DESIGNING INNOVATIVE AND SUSTAINABLE AFFORDABLE HOUSING: ARCHITECTURE FOR SOCIAL JUSTICE.

A DISSERTATION

Submitted in Fulfilment
of the Requirement for the degree of
MASTER OF ARCHITECTURE

by
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Under the supervision of
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BBD UNIVERSITY

SCHOOL OF ARCHITECTURE AND PLANNING
BABU BANARASI DAS UNIVERSITY LUCKNOW

June, 2025

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Certified that **AR. RAVI KANT TIWARI**

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"DESIGNING INNOVATIVE AND SUSTAINABLE AFFORDABLE HOUSING: ARCHITECTURE FOR SOCIAL JUSTICE"

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ABSTRACT

The purpose of this study is to evaluate various parameters taken to make an energy efficient office building. This analysis explores the energy consumption of an energy efficient building. For this reason an energy-efficient building has been chosen as the case model. The selected energy-efficient building is located in Gurgaon with a composite atmosphere. The analysis examines the steps taken to make every energy efficient building. The case building was analyzed by comparing different active and passive strategies of an already existing Net Zero Energy office building with better energy performance in composite climate. After analyzing various parameters, the amount of energy consumed by different means was evaluated and the parameters were selected which holds the large share of the total energy consumption of the office building. Building simulation on the existing building case model, based on the parameter, is performed to understand the strategies that should be used in enhancingthe case building's energy efficiency and reducing total energy consumption. Moreover, the data were analyzed and recommendations were made to improve the energy performance and the current building's overall EPI.

ACKNOWLEGDEMENT

I would like to express my gratitude to my Dissertation Guides Assistant Professor
Prof. SAURABH SAXENA I am very thankful fortheir support, motivation, encouragement, and patience. Both professors gave me all the encouragement, knowledge, and support I needed to complete my dissertation. They provided me with the important advice, guidance and directions that was needed for my dissertation to be completed. Secondly, I would like to thank Professor PROF.KESHAV KUMAR and Assistant Professor AR. SATYAM SRIVASTAVA for giving me all the requisite guidance and time to teach and providing me with all required guidance for my dissertation. I would also like to take this opportunity to thank my faculty teachers, who throughout the year have been extremely helpful; their teaching, experience and personal advice have been of greatvalue to me. Last but not least, I would like to extend my gratitude to my family throughout the entire process for their continuous support and encouragement.

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CHAPETR 1 INTRODUCTION

1.1 BACKGROUND

The builder was born in Britain and followed Indian traditional law when it came to the cost and sustainability of building. Mahatma Gandhi's morals and ideas greatly influenced Laurie Baker. He was the one who used sustainable resources to create beautiful buildings that resisted India's inclination toward the West. His main concept was cost reduction, which has been accomplished by using the following methods: One of the most important requirements that many people in developing nations like India still do not have access to is housing. High-earners who can afford to purchase standard or normal housing units make up only 20% of the population.

The remaining 80%, who are middle-class and lower-class, are thus having difficulty finding reasonably priced housing. Nonetheless, owning a home is a fundamental human necessity. A house is more than simply a physical building; it is a symbol of security, stability, and self-respect.

In many nations, the housing market has changed dramatically during the last several decades. Housing demands have increased as a result of urbanization, economic growth, and mounting population pressures. This increasing demand is being met by the development of numerous large-scale housing complexes. However, because of the high cost of land and construction, these initiatives are either too costly or unavailable to many low-income individuals and families.

Over the past few decades, the housing sector has undergone significant transformation in many countries. Urbanization, economic expansion, and growing population pressures have all contributed to an increase in housing demand. Many large-scale housing complexes are being developed in response to this growing demand. However, many low-income individuals and families cannot afford these projects due to the exorbitant cost of land and construction. Therefore, a new strategy for housing is required, one that takes into account the majority's financial constraints. At this point, the idea of affordable housing becomes crucial. It is more than just a catchphrase; it is a deliberate strategy meant to lower housing costs for low-income individuals without compromising on safety or quality.

What Is Low-Cost Housing?

It's common to misunderstand affordable housing. Some individuals think it entails building subpar dwellings with inexpensive, low-quality materials. It's a misconception. In actuality, affordable housing refers to clever and effective building techniques that lower overall expenses while maintaining the quality, safety, and comfort of homes. The goal is to cut back on wasteful spending, not to sacrifice living standards. This entails using the best local resources, reducing waste, employing suitable building methods, and

making sure the house satisfies all structural and safety requirements needed for long-term use.

Tiwari (1999) asserts that planning and management play a major role in providing affordable homes. Its main goal is to cut expenses without sacrificing the house's functionality or quality of life by making effective use of regional resources, knowledgeable labor, and tried-and-true technologies.

Key Features of Low-Cost Housing

Use of Local Materials:

Use of Local Materials: Low-cost housing encourages the use of locally accessible building materials, such as stabilized mud blocks, fly ash bricks, bamboo, stone, and other resources unique to a certain area, rather than importing pricey ones. These materials are environmentally beneficial in addition to being cost-effective.

Indigenous Construction Techniques:

Local and traditional building techniques are frequently more economical and environmentally friendly. For instance, bricklaying techniques such as rat-trap bond brickwork can use fewer bricks while still being strong and insulating.

Efficient Design:

A carefully thought-out home plan can drastically cut down on building time and material waste. Construction and maintenance expenses can be reduced with small, energy-efficient designs that maximize natural light and space.

Phased Construction:

Miles (2000) proposed that affordable housing may be built in stages. This indicates that the house is constructed in phases based on the owner's financial situation. For instance, the fundamental framework can be built first, followed by the construction of further rooms and finishing touches.

Low Maintenance:

Long-term durability and low maintenance are factors considered while choosing materials and methods. The intention is to construct homes that don't need costly maintenance or frequent repairs.

Energy Efficiency:

To consume less electricity, homes are built to maximize natural airflow, sunlight, and insulation. This encourages sustainable living and reduces utility costs.

Skill Development and Local Labor:
Training and hiring local workers is a common component of low-cost housing projects,

which strengthens the local economy and guarantees that building methods are suitable for the environment and culture of the area.

Effective Project Management:
Effective time, labor, and material management is essential to minimizing expenses. Delays and cost overruns can be avoided with careful planning and scheduling.

Why Low-Cost Housing Matters

It is impossible to overestimate the significance of affordable housing. It directly raises the level of living for lower-middle-class and impoverished people. Better employment, education, and health outcomes are correlated with stable housing. Furthermore, from an economic standpoint, affordable housing boosts the building sector and generates employment, particularly in rural and semi-urban areas.

Slums and informal settlements frequently arise in urban areas as a result of a shortage of reasonably priced housing. These places frequently lack basic safety, sanitary facilities, and infrastructure. In addition to helping with urban planning and development, affordable housing offers a planned, healthier substitute that raises the standard of living for the urban poor.

Obstacles and Things to Think About

Although there are many advantages to affordable housing, there are also certain drawbacks to take into account:

• The general public's and builders' ignorance of alternate building methods.
• A reluctance to embrace new technologies because of perceived risk or unfamiliarity.
• Regulatory obstacles that might not encourage creative or unconventional designs, such as building codes and land approval procedures.
• Financial challenges: a lot of low-income families still have trouble getting financial aid or housing loans.

Public-private collaborations, legislative changes, and government assistance are necessary to overcome these obstacles. For instance, the Pradhan Mantri Awas Yojana (PMAY) and other programs in India provide financial aid, incentives for developers, and subsidies in an effort to build affordable housing.

2. AIM

To understand how various materials and construction techniques can influence the cost factor in low-cost housing projects.

3. OBJECTIVE

- To examine the present one house scenario in Lucknow region.
- To study various Construction techniques that can be used to reduce the cost of construction.
- Study of alternative materials which can be used for Low-cost housing.
- Cost estimation of normal building and identifying the percentage reduction in cost for the low-cost building.
- To Understand the Low-Cost Housing parameters.
- BOQ (Bill of Quantity).

1.4 NEED

1.4.1.1 One of the most urgent issues facing developing nations is the demand for sustainable and reasonably priced housing. Economic disparity, urbanization, and rapid population expansion have resulted in a severe lack of decent, affordable housing, particularly for low-income families. Due to the high cost of building and land, most people in countries like India cannot afford conventional houses. Because of the increasing need for housing, affordable housing is now not only necessary but also relevant. But merely constructing inexpensive homes isn't the answer. The emphasis must be on cost-effective building methods that preserve livability, durability, and safety. This necessitates a careful examination and evaluation of substitute building supplies, techniques, and technologies that can accomplish these objectives.

1.5 SCOPE

1.5.1.1 The study focuses on investigating and evaluating economical building methods for creating cheap homes, particularly in developing and low-income areas. The use of regional resources, alternative construction techniques, cost analysis, sustainable design, and governmental regulations are all included. Assessing actual affordable housing projects in order to find best practices and workable solutions is another aspect of the scope. The study's overall goal is to offer information that can lower building expenses without sacrificing sustainability, safety, or quality.

6. LIMITATION

• **Geographic Restrictions:** Because of geographical variations in climate, building materials, and construction techniques, the study's conclusions could not be generally

applicable.

• **Data Availability:** Particularly in the informal housing sectors, there is little access to current and trustworthy data on construction techniques and costs.

• **Local Government Policies:** Zoning and regulatory regulations may limit the use of specific low-cost housing strategies, which could compromise their viability.

• **Technological Barriers:** The adoption of some low-cost construction techniques may be hampered by a lack of local expertise or technology.

• **Financial Restraints:** Even when more cost-effective building techniques are available, low-income groups might not have enough money to invest in inexpensive housing.

7. METHODOLOGY

The research approach is teleological (where the process is crucial), and a hybrid technique of both quantitative and qualitative analysis is used for the study of low-cost housing in the EWS sector. The research methodology will be as follows:

a) Conduct literature review and data collecting on low-cost housing.

b) Analysis of current low-cost housing trends in Delhi.

c) Analyzing present materials and techniques. d) Introducing sustainable materials for faster construction.

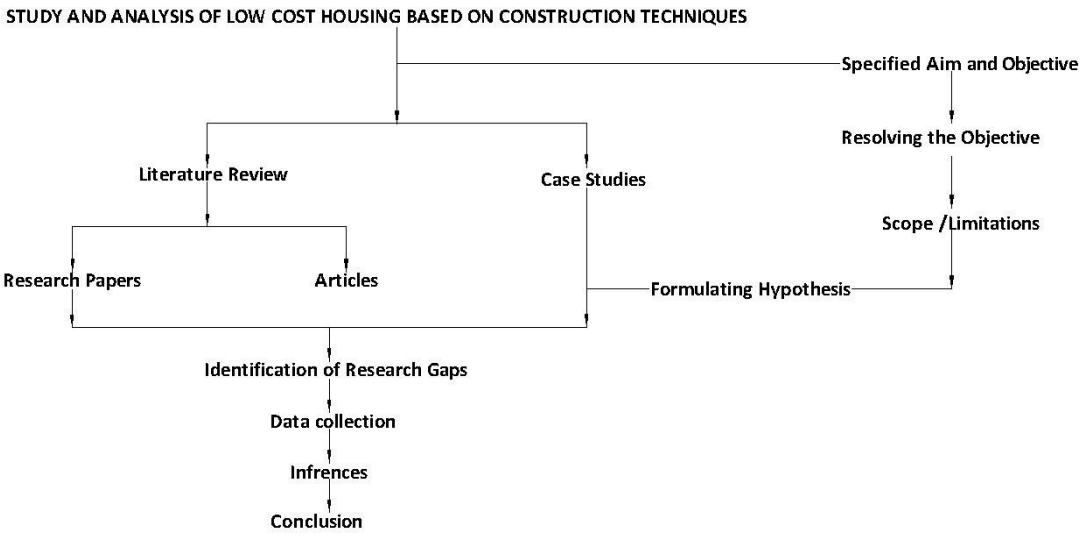
e) Interviews with prominent individuals who operate in low-cost construction.

g) Case study and inference.

g) Estimating the size of an EWS housing.

Analysis of the cost factor in traditional materials v/s new conventional materials that are used in the making of the dwelling.

a) Analysis of data and conclude inference.



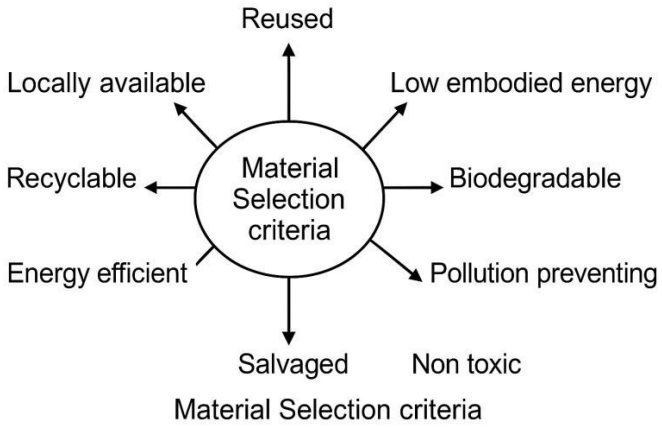


Figure 1 material selection criteria

CHAPTER 2 PARAMETERS FOR MATERIAL SELECTION

The structure's current pattern is pre-construction building and post-building stages. Each step of the building should be designed with the purpose of cost efficiency. These three periods show how materials evolve through different phases of a structure. The pre-building phase is assembly, which is further categorized into preparation, pressing, and transport. The primary components of the structural stage consist of development, activity, maintenance, and elimination. The selection of building materials is based on the performance of the material and its minimal environmental impact. Beyond a material or product's recognized core function, like insulation, its contribution to other areas of building performance may be prudently disregarded. Important characteristics such as hygrothermal and latent performance. This should be taken into consideration while choosing insulation materials.

The selection of building materials is a very complex decision that needs to be taken into account. By encountering a balance between cost, durability, sustainability, thermal and acoustical insulation, fire resistance, affordability, availability, adaptability, and regulatory compliance the built structure can be a production of high quality, sustainable, and ideal. A wide variety of applications are made with building materials to satisfy the functional and empathetic needs of an interior environment. Within the building industry, various disciplines concentrate on the most effective way to select materials that will meet these requirements. In the selection of material for a specific application, each quality is verified in order to avoid any hazard. The method described broadens the parameters of selection by evaluating other factors.

1. ENVIRONMENT FRIENDLY

The assembly of building components should be condition appropriate. Efforts should be made to investigate and improve the innovations for supplying high-quality assembly. Effective structural materials should reduce waste produced during manufacturing.

2. RECYCLED WASTE

Masonry waste can be reused, whilst timber waste can be used in the assembly of compressed wood or sensitive sheets.

3. Use of Natural Low Cost

Typified energy refers to the absolute amount of energy required to form material. The greater the amount of energy trapped in a material, the more significant the use of non-renewable sources. It is thus advantageous to use materials or composite materials derived from waste.

4. Locally Available building materials

The use of local resources reduces dependency on transportation, which incurs substantial structural material costs over long distances. The use of locally available building materials reduces construction costs while also being environmentally friendly.

5. Energy Efficient Building Materials

The energy efficiency of a building material can be measured using many criteria like as its R-value, concealing coefficient, and glowing productivity. Energy-efficient materials must reduce the amount of produced energy.

6. Non – Toxic Building Materials

The use of hazardous structural materials can have a significant impact on the well-being of individuals and building occupants. In this regard, it is appropriate to use non-poisonous building materials for development. There are a few synthetic compounds, such as ammonia, pitch resin chemicals for protection, plyboards for decoration, and building materials. The impact on the strength of these toxic materials must be considered while selecting them, and they should only be used where absolutely necessary.

7. Longevity, Durability, And Maintenance

The strength of the material is a very crucial factor when selecting a building material for construction purposes. It shows the materials' ability to withstand stress such as shear, tension, and compression. Sturdy materials guarantee that loads are efficiently carried through the structure of the building. By opting for this method localized stress areas that might cause material fatigue and failure are prevented. Architects may employ high-strength materials to create more inventive and aesthetically beautiful structures. They maintain structural integrity while enabling the creation the construction of lofty structures, wide spans, and distinctive designs without sacrificing structural integrity. An extended building's life span and safety standards can be raised by incorporating materials that are designed to withstand over time without defects and degradation. Strong development of materials not only increases the life of the project but also reduces the support cost. Reduced maintenance charges typically save a significant amount of construction operating expenditure.

8. Recyclability & Reusability

The material should be accessible in a recyclable or reusable form. For example, plastic trash can be reused to create new materials. The steel can be used to make RCC bars, limiting spreads, and other incidental things in building construction..

9. Biodegradability

When disposed of, the material should be able to naturally degrade. Common or natural materials would decay quickly. It is also important to consider if a substance decomposes naturally or emits toxic gasses.

10. COST-EFFECTIVENESS

Cost plays a vital role in building material selection criteria for construction usage which includes not only the initial cost of the material but also its ongoing maintenance, installation, but also long-term maintenance costs. The more stored energy of a substance, the greater the exploitation of non-exhaustible sources leading to the beneficial use of waste-derived composite building materials. Time savings on building projects and labor costs can be achieved by using materials that are quicker and easier to install. Fast construction can have a positive economic impact by reducing labor costs and

completing the project sooner than expected time. Choosing materials that are cost-efficient saves overall cost offer less amount of maintenance and are more resistant to harm the structure minimizing the need for costly repairs and maintenance, which also leads to a reduction in expenses over the lifecycle of the building. Choosing locally accessible materials is more low-cost due to the elimination of transportation costs hence selecting locally available materials minimizes overall projects. Selecting affordable materials that adhere to building codes and standards can help assist prevent legal issues and unnecessary costly repairs and replacements post-construction.

11. THERMAL PERFORMANCE

Insulating materials using less energy for heating and cooling that reduce heat transmission can minimize the consumption of utility bills and impact on the environment. It is very beneficial to the regions where there are significant fluctuations in temperature, efficient thermal insulation is particularly crucial. Thermal comfort is very essential for the health and productivity of the user. Superior thermal performance materials regulate the temperature preventing hot and cold patches in summer and winter to create a more liveable working environment and enhance occupant's lifestyles. Many building codes and standards mandate minimum requirements for thermal insulation performance. Choosing materials that fulfill these specifications may be necessary to obtain building permits or certifications.

12. ACOUSTIC PROPERTIES

The acoustic needs of various building spaces depend on the user and the activities happening. For example, good acoustics are necessary for instance, good acoustics are important for music performances in auditoriums, theatres, and concert halls, meanwhile in libraries, recording studios, and hospitals quiet environment is required. Privacy can be a very important factor for infrastructures such as conference rooms, hotels, offices, and residential dwellings. Acoustic materials increase the occupants' sense of security and privacy reducing the risk of confidential conversations being overheard. Prolonged exposure to high decibel levels of noise can lead to several health concerns, including heart problems, anxiety,depression, and insomnia.

Acoustic materials can help contribute to creating healthier, and more comfortable interior spaces which improves user's well-being and mental health by minimizing noise pollution. Therefore, acoustical materials improve
the usability and functionality of the area by adjusting the sound environment as per the requirements of the user. Acoustic performance should thus be
taken into consideration including other factors such as structural integrity, thermal performance, and physical appeal.

CHAPTER 3 MODERN CONSTRUCTION TECHNIQUES THAT CAN BE USED

Following are the modern construction methods that are widely used in developing nations:-

3.1 3D Volumetric Construction

Using this particular development innovation, 3D units are manufactured in controlled processing plant settings using the necessary development and construction resources. Completed units are transported to the site in various modules, fundamental underpinning squares, or final finished up units with all luxuries introduced, for assembly. Blocks can be raised fast at the site and have features of solid-like fire retardancy, sound resistance, and warmth.

Figure 2 3D volumetric construction

3.2 Precast Flat Panel Modules

These are essentially wall and floor modules that are constructed away from the actual site and then transported to the site for assembly. Load-bearing components such as ornamental cladding and insulating panels can also be manufactured. Also known as cross-divider development, the idea has gained traction as a result of persistent commitment to goals, simplicity, and rapid progress.

Figure 3 Pre-engineered Precast Flat Panel system

3.3 Tunnel Formwork System

This burrowing approach accelerates development for cell structures with repetitious patterns by constructing solid divisions or units in a single activity every day. Speedy work is accomplished by combining formwork and prepared blended cement with the comfort and vigour of industrial facility settings. Cranes are used to stack tunnel formwork and use it on-site.

3.4 Precast Foundation Technique

Foundations can be built quickly using precast concrete modules provided in a production line with a high-quality residual. Foundation-related building construction components gain strength from interconnected concrete piles. This method allows development activity to continue even in harsh conditions and restricts exhumation movement.

3.5 Hybrid Concrete Building Technique

This technology improves development turnaround time by combining the advantages of cement pre-projecting with on-site building. Quality improves when the cost of development falls. Crossover concrete constructions are easy to assemble, serious in nature, and perform consistently.

Figure 4 Hybrid Concrete construction

CHAPTER 4 CONVENTIONAL MATERIALS FOR LOW-COST HOUSING CONSTRUCTION

4.1 Wall Construction Materials

Burnt Clay Bricks are traditional bricks manufactured by molding clay and heating it in a kiln. These bricks are robust, fireproof, and widely used in building.

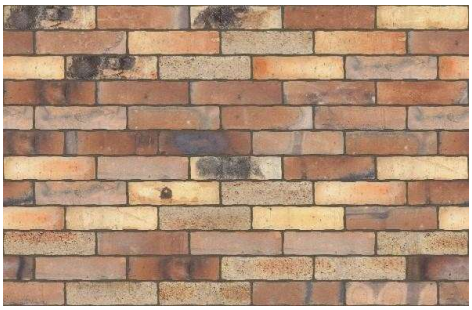


Figure 5 Wall Construction Materials

4.2 Fly Ash Bricks

Bricks are created of fly ash (a byproduct of coal combustion), cement, sand, and water. They are lightweight, affordable, and environmentally beneficial.

Figure 6 Fly Ash Brick

4.3PROPERTIES OF FLY ASH BRICKS

Strength And Durability

Fly exhibits high compressive strength varying from 7.5 Mpa to 10 Mpa

depending on the manufacturing process and mix design. The high strength makes it appropriate for load-bearing structures ensuring long-term durability and stability. Superplasticizers, silica fumes, and fibers can help reduce the water content while increasing the workability and strength of the bricks.
Proper curing of these bricks can also affect the durability of bricks, by adding inadequate curing will lead to poor strength development. Steam curing or autoclaving can increase the strength gain.

Thermal Performance

Fly ash bricks exhibit low thermal conductivity making them efficient heat-insulators. This aspect regulates the temperature inside the structures, reducing the energy consumption emitted from heating and cooling purposes. Lower the thermal conductivity and lower the resistance property of heat penetration from any external sources. Due to this rapid change in temperature due to thermal shock stress builds up leading to cracks or rupture. Fly ash bricks have good thermal shock, designed to withstand this rapid change in temperature without any risk of damage or crack. This property is very essential when exposed to alternating heat and cooling cycles.

Acoustic Insulation

Acoustic insulation refers to the ability of a material to reduce the sound waves transmission. Fly ash bricks can absorb sound energy at a variety of frequencies, particularly in the mid to highfrequency range. Fly ash bricks possess the qualities that make an effective acoustic insulation which is best for the structural quality of the structure and is known for its eco-friendly nature. Proper construction techniques for fly ash brick walls with seal-proof insulation can have acoustic properties. Fly ash bricks can contribute to creating a more comfortable indoor environment, promoting sustainability and eco-friendliness

Environmental sustainability

Since the primary material for the composition of fly ash bricks is fly ash, which is a by-product of industrial waste from landfills which reduces the environmental pollution utilizing the waste from disposal sites, this waste contributes to the conservation of natural resources and reduces the impact of coal combustion of impact on the environment. The technology used in manufacturing the fly ash bricks consumes less energy such as the hydraulic press, compared to the burnt clay bricks manufacturing process resulting in a reduction the carbon emissions and consumption of energy making it energy

efficient. By substituting clay with fly ash, the carbon emissions associated with manufacturing bricks are significantly reduced making fly ash bricks more environmentally sustainable.

Cost-efficiency

Fly ash is often available for very cheap or sometimes even free of charge compared to raw materials used in clay brick manufacturing which reduces the cost associated with the production of fly ash bricks making it a cost-efficient building material. Fly ash bricks are larger and lightweight compared to clay bricks which accelerate the speed of construction time.

Fire-resistance

Fire resistance is a very important criteria in construction materials, especially in fire-hazard regions. Fly ash bricks offer very visible fire-resistant properties, making them a favourable choice in building construction. These materials are cured to form a solid brick structure. The ability to withstand fire is the result of a cementitious matrix of fly ash and cement. The high temperature tolerance makes the fly ash bricks suitable for the application of fire-rated walls, fire barriers, chimneys, partitions, and enclosures. These bricks provide an additional layer of production against fire hazards, ensuring the safety of occupants since are manufactured according to building codes and standards for the requirements of fire rating.

Workability

The properties of raw materials used in the manufacturing of fly ash bricks including the chemical composition of fly ash, and the workability of the design mix improve the workability by strengthening the cohesiveness of the mix. The water-cement ratio of the fly ash brick plays a crucial role in its workability since excess water can lead to bleeding and segregation while less than the required amount of water might reduce the strength or durability hence to attain the requisite consistency water content needs to be evaluated carefully. Well-worked brick with uniform dimensions leads to a final construction with constant performance with aesthetics in the finished structure.

ADVANTAGES	DISADVANTAGES
Lightweight – 75% lighter than traditional concrete	Higher Initial Cost – More expensive than conventional concrete
High Strength & Flexibility – Resists cracking and deformation	Requires Skilled Labor – Proper mixing and application are essential
Durability & Corrosion Resistance – Ideal for outdoor & marine environments	Limited Structural Application – Not suitable for load-bearing elements
Energy Efficient – Provides thermal insulation	Glass Fibre Durability Issues – Can degrade over time if not well-protected
Sustainable – Uses less raw material & lower carbon footprint	Complex Mixing Process – Needs careful proportioning of ingredients
Aesthetic Versatility – Can be molded into different textures & designs	Brittle in Some Conditions – Needs reinforcement in large applications

ADVANTAGES AND DISADVANTAGES OF FLY ASH BRICKS

3. Compressed Stabilized Earth Blocks (CSEB)

1. Compressed Stabilized Earth Blocks, or CSEBs, are environmentally friendly building blocks manufactured primarily from earth, with a tiny quantity of cement or lime and water. These blocks are a modern take on traditional mud bricks, but they are stronger, more lasting, and more consistent.
   This is how it works.
   1. Local soil is gathered, typically consisting of sand, clay, and silt.
   2. To strengthen and extend the life of the blocks, add a little amount of cement or lime (5-10%).
   3. The mixture is compacted with a manual or mechanical press to form a solid block.
   4. The blocks are air-dried instead of burnt in a kiln, reducing energy use and pollutants.

