COST EFFECTIVE HOUSING TECHNIQUES

(A WAY TO IMPROVE ECONOMIC HOUSING)

A DISSERTATION
Submitted in Partial Fulfilment of the Requirements
for the degree
of

MASTERS OF ARCHITECTURE

BY
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Enrolment number-12101090045

Under the supervision of
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(Asst. Professor)

SCHOOL OF ARCHITECTURE AND PLANNING
BBD University, Lucknow

BBD UNIVERSITY

TO THE
SCHOOL OF ARCHITECTURE AND PLANNING
BABU BANARSI DAS UNIVERSITY, LUCKNOW

June 2024

ANNEXURE II

CERTIFICATE

It is certified that the work contained in this thesis entitled

"COST EFFECTIVE HOUSING TECHNIQUES"

by **Nitin Saxena** (Roll No 1200109007), for the award of

"Master of Architecture" from "Babu Banarasi Das University" has been carried out under my/our supervision and that this work has not been submitted elsewhere for a degree.

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Annexure IV
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CERTIFICATE OF THESIS SUBMISSION FOR EVALUATION

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1. Name : **Nitin Saxena**
2. 2. Enrolment No.: 12101090045
3. Thesis title: **Cost Effective Housing Techniques**
4. Degree for which the thesis is submitted: **M. Arch**
5. Faculty of the University to which the thesis is submitted – **Ar. Saurabh Saxena**
6. Thesis Preparation Guide was referred to for preparing the thesis. **YES** ☐ **NO** ☐
7. Specifications regarding thesis format have been closely followed.
8. The contents of the thesis have been organized based on the guidelines **YES** ☐ **NO** ☐
9. The thesis has been prepared without resorting to plagiarism. **YES** ☐ **NO** ☐
10. All sources used have been cited appropriately. **YES** ☐ **NO** ☐
11. The thesis has not been submitted elsewhere for a degree. **YES** ☐ **NO** ☐
12. Submitted 2 spiral bound copies plus one CD. **YES** ☐ **NO** ☐

Name: **Nitin Saxena**
Enrolment No. 12101090045

LIST OF CONTENT

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Thank you

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ABSTRACT

Housing is the most required development to build a nation developed. In India most of the population in urban as well as in rural areas still required a better shelters or houses for accommodation with better living environment including with all amenities, social, cultural, healthy, safe, hygienic, spacious, pollution free, climatically comfortable, eco-friendly and affordable houses.

The economic weaker section can't afford the housing cost in present conditions. Government of India support needy people by funds, and also provides subsidized affordable houses by developing many policies and projects in this direction.

This Dissertation aims towards the study of effective housing demand, current patterns of development and finding the Innovative Contraction techniques, Materials (local and ecofriendly), Planning and designing methods, to make the solution. With the help of techniques of construction, Planning, and use of local and sustainable material, the Cost-effective housing can be developed in less time and in budget.

KEY WORDS:

Cost effective housing, Fast and time saving construction, innovative techniques and methods, Nature friendly construction, Climatic comfort - Durability and safety, easy maintenance.

CHAPTER – I : INTRODUCTION:

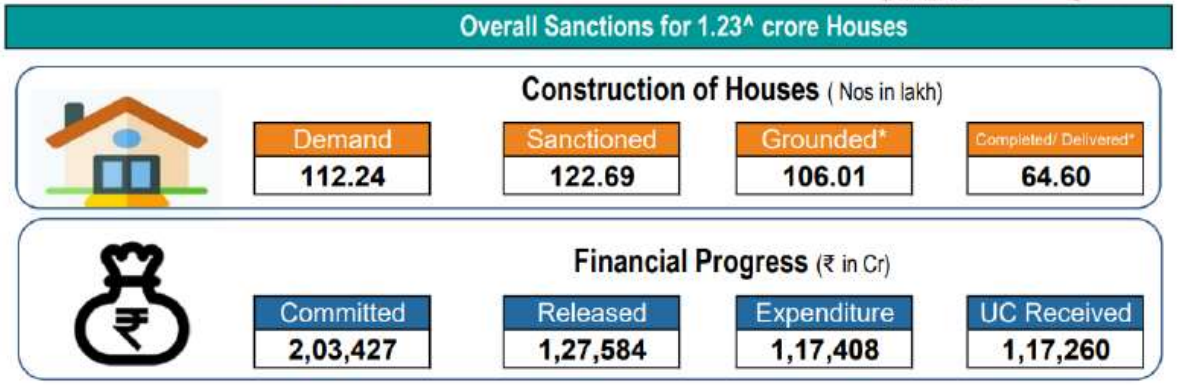
1.1 INTRODUCTION:

