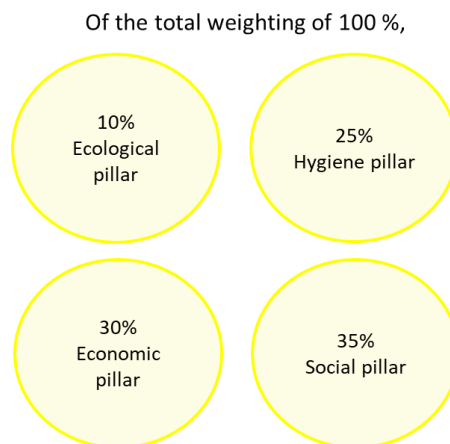


Fig 2.1.3.1 Sustainability pillars

HYGIENE QUALITIES OF ENVIRONMENT

- Grass surfaces and tree shades efficiently reduce the high surface temperature.
- Urban greenery reduces the air temperature in the urban area, at least on the local scale.
- Greenery is legitimately becoming a part of architectural and urban conceptions, which is documented in several published projects.
- Enhance social qualities of neighbourhood
- air pollution that have a strong influence on the health of communities and their social development.



Fig 2.3.1.2 Urban Greenery

CONCLUSION

Characteristics of the open spaces between residential buildings influence the ecological stability of the area, its hygienic qualities, the intensity and way of using by various social groups, and also the prices of real estates. These qualities indicate the environmental, social and economic sustainability of the urban area

The spaces between buildings may create hygienically quality environment. And local residents perceive the influence of the environment on their quality of life. According to the results of the research, the closed courtyards in the locality have a considerable importance for sustainable development of the area and for the satisfaction of local residents.

The residents perceive the courtyards as a valuable, safe place to relax. The courtyards create an environment with a considerably higher quality than the surrounding streets.

CHAPTER 3

DATA COLLECTION & ANALYSIS

3.1 INTRODUCTION

In the intricate tapestry of urban development, the balance between open space and built-up space in residential communities emerges as a critical determinant of livability, sustainability, and social cohesion. As cities around the world face the challenges of rapid urbanization, understanding the relationship between these two facets becomes increasingly important.



Moreover, the configuration of built-up areas influences environmental factors such as heat island effects, air quality, and ecological sustainability. Recognizing the symbiotic nature of these elements is vital for developing neighborhoods that foster community connection and environmental sustainability.

Fig 3.1.1. Urban green space

OPEN SPACE

A physical area or environment that is open and unobstructed. It can be a park, a field, a plaza, or any area that lacks significant buildings, structures, or other obstructions. Open spaces often provide a place for outdoor activities, relaxation, and natural beauty.

BUILT – UP SPACE

Refers to land or areas that have been developed with structures such as buildings, houses, roads, and other infrastructure.



Fig 3.1.2 Relationship between open space and built-up space

The relationship between built-up space and open space can be described as interdependent; Together they can allow for freer air movement and increased heat loss or gain.

The character of open spaces is largely determined by the building masses surrounding them, and the character of the building masses can be enhanced or subdued by the open spaces.

Built spaces indicate the purpose of the built form, whereas unbuilt spaces signify the spirit of the place.

Walls, when considered as a part of the physical form of buildings associated with the height of buildings, determine and shape the open space.

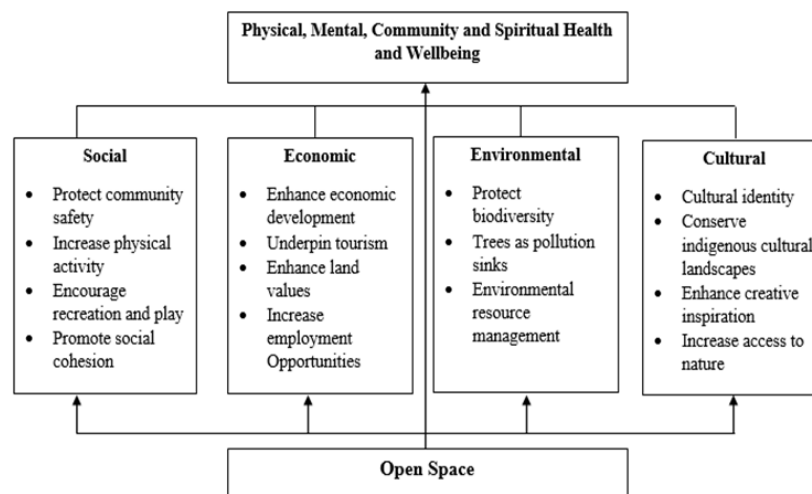


Fig 3.1.3 Sustainability pillars on open spaces

OPEN SPACE DESIGN REGULATIONS

NATIONAL BUILDING CODE OF INDIA (NBC):

Buildings that are 55 meters or more in height should have a minimum exterior open space of 16 meters. For heights above 27 meters, a minimum space of 9 meters should be left on sides where no habitable rooms face.

URBAN REGIONAL DEVELOPMENT PLANS FORMULATION AND IMPLEMENTATION (URDPFI) GUIDELINES:

Recommend 10 to 12 square meters of open space per person.

CHENNAI METROPOLITAN DEVELOPMENT AUTHORITY (CMDA):

Preparing guidelines and laws to protect open spaces and to ensure that they are not lost to apartment complexes and commercial buildings.

ADVANTAGES

- Better quality of life
- Live healthy
- Outdoor activities
- Bond better with neighbours
- Bonus for kids, elderly
- Excellent return on investment
- Serenity and Safety
- Enhances property value
- Building a Gated Community Near Nature
- The community's appearance has improved

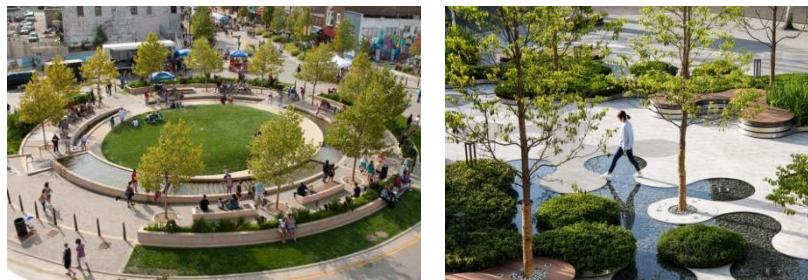


Fig 3.1.4. Healthy lifestyle



SUSTAINABILITY PERSPECTIVE

From a sustainability perspective, open spaces in urban environments like Chennai provide numerous ecological, social, and economic benefits. These spaces contribute significantly to sustainable urban development by enhancing environmental quality, promoting social well-being, and supporting economic resilience. Here are key points on the sustainability perspective of open spaces:

Environmental Sustainability

Biodiversity Conservation:

Habitats:

Open spaces, such as parks and gardens, create habitats for various species of plants, birds, insects, and small mammals, fostering urban biodiversity.

Ecological Networks: They act as green corridors, connecting different habitats and allowing species to move and interact, which is crucial for genetic diversity.

Climate Regulation:

Pollution Reduction:

Green spaces filter air pollutants, including particulate matter and gases like NO₂ and SO₂, improving overall air quality.

Temperature Moderation:

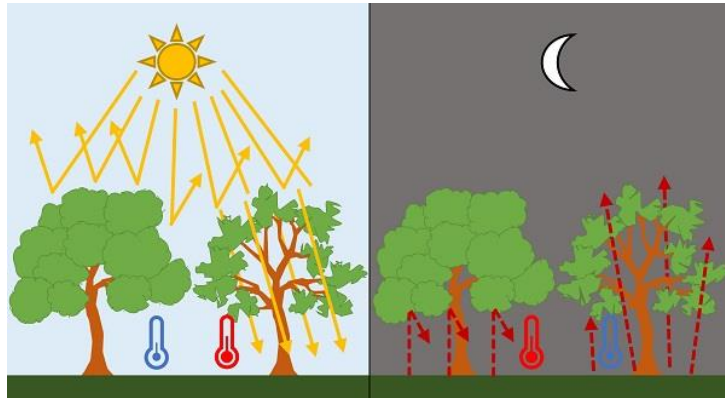


Fig 3.1.5. Trees – temperature moderator

Trees and vegetation in open spaces help to mitigate the urban heat island effect by providing shade and cooling through evapotranspiration.

Carbon Sequestration: Vegetation absorbs CO₂, playing a role in reducing urban carbon footprints and combating climate change.

Air and Water Quality:

Water Management:

These areas enhance stormwater management by promoting infiltration, reducing runoff, and recharging groundwater aquifers.

Social Sustainability

Health and Well-being:



Fig 3.1.6 Well being

Physical Health: Access to open spaces encourages physical activities such as walking, jogging, and sports, reducing risks of lifestyle-related diseases.

Mental Health: Natural environments provide psychological benefits, including stress relief, improved mood, and enhanced cognitive functioning.



Fig 3.1.7 Social cohesion

Community Cohesion:

Social Interaction: Parks and communal gardens foster social interactions, building stronger community ties and reducing feelings of isolation.

Cultural and Recreational Activities: These spaces host community events, cultural activities, and recreational programs, enriching the social fabric of the city.

Economic Sustainability



Fig 3.1.8 Cost effective strategy

Property Value Enhancement:

Real Estate: Properties near well-maintained open spaces typically have higher market values and attract more investment, boosting local economies.