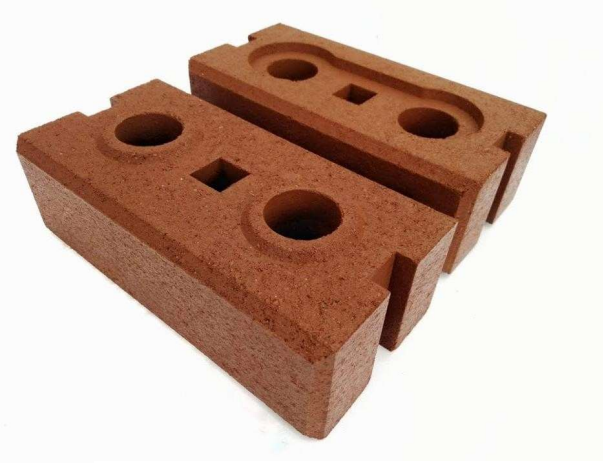


Figure 7 CSEB Brick

4.4 Mud Bricks

Mud bricks, often known as adobe, are among the oldest and most environmentally friendly building materials used by humans. They are made by combining natural ingredients like mud, clay, sand, and sometimes straw or other organic fibers, then forming the mixture into bricks and drying them in the sun.

What are mud bricks?

Mud bricks are sun-dried building blocks made from a variety of earth materials. Unlike burnt bricks, they are not roasted in kilns but rather harden in the sun's heat. This method has been utilized for hundreds of years and remains popular in many parts of the world due to its simplicity and environmental friendliness.

How Are Mud Bricks Made?

- Collect dirt that is high in clay and sand.
- 2. Combine soil, water, and organic components like as straw to increase strength and prevent cracking.
  3. Molding: Using molds, form the mixture into bricks.

  4. Let the formed bricks cure in the sun for a few days until firm.
  Benefits of Mud Bricks:
  • Eco-Friendly: Made from natural, locally sourced materials, with minimal environmental impact.
  • High thermal mass regulates indoor temperature and keeps homes cool in warmer climates, making them more energy efficient.
  • Low production costs make mud bricks affordable for low-income households. • Biodegradable, allowing for safe return to the land.

Limitations

Water Sensitivity: Can lead to erosion if not properly protected from rain.
Low structural strength compared to burned bricks, making it unsuitable for high-rise buildings.
Regular maintenance may be necessary, particularly in locations with significant rainfall.

Figure 8 MUD BRICK

4.5 Rammed Earth Walls

Rammed earth walls are an environmentally benign construction method that has been utilized for thousands of years. They are formed by compacting a mixture of soil, sand, gravel, and, in some cases, cement or lime into strong, solid walls. These walls are not only strong and load-bearing, but they also have a beautiful, natural appearance. With increased interest in sustainable construction, this ancient approach is making a strong comeback.

How Are Rammed Earth Walls Built?

1. Setting up the Mold (Formwork): Temporary frames, typically plywood or metal, are used to shape the wall.
2. Mixing Materials: Create a somewhat damp mixture of soil, sand, gravel, and a little amount of stabilizer (5-10% cement or lime).
3. Layering and compacting: Add the mix in 10-15 cm thick layers to the formwork. Each layer is carefully crushed with a rammer, reducing volume and increasing wall density and strength.
4. Formwork Removal: After finishing the area, remove the mold to expose a smooth, stone-like wall.
5. Curing involves allowing the wall to dry and harden over time, enhancing its strength.

Why Choose Rammed Earth Walls?

- **Eco-Friendly**: Uses natural, local materials to reduce costs, transportation, and pollution.
- **Energy Efficient**: Thick walls collect heat during the day and release it at night to keep buildings comfortable.
- **Strong and Durable**: Properly built, these walls can last for centuries.
- **Fire Safe**: They are fire-resistant due to their density and non-flammable material composition.
- **Naturally Beautiful** Their rustic, earthy style complements both modern and classic designs.

Advantages

- **Environmental Sustainability**: Uses locally sourced, natural resources to reduce transportation emissions and environmental effect.
- **Thermal Mass**: Thick walls assist regulate indoor temperatures by absorbing heat during the day and releasing it at night.
- **Durability**: Properly made rammed earth walls can last for generations.
- **Fire Resistance**: Rammed earth is very resistant to fire due to its dense and non-combustible nature.

- **Aesthetic Appeal**: Natural, earthy appearance that can be left untreated or completed with various treatments.

Figure 9 Rammed Earth Wall

4.6 Roofing Materials

Reinforced Cement Concrete (RCC) Slabs RCC slabs are an essential component of modern construction, particularly when it comes to creating strong and sturdy floors and roofs. They mix concrete, which is effective at handling pressure (compression), and steel bars, which are robust against pulling forces (tension). Together, they form a strong and load-bearing structure.

How Are RCC Slabs Built?

1. **Formwork Setup**: Use temporary molds made of wood or steel to form the slab and secure the concrete.
2. **Placing Steel Bars**: Position steel rods or meshes within the mold as per design.
3. **Pouring Concrete**: Pour a mixture of cement, sand, gravel, and water onto the steel bars.
4. **Compacting** Vibration removes air bubbles and strengthens the bond between the concrete and steel.
5. **Curing**: Keep the slab moist for a few days to ensure adequate hardening and strength.

Advantages of RCC Slabs

Very Strong: Strong enough to handle huge loads in multiple-story constructions.

- **Long-Lasting**: Durable, resistant to weather, fire, and pests.
- **Flexible in Design**: Flexible design allows for a variety of shapes and sizes.
- **Fire-Safe**: Concrete is fire-safe, protecting the steel inside.

1. Ferrocement Roofing Panels

Ferrocement roofing panels are made of steel reinforcement (mesh) integrated in a cement-based matrix. These panels are normally precast (molded) and then put on top of a structure. The material combines the flexibility and strength of steel with the durability of concrete, making it an excellent choice for roofing in low-resource areas.

Construction Process of Ferrocement Roofing Panels

1. **Creating the Frame**: Steel reinforcement, such as wire mesh or rebar, is formed into a grid or framework.
2. **Application of Cement Mortar**: Mix cement, sand, and water to create a firm coating on the mesh.
3. **Curing**: Panels are hardened for a few days before transportation and installation.
4. **Installation**: Panels are fastened to pre-designed supports or beams, forming the roofing system.
5. **Advantages of Ferrocement Roofing Panels**

- **Strength and Durability**: The steel mesh and cement combination of the panels ensures strength and durability, preventing cracking and weathering.
- **Cost-Effective**: Compared to other roofing solutions, the materials utilized are affordable and readily available locally.
- **Fire and Weather Resistant**: Ferrocement is fire and weather resistant due to its solid construction and lack of combustibility.
- **Lightweight**: Ferrocement panels are lightweight compared to typical materials like concrete slabs, making them easier to handle and install.
- **Eco-Friendly**: Ferrocement is eco-friendly as it uses local materials and has minimum environmental impact, particularly in rural or resource-constrained locations.

- **Considerations for Ferrocement Roofing Panels**
- **Skilled Labor Required**: Skilled labor is required for constructing ferrocement panels, including mesh framework and proper cement mortar application.
- **Maintenance**: Ferrocement roofs require maintenance to prevent moisture buildup and neglect-related damage, despite their durability.
- **Curing Time**: Curing time for these panels may cause building delays.

Where Are Ferrocement Roofing Panels Used?

- **Low-cost housing**: Low-cost housing, particularly in poor countries.
- **Temporary structures**: Temporary constructions are quick to install.
- **Industrial buildings and sheds**: buildings and sheds: Low-cost, durable roofing options.
- **Schools, hospitals, and community centers**: Schools, hospitals, and community organizations sometimes have restricted funds.

Figure 10 Ferrocement roofing Panels Used

4.6.2 GLASS FIBRE REINFORCED CONCRETE

Glass Fibre Reinforced Concrete (GFRC) is a composite material that blends

traditional concrete with alkali-resistant glass fibers, significantly boosting its strength, durability, and flexibility. These fibers enhance the concrete's tensile, flexural, and impact strength, improving its resistance to cracking and

environmental wear. GFRC is especially beneficial for thin sections, providing structural advantages where conventional concrete might be too heavy or

prone to failure. It offers moderate thermal insulation and can reduce thermal bridging in building facades. Although it doesn't provide substantial sound insulation by itself, GFRC can be incorporated into multi-layered wall systems to improve acoustic performance. Environmentally, GFRC is sustainable due to its reduced need for steel reinforcement and its ability to incorporate recycled materials, resulting in a lower carbon footprint. Additionally, it is cost-efficient in the long run, requiring less maintenance and enabling quicker installation due to its lightweight and prefabricated nature. GFRC is also fire-resistant, being non-combustible, and provides excellent fire protection. Its ease of

workability allows for intricate designs and fine details, making it a highly versatile material for both structural and decorative purposes in modern architecture.

Figure 11 Glass Fiber Reinforced Concrete

PROPERTIES OF GLASS FIBRE REINFORCED CONCRETE (GFRC)

Strength And Durability

Strength and durability are key characteristics of Glass Fibre Reinforced Concrete (GFRC). The addition of alkali-resistant glass fibers greatly enhances its tensile, flexural, and impact strength, surpassing that of traditional concrete. These fibers provide reinforcement, helping to prevent cracking and improve resistance to both mechanical stresses and environmental factors. GFRC is particularly beneficial in thin sections, where conventional concrete might be more susceptible to cracking or failure. Its superior durability leads to a longer service life, less frequent maintenance, and better performance in extreme weather conditions, making it a suitable material for a wide range of both structural and decorative architectural uses.

Thermal Performance

The thermal performance of Glass Fibre Reinforced Concrete (GFRC) is moderate, providing some insulation, though it is generally less effective than specialized insulating materials. When used in building envelopes like cladding or façade panels, GFRC can help improve thermal regulation by reducing thermal bridging and maintaining stable indoor temperatures. Its lightweight properties allow it to be paired with insulating layers to boost overall thermal efficiency. While GFRC on its own may not offer high insulation values, its integration into multi-layered wall systems enhances energy efficiency and supports the achievement of thermal performance standards in building designs.

Acoustic Insulation

Acoustic insulation in Glass Fibre Reinforced Concrete (GFRC) is limited compared to materials specifically designed for soundproofing. Due to its thin and dense structure, GFRC does not offer significant sound absorption or noise isolation on its own. However, when incorporated into multi-layer wall systems with sound-insulating materials like mineral wool or acoustic foams, it helps reduce noise transmission. In these configurations, GFRC serves as a strong

outer layer that enhances the overall acoustic performance. While not primarily selected for its soundproofing qualities, GFRC can still contribute to noise control when combined with other materials designed for acoustic insulation.

Environmental sustainability

Environmental sustainability is a major benefit of Glass Fibre Reinforced Concrete (GFRC), making it an ideal choice for eco-friendly building projects. Compared to traditional reinforced concrete, GFRC has a lower environmental impact due to its reduced need for steel reinforcement, which helps decrease embodied energy and greenhouse gas emissions. It can also incorporate recycled materials, such as fly ash and recycled glass fibers, further improving its sustainability. Additionally, GFRC's lightweight nature reduces transportation energy requirements and lowers the strain on structural support systems, leading to more efficient material usage. Its long lifespan and low maintenance needs minimize the need for frequent repairs and replacements, conserving
resources over time. Overall, GFRC contributes to sustainable construction by being efficient, recyclable, and having a smaller environmental footprint.

Cost-efficiency

Cost-efficiency is a key advantage of Glass Fibre Reinforced Concrete (GFRC), particularly when considering its long-term performance and overall lifecycle costs. While the initial expense of GFRC may be higher than traditional concrete, its durability, reduced maintenance needs, and ease of installation often offset these costs. The lightweight nature of GFRC results in savings on transportation, handling, and the need for heavy structural support. Furthermore, the ability to prefabricate GFRC panels in a controlled setting helps reduce on-site labor costs and construction time. These combined factors lead to lower total project costs over time, making GFRC an economically viable choice for both commercial and residential construction projects that prioritize long-term value.

Fire-resistance

Fire-resistance is one of the key strengths of Glass Fibre Reinforced Concrete (GFRC), making it an ideal and dependable material for buildings requiring fire

protection. GFRC is naturally non-combustible, meaning it won't ignite, burn, or release toxic fumes when exposed to high heat. The concrete matrix safeguards the embedded glass fibers, preserving the material's structural integrity during fire conditions. This fire-resistant property makes GFRC well-suited for fire-rated wall systems, façades, and other architectural elements where safety is essential. Its ability to endure high temperatures without significant damage enhances both occupant safety and the structural resilience of buildings in the event of a fire.

Workability

Workability is a key feature of Glass Fibre Reinforced Concrete (GFRC), offering significant flexibility in both design and construction. GFRC can be easily molded into intricate shapes and thin profiles, making it ideal for detailed architectural elements and customized designs. Its versatility enables it to be used in a wide range of applications, from decorative features like facades and panels to structural components. The material's workability is further enhanced by the ability to prefabricate GFRC, which reduces on-site labor and accelerates the construction process. Additionally, GFRC's ease of shaping allows for greater design innovation, enabling architects to create complex textures and forms that would be challenging or impossible with traditional concrete.

COMPARATIVE ANALYSIS OF MATERIAL ON THE BASIS OF PROPERTIES

Material	Compressive Strength (MPa)	Cost per m³	Thermal Conductivity (W/m·K)	Fire Resistance	Lifespan (Years)	Construction Speed	Major Limitations
Brick	10–60	₹12,450–₹20,750	0.6–1.0	Fire-resistant (2–4 hours)	100+ Years	20–25 m²/day	Heavy weight, lower thermal

							insulation
Autoclaved Aerated Concrete (AAC) Blocks	3–5	₹3,500–₹5,600	0.1–0.16	Fire-resistant (up to 4 hours)	50+ years	20–30% faster than bricks	Brittle, requires skilled labor
Fly Ash Concrete	30–60	₹4,800–₹7,200	0.4–0.6	Fire-resistant (up to 3 hours)	75+ years	Similar to conventional concrete	Slow setting time, requires proper curing
Traditional Lattice Jali (Stone)	15–30	₹500–₹1,500/Sq.m	0.6–2.0 (stone)	Fire-resistant (2–4 hours)	50–100+ years	Slow (manual carving, labour-intensive)	Heavy weight, brittle, limited design flexibility
Glass Fibre Reinforced Concrete (GFRC)	80–120	₹1,500–₹3,500	0.3–0.5	Fire-resistant (up to 2 hours)	50–75 years	1–2 days per panel	Brittleness if not properly reinforced; higher initial cost; limited structural role

COMPARATIVE ANALYSIS OF TECHNIQUES ON THE BASIS OF PROPERTIES

Techniques	Cost per m^2	Time Duration (per floor)	Total Project Duration (25–30 floors)	Labour	Applications in High-Rise
Prefabrication & Modular	₹2,500–₹3,500	3–5 days/floor	8–10 months	10–20 workers	Full modular rooms, bathroom pods, residential/commercial towers
Flat Slab Construction	₹2,200–₹2,800	7–10 days/floor	12–15 months	30–40 workers	Commercial buildings, residential towers
Precast Concrete Construction	₹2,400–₹3,200	5–7 days/floor	10–12 months	20–30 workers	Structural walls, façades, staircases in high-rises
Tunnel Formwork	₹2,800–₹3,800	4–6 days/floor	9–11 months	40–50 workers	High-rise apartments, hostels, hotels
Slipform Construction	₹3,000–₹4,500	1–3 days/floor	6–8 months	50–70 workers	Core walls, lift shafts, tall towers, chimneys

CHAPTER 5 LITERATURE REVIEW

S. No	Research Paper / Article Title	Publishing Date	Publisher(s) / Author(s)	Context	Inferences
1	A perspective study on fly ash–lime–gypsum bricks and hollow blocks for low cost housing development	Dec 2002	Sunil Kumar	Investigates the use of fly ash–lime–gypsum as an alternative to traditional bricks, aiming to reduce environmental impact and costs.	Confirms bricks and blocks made from industrial waste offer sustainable and cost-effective solutions, though adoption faces resistance and treatment costs.
2	Study of Low Cost Housing: A Review	Jan 2018	Akhildeep Kurup, Devendra Gawade (MGM's College, Kamothe)	Reviews cost-effective construction materials and methods to support affordable housing.	Identifies solutions using GFRG panels, bamboo, interlocking bricks, filler slabs, and prefabrication. Emphasizes the need for planning, trust, and market acceptance.
3	A Critical Review on Low Cost Housing System in India	2 April 2018	Salimeda Venkata Chary (Royal Institution of Chartered Surveyors)	Reviews low-cost housing methods addressing India's housing deficit and supporting schemes like PMAY.	Highlights cost-effective housing via modular methods, sustainable materials, efficient planning, and revised policies to overcome financing and land challenges.
4	Prospects of Low Cost Housing in India	Jan 2013	Swaptik Chowdhury, Sangeeta Roy	Explores sustainable, low- cost building materials and techniques	Emphasizes natural and industrial waste materials like bamboo, fly ash, rice husk to reduce cost,

				for India's conditions.	dependency on convention al materials.
5	Affordable Housing – A Much-Needed Solution for the Current Scenario	Oct 2009	Vidya Devi, Rinki Taur	Addresses the urgent need for affordable housing through low-cost materials, innovative methods, and sustainable practices.	Demonstrates that fly ash, local materials, and rapid construction methods enable cost-effective, sustainable, high-quality housing for low-income populations.

8.1 TECHNOLOGY DETAILS

INTRODUCTION-

The rigid polyvinyl chloride (PVC)-based form work system is a permanent, stay-in-place, and durable finished formwork for concrete walls. The extruded components slide and interlock to produce continuous formwork, with the wall's two faces joined by continuous web members that form hollow rectangular components. The web members are perforated with oval-shaped cores to facilitate the flow of poured concrete between the components. The hollow Novel Wall components are erected and filled with concrete in situ, resulting in a monolithic concrete wall with increased curing capacity due to water entrapment, as the polymer encasement prevents the concrete from drying prematurely, leaving only the top surface of the wall exposed to potential drying.

The polymer encasement controls cracks in the concrete vertically and horizontally while also providing vertical tension reinforcement, boosting the wall's structural strength. The resulting system is unique, offering significant benefits in terms of structural strength, durability enhancement, weather resistance, earthquake resistance, design flexibility, and ease of building. Steel dowels are required to secure the wall to the concrete foundation. This system is appropriate for residential and commercial buildings of all heights, from low to high rise. In order to achieve faster construction, strength, and resource efficiency, the composite structure with Pre-Engineered Steel Structural System as structural components is used in the current project.

9 PAARTH SAMRIDDHI EWS/LIG CASE STUDY -2

10 Paarth Republic is an 80-acre integrated township in Sarojini Nagar on the Lucknow-Kanpur Road that was created by Paarth Infra Build Pvt Ltd. Designed as one of Uttar Pradesh's first smart city projects, it intends to provide a mix of affordable and premium housing alternatives, as well as contemporary infrastructure and services.

9.1 Township Overview

Location: Sarojini Nagar, Lucknow-Kanpur Highway, approximately 6 km from Chaudhary Charan Singh International Airport.

Total Area: Approximately 80 acres.

Project Configuration: The township is segmented into multiple residential clusters, each referred to as a "State," including:

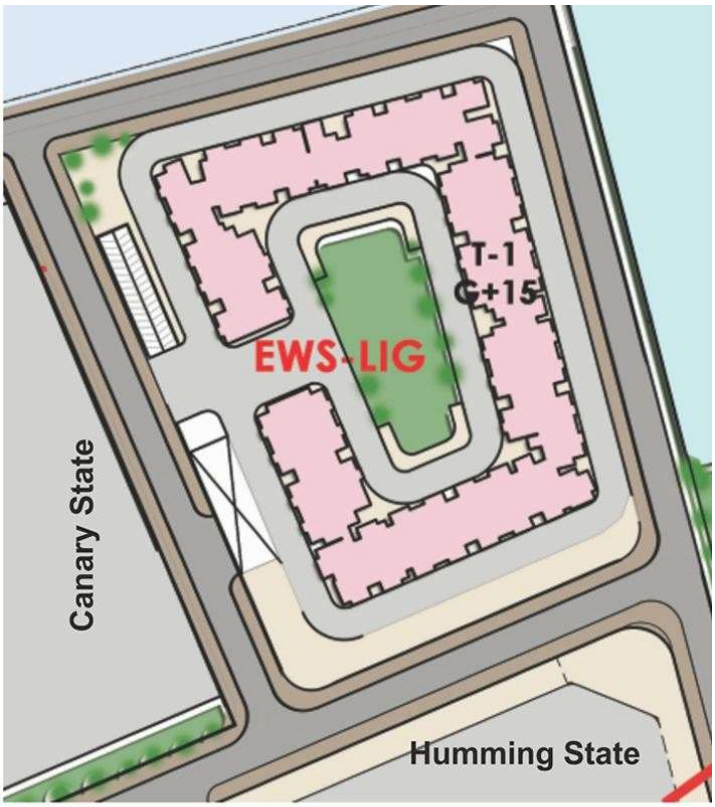
Goldfinch State: 2 BHK, 3 BHK & 3 BHK + Servant; sizes ranging from 1138 to 1662 sq.ft.

Humming State: 1 BHK, 2 BHK & 4 BHK + Servant; sizes ranging from 530 to 1950 sq.ft.

Canary State: 1 BHK & 2 BHK; sizes ranging from 523 to 789 sq.ft.

Humming Retreat: 1 BHK & 2 BHK; sizes ranging from 525 to 805 sq.ft

EWS/LIG (Asha/Abha): 1 BHK apartments; sizes ranging from 473 to 553 sq.ft.



EWS-LIG (Asha-Abha) SITE LAYOUT PLAN

9.2 Amenities:

- Completely operational cricket stadium and sports academy.
- Zen garden for leisure.
- Close to international airport.
- Integrated business and retail areas.
- Green areas and parks.

9.2 Affordable Housing Initiatives

10 Under the Pradhan Mantri Awas Yojana Scheme, Paarth Republic contains specific affordable housing clusters. The EWS/LIG (Asha/Abha) category offers 1 BHK apartments with sizes ranging from 473 to 553 sq.ft. and prices starting from ₹9.02 lakhs. These units are

intended to meet the housing needs of economically disadvantaged individuals and low-income groups.

1 BHK UNIT PLAN
LIG UNIT

CARPET AREA = 33.71 SQ MT.= 362.85 SQ FT.
BALCONY AREA =1.82 SQ MT.= 19.60 SQ FT.

BUILT UP AREA = 40.61 SQ MT.= 437.12 SQ FT.
SUPER AREA = 51.37 SQ MT.= 553 SQ FT.

NOTE:
UNIT CONVERSION (1 SQ.MT.=10.764 SQ.FT.)

ACCOMODATION:
1 BEDROOM, DRAWING ROOM, KITCHEN,
1 TOILET, 1 BALCONY.

1 BHK UNIT PLAN
EWS UNIT

CARPET AREA = 28.37 SQ MT.= 305.37 SQ FT.
BALCONY AREA =1.74 SQ MT.= 18.73 SQ FT.

BUILT UP AREA = 34.74 SQ MT.= 373.94 SQ FT.
SUPER AREA = 43.94 SQ MT.= 473 SQ FT.

NOTE:
UNIT CONVERSION (1 SQ.MT.=10.764 SQ.FT.)

ACCOMODATION:
1 BEDROOM, DRAWING ROOM, KITCHEN,
1 TOILET, 1 BALCONY.

9.3 Comparative Material Analysis

Component	LHP (Avadh Vihar)	Paarth Republic Anmol
Structure	Pre-engineered steel and PVC formwork.	RCC frame with brick masonry
Walls	Prefabricated panels	Brick masonry
Flooring	Vitrified tiles	Vitrified tiles
Doors/Windows	UPVC windows, flush doors	Hardwood frames, aluminum windows
Electrical	Modular switches, concealed wiring	Modular switches, concealed wiring
Plumbing	CPVC pipes	CPVC pipes
Sustainability	Rainwater harvesting, LED lighting	Standard provisions

9.4 Comparative Summary

Feature	Light House Project (LHP)	Paarth Samriddhi EWS/LIG (Asha & Abha)
Developer	Lucknow Development Authority (LDA)	Paarth Infrabuild Pvt. Ltd.
Location	Sector-5, Avadh Vihar Yojana, Lucknow	Kanpur Road, Lucknow
Total Units	1,040	920
Unit Types	1 BHK (EWS)	1 BHK (EWS & LIG)
Unit Sizes	34.51 sq.m (approx. 371.5 sq.ft.)	473 – 553 sq.ft.
Construction Technology	Stay-in-place PVC formwork with pre-engineered steel structural system	RCC frame structure with brick masonry
Total Project Cost	₹130.90 crore	Not specified
Cost per Unit	₹12.59 lakh (before subsidy)	₹10.50 – ₹12.27 lakh
Subsidy	₹7.83 lakh (₹4 lakh central + ₹1.39 lakh state subsidy)	Eligible under PMAY; exact subsidy details not specified
Beneficiary Contribution	₹4.76 lakh	₹10.50 – ₹12.27 lakh (before subsidy)

Amenities	Community center, commercial center, STP, external electrification, water supply, boundary wall, horticulture, rainfall gathering, and solid waste management	Gymnasium, power backup, purified water supply, 24x7 security, CCTV monitoring, firefighting systems, intercom facility, party hall, clubhouse, rainwater harvesting, sewage treatment plant, Vastu compliant, basement parking, indoor games, vast green space, magnificent landscaping

9.5 (BOQ) Bill Of Quantities

Basic Project Details

- **Project:** Low-Cost Housing Unit
- **Location:** Lucknow, Uttar Pradesh
- **Plot Size:** 25'x40' (1000 sq.ft)
- Built-up Area: 500 sq.ft
- **Type:** G+0, 1 Bedroom, 1 Hall, Kitchen, Toilet/Bath
- **Construction Type**: Load-bearing wall, RCC slab

9.6 Labor Considerations

- **Unskilled labor:** ₹350–₹450/day
- **Mason:** ₹600–₹700/day
- **Carpenter:** ₹700–₹800/day

- **Electrician/Plumber:** ₹700–₹900/day

9.7 Lab Material Choices For Cost Efficiency

- **Bricks:** Fly ash bricks or stabilized mud blocks
- **Roofing:** RCC slab or precast panels (if applicable)
- **Flooring:** IPS (Indian Patent Stone) or low-cost vitrified tiles
- **Doors/Windows:** Mild steel frame with steel/aluminum shutter
- **Plaster:** CM 1:6 with local sand

Item	Details
Project Type	Single-unit Low-Cost Housing
Built-up Area	Approx. 500 sq.ft
Total Estimated Cost	₹3,62,512
Cost per sq.ft	₹725/sq.ft (approx.)
Construction Duration	3–4 months
Design	1 Bedroom, Hall, Kitchen, Toilet
Contingency Included	Yes – 5% of base cost

9.8 BOQ Highlights – Low-Cost Housing (Lucknow)

Sr. No	Description of Work	Unit	Quantity	Rate (INR)	Amount (INR)
1	Site Clearance & Layout	LS	1	₹2,000	₹2,000
2	Earthwork in Excavation (foundation)	Cum	18	₹250	₹4,500
3	PCC (1:4:8) below footing	Cum	2.5	₹4,000	₹10,000
4	Brickwork in Foundation (1:6 CM)	Cum	4	₹5,500	₹22,000
5	RCC Footing + Plinth Beam (M20)	Cum	3.5	₹6,000	₹21,000
6	Superstructure (Brickwork 1:6)	Cum	20	₹5,500	₹1,10,000
7	Lintel (RCC + Shuttering)	Cum	1.5	₹6,000	₹9,000
8	Roofing – RCC Slab + Centering/Shuttering	Cum	5	₹6,500	₹32,500
9	Plaster (int/ext, 12mm thick, CM 1:6)	Sqm	180	₹200	₹36,000
10	Flooring (Tiles/IPS)	Sqm	45	₹450	₹20,250
11	Doors & Windows (Mild Steel/Wood)	LS	1	₹25,000	₹25,000
12	Painting (2 Coats Distemper + Primer)	Sqm	150	₹60	₹9,000
13	Sanitary Fixtures & Plumbing	LS	1	₹20,000	₹20,000
14	Electrical Wiring & Fixtures	LS	1	₹18,000	₹18,000
15	Water Tank + Overhead Connection	LS	1	₹6,000	₹6,000
	Misc. (Contingency, Waste, Tools - 5%)	**%**	**5%**	—	**₹17,262**

	TOTAL ESTIMATED COST	—	—	—	**₹3,62,512**

Conventional & Traditional Materials used for the analysis

This study establishes the fundamental concepts for incorporating alternative building materials for reinforced concrete frame construction used in large design projects. This article compares standard and alternative materials and saves costs in the areas of foundation, walling, roofing, flooring, and lintel. These alternative materials have been shown by numerous reference journals, and they are acceptable in terms of quality, solidity, and safety. Following these examinations, the plan, strategy, development techniques, and options were presented. Estimation has been completed, and it has been determined that employing the provided cost-effective materials can save around 20% of the building cost. The cost reserves were calculated on the basis of the real expenses and associated undertaking costs.

A distinctive structure consists of a variety of architectural frameworks and materials, with the major emphasis on manageability. A normal structure is based on the need to reduce the natural effects of structures and other supporting frameworks while maintaining comfort and wellness. To be more rational, the standard structure employs primarily readily available, inexhaustible, repurposed, or reused materials.

Traditional Materials which are currently in use

According to conventional practice, we use the following things for construction:

- **Steel:** Concrete has little tensional strength, hence steel is used to give rigidity and compensate for tensional pressures. Steel has existed alongside concrete since its inception. This holding cannot be broken up for large development projects, however there is another option for rural homes. A few studies are going on to increase the quality and hardness of concrete by adding a few admixtures and possibilities for aggregates, and so on. However, there is no demand for such items in rural houses because the quality and other factors are not as important and do not require much care. Nonetheless, having such procedures amounts to only a fractional replacement and does not significantly reduce costs. So the main option left is to find an alternative to steel.

- **Concrete:** Concrete is the most notable innovation of the nineteenth century. Since its inception, its use rate has never decreased. Several studies have been conducted to improve the quality of concrete and the use of nonrenewable wastes. However, this may increase the entire cost; this research does not discuss its alternatives.

- **Bricks:** In housing, brick masonry is used to cover the structure's facades. They could be clay or fly-ash bricks. Both of these varieties are often used currently. For the average house, bricks account for approximately 25% of the total cost; replacing them with alternatives could be cost-effective.

- **Mortar:** This type of mortar is used to plaster brick masonry. This is a mixture of cement and fine aggregates in a 1:6 ratio. Fine aggregates are becoming more difficult to get, increasing their cost. Reduce the use of fine aggregates, which will affect the overall cost of development. Replacing this with alternatives that reduce the use of fine aggregates and cement could be beneficial for low-cost construction.

Alternative Materials which can be used

- The research recommended the following alternative materials that can be utilized as substitutes for traditional materials:

- **Fly Ash Bricks (FAB)** is a construction material that has qualities similar to clay bricks and is used for masonry work. These blocks are reasonably priced, lightweight, have a low heat ingestion, etc. Thus, no plastering is required where the Fly Ash Bricks are located.

- **Quarry Sand** is also known as M sand, and it is extracted from rock dust at the quarry site. This sand can be used instead of River sand. It increases compressive strength in concrete when compared to conventional sand, resulting in better solidity, high quality, and usability, among other advantages.

- **Basalt Rebar** is a fibrous substance made from volcanic rock. This is used in other countries to reduce construction costs. When compared to conventional steel bars, it increases tensile strength significantly. These are the alternate materials for steel reinforcing that provide the same strength.

- **Vitrified tiles** are framed by the vitrification cycle; hence, it is extraordinarily solid and uniform assets. Vitrified tiles are scratch and stain resistant. It is not difficult to keep up with these tiles, which are more grounded than other tiles.

- **Organic fibers** Although fibers have several benefits, including low cost and easy availability, their use in cement-based products is limited due to their poor strength.

- **Plan of an EWS Building**

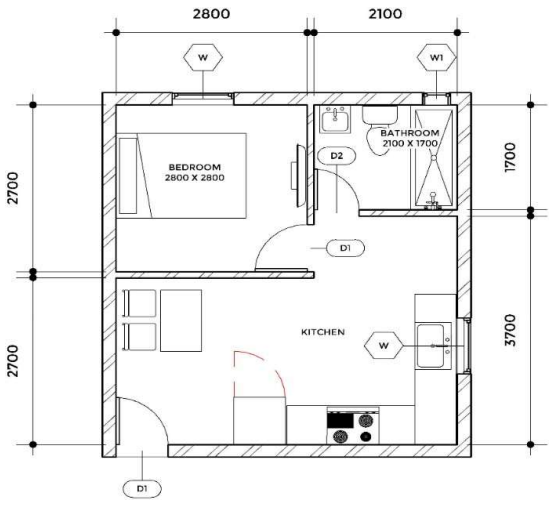
  The total carpet space (325 sqft) accommodated by the living room, bathroom, bedroom, and kitchen is given below.

  Scheduling work of a building

  Scheduling is the list of project milestones, tasks, and deliverables with proposed start and end dates. All of the work's start and end dates, as well as the project's total duration, have been determined.

SCHEDULLING OF WORK		
S.No	Description	Approx Days to complete the task
1	Site Clearence	2
2	Excavation	3
3	PCC Base	3
3.1	RCC Reinforcement	2
3.2	RCC Shuttering	1
3.3	PCC Concreting	7
4	Masonry Work	3
5	Flooring	3
6	Roofing GIC Sheets	1
7	Plastering	7
8	Painting	5
9	Electrical Work	1
10	Plumbing Work	3
11	Carpentry Work	2
13	Other Work	1
TOTAL		44

Figure 12 Scheduling of Work



Cost – Estimate of Material and Construction

The following contains the total cost of material and construction rates all as per DSR 2019

Low - Cost Housing

ESTIMATED COST

As per DSR 2019

S.no	Description of Item	Qty.	Unit	Rate (INR)	Amount	Ref.
1.00	EARTH WORK					
1.10	Earth work in surface excavation not exceeding 30 cm in depth but exceeding 1.5 m in width as well as 10 sqm on plan including getting out and disposal of excavated earth upto 50 m and lift upto 1.5 m, as directed by Engineer-in- Charge:	33	sqm	92.55	3054.2	2.1
2	CONCRETE WORK					
2.10	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:2:4 (1 cement : 2 coarse sand (zone-III) : 4 graded stone aggregate 20 mm nominal size)	21	cum	7296.35	153223	5.1.
3	BRICK WORK					
3.10	Half brick masonry with non modular fly ash bricks of class designation 10, conformingio IS :12894, in super structure above plinth and upto floor V level. *Cement mortar 1 : 4 (1 cement : 4 coarse sand)*	43	sqm	917	39431	6.45
4	FINISHING					
4.1	12 mm cement plaster finished with a floating coat of neat cement of mix. 1:6 (1 cement: 6 fine sand)	38	sqm	254.25	9661.5	13.1.2
4.2	White washing with lime to give an even shade : 13.37.1 New work (three or more coats)	39	sqm	28.55	1113.5	13.37.1
4.3	Finishing walls with water proofing cement paint of required shade : 13.44.1 New work (Two or more coats applied @ 3.84 kg/10 sqm)	26	sqm	91.25	2372.5	13.44.1
5	DOORS & WINDOWS					
5.1	Providing and fixing 35 mm thick factory made laminated veneer lumber door shutter conforming to IS : 14616 and TADS 15:2001 (Part B), fixing with butt hinges of required size with necessary screws, all complete as per directions of Engineer- in-charge and panelling with panels of : 12 mm thick plain grade -1, medium density flat pressed three layer particle board FPT - I or graded wood particle board FPT- I, IS : 3087 marked, bonded with BWP type synthetic resin adhesive as per IS : 848	1.0635	sqm	2636.3	2803.7	9.6.1
5.2	Upvc Casement Windows, Glass Thickness: 5-15 Mm	1.4	sqm	350	490	Pre - Fabricated
5.3	Providing and fixing steel roller for uPVC sliding window with necessary screws etc. complete	0.13	each	88.75	11.538	9.15.1
5.4	Providing and fixing ISI marked oxidised M.S. tower bolt black finish, (Barrel type) with necessary screws etc. complete. 100x10 mm	0.18	cum	39.1	7.038	9.63.4
5.5	Providing and fixing ISi marked oxidised M.S. door latches conforming to IS:5930 with screws etc. complete. 250x20x6 mm	0.00	cum	60.3	0.0651	9.65.2
5.6	Providing and fixir			28.9	130.05	9.66.1
5.7	Providing and fixing oxidised M.S. hasp and staple (safety type) conforming to IS : 363 with necessary screws etc. complete. 90 mm	0.45	cum	17.45	7.8525	9.67.3
6	FLOORING					
6.1	Cement concrete flooring 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate) finished with a floating coat of neat cement, including cement slurry, but excluding the cost of nosing of steps etc. complete. 11.3.1 40 mm thick with 20 mm nominal size stone aggregate	30	sqm	498.35	14951	11.3
6.2	Providing and laying vitrified floor tiles in different sizes (thickness to be specified by the manufacturer) with water absorption less than 0.08% and conforming to IS: 15622, of approved make, in all colours and shades, laid on 20mm thick cement mortar 1:4 (1 cement : 4 coarse sand), jointing with grey cement slurry @ 3.3 kg/ sqm including grouting the joints with white cement and matching pigments etc., complete.	28	sqm	1267.8	35498	11.4.1
7	ROOFING					
7.1	Providing reinforced by organic fibres and/or inorganic synthetic fibres cement 6 mm thick corrugated sheets (as per IS: 14871) roofing up to any pitch and fixing with polymer coated J, or L hooks, bolts and nuts 8 mm dia. G.I. plain and bitumen washers or with self drilling fastener and EPDM washers etc. complete (excluding the cost of purlins, rafters and trusses), including cutting sheets to size and shape wherever required	33	sqm	453.25	14957	12.8
8	SANITARY INSTALLATIONS					
8.1	Providing and fixing white vitreous china pedestal type water closet (European type W.C. pan) with seat and lid, 10 litre low level white P.V.C. flushing cistern, including flush pipe, with manually controlled device (handle lever), conforming to IS : 7231, with all fittings and fixtures complete, including cutting and making good the walls and floors wherever required : W.C. pan with ISI marked black solid plastic seat and lid	1	each	5140.55	5140.6	17.2.2
8.2	Providing and fixing wash basin with C.I. brackets, 15 mm C.P. brass pillar taps, 32 mm C.P. brass waste of standard pattern, including painting of fittings and brackets, cutting and making good the walls wherever require: White Vitreous China Wash basin size 630x450 mm with a single 15 mm C.P. brass pillar tap	1	each	2751.3	2751.3	17.7.2
8.3	Providing and fixing kitchen sink with C.I. brackets, C.P. brass chain with rubber plug, 40 mm C.P. brass waste complete, including painting the fittings and brackets, cutting and making good the walls wherever required: White glazed fire clay kitchen sink of size 600x450x 250 mm	2	each	3163.25	3163.3	17.9.1
	TOTAL COST				288767	

Figure 13 Estimate and material construction

Total Cost for Alternative Building Materials

The following table shows the overall cost of the alternative building. According to current market rates, materials, labor, and equipment have arrived, and low-cost effective materials have been chosen to cut building expenses.

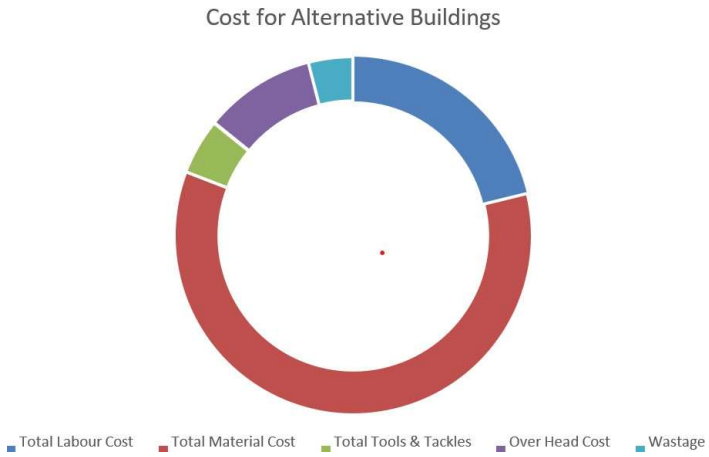


Figure 14 Pie Chart for Alternative Building Materials

Total Cost for Conventional Building Materials

The following table shows the overall cost of the standard building. According to current market rates, the supplies, labor, equipment, etc. have arrived..

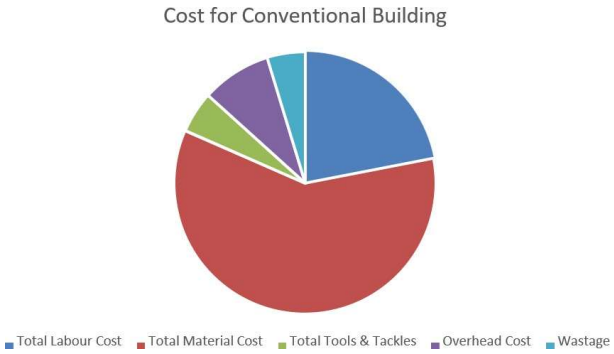


Figure 15 Pie Chart for Conventional Building Materials

Conclusion:

A detailed cost analysis comparing traditional construction methods with low-cost alternatives has been conducted, and the findings provide insightful conclusions regarding material efficiency and economic feasibility. Traditional construction typically relies on materials such as clay bricks, natural river sand, steel reinforcement bars, wooden windows, and marble or natural stone flooring. While these materials offer durability and aesthetic appeal, they significantly increase the overall cost of construction, particularly for large-scale or budget-sensitive projects.

In contrast, low-cost construction makes use of readily available, economically efficient, and environmentally sustainable materials that do not compromise on structural integrity or long-term performance. The analysis revealed that substituting traditional materials with alternatives such as fly ash blocks, Robo sand, basalt reinforcement bars, UPVC windows, and vitrified tiles can lead to cost savings of up to 20% in the overall construction budget. These savings arise from several factors, including reduced material costs, faster construction timelines, lower transportation expenses, and decreased maintenance requirements.

Fly ash blocks, for example, are lightweight, thermally insulating, and easier to handle than conventional bricks, leading to quicker installation and lower labor costs. Robo sand, a manufactured sand alternative, not only reduces dependency on depleting river sand resources but also provides consistent quality and strength for concrete applications. Basalt bars offer a corrosion-resistant, lightweight alternative to steel reinforcement, which can extend the life of structures and reduce long-term maintenance costs. Similarly, UPVC windows require less maintenance than traditional wooden frames and provide better thermal insulation, contributing to energy savings. Vitrified tiles offer a cost-effective and durable flooring option with high resistance to stains, scratches, and moisture.

Based on these findings, it is strongly recommended that future construction projects, particularly those aimed at providing affordable housing for low-income populations, adopt a more pragmatic and resource-conscious approach. Utilizing construction materials that are both cost-effective and performance-efficient can help deliver high-quality living environments at significantly reduced costs. This approach also aligns with sustainable development goals by minimizing environmental impact through the use of recycled and eco-friendly materials.

In conclusion, the integration of alternative construction materials represents a strategic shift in the building industry. It provides a feasible path forward for developing affordable, durable, and sustainable housing for economically weaker sections, without compromising on safety, comfort, or longevity.

CHAPTER- 1

INTRODUCTION

INTRODUCTION

The global housing crisis has exposed deep-rooted social inequalities, where millions continue to live without access to safe, affordable, and dignified shelter. As urban populations grow and climate challenges intensify, architecture must rise to meet a dual responsibility: to provide inclusive housing and to do so in ways that are environmentally sustainable. **Designing innovative and sustainable affordable housing** is not merely a technical exercise — it is an ethical imperative rooted in the pursuit of **social justice**. This approach demands creativity, empathy, and cross-disciplinary collaboration. By integrating **bioclimatic design**, **local materials**, **renewable energy**, and **community participation**, architects can shape built environments that empower marginalized populations and promote equity. These housing solutions must not only meet immediate shelter needs but also foster long-term resilience, wellbeing, and cultural identity.

In this context, architecture becomes a transformative tool — a means to redress systemic injustices and to build a future where affordable housing is not a privilege, but a universal right

AIM

The aim of **Designing Innovative and Sustainable Affordable Housing: Architecture for Social Justice** is to develop housing solutions that are economically accessible, environmentally responsible, and socially inclusive. This initiative seeks to empower underserved communities by creating living environments that uphold human dignity, promote equity, and respond to local cultural and climatic contexts.

Through innovation in design, materials, and construction methods, the goal is to not only address the basic need for shelter but to contribute to a more just and sustainable urban future for all.

METHODOLOGY

The methodology for designing innovative and sustainable affordable housing rooted in social justice involves a multi-layered and participatory approach. The following steps outline the core process:

1.Contextual Analysis

1. Study of local socio-economic conditions, climate, culture, and existing housing challenges.
2. Identification of marginalized or underserved communities most in need of affordable housing.

2.Community Engagement

1. Involvement of local residents and stakeholders through participatory design workshops, interviews, and surveys.
2. Co-creation of design ideas to ensure cultural relevance and social ownership.

3.Sustainable Design Strategies

1. Integration of passive design principles (natural ventilation, daylighting, thermal mass).
2. Use of eco-friendly, low-cost, and locally available materials.
3. Incorporation of green technologies such as solar energy, rainwater harvesting, and waste recycling.

4.Innovative Construction Techniques

1. Exploration of modular, prefabricated, or low-tech construction systems to reduce costs and time.
2. Adoption of flexible and adaptable layouts to accommodate changing family needs.

5.Policy and Financial Framework

1. Collaboration with government bodies, NGOs, and developers to align with affordable housing policies and financial models.
2. Exploration of subsidies, microfinancing, and cooperative ownership models.

6.Implementation and Monitoring

1. Prototyping or piloting of housing units to test design viability.
2. Post-occupancy evaluation to assess performance, user satisfaction, and social impact.

7.Scalability and Replication

1. Documentation of best practices and lessons learned for application in other regions.
2. Development of adaptable design toolkits for wider use by architects and planners

CASE SUDY -1

1. Quinta Monroy Housing

Quinta Monroy (Chile),

Project Overview:
•**Location:** Iquique, Chile
•**Year Completed:** 2004
•**Architect:** Elemental (led by Alejandro Aravena)
•**Client:** Government of Chile – Ministry of Housing
•**Number of Families:** 100 low-income families
•**Total Site Area:** 5,000 m²
•**Budget per Unit:** Approximately USD $7,500

•**Objective:** To provide formal housing for 100 low-income families living in an informal settlement, within the city limits

Key Features:
•**Incremental Housing Strategy:** Half of the house was built by the government (basic structure and services), while the other half was left for residents to complete and customize over time.

•**Site Integration:** Located within the city to maintain access to jobs, schools, and services.

•**Cost-effective Design:** Worked within a tight budget (~$7,500 per unit), using simple materials and layouts.

Social Justice Impact: Avoided displacement, enabled self-improvement, and respected residents' autonomy

Background and Challenges:
•The 100 families had been living on the centrally located land informally for over 30 years.
•The Chilean government purchased the land and tasked Elemental with creating **social housing** within the city (not in peripheral slums).
•The challenge was to **build within a strict budget**, while offering the **same quality of urban life** as middle- or upper-income citizens.
•Elemental wanted to avoid typical low-cost housing solutions that isolate the poor on the outskirts of cities.

Design Concept: “Half a Good House”

Core Idea:

•Build only the **structural and essential half** of a house that meets basic standards: walls, roof, kitchen, bathroom, and services.

•Leave the remaining half of the plot empty — providing the **framework and space** for residents to **expand the home incrementally**.

Why?

•The goal was to **maximize the value** of the housing within budget constraints.

•Empower residents to **customize and improve** their homes based on personal needs, family size, and economic capability.

Key Architectural Features

Feature	Description
Incremental Growth	Families were given a strong structural core and encouraged to self-build.
Modular Design	Housing units followed a 9 x 9 m grid, divided into a built section and an expansion zone.
Row Housing Configuration	Compact layout optimized site use and preserved urban continuity.
Urban Integration	The site remained within city limits — residents retained access to jobs, schools, and transit.
Services Installed	All units included water, sewage, electricity, and proper bathrooms.

Quinta Monroy (Chile),

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Quinta Monroy

Residential

ELEMENTAL is a Chile-based architecture practice focusing on architectural work of public interest and with social impact.

Af Nina Tory-Henderson

In 2016, Alejandro Aravena, ELEMENTAL's director, was awarded the Pritzker Prize and curated the Venice Architecture Biennale.

These achievements recognise the importance of ELEMENTAL's social and humanistic approach to architecture, which shows how architecture at its best can improve people's lives.
— Thomas Pritzker, Chairman of the Pritzker Organization

Social and Environmental Impact:

*** Social Justice:**

•**Prevents Displacement:** Families remained in the same urban neighborhood instead of being relocated to city outskirts.

•**Equity in Design:** Each family had equal opportunity to expand their home, avoiding stigmatization.

•**Empowerment through Participation:** Residents had control over the customization and identity of their living space.

🌱 **Sustainability:**

•**Low-cost, durable materials** reduced environmental footprint.

•**Passive design elements** such as ventilation and daylighting contributed to energy efficiency.

•**Community-led maintenance** increased longevity and user ownership.

Recognition and Awards:

•**Praised globally** as a pioneering model for incremental social housing.

•Alejandro Aravena and Elemental won the **Pritzker Architecture Prize (2016)** in part due to this project.

Conclusion:

Quinta Monroy exemplifies **architecture as a tool for social inclusion**. It redefines what affordable housing can be — not just shelter, but a **platform for upward mobility**, **dignity**, and **community empowerment**. The design balances innovation, practicality, and humanity, offering a scalable model for cities facing similar challenges around the world.

ELEMENTAL first made a name for themselves in 2004 with Quinta Monroy, a social housing project in the center of Iquique, Chile. The site had been illegally occupied by 97 families since the 1960s; the architects rehoused these families on the same 5,000-square-metre site.

The site's central location meant that the land was three times the price of what social housing could usually afford, but the subsidy provided by the government was exactly the same: 7,500 USD per family, which had to cover the land, infrastructure, and building costs. The challenge was how to build decent homes for these families when there was almost no money left for the housing itself after purchasing the land.

When there is not enough money to build a comfortably sized home for a family, the market response is to simply make them smaller. ELEMENTAL rephrased the answer and thought, instead of building smaller homes, why don't we build half of a good, comfortably sized one?

This 'half-a-house' designed by ELEMENTAL was essentially the core of a home, the half that the residents couldn't build on their own. The initial dwellings were double-height, robust concrete block structures fitted out with the very basics — a kitchen, bathroom, some partition walls, and an internal timber stair. Each of these box-like structures alternated with an empty space of exactly the same size. In this opening the family could expand their own home, configuring the space however they desired.

The initial building must provide a supporting, rather than a constraining, framework in order to avoid any negative effects of self-construction on the urban environment over time, but also to facilitate the expansion process.

— Alejandro Aravena, founder of ELEMENTAL

For ELEMENTAL it was important that this housing typology could become an investment rather than a financial loss. Unlike almost all other property, social housing often loses its value from the moment it is built; however, Quinta Monroy, has gained a huge amount of value since its completion. Generally located on the fringes of cities, where land is cheap, social housing areas are typically sites of isolation, social conflict, and inequality. Choosing to rehouse the residents in their existing central location, the inhabitants of Quinta Monroy live within the fabric of the city, not excluded from it, with access to work, education, public transport, and good health facilities. In this project, 70% of the budget was spent on the land and 30% on infrastructure and building, where usually the inverse is true.

The housing cores were inbuilt with generosity and flexibility. Each half a house was designed as if it were a part of a middle-income home, with spacious rooms and good-quality (although limited) facilities. Each had the potential to become a generous family home. As the residents moved in, they could take these generous spaces and tailor the structure to their needs, customizing their space at their own expense and labor — adding color, texture, and life. Through this process not only did the dwellings grow in size and value, but the residents also developed a sense of pride, ownership in and belonging to their homes. With generous, customizable homes and a desirable location, each dwelling more than doubled in value within the space of a year. For families in need, this means a modest government subsidy could then lead to a real turning point away from poverty.

In this project, ELEMENTAL asks: “How can we, through design, channel people’s own capacity for building?” Rather than seeing informal settlements as the problem, the architectural practice has looked to them for solutions, and in doing so has created a unique housing typology that it has continued to use throughout South America.