Attraction and Retention: Green spaces make urban areas more attractive for residents, businesses, and tourists, contributing to economic vitality.

Cost Savings:

Energy Efficiency: Vegetation can provide natural cooling, reducing energy costs associated with air conditioning in adjacent buildings.

Health Expenditure Reduction: Improved air quality and physical activity levels can lower public health expenditures by reducing the prevalence of pollution-related and sedentary lifestyle diseases.



Fig 3.1.9. Sustainable development goals

11.7.PROVIDE ACCESS TO SAFE AND INCLUSIVE GREEN AND PUBLIC SPACES

By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities.

CHAPTER 4

LITERATURE CASE STUDIES

4.1 ARANYA HOUSING INDORE

4.2

Aranya Low-Cost Housing situated in Indore was commissioned by Indore Development Authority and co-funded by World Bank and India's Housing and Urban Development Corporation (HUDCO), for Economically weaker sections of society addressing the shortage of houses and shelter at that time.

86 hectares consisting of six self-contained neighbourhoods.



Fig 4.1.1 Aranya housing

OBJECTIVES

- i. To improve and upgrade the existing slum area.
- ii. To provide serviced sites for new housing developments instead of building complete houses. To provide for 6,500 residential plots ranging in size from 35 sq.m for EWS to 475 sq.m for high income groups.
- iii. To create township with a sense of continuity and fundamental values of security in a good living environment
- iv. Achieve a community character by establishing harmony between the built environment and the people.

- v. Create a balanced community of various socio-economic groups to evolve a framework through design.



Fig 4.1.2 Housing typology

Small open spaces play a vital role, especially in a low-income neighbourhood. Such places are used differently, such as: small temple, festival gathering and resting platforms, planting trees, drying clothes, storage place, small shops.

For large open spaces, people have used some of them as temples, beautiful landscapes, and large gathering site. But unfortunately, a lot of large open spaces have been left empty, and some are even full of waste.

Every 10 clusters of houses shared a courtyard. The six sectors had their own green spaces and one larger public space for the whole township.

CLIMATE RESPONSIVE FEATURES

Each house has minimum surface exposure. This reduces the heat gain by the house during the hot summer.

The houses are oriented with longer side in north-south axis in order to reduce the solar gain.

The buildings are close to each other such that they shade the public spaces in between the houses.

Plastered walls and jalli walls are present in the houses.

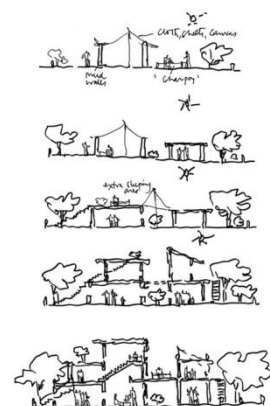


Fig 4.1.3 Climate responsiveness

The streets remain half shaded thus help in reducing the heat

gain and provides shaded common spaces.

DESIGN CONSIDERATIONS

- Promote person-to-person contact through cluster of human scale.
- Provide an individual character to each other.
- Create functionally sympathetic and aesthetically pleasing street environments.
- Provide spaces for social, economic and domestic activities.
- Promote income generation at cluster level.
- Provide all essential amenities and utilities to every street.
- Define clearly each cluster's territory and the sense of entry.
- Have regard for pedestrian.
- Optimise cluster patterns for economic activities and easy access.

4.2 TARA HOUSING NEW DELHI



Fig 4.2.1. Plan

Tara Co-operative group housing is located in the urban context of New Delhi. With a total of 160 units, it was designed for the Middle Income Group with a spatial configuration of low-rise and high density.

The key attributes of this project:

- i. It is Climate responsive.
- ii. It has segregated pedestrian and vehicular circulation.
- iii. It has planned open spaces.

Central community courtyard that acts as a humidification zone brings in multiple activities during efficient times of the day.

With the central courtyards and ventilation in the houses on both sides. It provides excellent cross ventilation.

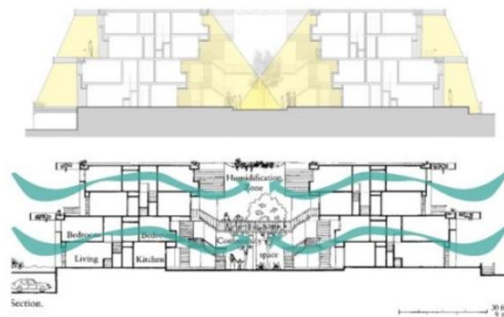


Fig 4.2.2 Central courtyard

Orientation and microclimate

The N-S orientation of the narrow built-up provides thermal comfort to the users in central community space and also provides winter sun to the individual terraces and central spine.

Majority of the private open spaces on the SE get optimum sun in the morning and afternoon during winters.

The majority of the surface and hard surface which absorbs and reflects the solar radiation and radiates heat later.

This is neutralized by the wind funnel created by the comparatively smaller openings on NW and large double height multifunctional hall on SE and green pockets in the central spine. The interlocking of the two longitudinal staggered decks provide mutual shading and provides thermal comfort to the users in the central spine.



Fig 4.2.3 Central space

Open Space System

The open spaces are derived from the configuration of horizontal and vertical base planes and the character is defined by sense of enclosure and texture.

There is hierarchy of open spaces due to the alteration in the planes in response to the climatic conditions and to achieve the desired visual character.



Fig 4.2.4 Open and private space system

Private Spaces

The extension of living area into the green space in the ground floor and the partially shaded 10sqm terraces spaces open onto visual greens and are not connected to active greens . Hence the privacy is retained. However there is lack of interactions

Public Spaces

The open staircases and their landing are interactive zones . The central spine is an active enclosed space which turns semi open space with presence of large green trees houses an OAT, children's play area, green pockets.

The multi-functional hall acts as transition space from the central spine to the green scape on the South East. The soft scape on the South East is bounded and buffered by peripheral plantation.



Fig 4.2.5.Public space

Correa designed a low-rise, high-density housing accommodating more than 125 apartments- two and three-bedroom units.

The dwelling units are stacked in two decks, the upper ones are stepped back to form a terrace for each family. This is done with the objective of creating a central area that allows units to shade each other against the scorching Delhi summer sun.

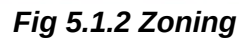
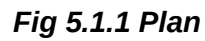
The central street between row houses has been designed as a multi-functional landscaped spine. This street serves as a major circulation route, community space, children's play area, and enhances the visual appeal of the complex.

The rows of dwelling units are surrounded by open space on one side and enclosed by dense tree foliage on the other to give them a cushion against the summer heat and noise pollution.

To enhance the quality of life, Correa designed the layout in a way that pedestrian and vehicular movement is well defined and segregated. He originally provided six entrances, of which only three are now functional due to security concerns. One of these is dedicated solely to pedestrians.

There is a hierarchy of open spaces in response to climatic conditions and to achieve the desired visual effect

5.1 URBANRISE – REVOLUTION ONE - PADUR



1. Located at IT corridor of the city

2. Well connected to the buzzing and thriving OMR, Kelambakkam – Vandalur road

3. Comfortable living

4. Perfect work-life balance

5. Nearby educational institutions, hotels, malls, and entertainment centres

TEMPERATURE

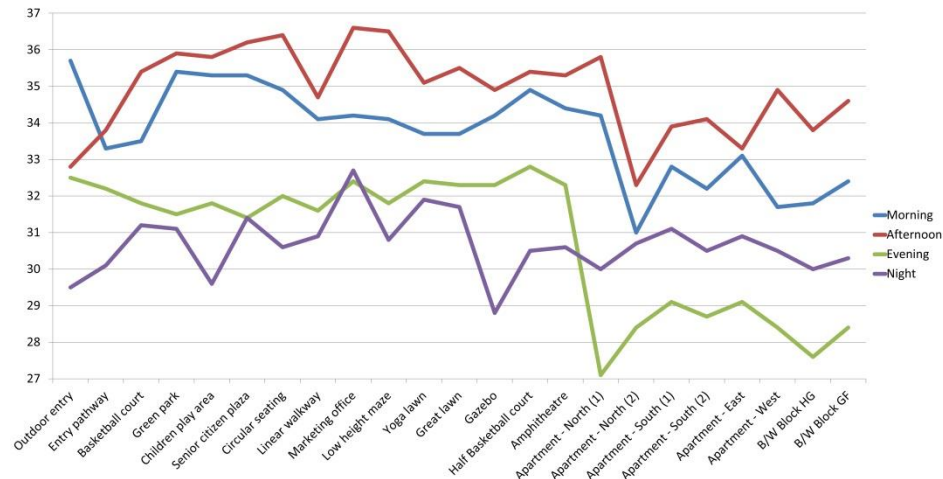


Fig 5.1.3 Temperature graph

- At morning temperature is higher of 35.7°C at Outdoor entry located at East and lower of 31°C at Apartment North pathway.
- At afternoon temperature is higher of 36.6°C at Marketing office since there is no shade and lower of 32.3°C at Apartment North pathways due to obstruction of heat by building.
- At evening temperature is higher of 32.8°C at Half basketball court due to solar radiation reflection and no shade and temperature is lower 27.1°C at Apartment North pathway.
- At night temperature is higher of 32.7°C at Marketing office and lower of 28.8°C at Gazebo as its surrounded by vegetation.