CASE SUDY -2

Aranya Housing – Indore, India

Here is a **detailed case study** on the iconic **Aranya Housing Project – Indore, India**, designed by the legendary architect **B.V. Doshi**, which exemplifies **sustainable, inclusive, and people-centric affordable housing**

Project Overview:

- **Location:** Indore, Madhya Pradesh, India
- **Year Initiated:** 1989
- **Architect: Balkrishna V. Doshi**
- **Client:** Indore Development Authority (IDA)
- **Site Area:** 86 hectares (around 214 acres)
- **Population Housed:** ~60,000 people (6,500 housing units)
- **Target Group:** Economically Weaker Sections (EWS), Low-Income Groups (LIG), and other income groups

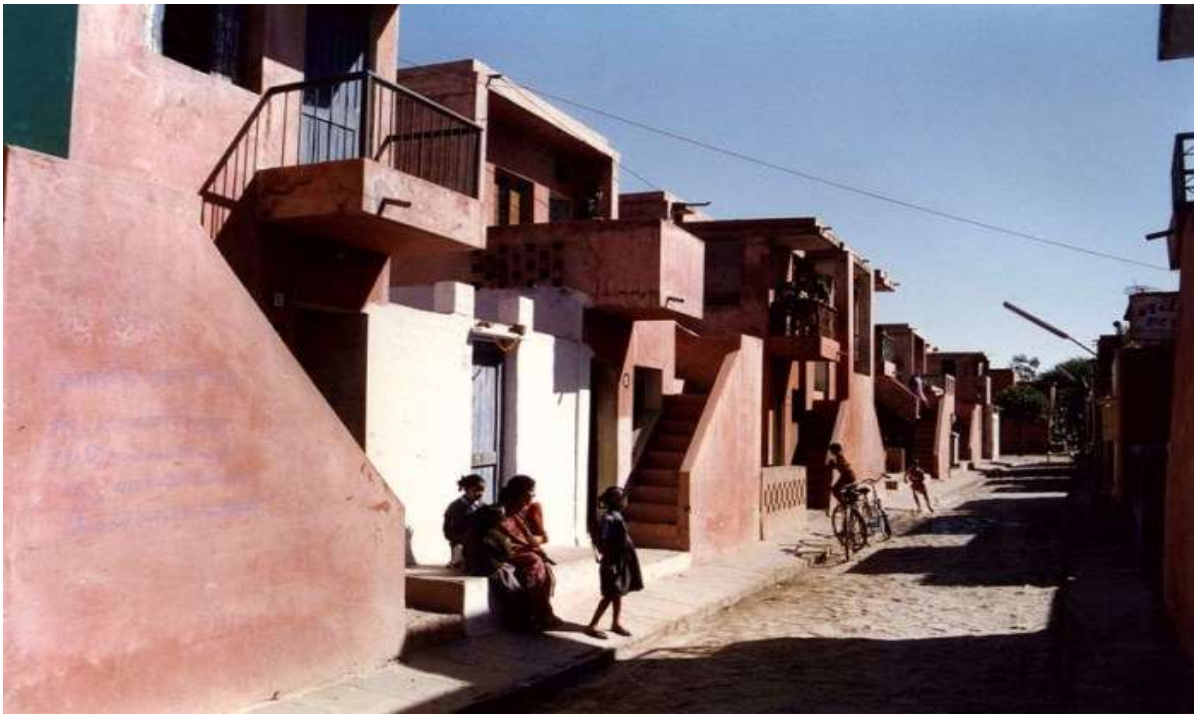
Key Features:

- **Site and Services Model:** Residents received a serviced plot with water, sanitation, and access to infrastructure, allowing them to build incrementally.
- **Clustered Neighborhoods:** The layout promoted social interaction, safety, and a strong sense of community.
- **User-led Growth:** Flexibility in how residents expanded their homes over time based on needs and affordability.
- **Social Justice Impact:** Empowered low-income families through ownership and participation, fostering long-term stability

Aranya Low-Cost Housing, each core house comprises a plinth and service spaces (bath and kitchen). In the project, the architect utilized the core housing concept to create affordable housing for low-income families in the region. As a result, the inclusion of core housing, user participation took place. The architect prepared different housing options concerning single houses and diversified incremental growth scenarios and flexible layouts. Even two samples belonging to the same housing option could be varied and customized differently by users. However, in Aranya Low-Cost Housing, user participation helped to accomplish greater typological variety

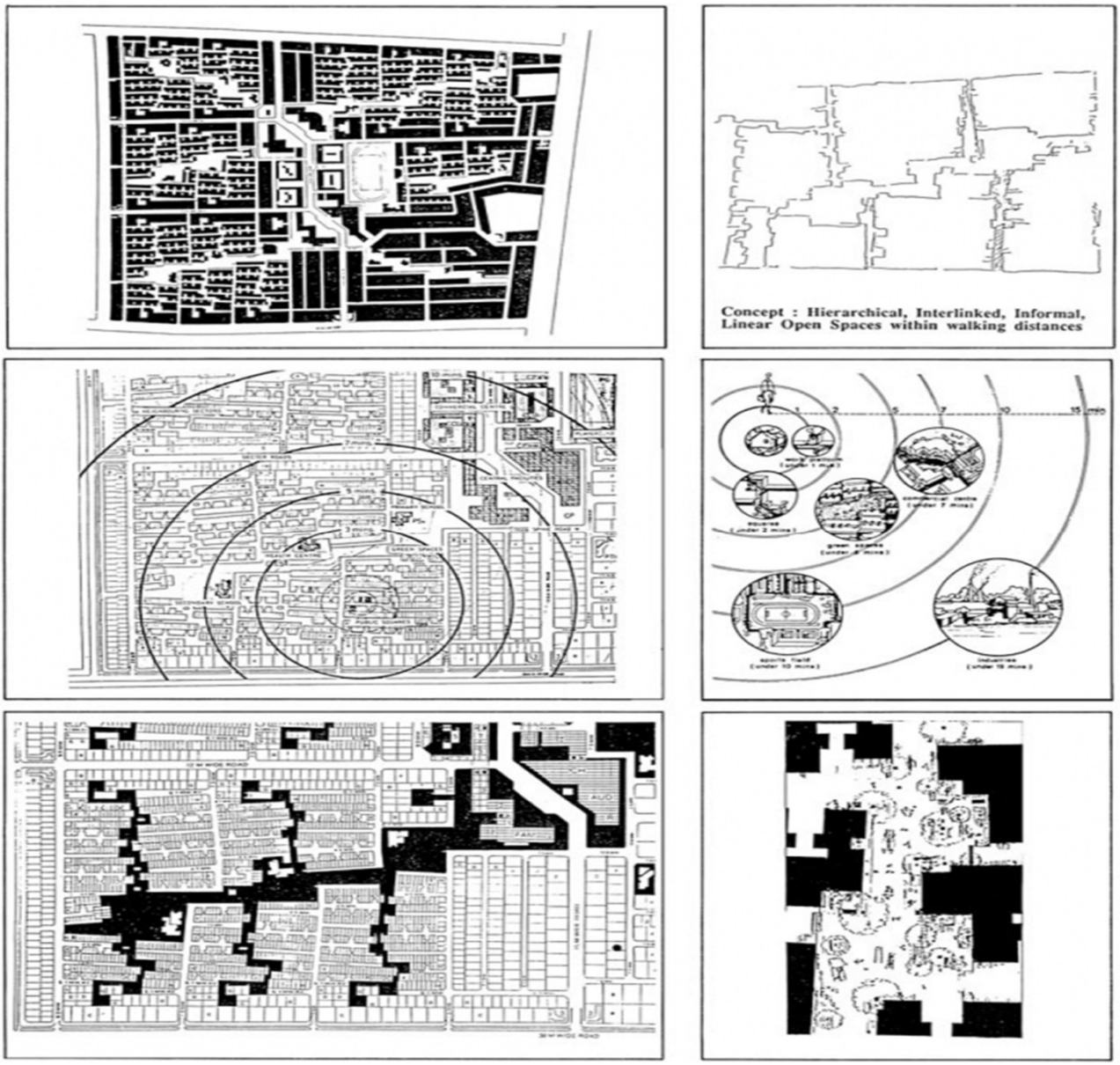
Aranya Low-cost Housing Case study

- **Project name**: Aranya Housing Project
- **Description**: Incremental Housing Project, Low-income housing
- **Design**: Vaastu-Shilpa Foundation
- **Building status**: in use
- **Location**: Indore, India



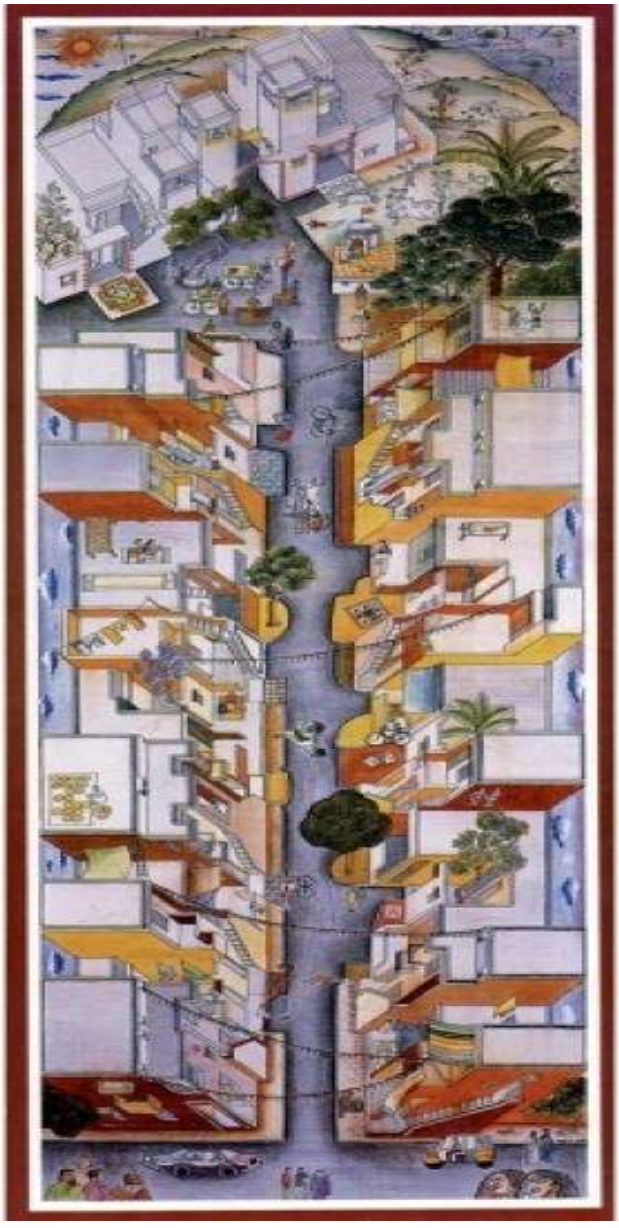
Location and Planning of Aranya Low-cost Housing

There is a stadium at the center, and in the northwest, west, and southwest of it, there are urban services. Also in the western part of the whole complex, single houses accounted for the significant residential type. Therefore single houses formed three neighborhoods accompanied by three zigzag-shaped open-air gathering zones. Also, those building programs include flats, single houses, green areas, hospitals, schools, and other types of urban services in the remaining directions. Aranya Low-Cost Housing was not composing of housing units only as it included various urban services; hence it comes under an urban-scale neighborhood project.

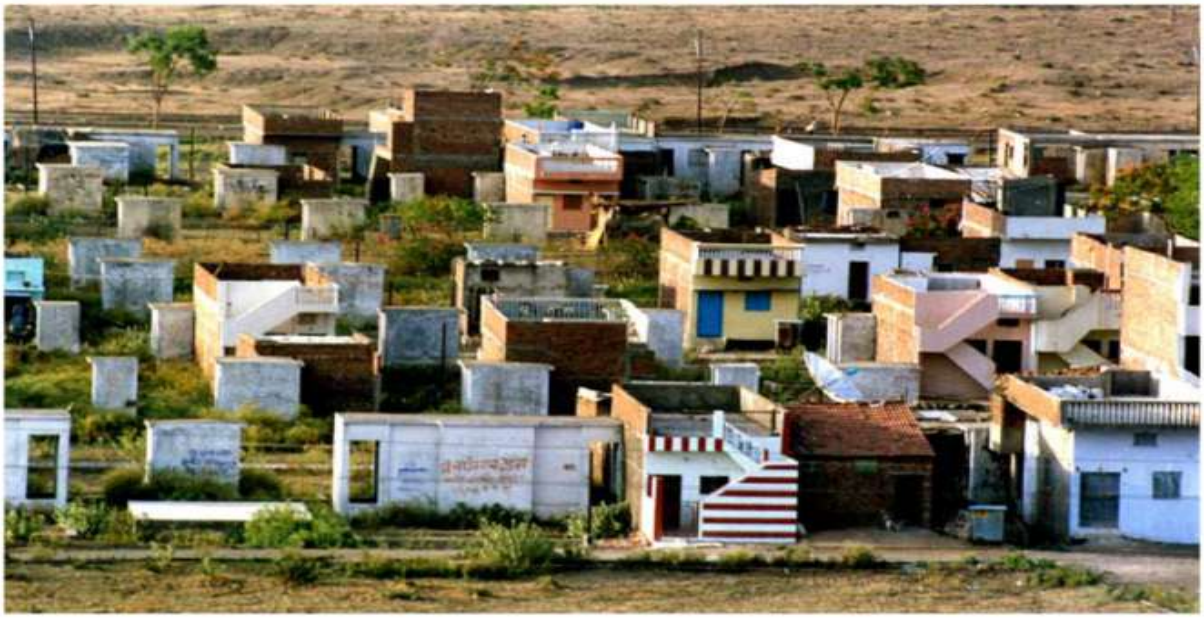


Aranya housing township Planning

Images of elevations from before habitation indicate single houses' half-house identity as the dynamic path of up-to-down moving voids is visible. From facades, not only the half house identity but also vernacular and traditional architectural ornaments and forms are also observable (e.g., tower-like typology on the north elevation, the concave bridge-like formation and the pentagram-shaped void between those tower-like structures, perforations on handrails and high parts of those tower-like formations). As a result, there were multiple forms and different core house options, 53 concluding that the Aaranya case is out of a rigidly repeating typology in preoccupation and post-habitation stages



By utilizing core housing in Aaranya's case, users are giving a chance to develop, design, and construct their own homes and decrease building costs. "Brick loadbearing walls" and "cement concrete floors," which were "conventional and locally 54 available building materials and construction techniques," were implementing in Aranya Low-Cost Housing to obtain a cheaper housing alternative. However, an estimate says that approximately 51,000 families were homeless or living in illegal settlements



Planning Concept of Aranya Low-cost Housing

Moreover some conceptual basis for planning Aranya are:

•Vitality – development to support socio-economic aspirations of the community.

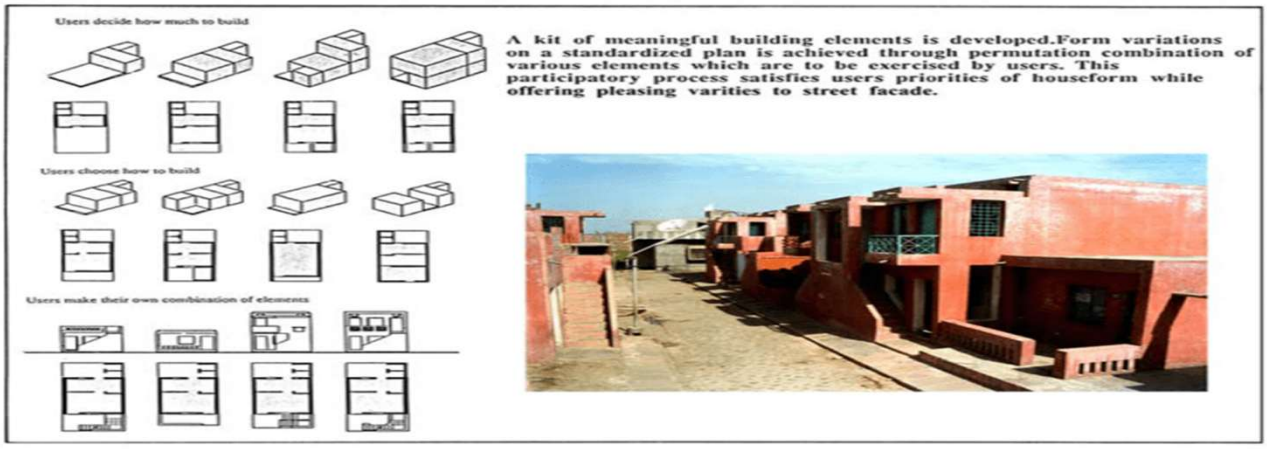
•Imageability – built-form to impart identity and inculcate a sense of belonging amongst the inhabitants.

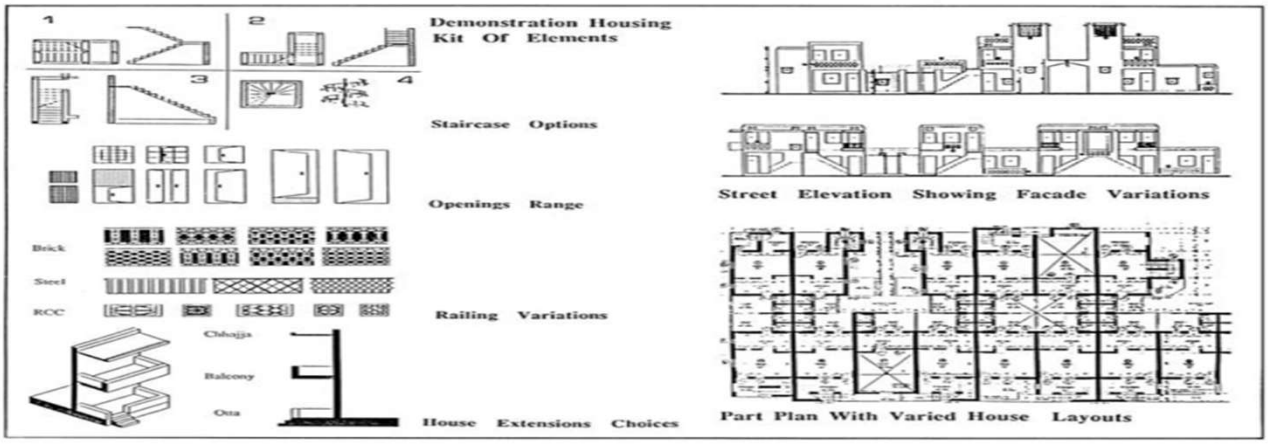
•Equity – to create an equitable balanced community with a satisfactory level of environmental qualities and opportunities for all.

•Efficiency – to realize development that optimizes natural, material, and human resources to the user group's advantage.

•Flexibility – to evolve a framework that absorbs the progressive change and growth as a part of the natural development process.

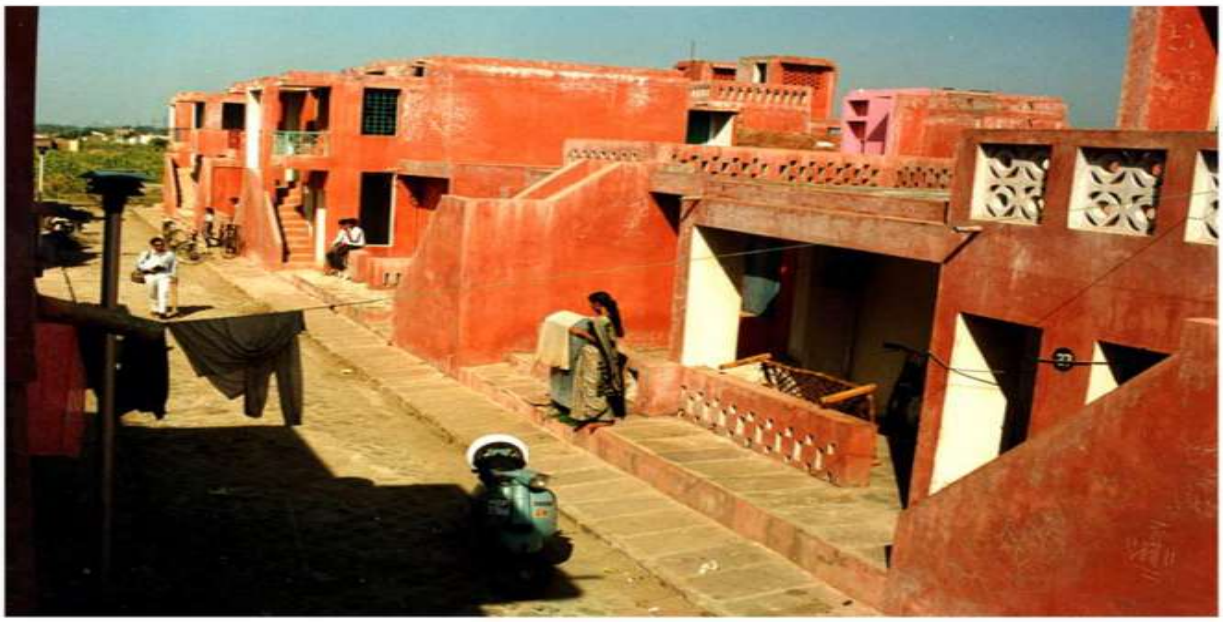
•Feasibility – to ensure development within the given legal, fiscal, and organizational milieu





Design of Aranya Low-cost Housing

Aaranya Township is designed as a services project spread out in six sectors that congregate on a central spine, i.e., the Central Business District. Moreover, one of the critical elements of Doshi's design was a hierarchy of open spaces that include small courtyards to be sharing by three to four families, larger green spaces for each sector. And also a central playing field to aid the entire development. Also, open spaces and pedestrian pathways interconnect the clusters to the central spine. Each user has an array of choices available, from one-room shelters to supplementary spacious houses. The emphasis is making on family and neighborhood while encouraging adaptation and personalization according to their needs and resources.



The lower-income Groups were given numerous options that including a site and plinth, a service core, and one room, contingent on how much they can afford. Owners were free to use any material for the construction and decoration of the house. Brick, stone, and cement were locally available. Bright Colors in the facades, railings, grills, and cornices commonly seeing in the old houses of Indore are using in some of the houses. Interior streets and squares in the Economically Weaker Section are stone-paving, decreasing their cost and maintenance. Peripheral roads are asphalt paving for heavy traffic.

Incremental Growth Of House From A Plinth And Service Core To Two Storeyed Structure.

Indore’s Climate was effectively taken into account, and a conducive living environment was achieving in Aaranya. Most of the plots are small in and size, and the houses are clustered in low-rise blocks. The more extended side facade is oriented in the north-south axis to reduce the solar radiation on the building. Especially during summers. The two openings on the north and south permit the natural light and cross ventilation—the adjacent buildings sufficiently shade courtyards within houses, cul-de-sacs, public squares, and small activity areas.

About the Streets

The formal street network induces vehicular traffic outward to the perimeter road. In contrast, pedestrian traffic on informal pathways and open space networks flow in the opposite direction achieving clear and safe segregation of slow- and fast-moving traffic. Also, non-rectilinear alignment of streets with varying widths bends, and widening is providing to accommodate a range of spontaneous human activities. The hierarchy of commercial activities coincides with the street hierarchy. Standard commercial outlets are along major arterial roads, while informal shopping areas occur along narrow streets and open spaces throughout the settlement

At Aranya, they built only a small sample of 80 model homes in 1989, loadbearing brick on a concrete plinth with walls plastered and painted, to initiate the development. The architect drew only a set of ingredients to be appropriated, giving residents the language and space to 'upgrade their life.' Growth is planned but informal, confined by the masterplan's hierarchy of built form and open spaces, and held together by a lattice of infrastructural lines. The building and strengthening of ties between social activities. And also physical structures translate into specific architectural elements: the underlying plinth onto added steps and ledges, shared landings, tiny balconies, and open terraces. Here the idea is that every space gets using; staircases are not just for going up and down but also an interaction spot. Public life is allowing to seep into, encompass and infuse living spaces.

Comparative Insights:

Aspect	Quinta Monroy (Chile)	Aranya Housing (India)
Architectural Approach	Half-built incremental housing	Serviced plots with community clusters
Resident Role	Finish and expand homes themselves	Self-build based on personal capacity
Affordability Strategy	Government subsidy and compact design	Low-cost serviced land and infrastructure
Cultural Fit	Adapted to Chilean urban context	Deeply rooted in Indian social fabric
Social Impact	Prevented displacement, enabled dignity	Encouraged community resilience and pride

Case study-3

Savda Ghevra Resettlement Colony (Delhi).

Case study-3
Savda Ghevra Resettlement Colony (Delhi).

India's capital is marked by different settlement types, defined by diverse degrees of formality, legality, and tenure. As part of a larger project on urban transformation in India, Cities of Delhi seeks to carefully document the degree to which access to basic services varies across these different types of settlement, and to better understand the nature of that variation. Undertaken by a team of researchers at the Centre for Policy Research (CPR), New Delhi, the project aims to examine how the residents of the city interact with their elected representatives, state agencies, and other agents in securing public services.

Through three sets of reports, the project provides a comprehensive picture of how the city is governed, and especially how this impacts the poor. The first, of which this is one, is a set of carefully selected case studies of slums, known as jhuggi jhopri clusters (JJCs) in Delhi, unauthorised colonies, and resettlement colonies. The second set of studies explores a range of different processes through which the governing institutions of Delhi engage with residents. The third focuses on selected agencies of governance in Delhi. All reports are made public as they are completed.

Cities of Delhi is directed by Patrick Heller and Partha Mukhopadhyay and coordinated by Shahana Sheikh and Subhadra Banda. The project has received funding from Brown University and the Indian Council for Social Science Research.

Planning the Slum

JJC Resettlement in Delhi and the Case of Savda Ghevra

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Introduction

This report presents the case of a resettlement colony in Delhi, built to house residents evicted from jhuggi jhopri clusters (JJCs), squatter settlements located on public land. The JJC is one of seven government-designated categories of unplanned settlements1 in Delhi; it is a category estimated to include nearly 420,000 households,2 about 15 percent of Delhi's population.3 The city has experienced a long history of policies designed to remove JJCs from the city centre and relocate their residents to Delhi's periphery. Many of these have involved allotting JJC residents plots in 'Jhuggi Jhopri (JJ) Resettlement Colonies'.

Since India's Independence, Delhi has seen three waves of relocation: in the 1960s, in the 1970s, and, most recently, in the 2000s. The Delhi Urban Shelter Improvement Board (DUSIB) reports that between 1961 and 1977, the Delhi Development Authority (DDA) established 44 resettlement colonies under the retrospectively named 'Old Plan Scheme of JJ Resettlement'.4 In the first nine years of this policy, 18 JJ Resettlement Colonies were established.5 After a five-year break, the DDA undertook a massive resettlement push, relocating another 240,000 JJC households in just two years.6 By 1977, the Agency had built 26 additional resettlement colonies, bringing the total to 44 colonies.7

The most recent wave of relocation in Delhi was marked by eviction and resettlement of JJC residents to make way for infrastructure projects necessary for the Commonwealth Games, held in Delhi in 2010. During this period, residents were relocated to 11 sites, mostly in north, northwest, and west Delhi. These newest resettlement colonies—which include Savda Ghevra, Bawana, Holambi Kalan, Papan Kalan, Rohini, and Narela8—bring Delhi's total number of resettlement colonies to 55.

There is no official estimate of the population living in these 55 colonies. The most comprehensive figure available is a September 2013 estimate by the Government of the National Capital Territory of Delhi (GNCTD), which concludes that 250,000 households (approximately 1.25 million people) live in the 44 resettlement colonies established as a result of the first two waves of resettlement. This estimate does not include those living in the 11 newest colonies.

Officially referred to as 'Jhuggi Jhopri (JJ) Resettlement Colonies' by the government, these settlements should logically be understood as 'planned', implemented as they are by government design. As Gautam Bhan observes:

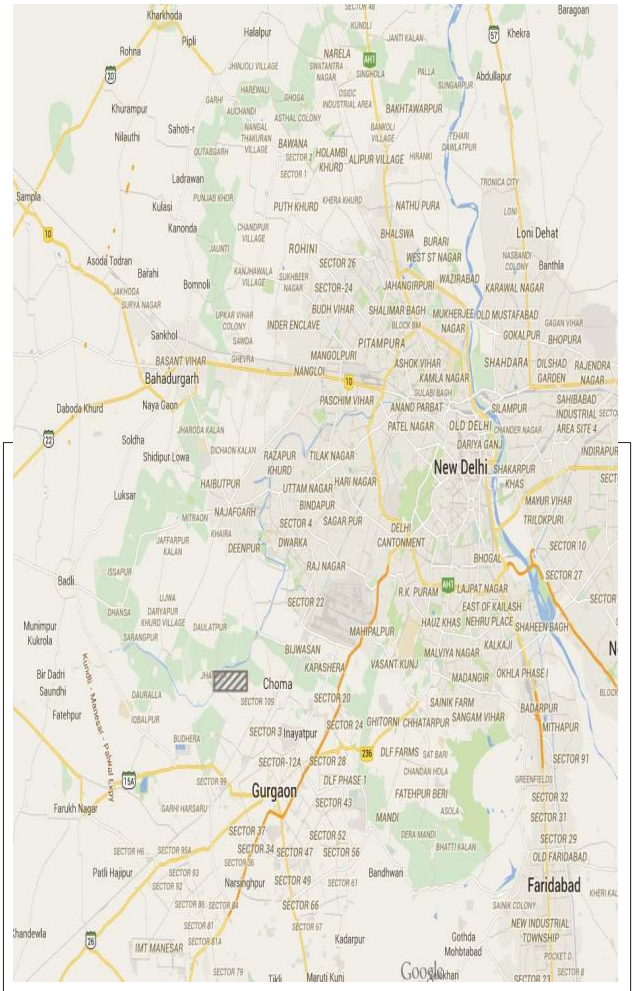
> [Resettlement colonies] are explicitly included within the development area of the master plan in a zone marked for residential use, laid out according to standards and norms for resettlement colonies in the master plan and, critically, they fulfil all these conditions at the time they were built.9

Yet, while it places resettlement colonies physically inside the 'planned' city, the government of Delhi treats resettlement colonies as a distinct category, separate from planned colonies. This may be a tacit recognition on the part of the government that even though they are 'planned', as we document in this report, many resettlement colonies have not been provided with basic services and are in many ways being overtaken by informal arrangements. In other words, even as JJC residents are shifted into colonies designed by the government they remain officially within the framework of the marginal, 'unplanned' city, subject to vulnerabilities similar to those that mark the JJCs the policy is meant to displace.

The government's relocation of JJC residents is explicitly motivated by the concept of 'rehabilitation', an impetus that suggests resettlement sites should have the basic services like water and sewerage that JJCs so often lack. In reality, however, these colonies are rarely serviced before residents arrive. Rather, services follow residents after they are relocated, resulting in the same disorganised and incomplete service delivery present in the JJCs these colonies are meant to 'rehabilitate'. This means that resettlement colonies, though planned, end up having many slum-like characteristics. It is a reality that has led scholars to label such resettlement colonies 'planned slums'.10 This report documents an example of this phenomenon in one of the city's most recently established resettlement colonies, the Savda Ghevra colony in west Delhi.

This report is the result of extensive field visits to the community, by a team of six researchers over seven months, between March and October 2013, with follow up work in summer 2014. A research protocol was framed in the form of an open-ended questionnaire with specific themes for collecting qualitative primary data from respondents identified using a snowballing technique.

Respondents included residents from different blocks of the resettlement colony, members of the residents' welfare associations (RWAs), elected representatives, staff of government agencies, and members of NGOs active in the colony. Respondents were balanced across gender, and information provided by individuals was corroborated with other residents. In a number of cases, information provided by respondents was inconsistent and is reported as such. All the other findings we present are based on multiple responses that were consistent across respondents and that we judged, following the standards of qualitative research, to be robust enough to be reported as such.



= Area of Detail

The Place

The Savda Ghevra JJ Resettlement Colony was established in 2006 in Phases I and II of Savda Ghevra. Sited on 250 acres on the western periphery of the city, it is the newest resettlement colony resulting from the most recent wave of evictions and relocation in Delhi. Records of the Government of the National Capital Territory of Delhi (GNCTD) describe these two phases of the colony as including 8,686 plots.11 A third phase of the colony remained undeveloped until August 2012, when construction of 7,620 EWS (economically weaker sections) flats began.12 Although work on these five- storeyed buildings continues, there are no residents in these flats.

It is difficult to find an official estimate of the population living in the colony, but an NGO active in the area reports that it exceeds 46,000.13 Electoral rolls indicate 14,707 voters from the colony. Located off National Highway 10, the colony is about 30 kilometres from Connaught Place, the de facto centre point of Delhi. It is part of the Mundka assembly constituency and the Mundka municipal ward.

The colony was built on agricultural land that had been

Savda Ghevra JJ Resettlement Colony is outlined in blue. The surrounding farmland is visible, as is the low density of development, compared to the rest of Delhi. An interactive map of this and other research sites is available at citiesofdelhi.cprindia.org/map.

shared by the neighbouring villages of Savda and Ghevra.14 The Delhi Development Authority (DDA), which had come to own the land, 15 sold it to the Slum and JJ Department of the Municipal Corporation of Delhi (MCD), which managed the allotment of plots to JJC residents during 2006 and 2007. 16 From this time until 2010 the Slum and JJ Department governed the Savda Ghevra Resettlement Colony; in 2010, along with the Department's other responsibilities, governance of the colony was transferred to the newly created state-level Delhi Urban Shelter Improvement Board (DUSIB).17

JJC residents were relocated to Savda Ghevra from communities located a substantial distance from the new colony. The closest of these, located at Tagore Garden, was 20 kilometres distant, while the furthest, at Lakshmi Nagar, was 44 kilometres away. Residents also moved from JJCs at Karkardooma, Shahdara, Palam, Raja Garden, Lodhi Road, Nizamuddin, Geeta Colony, Dilshad Garden, Khan Market, Yamuna Pushta, Pragati Maidan (Naglamachi), and Jawaharlal Nehru Stadium. Savda Ghevra and other recent resettlement locations have set a new standard of peripheralisation for the urban poor in Delhi; resettlement colonies established in the 1960s and 1970s were located more centrally, within 20 kilometres of Connaught Place.18

Residents give different accounts about the transparency of the relocation process, and whether or not they received government assistance to make the move.

While most residents reported that they were simply given provisional identification slips and subsequently relocated to Savda Ghevra, a place most had never seen, a few claimed that they had been shown the location of Savda Ghevra before they were actually assigned a plot and made the move. Further, while some residents told us that they had received transport or an allowance to shift their belongings from their previous residences to Savda Ghevra, others said they received no moving assistance from government agencies.

What is certain is that when relocated residents arrived at Savda Ghevra in 2006 and 2007 they found no roads or services. One female resident described the area as forested and "village-like". Another recalled the challenge of meals in this relative wilderness. Worms were a major concern; when they cooked a meal they had to keep it on a chauki (a small table about six inches above the ground) and consume it within 30 minutes to prevent it from being spoiled by worms.

The DUSIB's plot allotment system did not ensure that people who had been neighbours at a particular JJC would live near one another at Savda Ghevra. In fact, people who had previously been living in the same JJC were allotted plots in different blocks in the resettlement colony. We do not know if this separation was intentional, or the result of a random lottery system, but this fragmentation of existing communities has meant that Savda Ghevra remains relatively disorganised, without the structure of pradhans present in many established unplanned settlements.

With the exception of F block, plots in A through O blocks of the colony—fourteen blocks—have been allocated to relocated JJC residents, although some contain only a few plots. Residents recall that the most recent resettlement of a JJC to Savda Ghevra happened in 2009 when households from a colony near Khan Market were relocated in the lead-up to the 2010 Commonwealth Games. Although more than 1,000 plots remain vacant and ready for resettlement according to a DUSIB official, DUSIB's records show that no JJC households have been resettled to Savda Ghevra in the past year.19

The size of the plot assigned to a given resident at the time of resettlement was determined by how many years he or she could provide proof of residence in the JJC. Allocation was determined by two different 'cut-off' dates: 1990 and 1998. If the documents presented by a JJC household showed residency prior to the 1990 cut-off, it received an 18 square metre plot. Those who presented documents satisfying the 1998 cut-off date were allotted a plot of 12.5 square metres. Residents proved residency with traditional forms of identification such as voter ID and ration cards, as well as V P Singh tokens, a form of residence proof held by some long-term JJC residents

in the city.20 These plots are dramatically smaller than those allotted to resettled JJC residents in the 1960s, when plots measured 80 square yards (67 square metres).

Service Provisioning

WATER

By 2004, the Delhi Jal Board had extended its formal, piped water distribution network to include many of Delhi's older resettlement colonies, those established in the 1960s and 1970s.29 According to the DJB website, a resident living in an area covered by the DJB water distribution system can apply for a water connection by submitting a form to the Zonal Revenue Officer (ZRO) along with documents for proof of identity, property ownership, and residence.30

Resettlement colonies established in the 2000s do not benefit from this water distribution network. In these settlements, public or community standposts installed by the DJB (referred to as totees by residents) and public hand pumps are the main sources of water. DJB and private water tankers supplement this groundwater supply.

Unlike newer resettlement colonies in Delhi, Savda Ghevra does not have community water standposts or hand pumps. For the first six or seven years of the colony's existence, water was supplied mainly by DJB water tankers and private bore wells. Since 2013, residents have also been able to buy drinking water from 'water ATMs', water dispensing machines installed across the colony by a private provider contracted by the DJB and DUSIB, as well as a kiosk constructed by an NGO.

When Savda Ghevra was established in 2006 access to water was an enormous problem. Residents relied on DJB tankers, two or three of which visited the colony each day at three chowks (crossroads). Residents would often queue at a water tanker around 1 p.m., only to receive a single bucket of water at 5 or 6 in the evening. A woman resident recalled that accessing water was tense and disorganised, and that, "maara-maari ho jaati thi".

("Physical fights would happen.") Residents augmented this supply with water from public taps in neighbouring areas such as the Ghevra village and the Ghevra Railway Station.

According to residents, the water situation has improved since then, although there is still no piped water in the colony. Today, while there is no fixed schedule for the water tankers, each household is able to access a DJB water tanker once every two or three days and residents report this provides them sufficient drinking water. No payment is made for the water received through DJB tankers. On average, six or seven water tankers come to different blocks in the colony on a daily basis. In case the water tankers do not come at the expected frequency, residents say that they contact the DJB office at Karala from which the tankers are sent.

One DJB water tanker provides water for thirty households; however, water distribution through these tankers appears to be disorganised. NGO workers in the colony explained that because there is no fixed schedule for the tankers, residents organise their lives around water, with children often skipping school to collect water.

Households are not guaranteed a fixed quantity of water from DJB tankers. An NGO worker explained that that the amount of water a household gets from the tankers "depends on how many people the household has to carry water". Residents often store extra water in a drum since they are not sure when the next water tanker will come.

The relatively limited supply of water from DJB water tankers is used for drinking. Bore wells supply other needs, but, according to residents, the ground water is saline and polluted by fertiliser runoff from surrounding farmland. Nonetheless, it is sometimes used for drinking in cases of shortage. Many households have dug their own bore wells, and some have grouped together to share a single well.

Residents informed us that the exercise of digging a bore well (about 60 feet deep) and installing a pump costs around Rs. 10,000. In cases where inter-household agreements exist between people who have dug a well and others who want water, a household can get one

drum daily at the rate of Rs. 200 per month from the household that has dug the well.

The water ATMs that have been in operation since October 2013 are maintained by Sarvjal (literally, water for all), an organisation founded by the Piramal Foundation and run by Piramal Water Private Limited, which, according to the Sarvjal website, "is a for-profit social enterprise which creates affordable access to safe drinking water for the under-served at the last mile".31 Piramal Water Private Limited has a contract with both the DUSIB and the DJB to run the ATMs.

Sarvjal's main water treatment plant is located in J Block of the colony, on land owned by the DUSIB. Raw ground water is first extracted from a bore well, which was sunk by the DJB specifically for the plant, and then treated to be safe for drinking. Potable water is sold at ATMs throughout the colony for Rs. 0.3 per litre; residents can also buy water from an ATM directly at the treatment plant for half this price.32 A resident can draw up to 20 litres of water per visit. In November 2013, about 400 litres of drinking water were supplied by these ATMs each day. In April 2014 a newspaper article quoted the project's operations manager, who reported that while daily use had increased to between 2,000 and 2,500 litres, the project had only been able to reach 20 percent of the population in the colony.33

The Centre for Urban and Regional Excellence (CURE), an NGO that has been working in the resettlement colony for several years as a part of the Sanjha Prayas34 initiative, has offered another solution to the challenges of water distribution. In March 2013 CURE began working to create non-profit 'water kiosks', and has completed two kiosks to date, of which only one is operational. This two-storey building—marked with a sign reading Shudh Jal Ghar Samiti (Pure Water House Collective)—houses a water tank on the upper floor, filled with groundwater treated on site. A machine for this process is on the first floor of the kiosk, and the resulting drinking water is sold in 20 litre cans for Rs. 10.

SANITATION: TOILETS, DRAINS, AND SOLID WASTE MANAGEMENT

As it is in much of the city, sanitation in Delhi's resettlement colonies is managed by three government agencies: construction and maintenance of sewer lines across Delhi is the responsibility of the DJB; construction and maintenance of toilets for residents of resettlement colonies is managed by the DUSIB; drains are constructed by DUSIB and maintained by the municipal corporations; and solid waste management is the mandate of the respective Municipal Corporation of Delhi (North, South, or East).

The DJB presents ostensibly clear instructions for obtaining a new sewer connection on its website, instructions that suggest any Delhi resident can apply for a connection.35 The site does not mention, however, that a consumer is only eligible for a sewerage connection if a trunk sewer system already exists in his or her area. There is no sewerage system in Savda Ghevra Resettlement Colony. NGO workers claim that sewerage in the area is not included in the Master Plan of Delhi. In the absence of a trunk sewer system, residents mostly use community toilet complexes that are connected to septic tanks. Residents who can afford it have also built toilets in their homes, connected to individual septic tanks or less formal cesspools.

One community toilet complex (CTC) was built in each inhabited block of the colony around the time of original settlement. Residents recall that when they were relocated to the colony, many CTCs were locked, and some have remained sealed to this day. One respondent explained that residents had little incentive to get these toilets unlocked because, "the open farms are always there".

A typical CTC has twenty latrine seats each for men and women in separate sections; three or four of the latrine seats in the women's section are often reserved for children. These numbers should be compared with the number of plots in each block, which ranges from 600 to 1,250, each of which is meant to house a family. As a result there are often long queues at CTCs. While a few

residents said that the toilets were being maintained by the DUSIB, others said that toilets were being run by residents who had received 'contracts' from the area's municipal councillor. A woman who was maintaining
the CTC for H Block explained that she had been running the CTC for six years and had been "told to run the toilet complex by the councillor". Like most of these caretakers, she has no formal contract. We did meet one caretaker who had a somewhat more formal arrangement. He held an official letter from the municipal councillor granting him "permission for maintenance" of one CTC.
The contractors maintaining the toilets charge adult men and women Re. 1 per use; it is free for children. Some residents complain that the CTCs are often poorly maintained, dirty, and lacking sufficient water supply. While a large number of residents use the CTCs, respondents told us that there are too few complexes
and their hours are too limited: they are open from 5 a.m. until 10 or 11 p.m.

Many households have constructed toilets to use during late night and early morning hours. Though many of these are constructed inside homes, some have been built just outside. Toilets constructed outside a house are usually small, temporary enclosures made of bamboo poles covered with reused flex sheets36 for privacy.
Since there is no sewerage system, some of these toilets discharge waste into underground concrete tanks, which most residents refer to as 'septic tanks'. These tanks have to be cleaned when they fill up, at an annual cost that one resident estimated at Rs. 500. Waste from private toilets without 'septic tanks' flows either into a storm drain outside the house or is simply routed to a cesspool. The colony has many cesspools ranging in size, including several parks that have been converted to large common cesspools full of green water.

CURE, the local NGO responsible for developing the water kiosk scheme, has also undertaken a project to construct a community septic tank (CST) system. This decentralised system designed to give residents access to sewerage despite the colony's total disconnection from the trunk sewerage network. CURE staffers told us that,
together with community input and the help of a visiting British architect, they have designed a project that
will bring a toilet inside every home. The construction work for the pilot stage, funded by Mahila Sewa Trust, began in April 2013 in one part of A Block. A system of underground pipes aggregates sewage from groups of houses and carries it to a sewage treatment plant that CURE received permission to build in an area demarcated as a park. Residents whose toilets are connected through this system will pay Rs. 30 per month for the system.37
While this decentralised approach to sewerage might present an innovative solution to sanitation challenges in unplanned settlements across the city, implementation in Savda Ghevra has faced many difficulties. A resident said that during the construction process, "the lanes were left uneven due to the digging of manholes and laying
of pipes. Children would fall while playing and at night it was all the more difficult to walk through the lanes." After a year of often frustrating delays the sewerage network became operational in March 2014. Since then about 70 households have connected their toilets to the
system. The lanes are yet to be re-laid, and continue to be treacherous.
The cost of using a CTC or constructing a private toilet means that the colony's poorest residents defecate out- side in neighbouring areas. Young children often urinate and defecate on roads and into storm water drains.
Although storm water drains had been constructed at Sevda Ghevra at the time of settlement, during visits we observed that most of these drains were either full of stagnant water or clogged with solid waste. One resident observed that the drains are poorly designed and have no slope.

The three municipal corporations are responsible for collecting and disposing of solid waste from areas under their jurisdiction, including resettlement colonies.
Door-to-door garbage collection, however, is not the mandate of the municipal corporations according to their governing legislation, the MCD Act. In planned colonies, residents' welfare associations (RWAs) organise and hire private individuals to provide this service.

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Ration Cards

These are cards for accessing food grains and other essential commodities from the Public Distribution System through a network of Fair Price Shops at subsidised prices. Different ration cards are distributed to people according to income.

In 2008, one to two years after resettlement, residents were issued new voter ID cards listing their current Savda Ghevra addresses. Today, they report that nearly all of the over-18 population in the colony have voter ID cards. One woman explained that elected representatives ensure that the population has voter ID cards so that they can "come and ask for our votes". Another resident added that, "If one wants to get a voter ID card made fast then they may need to pay anything between Rs. 500 to Rs. 1,200. . . It can be done." Respondents across the city have reported this exchange.

Most residents reported that they have Aadhaar cards, and one resident estimated that about 75 percent of the residents have an Aadhaar card. However, a few residents explained that some children could not get an Aadhaar card made since they did not have birth certificates.

Residents had many complaints about ration cards. A few residents told us that although they have above poverty line (APL) ration cards, they cannot access their ration.

Another resident said that even those with ration cards certifying that they are below the poverty line (BPL) do not get rations.40 Other residents, who have been living in the colony since 2007, explained that they had still not been successful in getting ration cards at their Savda Ghevra address and so had no choice but to buy wheat and rice at the market price

PUBLIC FACILITIES

There are three large government schools in the area including a Sarvodaya Vidyalaya, a government co-edu- cational middle school, and an MCD school. While most residents seemed satisfied with the government schools in the area and stated that almost all children attend schools, a few complained about their poor quality.

All residents we interacted with complained about the lack of a government hospital in the colony. They explained that there is only an MCD dispensary in the colony, where one can get basic medicines; the closest government hospital is the Sanjay Gandhi Memorial Hos- pital in Mangolpuri. This hospital is located a little over 13 kilometres from the colony and patients rushing there in autorickshaws have been known to die before arriving.

When residents were first resettled at Savda Ghevra there was very poor bus service, but service to the settlement is now quite good, with at least three Delhi Transport Corporation bus routes that begin and terminate at the colony.41 The main bus stop for the colony is situated at a four-lane crossroad between blocks A and B of the colony.

The closest metro station is the Mundka station, about 7 kilometres from the colony. It usually takes 15 or 20 minutes to cover this distance in a private vehicle, but if the railway crossing south of the colony is in use it can take 30 or 45 minutes.

Negotiated Citizenship

If the Savda Ghevra JJ Resettlement Colony stands at the city's geographic margin, its residents occupy an even more peripheral place in the government's gaze. Indeed, in many ways the settlement is more poorly serviced than the unplanned settlements it is designed to replace. Despite residents' widespread frustration with poor service provisioning and frequent demands for improvement, state actors have made very few interventions. The government's decision to ignore the colony's needs has been facilitated by the fact that interactions have nearly all been on an individual basis. This lack of organisation is in part a consequence of the resettlement process itself, which split JJC communities across blocks of the colony. Nongovernmental organisations have emerged to fill parts of the gap left by the state in Savda Ghevra, providing services such as drinking water and garbage collection.

There are no government offices in the resettlement colony, with the exception of a DUSIB office in Phase

III, quite far from most residents. The state's absence in Savda Ghevra is further reflected in its representatives' infrequent presence in the community. One respondent told us that, "They [the MLA and municipal councillor, both members of the BJP] do not come to this area . . they only come when they need our help and during elections." Another said, "Woapne kaam se aate hai waise kabhi nahi aate." ("They only come for their own work, otherwise they don't come to this area.") Although the MLA rarely comes to the colony, he often summons its residents to swell the crowds at rallies in exchange for small payments or gifts. One resident said that, "The MLA has never visited us. . . but whenever he needs people for a rally he comes to us for that. He gives gifts or money to those who attend his rally." He mentioned one recent rally for which residents had received Rs. 500 each for their attendance.

In our conversation with the MLA, a member of the BJP, he did not substantively dispute these perceptions.
Although he listed the various projects he had overseen in his constituency, none was located in Savda Ghevra. He agreed that the colony is plagued by poor servicing and other problems, but did not accept any responsibility.
Rather, he blamed the then Congress-led state govern- ment that had organised the resettlement. The process, he said, "was not planned initially and thus people suffer on account of many issues, especially towards

Anecdotally, the municipal councillor were more varied. A few groups of residents disagreed strongly with the perception that the councillor has been absent, asserting that he has been active in accomplishing a range of tasks. While some dismiss his accomplishments as transactional, an attempt 'to get votes', one resident described him as "like a guardian, not just a political leader". Others echoed this praise, some in the strongest terms. One respondent told us that, "When we came here seven or eight years ago there was nothing here.
Everything has been given to us by [the councillor]". Another resident said, "Humaare kehene se pehele hee woh humaari samasyaaon ko mehsoos kar lete hain. Jaise ek Maa apne bache ki bhoonk samajhti hai waise hee woh humko samajhtein hain." ("Even before we articulate our problems he knows and feels our problems. . . He understands us just like a mother knows the hunger of a child."). Residents emphasised that what allegiances are present in the colony are based on individual politicians, not party. Many of those who spoke so fondly of the councillor were explicitly opposed to the MLA even though both are members of the BJP.

The process of resettlement, which split residents of relocated JJCs across the new colony, has left Savda Ghevra relatively disorganised as a community, with no single pradhan or leader. What organisation has happened has been largely under the direction of nongovernmental organisations. In a direct attempt to strengthen community structures, CURE, an NGO active in the colony, has promoted the formation of residents' welfare associations (RWAs) in certain blocks.
We met with NGO workers from CURE together with office bearers of the RWA in C Block of the colony, which was established under CURE's direction in October 2012. According to both NGO workers and RWA officers, the NGO has continued to "handhold" RWA members, providing them training on how to conduct the RWA's activities. The RWA's officers explained that they were motivated to form the association by their impotence in the face of everyday problems, especially poor service delivery in the colony. One officer explained, "RWA ke banane se pehle log yahaan sangathit nahin the, isiliye sarkar ne sunvaayee nahin ki". ("Prior to forming the RWA, the people here were not organised, that is why the government did not hear us out.") Another officer of the RWA emphasised that they had formed the RWA to claim their rights: "RWA isiliye banayee ki humaare adhikaar ko maang sakein". ("We have made an RWA so that we can demand our rights.") Like others in the community, they attributed the block's disorganisation to the fact that residents from many JJCs—Lakshmi Nagar, Geeta Colony, Shahdra, and Kakkardooma—had been relocated to C Block, a pattern repeated across the settlement. Although officers of the RWA claim that the association has no political affiliation, during our later visits to the colony other residents referred to the RWA office as a party office for the Indian National Congress.

Savda Ghevra is one of 130 locations in Delhi that has a Suvidha Kendra (SK) Gender Resource Centre (GRC).
GRCs were established by the GNCTD as a part of an initiative called Mission Convergence, which was started in August 2008 to consolidate access to government schemes under one roof. Management of these centres is contracted to NGOs, which serve as intermediaries between area residents and various government departments.

Since 2008, the GRC at Savda Ghevra has been run by the Ray Welfare Trust. The centre is managed by a director and coordinator from outside the colony, and staffed by two community-based workers. The centre's primary role is to provide access to various application forms—such as ration card application forms, laadli (girl child) scheme forms,42 and pension scheme forms—and then send completed forms to the proper government office. Apart from this, the GRC organises monthly nutrition camps,
bi-monthly health camps, remedial classes for under-performing students, adult education classes, classes for out-of-school children, vocational training, and legal and counselling sessions. Once every six months, the centre organises large public meetings, which are very well attended. Local officials representing police, schools, and other local institutions are present at these meetings to address community concerns.