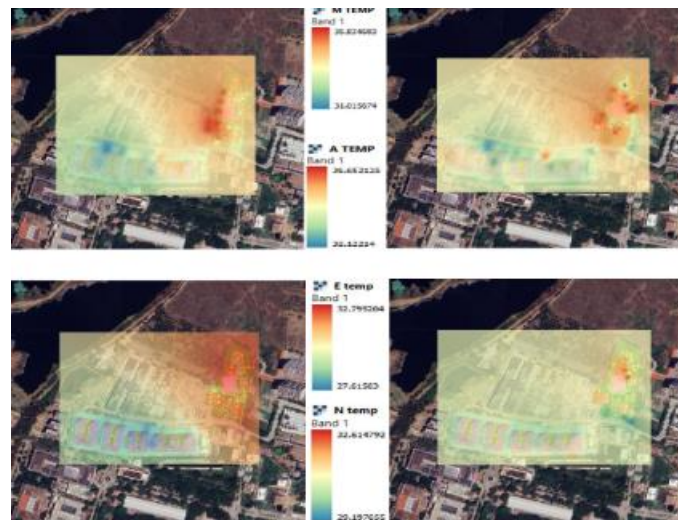


Fig 5.1.4 Temperature thermal map

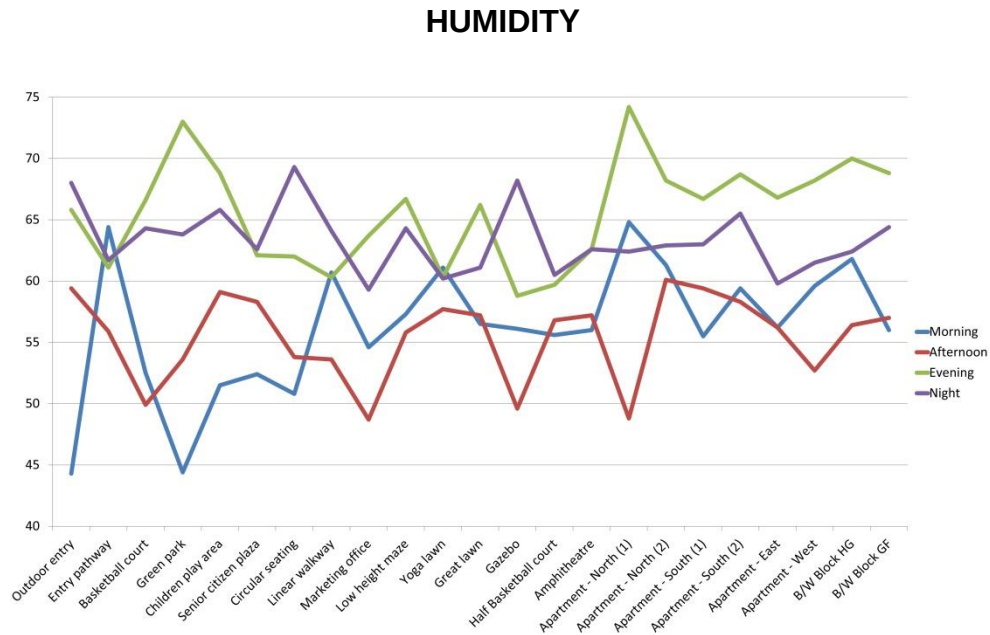


Fig 5.1.5 Humidity graph

- a) At morning humidity is higher of 64.8% at Apartment North (1) pathway and lower of 44.3% at Outdoor entry.
 - b) At afternoon humidity is higher of 60.1% at Apartment North pathway (2) and lower of 48.7% at Marketing office entrance.
 - c) At evening humidity is higher of 74.2% at Apartment North pathway (1) and lower of 59.7% at Half basketball court.
 - d) At night humidity is higher of 68.2% at Gazebo and lower of 59.3% at Marketing office entry.
- Temperature and humidity are inversely proportional.

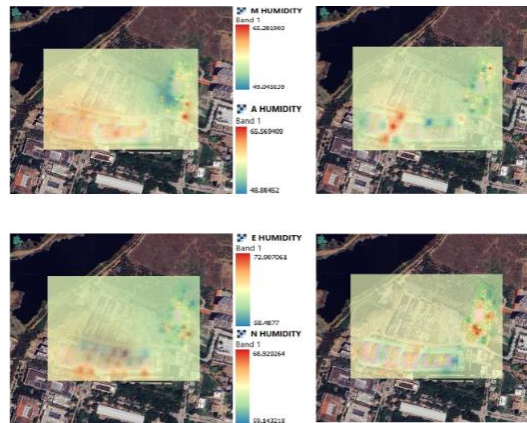


Fig 5.1.6 Humidity thermal map

SURFACE TEMPERATURE

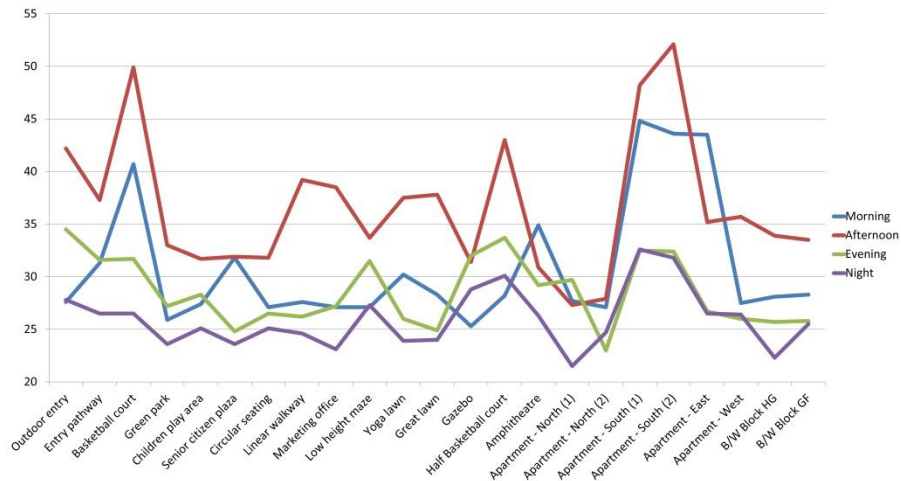


Fig 5.1.7 Surface temperature graph

- At morning surface temperature is higher of 44.8°C at Apartment South pathway due to solar reflection of ground surface material and lower of 25.3°C at Gazebo due to its shade.
- At afternoon surface temperature is higher of 52.1°C at Apartment South pathway due to solar reflection of ground surface material and lower of 27.3°C at Apartment North pathway as the building obstructs the heat radiation.
- At evening surface temperature is higher of 34.5°C at Outdoor entry due to no shade and lower 23°C at Apartment North pathway as the buildings obstructs the thermal radiation.
- At night surface temperature is higher of 32.6°C at Apartment South pathway due to high solar reflection of ground surface material and lower of 21.5°C at Apartment North pathway as the solar radiation is obstructed by buildings.

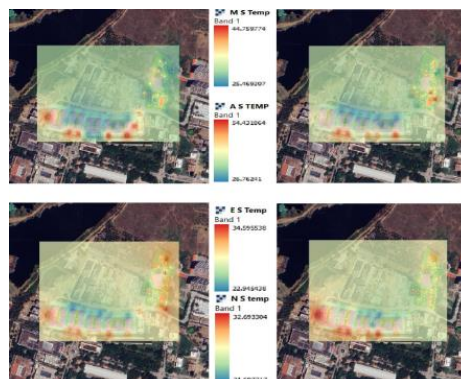


Fig 5.1.8 Surface temperature thermal map

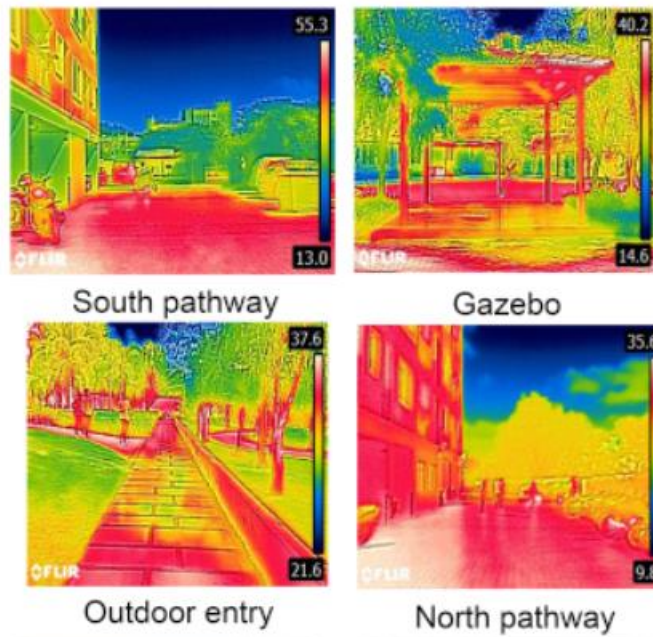


Fig 5.1.9 Flir image

WIND VELOCITY

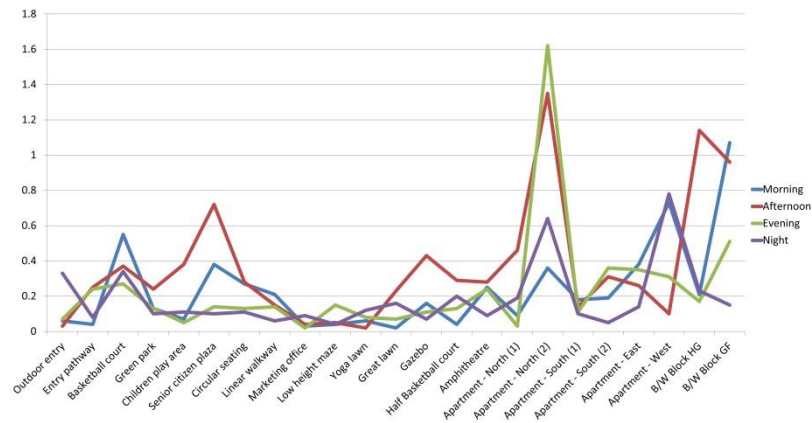


Fig 5.1.10 Wind velocity graph

- a) At morning wind velocity is higher of 1.07m/s b/w block GF by cross ventilation and lower of 0.02m/s at great lawn located at west.
- b) At afternoon wind velocity is higher of 1.35m/s at North pathway in the apartment zone and lower of 0.02m/s in yoga lawn located at East.