We attended one such meeting in September 2013. The meeting was called Awaaz Uthaao – Jan Sabha (Raise Your Voice – Public Meeting), organised to discuss issues like harassment of women and girls in public spaces.
Girls and women made up a majority of the audience and principals of government schools were present. During the meeting, representatives of Mission Convergence encouraged the formation of women's collectives to take on the responsibility of "monitoring of those elements who might harass women and girls" and ensure that "everyone is alert". After a short play performed by a theatre group, the local station house officer (a senior police officer) addressed the gathering. He identified substance abuse (nashaa) as a fundamental challenge
in Savda Ghevra, claiming that men in almost every household have problems with drugs or alcohol. He called on the community's women to influence men to stop substance abuse, as well as for an increase in women's collectives.

In addition to the GRC, there are 11 NGOs working in Savda Ghevra in a range of areas, including education, health, microfinance, and vocational training. While some of these had been associated with residents
in bastis prior to resettlement, many have come up since relocation. It is clear that this density of
nongovernmental actors has emerged to fill two needs in the settlement: the organisational void left by the fracturing of resettlement, and the exceptionally poor servicing provided by the state.

Elections

The run-up to the Delhi Assembly elections in 2013 provided us an opportunity to understand what the residents of Savda Ghevra Resettlement Colony consider to be important election issues, to observe their electoral loyalties, and document the campaign strategies of various political parties and candidates in the colony.
The following reporting is based on four field visits to Savda Ghevra by seven researchers between 25 October and 18 December 2013, as well as meetings with workers at party offices of the AAP, BJP, and Congress, and with an independent MLA candidate.

In interviews, residents emphasised access to basic services as a key criterion in their electoral decision-making. Other respondents mentioned pensions for the elderly as an important concern. Although residents' ten- year licenses will expire in 2016 or 2017, no respondent mentioned license renewal as an election issue.

The BJP had originally announced that the sitting MLA would run as its candidate for the 2013 election. The area's councillor had hoped to receive the ticket but was denied. To express his frustration he resigned as Mayor of the North Delhi Municipal Corporation and some thought he would resign from the BJP entirely. A core group of residents that support the councillor was also

very upset about the BJP's decision to pass him over and organised a mahapanchayat, or meeting of the villages and colonies in the constituency, to discuss who should represent the party in elections. This mahapanchayat received much media attention at the time.43 Following the meeting, the BJP reversed its decision and announced the councillor as its candidate.

Like residents we spoke to across the city's unplanned settlements, many respondents in Savda Ghevra approached the elections with apathy. One woman told us, "They [elected representatives] don't do anything for five years and then they come just before elections, fold their hands in front of us and ask us to vote for them".
Another voter explained that people make decisions based on the gifts they receive in advance of the election: "Whichever party lands up and gives them money the night before the election wins". In the months leading
up to the election, residents reported receiving cash and gifts like saris and steel pots from candidates who were expecting to fight the elections. They noted that candidates specifically targeted women with voter identity cards.

Savda Ghavra was also the site of the most interesting electoral story we witnessed during this phase of our fieldwork. In addition to candidates from the major political parties, a local landowner and political novice stood for the election as an independent candidate from the Mundka Assembly constituency. He introduced himself as a samaajik karyakarta (social worker), claiming that he had won an award for distinguished service to the elderly from the President of India in November 2012. His supporters told us that he had financed and organised a vast array of social services in the constituency including providing free water tanker service, housing for homeless and poor, primary healthcare, and a photocopying service. He had also, they claimed, distributed 51,000 steel pots and 50,000 bed sheets to residents, as well as given a monthly pension of Rs. 200 to 70,000 women in the constituency. While the magnitude of these claims cannot be verified, our interviews leave little doubt that he had been running a parallel private government in the constituency for some time.

In December, this social worker-landowner won the election, with 34.3 percent of the vote. This was the only constituency of Delhi's 70 assembly constituencies where an independent candidate was elected as the MLA. This is an important and revealing story: an individual, by filling the void left by the absent state, was able to win the popular support necessary to become a part of that state.

The Bharatiya Janata Party (BJP) was second, with 29.6 percent of the vote, while the Aam Aadmi Party (AAP) was third with 15.6 percent. The Indian National Congress finished fourth, receiving 12.5 percent of the vote. Elections at the Savda Ghevra Resettlement colony did not mirror these larger, constituency-level results.
A quick analysis of the election data for polling booths where the residents of Savda Ghevra voted suggests that
26.28 percent voted for the Indian National Congress, while 23.68 percent voted for the independent candidate. Further, while 20.3 percent voted for the Bharatiya Janata Party (BJP), 17.31 percent voted for the Aam Aadmi Party (AAP).

Conclusion

Resettlement colonies were designed to house the residents who have been evicted from Delhi's JJCs over more than four decades. In Savda Ghevra JJ Resettlement Colony, one of the city's most recently established resettlement colonies, residents were relocated from JJCs across the city, breaking community ties and removing residents from their sites of employment. This disruption

was not balanced by clearly improved security of tenure: residents' property rights remain severely limited, and they are not legally guaranteed protection from another eviction.

Savda Ghevra presents a case of what some scholars have called a "planned slum": even as these residents are explicitly shifted out of 'encroachments', they maintain
similar, poor access to government services. It exemplifies a mode of settlement in which the state has in effect designated an unserviced zone for specific populations on the periphery of the city.

In the absence of the state, nongovernmental actors and market actors have emerged to provide services as basic as water and toilets. These solutions, however, have proved inadequate to the needs of the more than
40,000 residents of Savda Ghevra. Into this vacuum, we witnessed the rise of an entrepreneurial individual who established his own system of service provision.

We watched him leverage the resulting support of the community into political capital that he used to win an election. The fact that he was able to win is testament that even the poorest and most marginalised voters ultimately do expect certain goods from the state, and they will express that expectation with their votes.

NOTES

1. Categories of settlements in Delhi presented in Economic Survey of Delhi, 2008-2009, page 169, citing Delhi Urban Environment and Infrastructure Improvement Project (DUEIIP)-2021.

2. DUSIB's 2011 List of 685 JJCs in Delhi

3. Calculated based on an average household size of five and the population of Delhi's Urban Agglomeration from the 2011 census data.

4. http://delhishelterboard.in/main/?page_id=86

5. micro Housing Solutions (mHS), 'Report on Self-construction: Enabling safe and affordable housing in India' (October 2011).

6. Ibid.

7. http://delhiplanning.nic.in/Economic%20Survey/ ES%202005-06/Chpt/14.pdf

8. City Development Plan 2006 for Delhi

9. Gautam Bhan, 'Planned Illegalities: Housing and the 'Failure' of Planning in Delhi: 1947-2010', Economic and Political Weekly (15 June 2013).

10. Usha Ramanathan, 'Illegality and Exclusion: Law in the Lives of Slum Dwellers', in State of Justice in India: Issues of Social Justice (Sage, 2009).

11. Interview with DUSIB executive engineer on 11 June 2013.

12. Ibid.

13. http://worlddesignimpact.org/projects/ project2013/29/

14. Note by Centre for Urban and Regional Excellence (CURE) on Sanjha Prayas Ajeevika Karyakram (SPAK) in Savda Ghevra (2013).

15. There is no public record of the exact date of acquistion by the DDA. We do know, however, that in 2005 a land use change for "252.4 acres of land at Savda Ghevra for relocation of Slum/ JJ squatters was approved by the Authority [DDA]".

Source: http://www.dda.org.in/about_us/pop_ups/MAJOR%20FUNCTIONS%20 (12.12.pdf

16. Mahila Housing SEWA Trust (MHT) and micro Home Solutions (mHS), 'Re-thinking Re-settlement Colonies: Savda Ghevra', Collab- orative Study on Savda Ghevra Resettlement Colony (April 2011).

17. Interview with a top DUSIB official on 2 May 2013.

18. micro Housing Solutions (mHS), 'Report on Self-construction: Enabling safe and affordable housing in India' (October 2011).

19. The JJC households who have been resettled by the DUSIB have been moved to EWS flats at other locations.

20. In 1989-1990, during V P Singh's tenure as Prime Minister, these tokens were issued to JJC residents as formal proof of residence. The tokens were the result of a four-month long survey by Delhi Administration—the governing body that preceded the GNCTD in Delhi—that aimed to enumerate every slum household in the city. Source: D. Asher Ghertner, 'Calculating without numbers: aesthetic governmentality in Delhi's slums', Economy and Society, 39/2 (2010).

21. An example of a Red Slip (dated 4 August 2006) cited in Nikhil Joseph and Pascal Goodman, 'On the Outskirts of Legality: Policy and Legal Aspects of Slum Resettlement in Delhi', Centre for Civil Society Working Paper No. 197.

22. Condition 12 of the agreement, the entirety of which was shared by a resident during a field visit in March 2013. The agreement also states that the allottee must take possession of the plot within 15 days of signing the agreement and mandates that he or she con- struct a habitable house within six months. The agreement also binds the allottee to any additional strictures that the government might establish: "From time to time, the conditions which are put out by the Department will be acceptable to the allottee."

23. Rs. 5,000

24. Rs. 2,000

25. http://delhi.gov.in/wps/wcm/connect/cddf87804c0a6eacbe16bf8696242497/Urban+Development+107_134.pdf ?MOD=AJPERES&lmod=802871 45&CACHEID=cddf87804c0a6eacbe16bf8696242497

26. Order no. 234(7)/UD/BSUP/2012/17270-17281, Department of Urban Development, Government of NCT of Delhi. 20 June 2013.

27. Originally designed as an instrument through which an individual can give another the power to manage his or her affairs, the GPA has also been used by individuals with property of "imperfect title who cannot or do not want to execute registered deeds of conveyance." GPAs also allow property buyers and sellers to avoid paying stamp duty and registration charges.

28. Julia King, 'Early Results from Savda Ghevra Field Work, Delhi' (April 2011). (http://web.mit.edu/incrementalhousing/ articlesPhotographs/pdfs/Julia-King-ARTICLE-e.pdf)

29. http://delhiplanning.nic.in/Write-up/2003-04/Volume-II/ Water%20supply%20&%20sanitation.pdf

30. http://www.delhi.gov.in/wps/wcm/connect/doit_djb/DJB/Home/ Customer+Section/Water/

31. http://www.sarvajal.com/#sarvajal

32. To buy water, a resident needs a refillable debit card. These are available for Rs. 100, which includes Rs. 50 of credit.

33. Damini Nath, 'Not many takers for water kiosks', the Hindu (26 April 2014).

34. Sanjha Prayas (literally, common endeavour) is a scheme started by the GNCTD in 2007. It was envisaged as a bhagidari (partnership) between residents of JJCs and resettlement colonies in Delhi and the GNCTD mediated by NGOs.

35. http://www.delhi.gov.in/wps/wcm/connect/doit_djb/DJB/Home/Customer+Section/

36. These flex sheets, which are also used in construction of some

37. kaccha houses, are usually old advertisements. The project has produced two promotional videos that outline the plan: http://vimeo.com/65895143; http:// vimeo.com/69853486

38. Chai-paani (tea-water) is a phrase often used by lower level government staff to describe small off-the-books payments for services.

39. The private partner in Tata Power Delhi Distribution Limited (TPDDL) is the Tata Group, and the private partner in both BSES Rajdhani Power Limited (BRPL) and BSES Yamuna Power Limited (BYPL) is the Reliance Anil Dhirubhai Ambani Group (ADAG).

40. A family qualifies for a BPL card if its annual income is below Rs. 24,200; it is considered APL if its income is above this threshold. APL cards are further catgorised as 'stamped' and 'unstamped', identifying families whose income is, respectively, below and above Rs. 1,00,000. Source: http://www.delhi.gov. in/wps/wcm/connect/doit_food/Food/Home/Citizen+Charter/

41. These bus routes provide access as far as Sarai Kale Khan (949EXT), the airport (947), Bhatti mines (947A) and Shahdra and Dilshad Garden (236EXT), residents reported that a bus leaves the colony every 20-30 minutes.

42. The laadli scheme was begun by the GNCTD in 2008 to improve the social status of girls through education. As part of the scheme, the GNCTD makes periodic payments in the girl's name, establishing a fixed deposit account to be redeemed along with accrued interest when the child turns 18 and completes Class 10 as a regular student. (Source: http://wcddel.in/eligibility.html)

43. See: 'Ticketed, BJP leaders on exit mode', the New Indian Express (10 November 2013); Twisha Hans, 'Mundka voters eye transport, civic amenities & water', the Statesman (29 November 2013).

CHAPTER -3: SITE ANALYSIS

The coordinates 26°33'11.2"N 80°16'06.5"E correspond to a location in Lucknow, Uttar Pradesh, India. Here's a detailed site analysis based on available data:

🌍 Site Overview

•**Location**: Central Lucknow, Uttar Pradesh

•**Urban Context**: Situated within the urban fabric of Lucknow, offering access to city amenities and infrastructure.

🌡️ Climate and Weather

The region experiences a tropical climate with distinct wet and dry seasons.

•**Current Conditions**: Mostly cloudy, 89°F (32°C)

•**Forecast**:

- **Monday, June 16**: High: 100°F (38°C), Low: 82°F (28°C)
- **Tuesday, June 17**: Thunderstorm in the morning, High: 99°F (37°C), Low: 80°F (27°C)
- **Wednesday, June 18**: Thunderstorm in the morning, High: 96°F (36°C), Low: 83°F (28°C)
- **Thursday, June 19**: Cloudy with rain in the afternoon, High: 94°F (34°C), Low: 79°F (26°C)
- **Friday, June 20**: Thunderstorm in the morning, High: 93°F (34°C), Low: 82°F (28°C)
- **Saturday, June 21**: Thunderstorm in the morning, High: 94°F (34°C), Low: 82°F (28°C)
- **Sunday, June 22**: Cloudy with rain, High: 93°F (34°C), Low: 84°F (29°C)

🏞️ Topography and Land Use

•**Topography**: The area is characterized by flat terrain typical of the Indo-Gangetic plain.

•**Land Use**: Predominantly urban with residential, commercial, and institutional developments.

•**Vegetation**: Urban greenery including parks and roadside plantations.

📏 Infrastructure and Accessibility

•**Transportation**: Well-connected by road networks; proximity to major roads facilitates easy access.

•**Utilities**: Access to municipal water supply, electricity, and sewage systems.

•**Public Services**: Nearby educational institutions, healthcare facilities, and commercial centers.

🌾 Environmental Considerations

•**Air Quality**: Urban air quality may vary; monitoring is advisable for sensitive activities.
•**Noise Levels**: Urban noise levels are typical; may vary depending on proximity to major roads.
•**Green Spaces**: Availability of parks and recreational areas contributes to environmental quality.

📌 Conclusion

The site at 26°33'11.2"N 80°16'06.5"E is situated in a central urban area of Lucknow, offering access to city amenities and infrastructure. The tropical climate with distinct wet and dry seasons influences the environmental conditions. Urban topography and land use are typical of the region, with flat terrain and mixed-use developments. Infrastructure and accessibility are well-developed, supporting residential and commercial activities. Environmental considerations such as air quality, noise levels, and green spaces are important for sustainable development

CHAPTER 4: DESIGN BRIEF

Project Title

Affordable Housing Prototype for Riverine Communities –

Project Type

Low-cost, net-zero energy residential housing with options for incremental growth, intended for economically weaker sections and flood-prone communities in peri-urban areas.

Location & Site Contex

Site: Peri-urban plot in Bithoor, ~25 km from Kanpur city, located near the Ganga riverbanks.Plot Characteristics:

Flat terrain, alluvial soil Prone to monsoon flooding (requires elevated design)Easy road access to Kanpur Rich in cultural and religious significance

Aims & Objectives

To develop an energy-efficient, climate-responsive, affordable housing prototype tailored for riverine and low-income Indian settlements.To minimize operational energy use and utilize renewable energy to meet household demands.To employ local materials and labor to support the local economy and cultural integration.To create a replicable, modular housing model adaptable to various sites and family sizes.

Target Users

Economically weaker section (EWS) and lower-income group (LIG) familiesLocal artisans, laborers, or displaced riverine households3–5 member households, possibly multigenerational

Key Design Strategies

1. Passive Design Features

Orientation: maximize natural ventilation (east-west)
Courtyard planning for daylight & air circulation
Wide roof overhangs, shaded verandas, ventilated plinth
High thermal mass using earthen/CSEB walls

2. Renewable Integration

Rooftop Solar PV: 1–1.5 kW per house
hold Solar water heaters
Battery backup or hybrid grid system

3. Flood Resilience

Raised plinth (minimum 1.2 m)
Drainage slope and rainwater harvesting
Use of flood-durable materials (lime, stone, CSEB

4. Local Materials & Systems

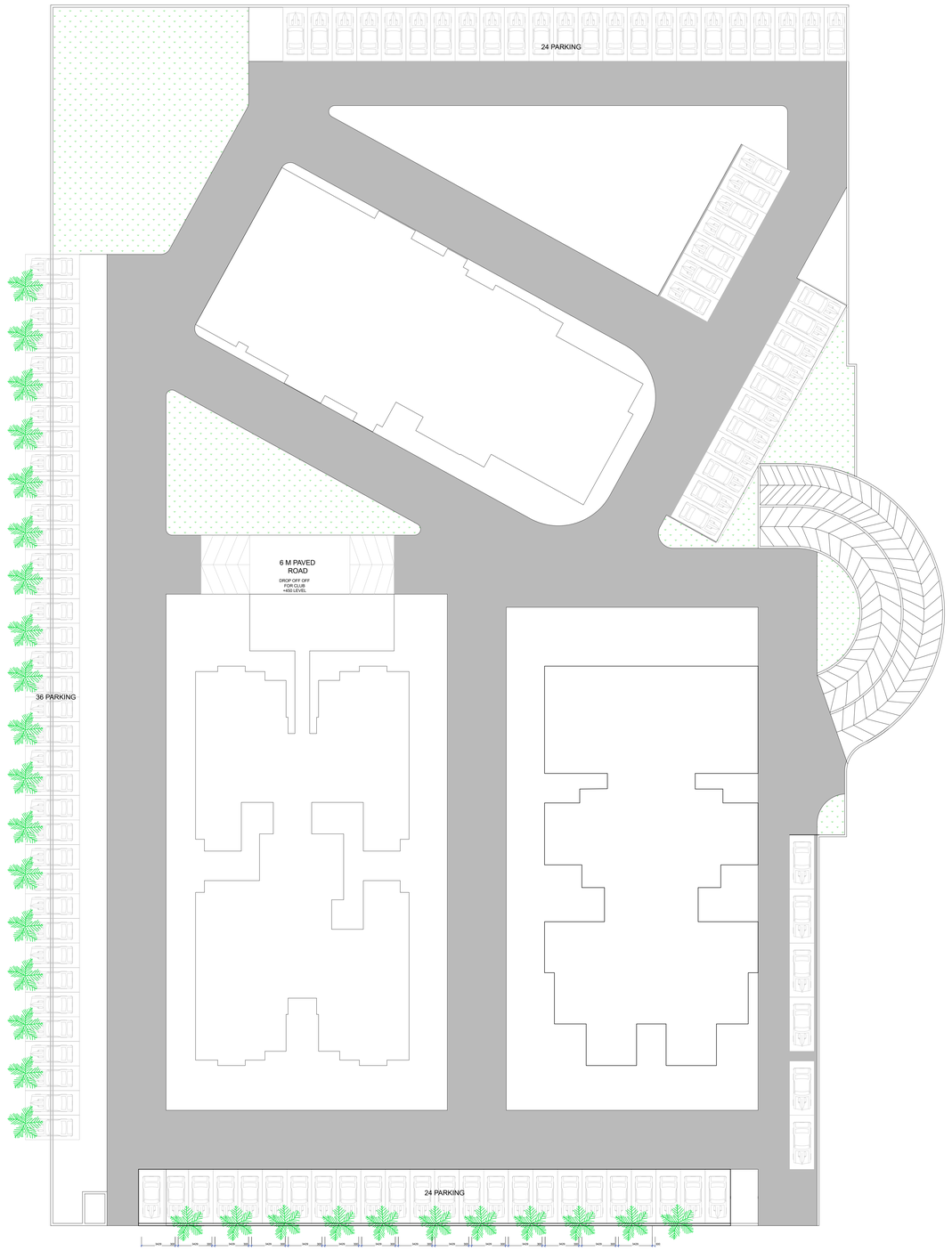
Compressed Stabilized Earth Blocks (CSEB)
Bamboo/cane reinforcement for roofing
Lime plaster, mud flooring, locally woven jute insulation
Modular toilets with bio-digester/septic tank

5. Affordable Construction Techniques

Modular layout for incremental housing
Prefabricated door-window units
Participatory construction with local labor

Conclusion

This design brief proposes a culturally rooted, climate-responsive, and economically accessible prototype that can pave the way for large-scale net-zero affordable housing across India's flood-prone and resource-scarce settlements.

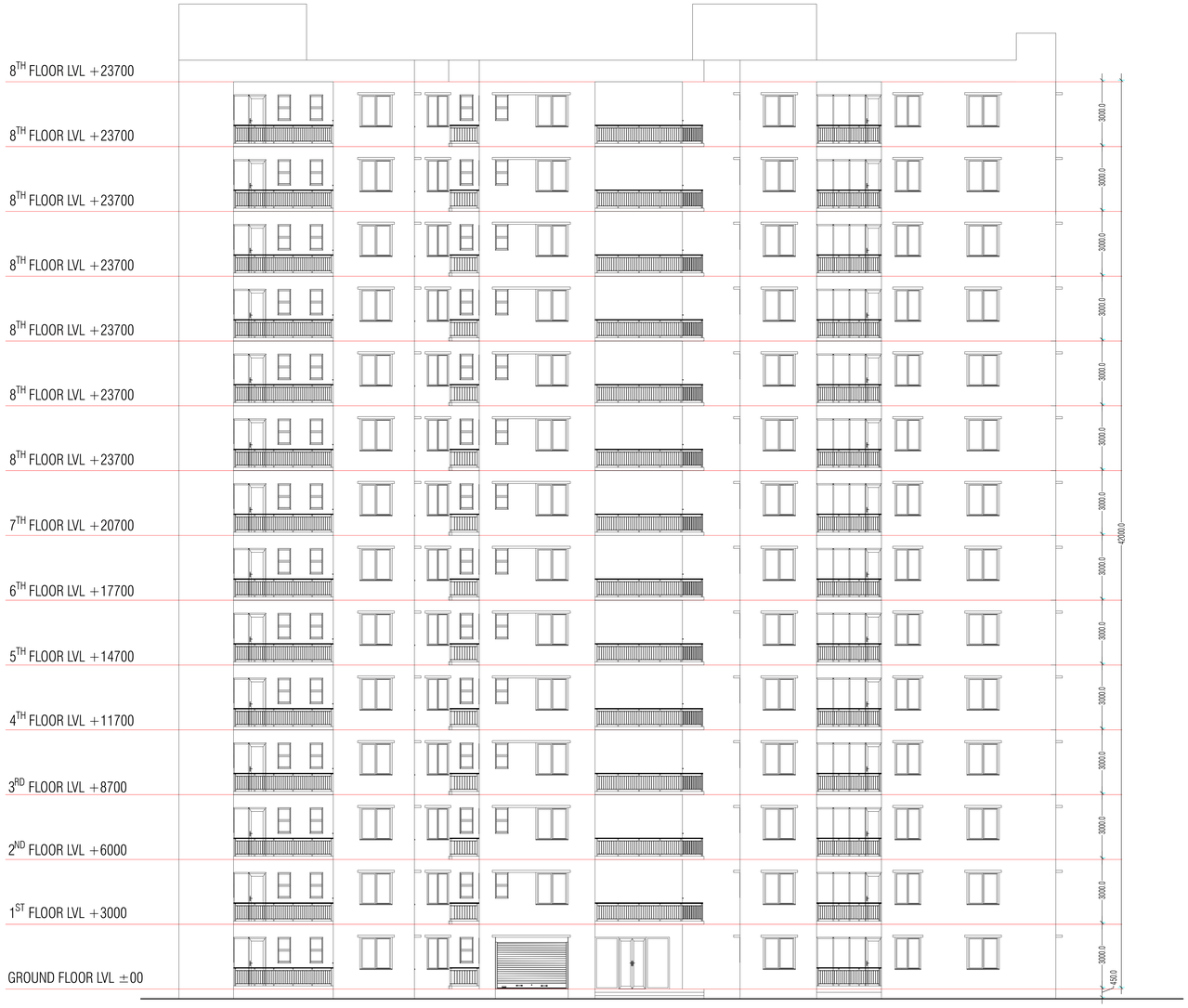


SITE PLAN WITH
TERRACE FLOOR PLAN

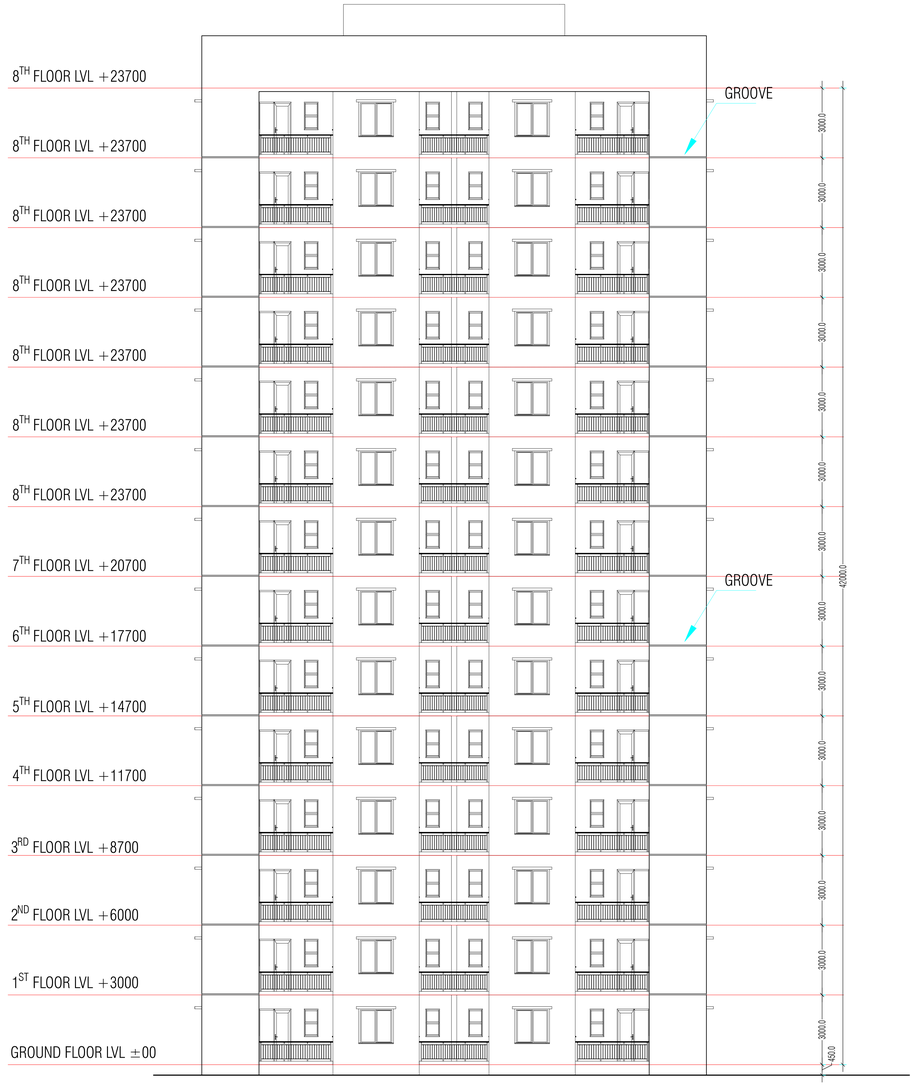
N	**DRAWING TITLE-** FLOOR PLAN	NOTE: ALL DIMENSIONS ARE IN MM SCALE - 1:100 SHEET NO.- 0	**PROJECT NAME-**	DESIGNING INNOVATIVE AND SUSTAINABLE AFFORDABLE HOUSING: ARCHITECTURE FOR SOCIAL JUSTICE.	**SUBMITTED BY-** AR. RAVIKANT TIWARI M.ARCH IV SEM. 1220109003 2024-25 BBDU, LUCKNOW **GUIDED BY-** PROF.(AR.) SAURABH SAXENA