- c) At evening wind velocity is higher of 1.62m/s in the North pathway in apartment zone and lower of 0.02m/s at entry of marketing office as the building obstructs the wind flow.
- d) At night wind velocity is higher of 0.78 m/s at the West pathway in apartment and lower of 0.04m/s in low height maze.

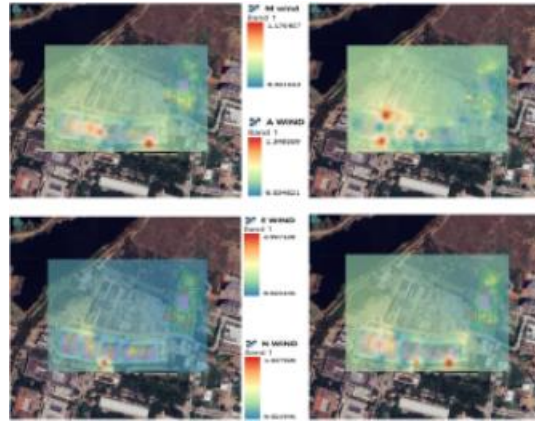


Fig 5.1.11 Wind velocity thermal map

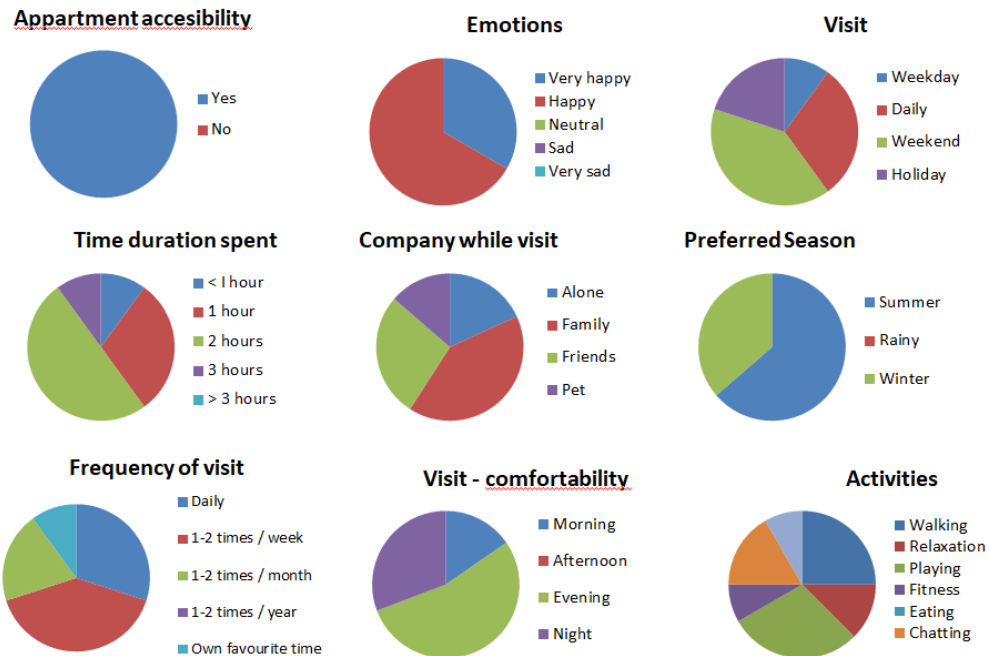


Fig 5.1.12 Questionarre survey

5.2 CLOVER BY THE RIVER – KOTTURPURAM



Fig 5.2.1 Plan

TEMPERATURE

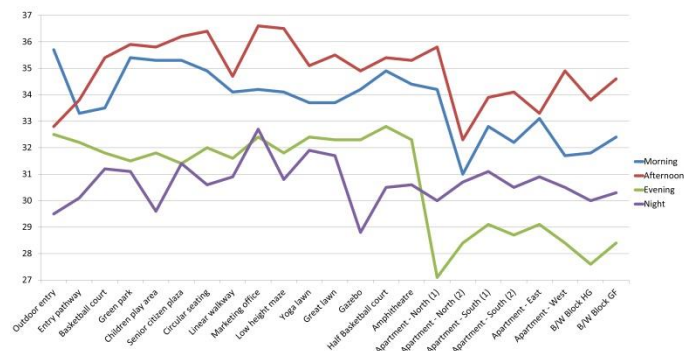


Fig 5.2.2 Temperature graph

At morning temperature is higher of 35.8°C at Jade entry located at North-east as there is no vegetation and lower of 31.3°C at Children play area 1 which has good ventilation.

At afternoon temperature is higher of 35.1°C at basketball court since there is no shade and lower of 32.7°C at entry.

At evening temperature is higher of 32.9°C at football court due to no shade and is lower 30.8°C at Mint entry located at South.

At night temperature is higher of 31.6°C at Jade entry as there is no vegetation and lower of 27°C at Mint entry located at South.

HUMIDITY

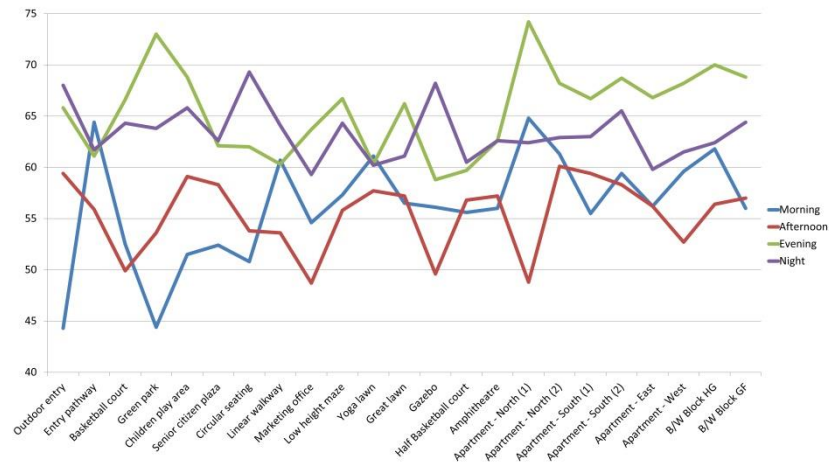


Fig 5.2.3 Humidity graph

At morning humidity is higher of 65.7% at CPA 1 and lower of 56% at Jade green entry.

At afternoon humidity is higher of 63% at Entry and lower of 53.8% at basketball court.

At evening humidity is higher of 65.2% at Mint entry and lower of 56% at Football court.

At night humidity is higher of 69.2% at Mint Entry and lower of 62.8% at Jade green entry.

Temperature and humidity are inversely proportional.

SURFACE TEMPERATURE

At morning surface temperature is higher of 53.9°C at Basketball court due to solar reflection of ground surface material and lower of 26.7°C at Swimming pool as water takes more time to gain heat and it is shaded.

At afternoon surface temperature is higher of 56.3°C at Basketball court due to solar reflection of ground surface material and lower of 27.6°C at Swimming pool.

At evening surface temperature is higher of 35.6°C at Pine entry due to no shade and lower 25.8°C at swimming pool as the buildings obstructs the thermal radiation.

At night surface temperature is higher of 31.9°C at Pine entry due to no shade and lower of 23.7°C at swimming pool as the solar radiation is obstructed by buildings.

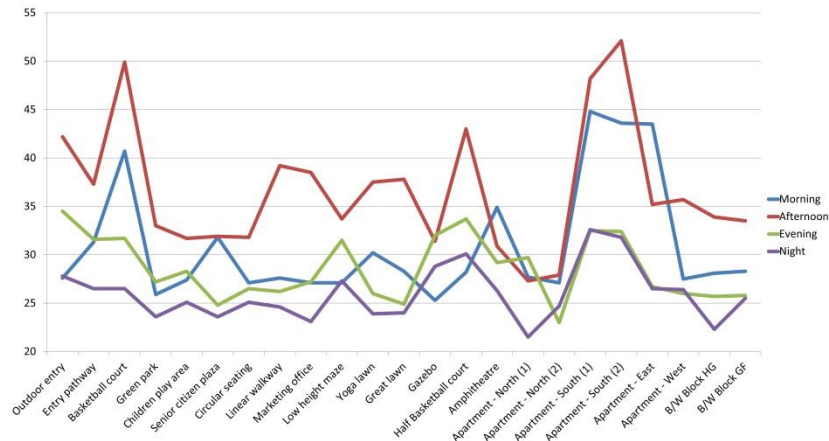


Fig 5.2.4 Surface temperature graph

WIND VELOCITY

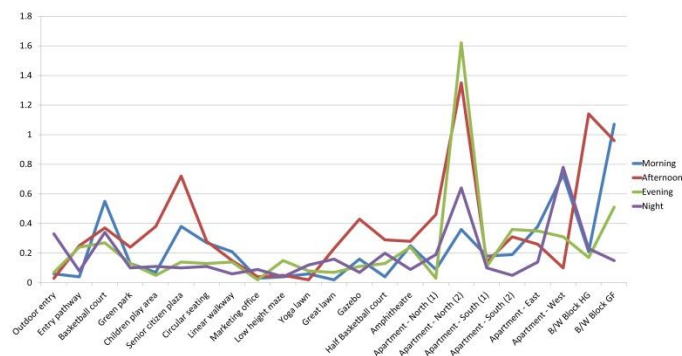


Fig 5.2.5 Wind velocity

At morning wind velocity is higher of 4.13m/s at the Mint entry located at South west and lower of 0.04m/s at swimming pool as it get obstructed by the building.