SITE PLAN WITH GROUND FLOOR PLAN

N	**DRAWING TITLE-** FLOOR PLAN	NOTE: ALL DIMENSIONS ARE IN MM SCALE - 1:100 SHEET NO.- 0	**PROJECT NAME-**	DESIGNING INNOVATIVE AND SUSTAINABLE AFFORDABLE HOUSING: ARCHITECTURE FOR SOCIAL JUSTICE.	**SUBMITTED BY-** AR. RAVIKANT TIWARI M.ARCH IV SEM. 1220109003 2024-25 BBDU, LUCKNOW **GUIDED BY-** PROF.(AR.) SAURABH SAXENA



LEFT SIDE ELEVATION



FRONT ELEVATION

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DRAWING TITLE-

ELEVATION

NOTE: ALL DIMENSIONS ARE IN MM

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RIGHT SIDE ELEVATION

BACK ELEVATION

N

DRAWING TITLE-

ELEVATION

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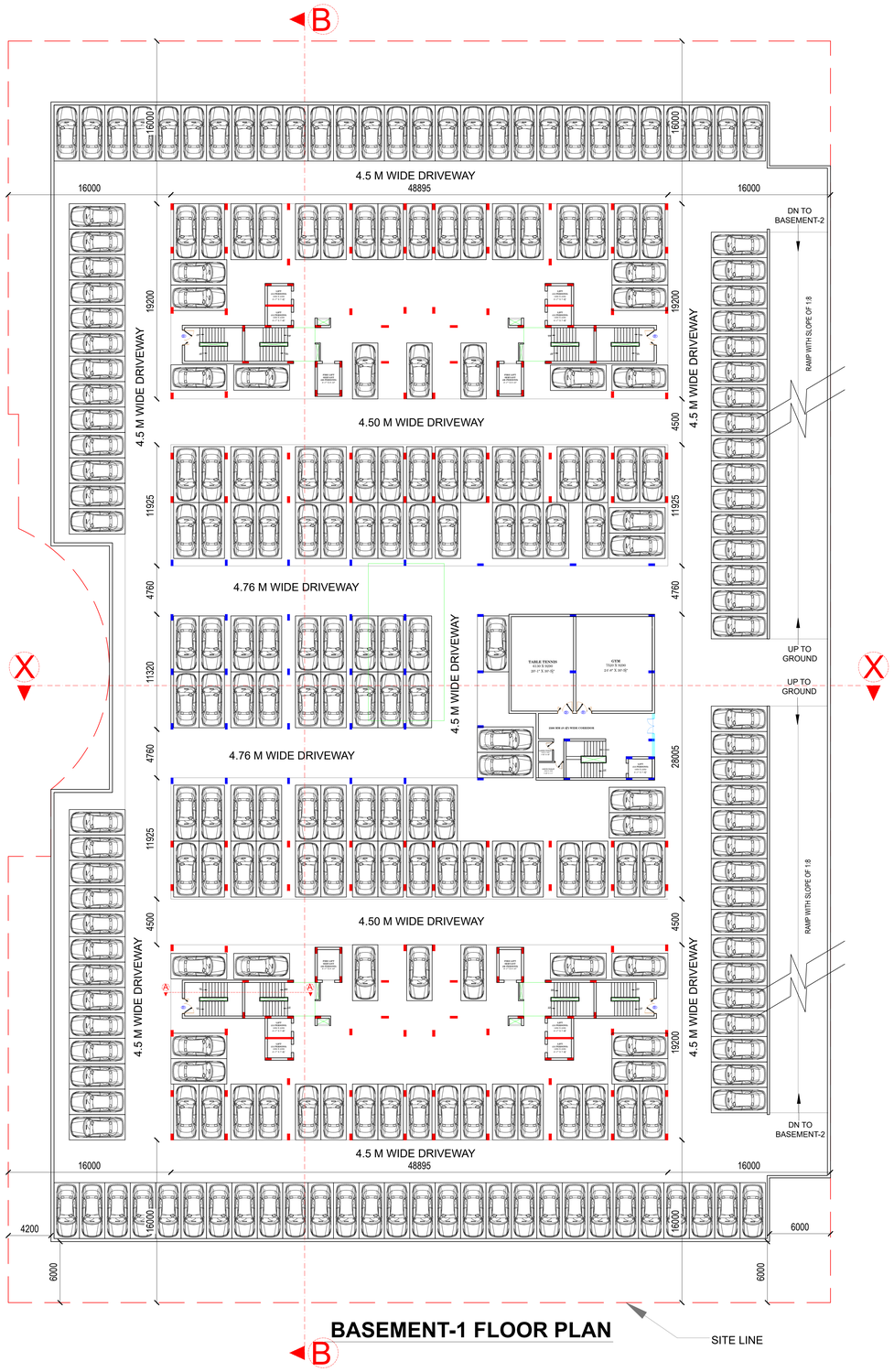

BASEMENT, STILT AND CLUB AREA STATEMENT

BASEMENT- 1	8383.56			
CLUB	216.37	LIFT WELL ,FIRE STAIR, & BALCONY	4.34	212.03
BASEMENT- 2	8067.32			
STILT FLOOR	2373.76			
CLUB	405.39	LIFT WELL ,FIRE STAIR, & BALCONY	4.34	401.05
			9988.68	49977.06

UNIT AREA STATEMENT:

(1) 3BHK+STUDY UNIT F.S.I. AREA =151.70 sq.mt.
(2) NO. OF 3BHK+STUDY UNIT = 100 UNITS

(3) 3BHK UNIT 3 FSI AREA =129.55 sq.mt.
(4) NO. OF 3BHK UNIT 3 =100 UNITS

(5) 3BHK UNIT 1&2 FSI AREA =129.03 sq.mt.
(6) NO. OF 3BHK UNIT 1&2 =200 UNITS

REQUIRED PARKING:

(1) NO. OF 3BHK+ STUDY UNIT = 100 UNITS @ 1.5/unit=150 cars
(2) NO. OF 3BHK UNIT 3 =100 UNITS @ 1.5/unit=150 cars
(3) NO. OF 3BHK UNIT 1&2 =200 UNITS @ 1.25/unit=250 cars
(4) 10% VISITOR'S PARKING =55 Cars
(5) TOTAL REQUIRED PARKING =605 cars

TOTAL F.S.I ACHIEVED -
PREVIOUS SANCTIONED F.S.I - 25300.44 sqm

PROPOSED F.S.I - 49977.06 sqm

PARKING PROVIDED:

S.NO	FLOOR	CAR PARKING
1.	BASEMENT FLOOR 1	253
2.	BASEMENT FLOOR 2	269
3.	STILT FLOOR	90
4.	STILT FLOOR (DECK)	53
	TOTAL PARKING:	665

N

DRAWING TITLE-

FLOOR PLAN

NOTE: ALL DIMENSIONS ARE IN MM

SCALE - 1:100

SHEET NO.- 0

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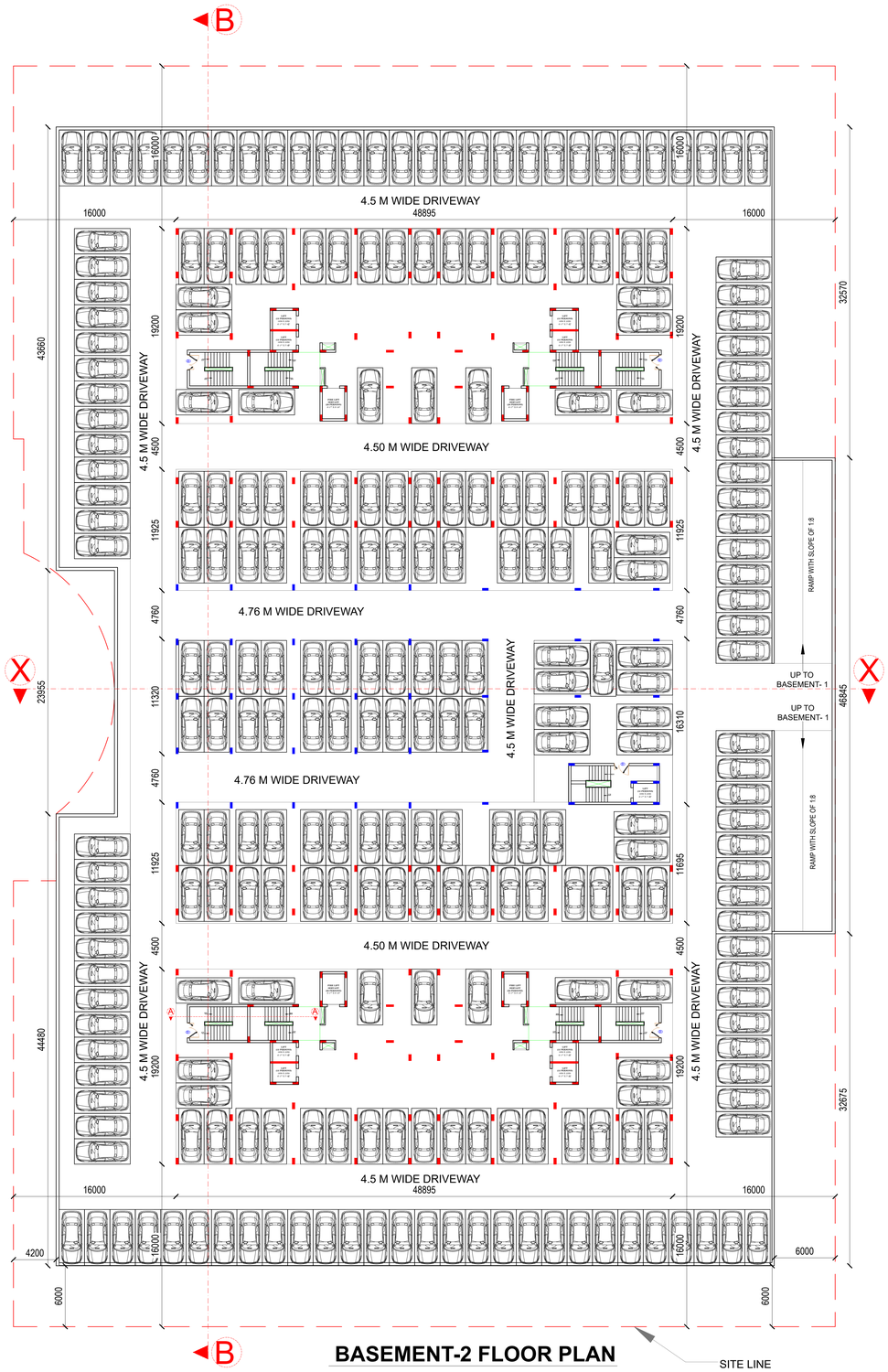

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(5) TOTAL REQUIRED PARKING =605 cars

TOTAL F.S.I ACHIEVED -
PREVIOUS SANCTIONED F.S.I - 25300.44 sqm

PROPOSED F.S.I - 49977.06 sqm

PARKING PROVIDED:

S.NO	FLOOR	CAR PARKING
1.	BASEMENT FLOOR 1	253
2.	BASEMENT FLOOR 2	269
3.	STILT FLOOR	90
4.	STILT FLOOR (DECK)	53
	TOTAL PARKING:	665

N

DRAWING TITLE-

FLOOR PLAN

NOTE: ALL DIMENSIONS ARE IN MM

SCALE - 1:100

SHEET NO.- 0

PROJECT NAME-

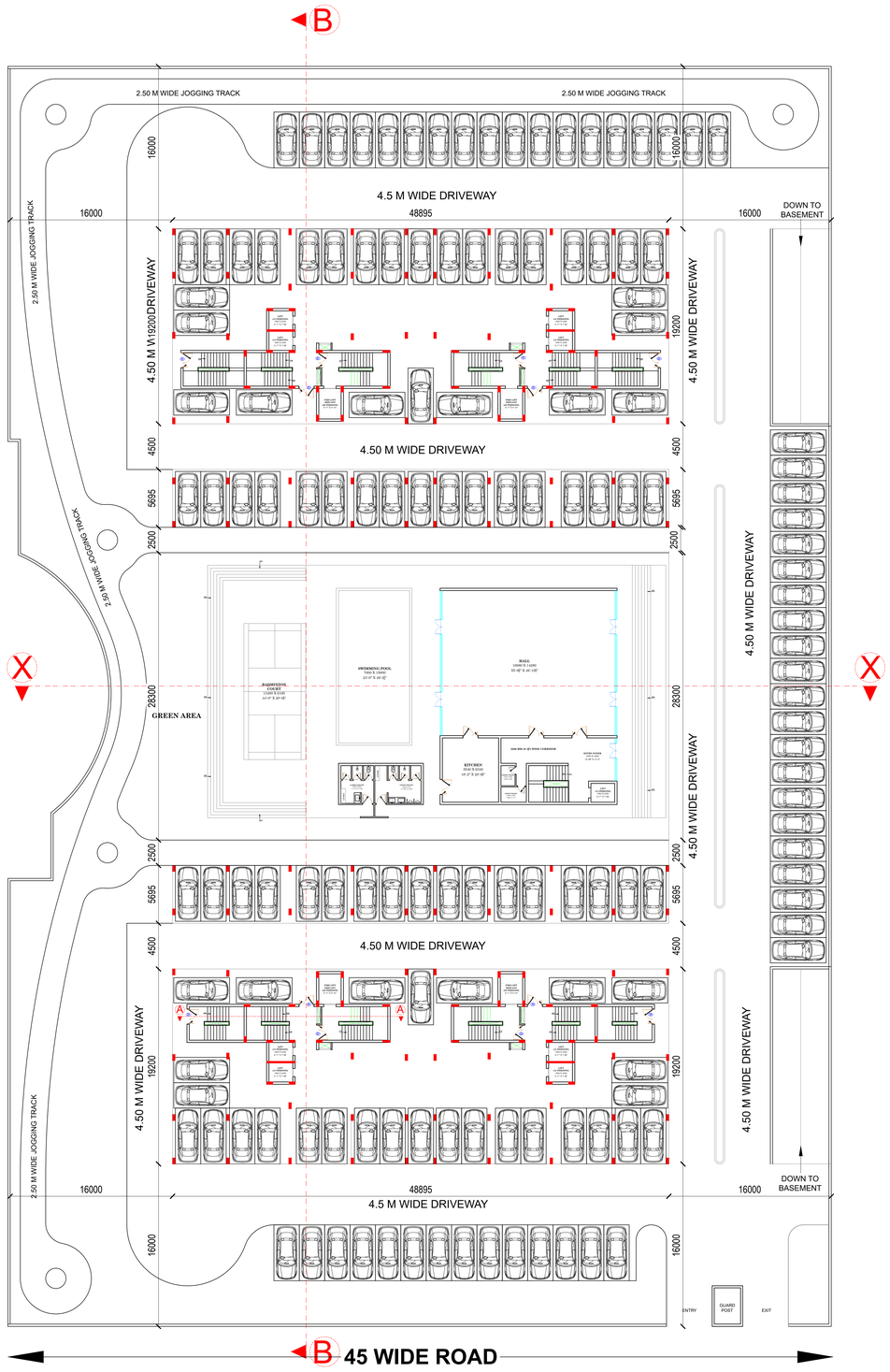
DESIGNING INNOVATIVE AND SUSTAINABLE AFFORDABLE HOUSING: ARCHITECTURE FOR SOCIAL JUSTICE.

SUBMITTED BY-

AR. RAVIKANT TIWARI
M.ARCH IV SEM.
1220109003
2024-25
BBDU, LUCKNOW

GUIDED BY-

PROF.(AR.) SAURABH SAXENA



STILT FLOOR PLAN

BASEMENT, STILT AND CLUB AREA STATEMENT

BASEMENT- 1	8383.56				
CLUB	216.37	LIFT WELL ,FIRE STAIR, & BALCONY		4.34	212.03
BASEMENT- 2	8067.32				
STILT FLOOR	2373.76				
CLUB	403.39	LIFT WELL ,FIRE STAIR, & BALCONY		4.34	401.05
				9988.68	49977.06

UNIT AREA STATEMENT:

(1) 3BHK + STUDY UNIT F.S.I. AREA =151.70 sq.mt.
(2) NO. OF 3BHK + STUDY UNIT = 100 UNITS

(3) 3BHK UNIT 3 FSI AREA =129.55 sq.mt.
(4) NO. OF 3BHK UNIT 3 =100 UNITS

(5) 3BHK UNIT 1&2 FSI AREA =129.03 sq.mt.
(6) NO. OF 3BHK UNIT 1&2 =200 UNITS

REQUIRED PARKING:

(1) NO. OF 3BHK + STUDY UNIT = 100 UNITS @ 1.5/unit=150 cars
(2) NO. OF 3BHK UNIT 3 =100 UNITS @ 1.25/unit=150 cars
(3) NO. OF 3BHK UNIT 1&2 =200 UNITS @ 1.25/unit=250 cars
(4) 10% VISITORS PARKING =55 Cars
(5) TOTAL REQUIRED PARKING =605 cars

TOTAL F.S.I ACHIEVED -
PREVIOUS SANCTIONED F.S.I - 25300.44 sqm

PROPOSED F.S.I - 49977.06 sqm

PARKING PROVIDED:

S.NO.	FLOOR	CAR PARKING
1.	BASEMENT FLOOR 1	253
2.	BASEMENT FLOOR 2	269
3.	STILT FLOOR	90
4.	STILT FLOOR (SEDA)	53
	TOTAL PARKING:	665

DRAWING TITLE-

FLOOR PLAN

NOTE: ALL DIMENSIONS ARE IN MM

SCALE - 1:100

SHEET NO.- 0

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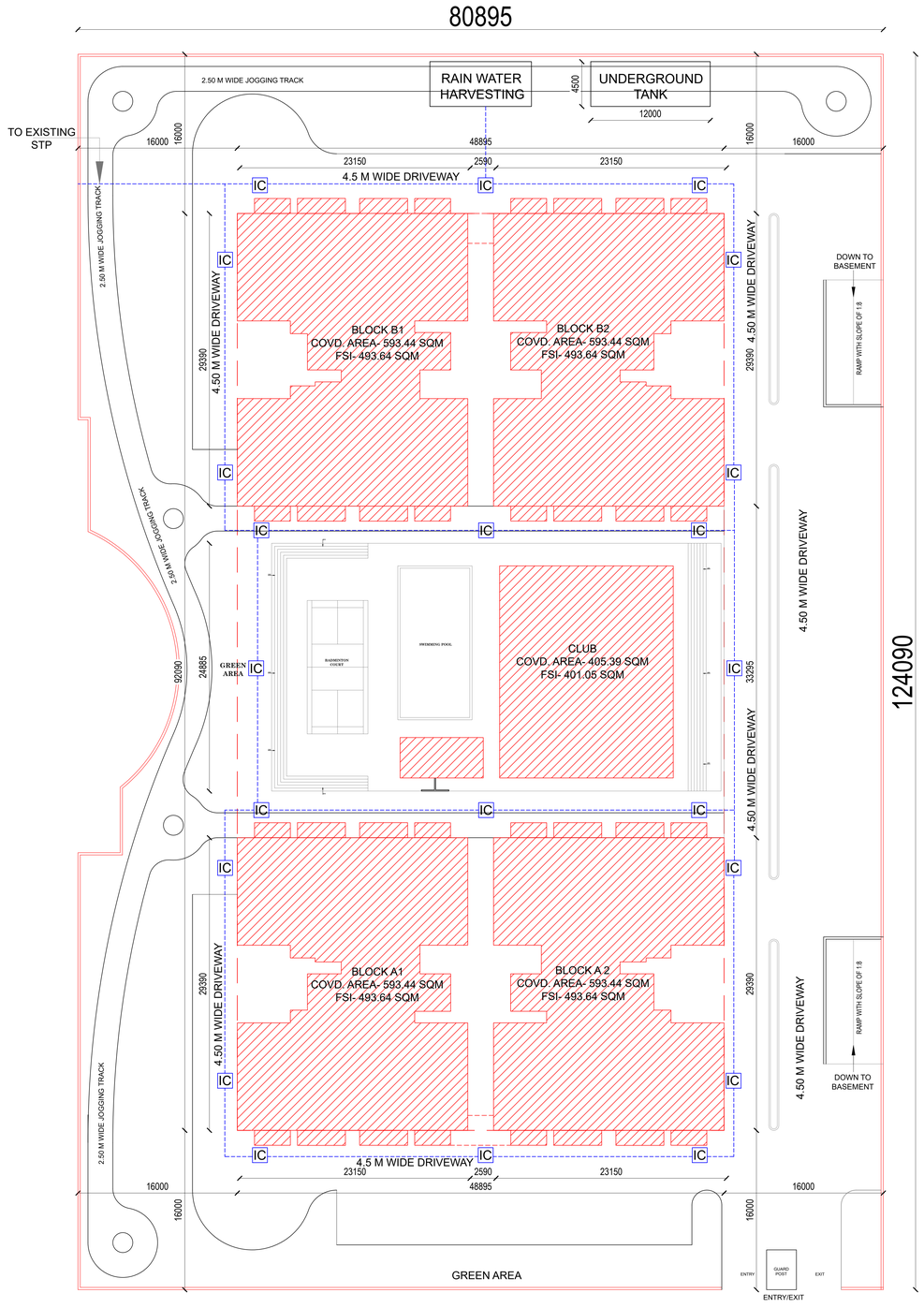

SERVICE PLAN

BASEMENT, STILT AND CLUB AREA STATEMENT

27.	BASEMENT- 1	8383.56				
28.	CLUB	216.37	LIFT WELL ,FIRE STAIR, & BALCONY		4.34	212.03
29.	BASEMENT- 2	8067.32				
30.	STILT FLOOR	2373.76				
31.	CLUB	405.39	LIFT WELL ,FIRE STAIR, & BALCONY		4.34	401.05
					9988.68	4997.06

UNIT AREA STATEMENT:

(1) 3BHK + STUDY UNIT F.S.I. AREA =151.70 sq.mt.
(2) NO. OF 3BHK + STUDY UNIT = 100 UNITS

(3) 3BHK UNIT 3 FSI AREA =129.55 sq.mt.
(4) NO. OF 3BHK UNIT 3 =100 UNITS

(5) 3BHK UNIT 1&2 FSI AREA =129.03 sq.mt.
(6) NO. OF 3BHK UNIT 1&2 =200 UNITS

REQUIRED PARKING:

(1) NO. OF 3BHK + STUDY UNIT = 100 UNITS @ 1.5/unit= 150 cars
(2) NO. OF 3BHK UNIT 3 =100 UNITS @ 1.25/unit= 150 cars
(3) NO. OF 3BHK UNIT 1&2 =200 UNITS @ 1.25/unit= 250 cars
(4) 10% VISITORS PARKING =55 Cars
(5) TOTAL REQUIRED PARKING =605 cars

TOTAL F.S.I ACHIEVED -

PREVIOUS SANCTIONED F.S.I - 25300.44 sqm

PROPOSED F.S.I - 49977.06 sqm

PARKING PROVIDED:

S.NO.	FLOOR	CAR PARKING
1.	BASEMENT FLOOR 1	253
2.	BASEMENT FLOOR 2	269
3.	STILT FLOOR	90
4.	STILT FLOOR (GECK)	53
	TOTAL PARKING:	665