At afternoon wind velocity is higher of 3.52m/s at Mint entry and lower of 0.11m/s at Amphitheatre as it is not surrounded by vegetation.

At evening wind velocity is higher of 1.92m/s in the Mint entry and lower of 0.05m/s at CPA 2 due to obstruction of wind.

At night wind velocity is higher of 2.37m/s at Mint entry and lower of 0.011m/s in CPA 2.

5.3 MANTRI SYNERGY

LOCATION – PADUR



Fig 5.3.1 Plan



Fig 5.3.2 Zoning

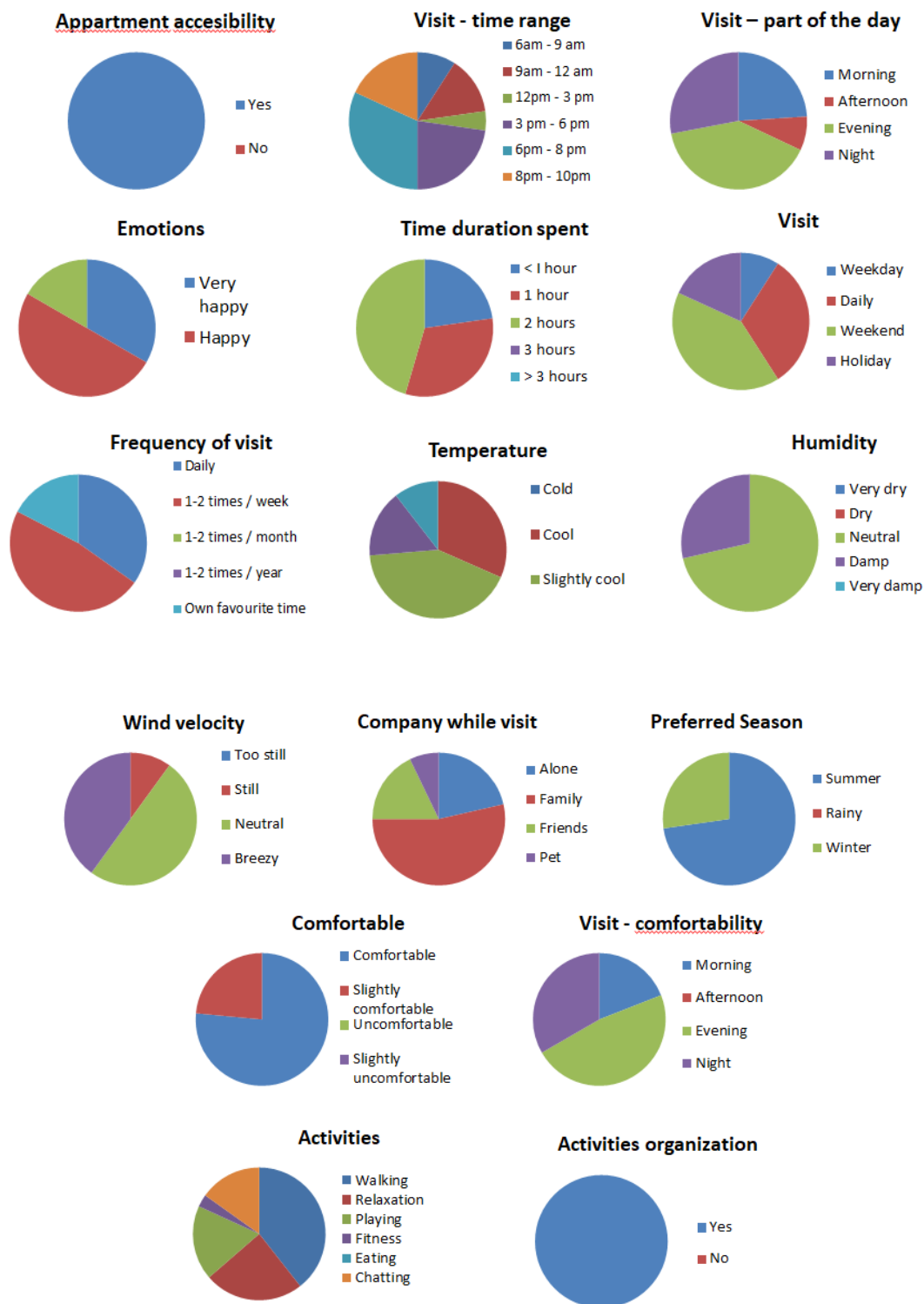


Fig 5.3.3 Questionnaire survey

5.4 OLYMPIA OPALINE



Fig 5.4.1 Plan

TEMPERATURE

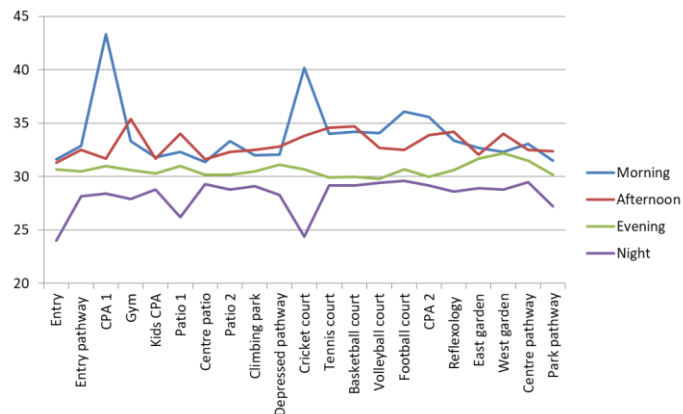


Fig 5.4.2 Temperature graph

At morning temperature is higher of 43.3°C at Children play area 1 located at West and lower of 31.4°C at Centre patio.

At afternoon temperature is higher of 35.4°C at gym since there is no shade and lower of 31.3°C at entry.

At evening temperature is higher of 32.2°C at west garden due to improper shading and temperature is lower 29.8°C at Volleyball court.

At night temperature is higher of 29.6°C at football court as there is no vegetation and lower of 24°C at entry as its surrounded by vegetation.

HUMIDITY

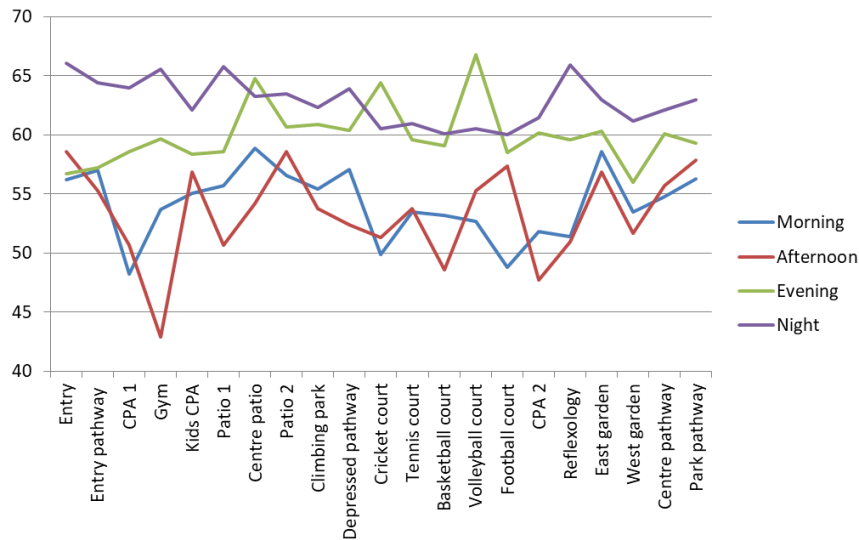


Fig 5.4.3 Humidity graph

At morning humidity is higher of 58.9% at Centre patio and lower of 48.2% at CPA 1.

At afternoon humidity is higher of 58.6% at Entry and lower of 42.9% at gym.

At evening humidity is higher of 66.8% at Volleyball court and lower of 56% at West garden.

At night humidity is higher of 66.1% at Entry and lower of 60% at Football court

Temperature and humidity are inversely proportional.

SURFACE TEMPERATURE

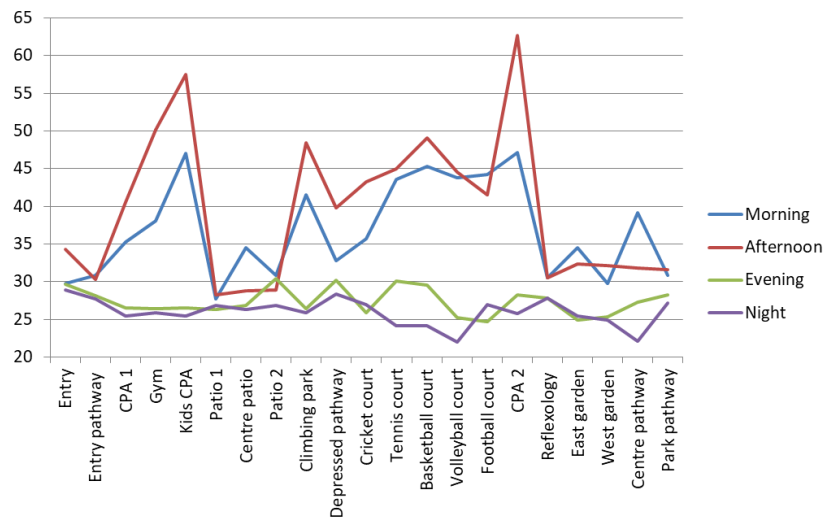


Fig 5.4.4 Surface temperature graph

At morning surface temperature is higher of 47.1°C at CPA 2 due to solar reflection of ground surface material and lower of 27.7°C at Patio 1 due to its shade.

At afternoon surface temperature is higher of 62.7°C at CPA 2 due to solar reflection of ground surface material and lower of 28.3°C at Patio 1 dues to its shade.

At evening surface temperature is higher of 30.1°C at Tennis court due to no shade and lower 24.7°C at Football court .

At night surface temperature is higher of 28.9°C at entry and lower of 22°C at Volleyball court.

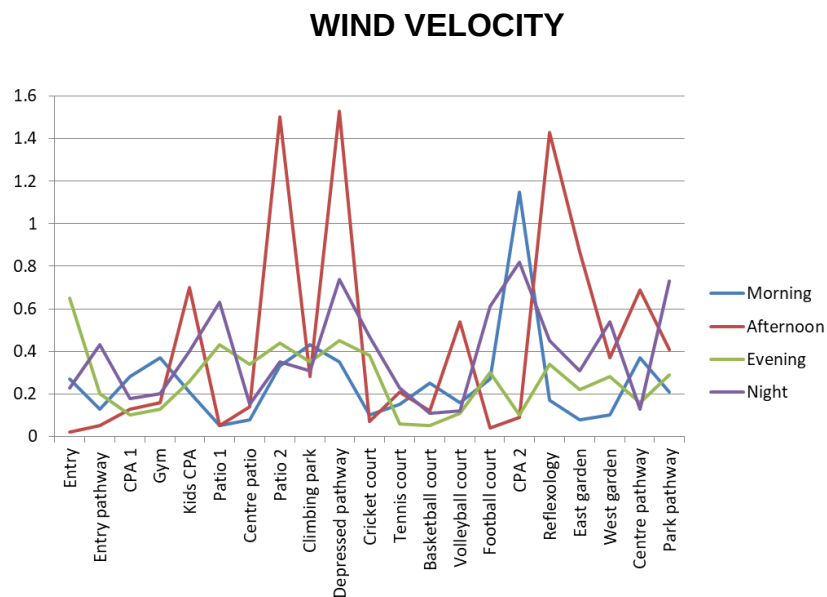


Fig 5.4.5 Wind velocity graph

At morning wind velocity is higher of 0.43m/s at the climbing park and lower of 0.05m/s at patio.

At afternoon wind velocity is higher of 1.53m/s at depressed pathway and lower of 0.02m/s at entry located at South.

At evening wind velocity is higher of 0.65m/s in the entry and lower of 0.05m/s at basketball court due to no vegetation at its periphery.

At night wind velocity is higher of 0.82 m/s at CPA 2 and lower of 0.011m/s in basketball court.

Table 5.1 Comparison between case study

S.NO	PARAMETERS	URBANRISE REVOLUTION ONE	OLYMPIA OPALINE	MANTRI SYNERGY	CLOVER BY RIVER
1	Location	Padur	Navalur	Padur	Kotturpuram
2	Area	12.75 acre	50 acre	27.79 acre	4 acre
3	Road width	18m road	18m road	18m road	11m road
4	Building typology	High rise	High rise	High rise	High rise
5	Building axis	North-South	East-West	East-West	North -South
6	No. of floors	19 floors	19 floors	13 floors	19 floors
7	Surface material	Pavement blocks,cement concrete	Pavement blocks	Pavement blocks	Paver blobks
8	Open space typology	Public	Private	Private	Private
9	Outdoor zone - axis	East-West	East-West	North-South	North west – South east
10	Vegetation	Yes	Yes	Yes	Yes
11	Sports	Basketball , football , green park	Basketball,football,tennis,cr icket,volleyball	Basketball,Cricket,Tennis	Basketball, Football
12	Walking track	Around periphery and outdoor zone	Around periphery and outdoor zone	Around periphery	Near outdoor recreation zone

CHAPTER 6

SITE STUDY AND ANALYSIS

6.1 SITE SELECTION

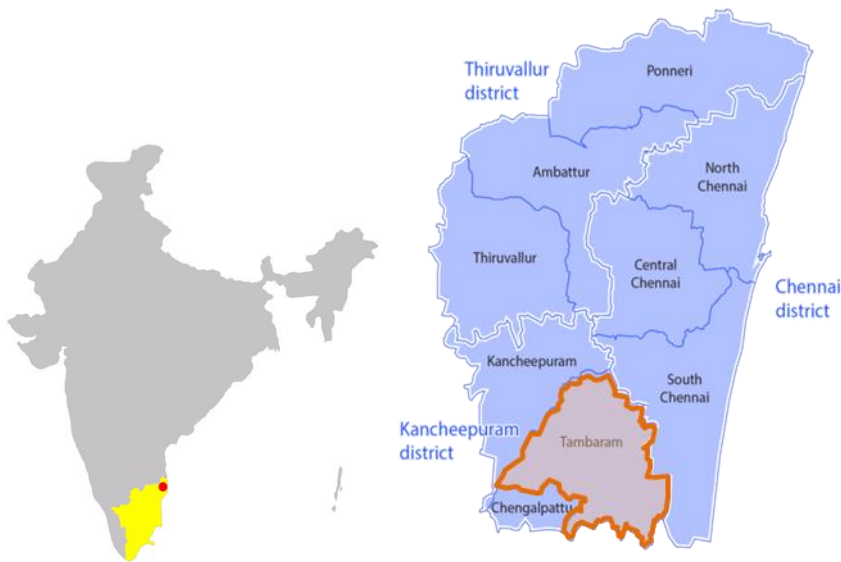


Fig 6.1.1 Site location

SITE LOCATION – TAMBARAM

6.2 SITE JUSTIFICATION

Area – 12.75 acres

21.35m primary road width

Site visit – 09.02.24

Why?

Easy access to central landmarks such as GST road, OMR road, koyambedu, anna nagar and ambattur.

Availability of hospitals, schools, colleges and entertainment facilities.