DRAWING TITLE-

FLOOR PLAN

NOTE: ALL DIMENSIONS ARE IN MM

SCALE - 1:100

SHEET NO.- 0

PROJECT NAME-

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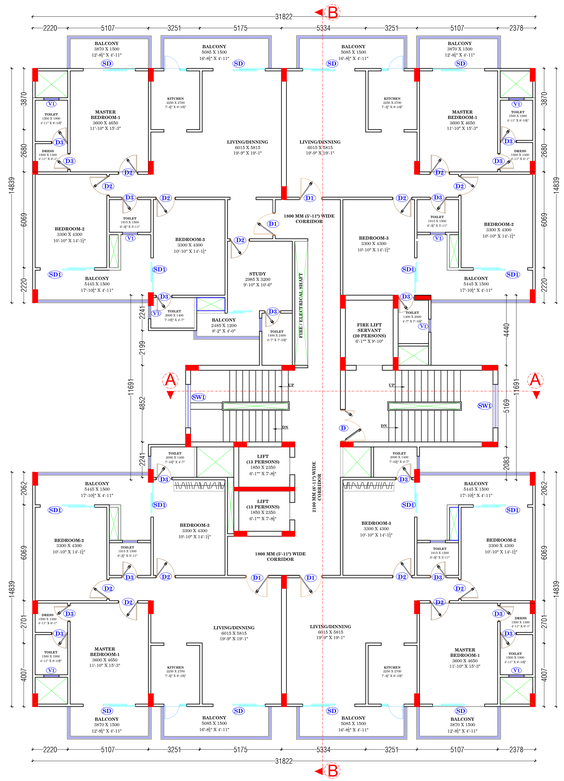
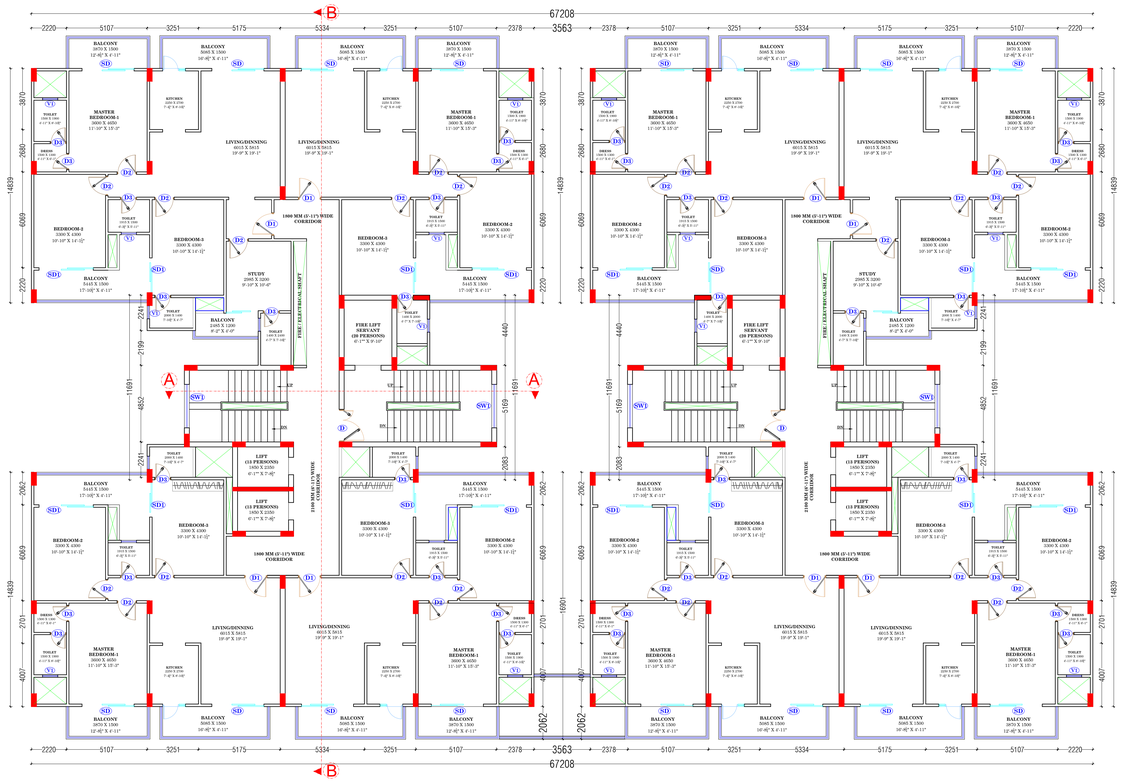
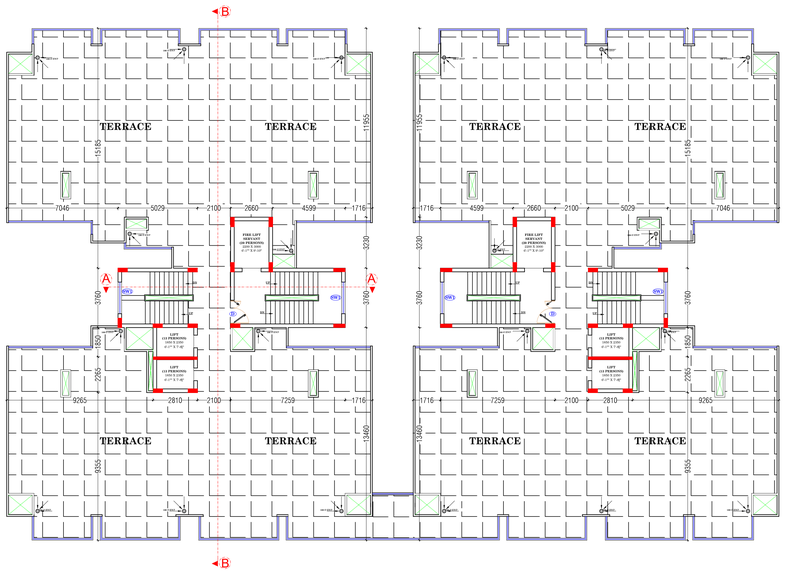


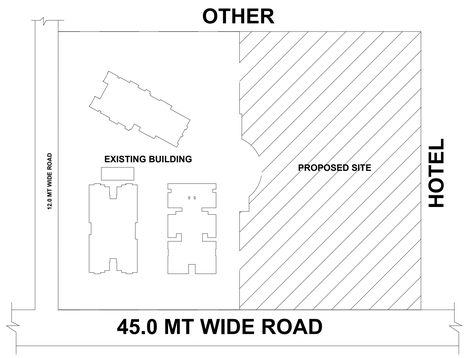
TYPICAL FLOOR PLAN
(1st,3rd TO 23rd & 25th)



SECOND FLOOR PLAN



TERRACE FLOOR PLAN



LOCATION PLAN

Key Plan

(AREA STATEMENT) GROUP HOUSING FOR AMRIT HEIGHTS 2, LUCKNOW

S.No	DESCRIPTION	AREA SQ.M
1	PLOT AREA	22000.43
2	ROAD WIDENING	0.00
3	AREA FOR FUTURE EXPANSION	1923.36
4	NET PLOT AREA	20077.07
5	BASIC PERMISSIBLE F.S.I	2.50
6	PERMISSIBLE FSI AREA	50192.69
7	PURCHASABLE AREA 50 % OF PERMISSIBLE AREA	25096.34
8	TOTAL MAXIMUM PERMISSIBLE FSI AREA	75289.03
9	TOTAL F.S.I ACHIVED	75277.50

PREVIOUS SANCTIONED F.S.I		(AREA SQM)
6.	BLOCK 1	9850.55
7.	BLOCK 2	6424.05
8.	BLOCK 3	9025.84
9.	TOTAL SANCTIONED F.S.I (BLOCK 1+2+3)	25300.44
10.	BALANCE F.S.I	49988.59

AREA STATEMENT OF BLOCK- A

S.NO.	DESCRIPTION	COVD. AREA	REMARK (DEDUCTION FOR F.A.R.)	AREA DEDUCTION FOR F.A.R.	AREA TOWARDS F.A.R.
1.	FIRST FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
2.	SECOND FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
3.	THIRD FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
4.	FOURTH FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
5.	FIFTH FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
6.	SIXTH FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
7.	SEVENTH FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
8.	EIGHTH FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
9.	NINTH FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
10.	TENTH FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
11.	ELEVENTH FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
12.	TWELFTH FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
13.	THIRTEENTH FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
14.	FOURTEENTH FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
15.	FIFTEENTH FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
16.	SIXTEENTH FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
17.	SEVENTEENTH FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
18.	EIGHTEENTH FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
19.	NINTEENTH FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
20.	TWENTY FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
21.	TWENTY ONE FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
22.	TWENTY TWO FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
23.	TWENTY THREE FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
24.	TWENTY FOURTH FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
25.	TWENTY FIFTH FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
26.	MUMTY& MACHINE RM.	161.86			
	TOTAL	29833.86		4990	24682
				4990*2= 9980	24682*2= 49364

TREE/PLANTATION

RAIN WATER HARVEST. CHAMBER & HOLE

R. W. HOLE — R. W.HAR. CHAMBER — R. W. HOLE

SEWER LINE/MAN HOLE

M. H.

N

DRAWING TITLE-

FLOOR PLAN

NOTE: ALL DIMENSIONS ARE IN MM

SCALE - 1:100

SHEET NO.- 0

PROJECT NAME-

DESIGNING INNOVATIVE AND SUSTAINABLE AFFORDABLE HOUSING: ARCHITECTURE FOR SOCIAL JUSTICE.

SUBMITTED BY-

AR. RAVIKANT TIWARI
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2024-25
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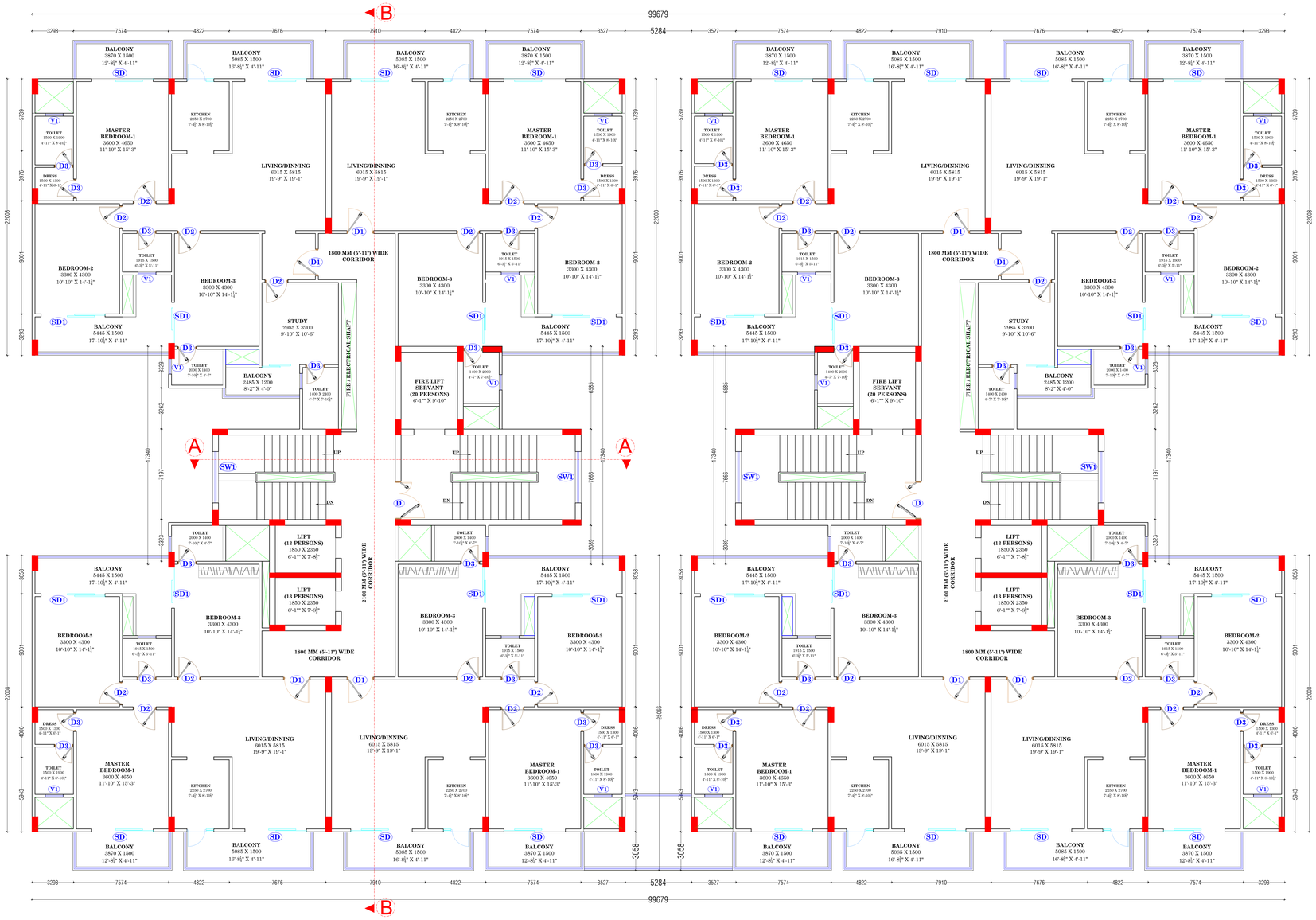
PROF.(AR.) SAURABH SAXENA



24th FLOOR PLAN

(AREA STATEMENT) GROUP HOUSING FOR AMRIT HEIGHTS 2, LUCKNOW

S.No	DESCRIPTION	AREA SQ.M
1	PLOT AREA	22000.43
2	ROAD WIDENING	0.00
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8.	EIGHTH FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
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10.	TENTH FLOOR	1186.88	LIFT WELL ,FIRE STAIR, & BALCONY	199.6	987.28
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TREE/PLANTATION

RAIN WATER HARVEST. CHAMBER & HOLE

R. W. HOLE — R. W.HAR. CHAMBER — R. W. HOLE

SEWER LINE/MAN HOLE

M. H.

N

DRAWING TITLE-

FLOOR PLAN

NOTE: ALL DIMENSIONS ARE IN MM

SCALE - 1:100

SHEET NO.- 0

PROJECT NAME-

DESIGNING INNOVATIVE AND SUSTAINABLE AFFORDABLE HOUSING: ARCHITECTURE FOR SOCIAL JUSTICE.

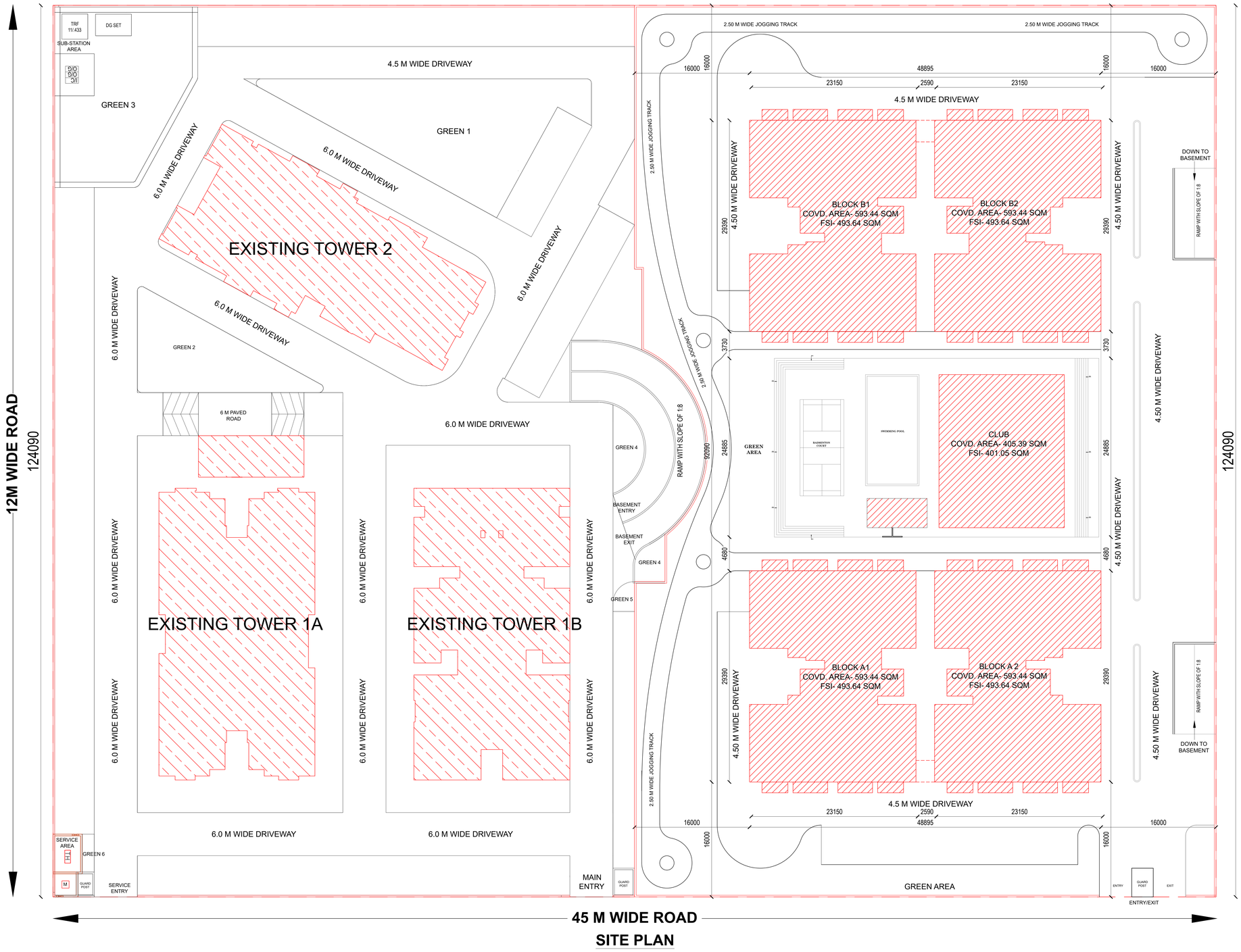
SUBMITTED BY-

AR. RAVIKANT TIWARI
M.ARCH IV SEM.
1220109003
2024-25
BBDU, LUCKNOW

GUIDED BY-

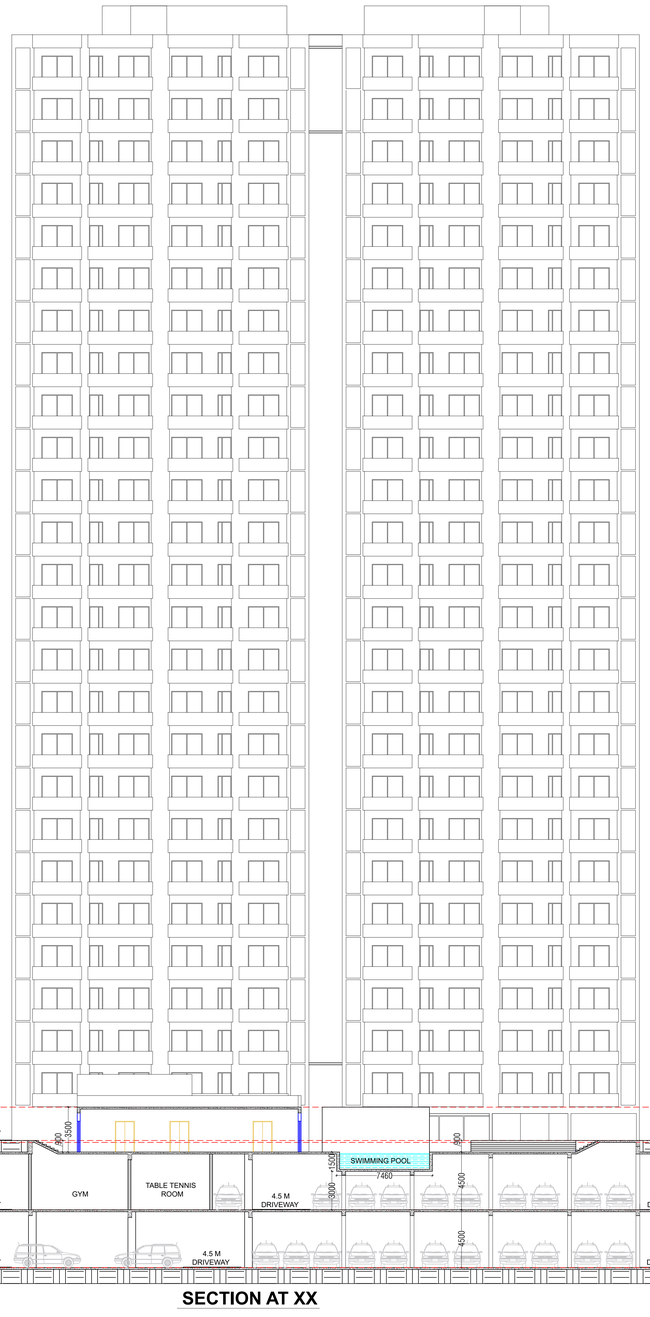
PROF.(AR.) SAURABH SAXENA

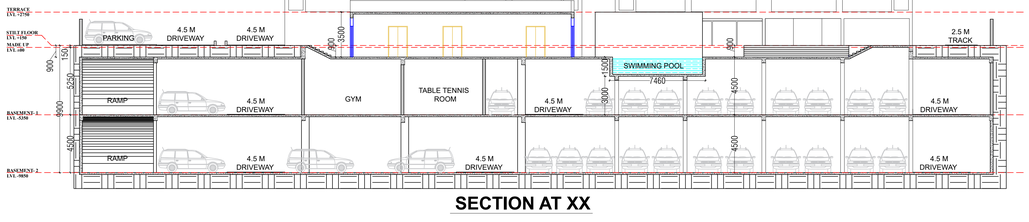
OTHER



SITE PLAN

N	**DRAWING TITLE-** FLOOR PLAN	NOTE: ALL DIMENSIONS ARE IN MM SCALE - 1:100 SHEET NO.- 0	**PROJECT NAME-**	DESIGNING INNOVATIVE AND SUSTAINABLE AFFORDABLE HOUSING: ARCHITECTURE FOR SOCIAL JUSTICE.	**SUBMITTED BY-** AR. RAVIKANT TIWARI M.ARCH IV SEM. 1220109003 2024-25 BBDU, LUCKNOW **GUIDED BY-** PROF.(AR.) SAURABH SAXENA





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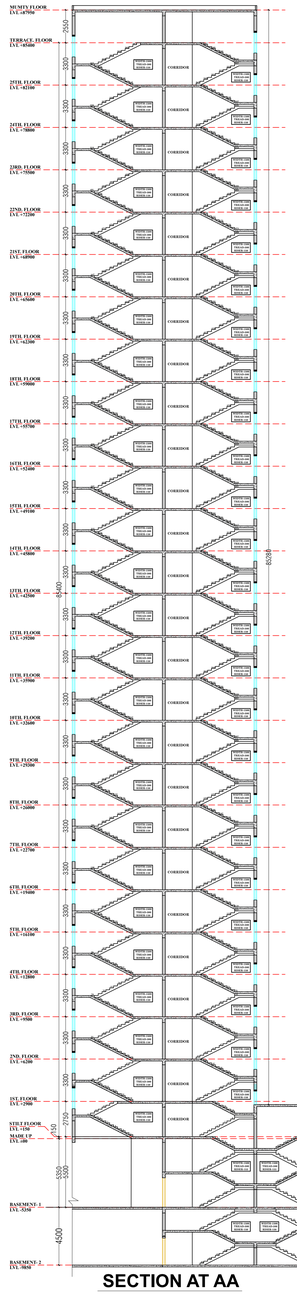

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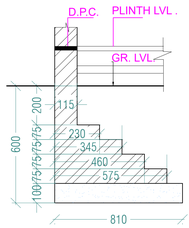
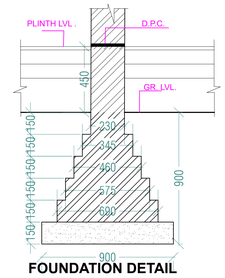
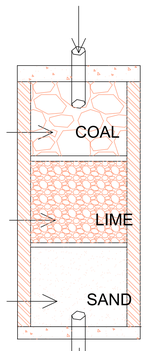


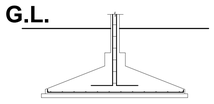
FOUNDATION DETAIL
(115 th. wall)



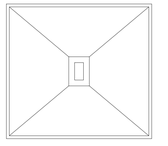
FOUNDATION DETAIL
(230 th. wall)



WATER-HARVESTING
TANK (N.T.S.)



TYPICAL SEC.



FOOTING PLAN
(R.C.C.COLUMN)

DRAWING TITLE-

FLOOR PLAN

NOTE: ALL DIMENSIONS ARE IN MM

SCALE - 1:100

SHEET NO.- 0

PROJECT NAME-

DESIGNING INNOVATIVE AND SUSTAINABLE AFFORDABLE HOUSING: ARCHITECTURE FOR SOCIAL JUSTICE.

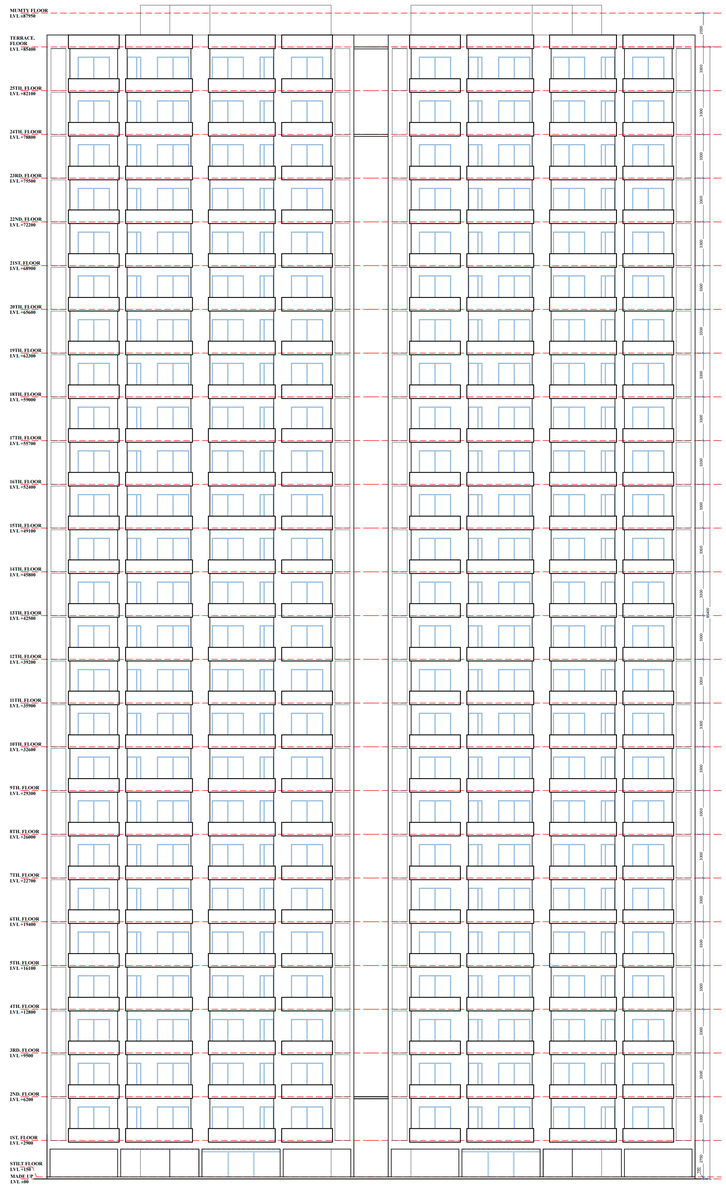
SUBMITTED BY-

AR. RAVIKANT TIWARI
M.ARCH IV SEM.
1220109003
2024-25
BBDU, LUCKNOW

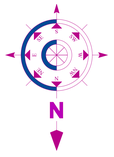
GUIDED BY-

PROF.(AR.) SAURABH SAXENA

SIDE ELEVATION



FRONT ELEVATION



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