Proximity to IT parks

6.3 SITE ANALYSIS



LANDUSE MAP

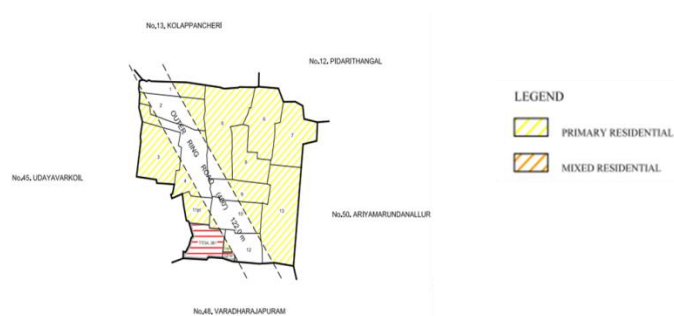


Fig 6.3.1 Landuse map

ROAD CONNECTIVITY



NEARBY ACCESS



Bus stop at 85m

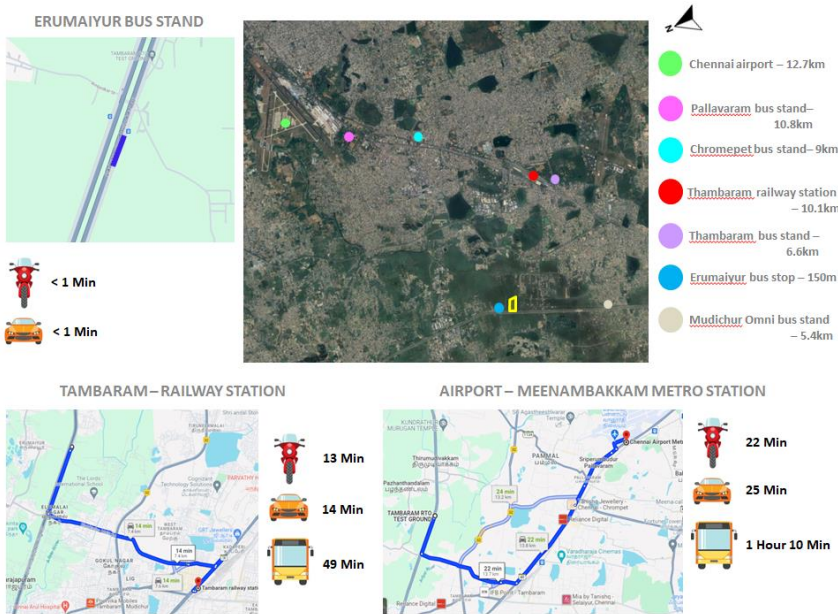


Fig 6.3.2 Connectivity

SITE MORPHOLOGY



2010



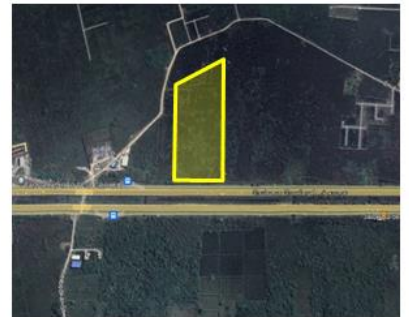
2013



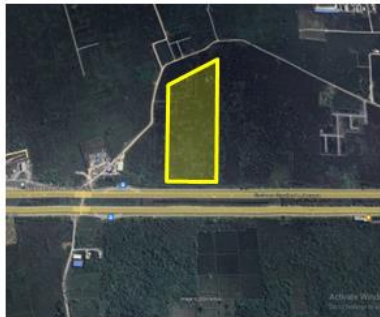
2018



2020



2022



2024

Fig 6.3.3 Site morphology



SITE SECTION

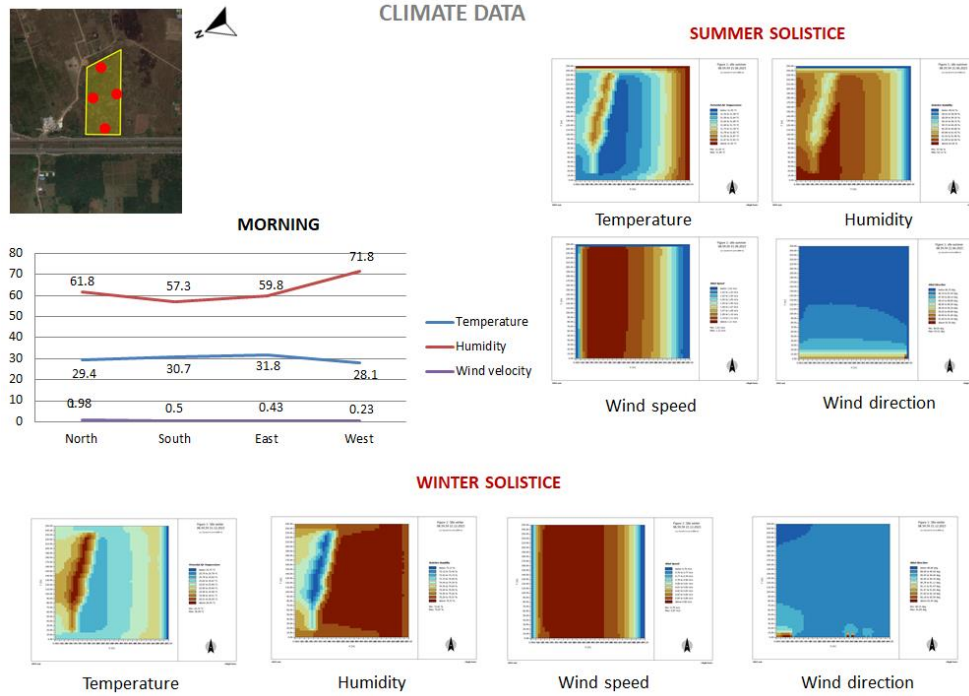


Fig 6.3.4 Morning data

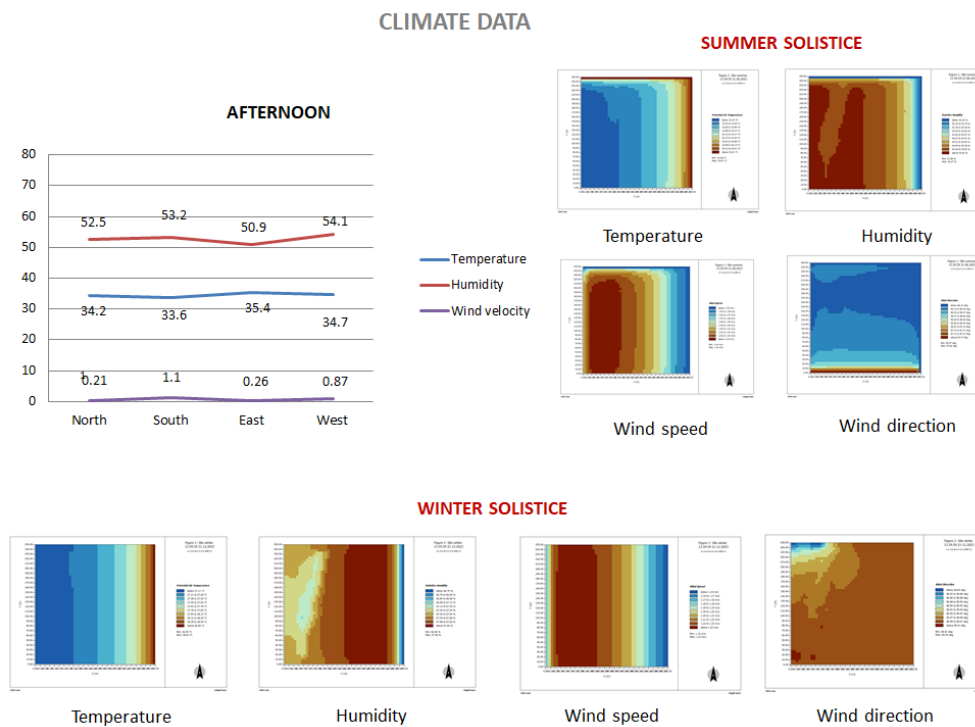
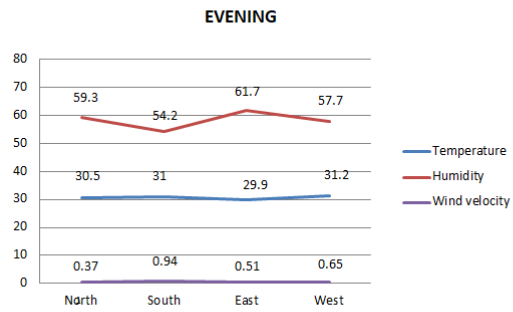
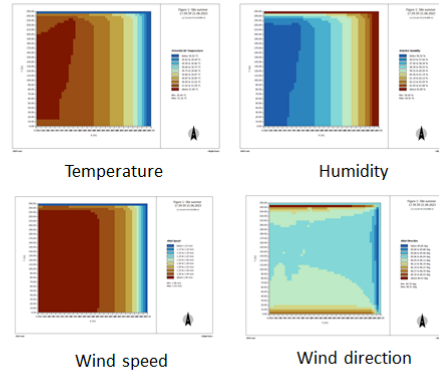


Fig 6.3.5 Afternoon data

CLIMATE DATA



SUMMER SOLISTICE



WINTER SOLISTICE

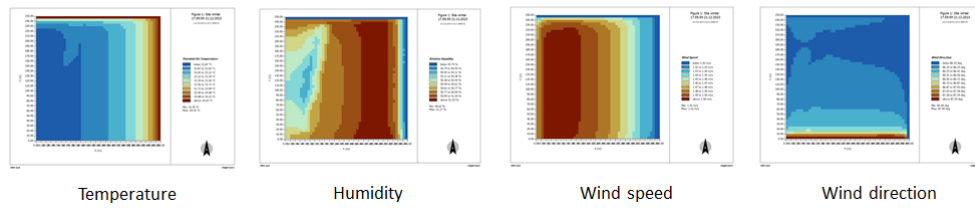
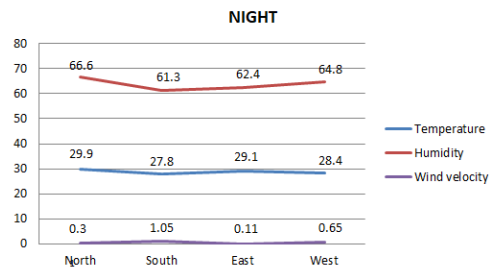
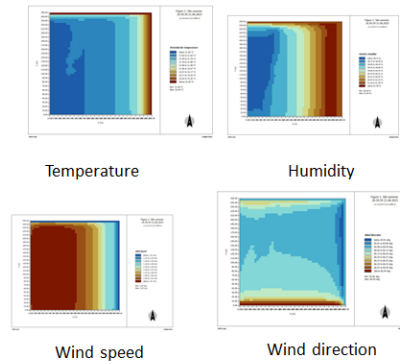


Fig 6.3.6 Evening data

CLIMATE DATA



SUMMER SOLISTICE



WINTER SOLISTICE

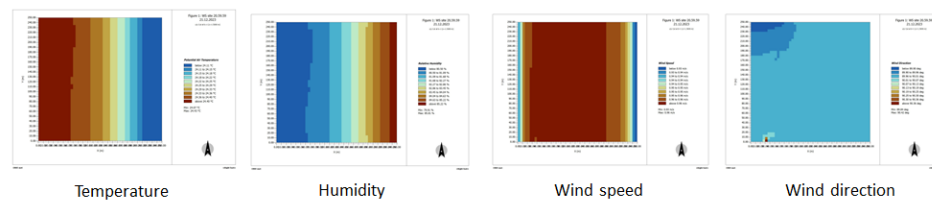


Fig 6.3.7 Night data

CLIMATE ANALYSIS



Fig 6.3.8 Climate data

CHAPTER 7

ZONING ANALYSIS

7.1 ZONING 1

ZONING

ZONING 1

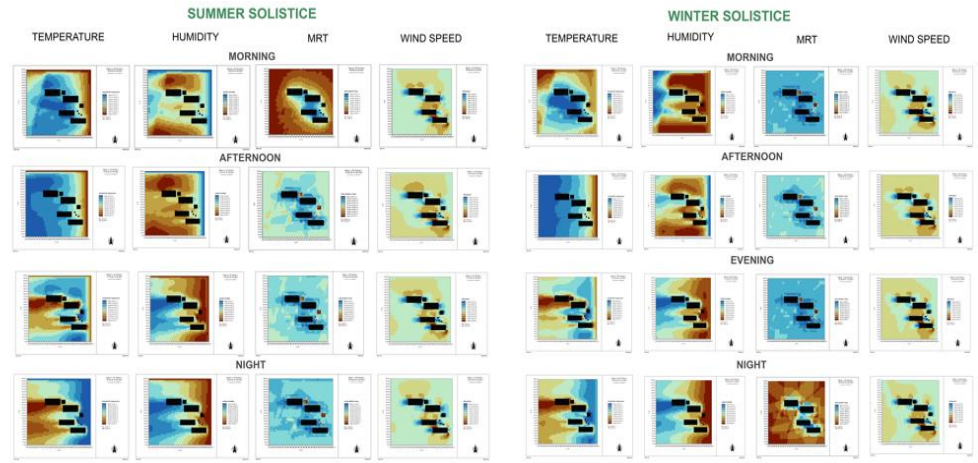


Basic rectangle building form is applied in North – South orientation.

Amenities are given in South west region it can be treated with vegetation and shade to reduce heat ain.

The ventilation is also compartively higher in this region.

Staggered position of buildings also influences the wind pattern.



7.2 ZONING 2

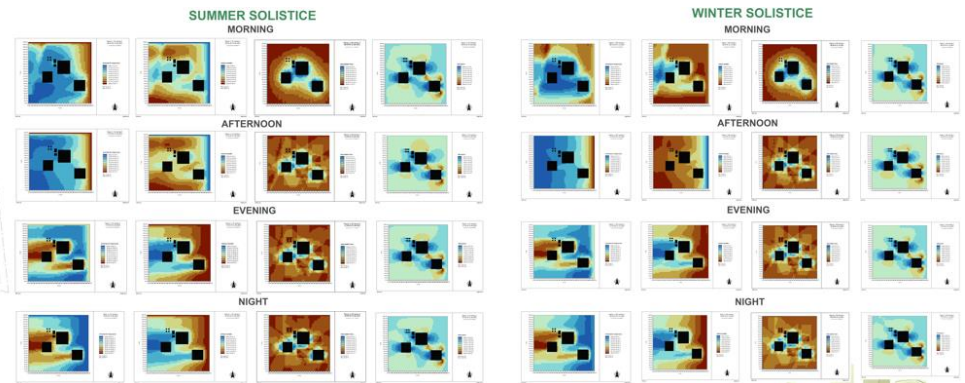
ZONING 2



Basic square building form is done in the layout.

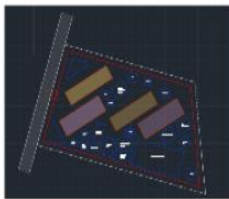
The amenities are given at the centre.

The west facade needs to be treated to reduce the solar radiation.



7.3 ZONING 3

ZONING 3



Inclined rectangle building form is applied

Amonities are given in South and east region it can be treated with vegetation and shade to reduce heat str.

The ventilation is also comparatively higher in this region

Staggered position of buildings also influences the wind pattern by venturi effect.



7.4 ZONING 4

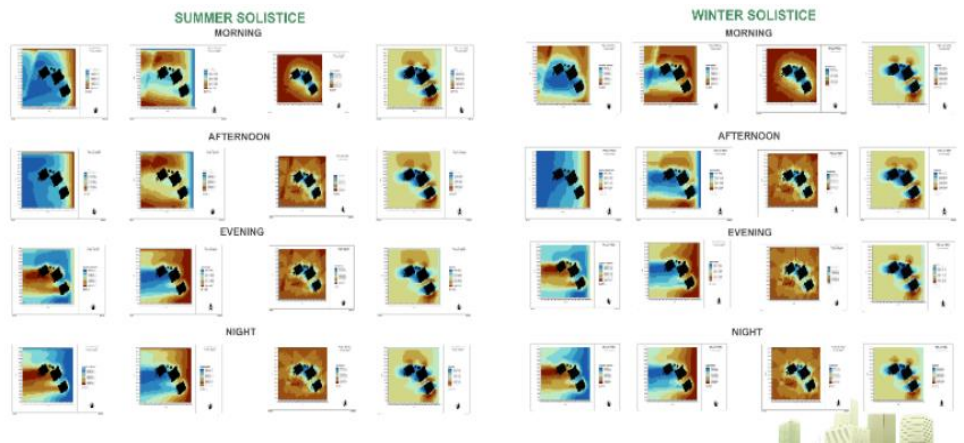
ZONING 4



Basic square has be tilted to 45 degrees.

The amenities are given at the centre.

To reduce the heat gain outdoor activities areas vegetation can be utilized.



7.5 ZONING 5

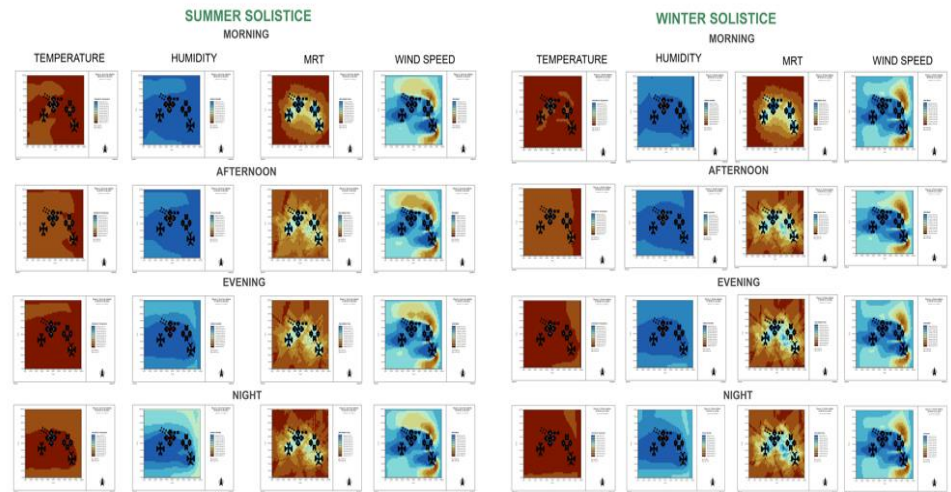
ZONING 5



Radial form is used here

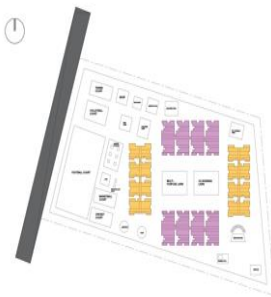
The building radiated from its circulation.

Amenities are given in between the buildings.



7.6 ZONING 6

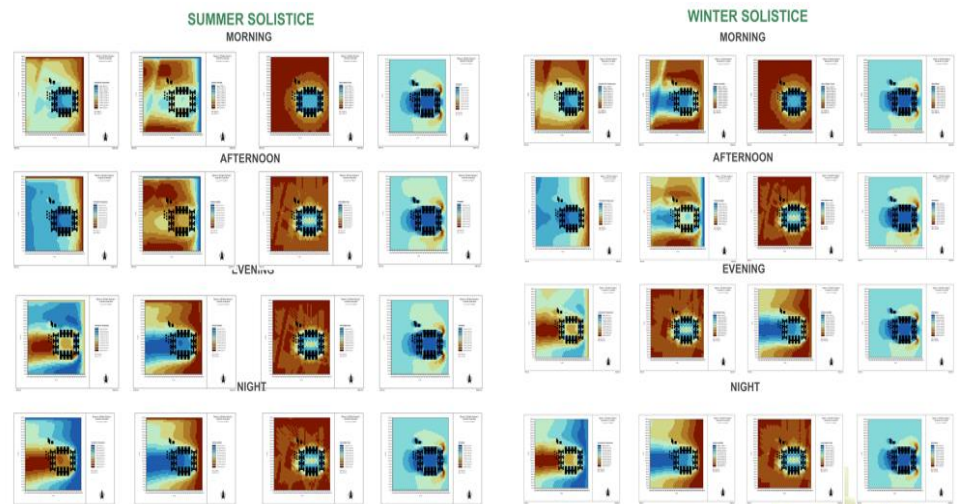
ZONING 6



North south orientation is applied.

The amenities are located at the west region.

Site is divided into 2 halves. The first half has amenities and the other half has apartment zone.



CHAPTER 8

CONCLUSION

8.1 RECOMMENDATION



Fig 8.1.1 Site plan

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