Large sections of the society are migrating to urban areas for better job opportunities and quality of life from rural areas. These Cities need to provide a receptive, innovative and productive environment, which can promote faster and sustainable growth ensuring a better quality of living. Cost Effective or Low-cost housing is a critical issue in India, as many people cannot afford to buy or rent a home. There are many challenges faced by middle and lower-income groups in attaining home ownership. The use of low-cost construction techniques and local materials is to provide affordable housing solutions in proper way to improve the living of low-income communities in the society.

1.2 NEED OF THE PROJECT (PRADHAN MANTRI AWAS YOJANA) :

The Ministry of Housing and Urban Affairs (MoHUA) through its flagship mission Pradhan Mantri Awas Yojana – Urban (PMAY-U) ensures a PUCCA HOUSE to all eligible urban households. PMAY-U aims to achieve Urban Development through Transformation, Innovation and Sustainable Inclusions. Due to Rapid increase in urbanization and believing it as an opportunity to reduce poverty.

PMAY (U) Achievement (provisional), as on 28th November 2022



Source: PMAY Website

1.3 GLOBAL HOUSING TECHNOLOGY CHALLENGE (GHTC-INDIA)

• The Ministry of Housing and Urban Affairs, Government of India has conceptualized a Global Housing Technology Challenge – India (GHTC-India).

• To identify and main stream a basket of innovative technologies from across the globe that are sustainable and disaster-resilient.

• Such technologies would be cost effective, speedier and ensure a higher quality of construction of houses, meeting diverse geo-climatic conditions and desired functional needs.

• A Technology Sub-Mission (TSM) has been setup.

COMPONENTS OF GLOBAL HOUSING TECHNOLOGY CHALLENGE (GHTC-INDIA)

Construction Technology India: Grand Expo-Cum-Conference

- Promotion of Innovative Construction Technology
- Platform to Facilitate Signing of MoUs and form Potential Partnerships.
- Technical Evaluation, Exchange of Knowledge and business.
- Exhibition of Technologies

Proven Demonstrable Technologies

- Onboard States & Local Support Partners
- Six Light House Project Sites
- Induct Established Proven technologies across the Globe
- Identify Basket of Site-specific Technologies
- Different Technology for Each Site
- Live Laboratories for learning
- Technology to be Adopted in Curriculum and India System

Potential Future Technologies

- Setting up **ASHA- India** (Affordable Sustainable Housing Accelerators)
- Support Domestic Technologies by Product Development, Mentoring & Market Support
- Incubation Centers in IITs
- Organizing Periodic Accelerator Workshops

CHAPTER –I I : AIM , OBJECTIVE AND SCOPE:

2.1 AIM OF THE PROJECT:

The main Aim of the study is comparative analysis with the latest construction techniques and trends of Low-cost Housing along with the Fast and time saving construction type, Innovative methods, Nature supportiveness, climatic comfort and durability factors, and maintenance measures and requirements.

2.2 OBJECTIVE:

The main objective of the study is:

- To understanding the actual requirements of the cost-effective housing by comparative study and analysis of by case study and literature.
- To find the cost-effective factors for the project and innovative techniques.
- To find out the better and alternate solution for the development of the project betterment.

2.3 SCOPE AND LIMITATION:

- . Cost effective housing study for the housing developed for economically weaker section.
- . Housing study for Group housing and cluster housing.
- . Housing developed or subsidies by Government or Government agencies and developed for
- EWS sections by private developers as per the Govt. guidelines.
- . Location and development for Urban and adjacent areas.
- . Type of housing Studio - 1RK. And 1BHK. sizes.
- . Considering Sites using Modular and Pre cast construction techniques.

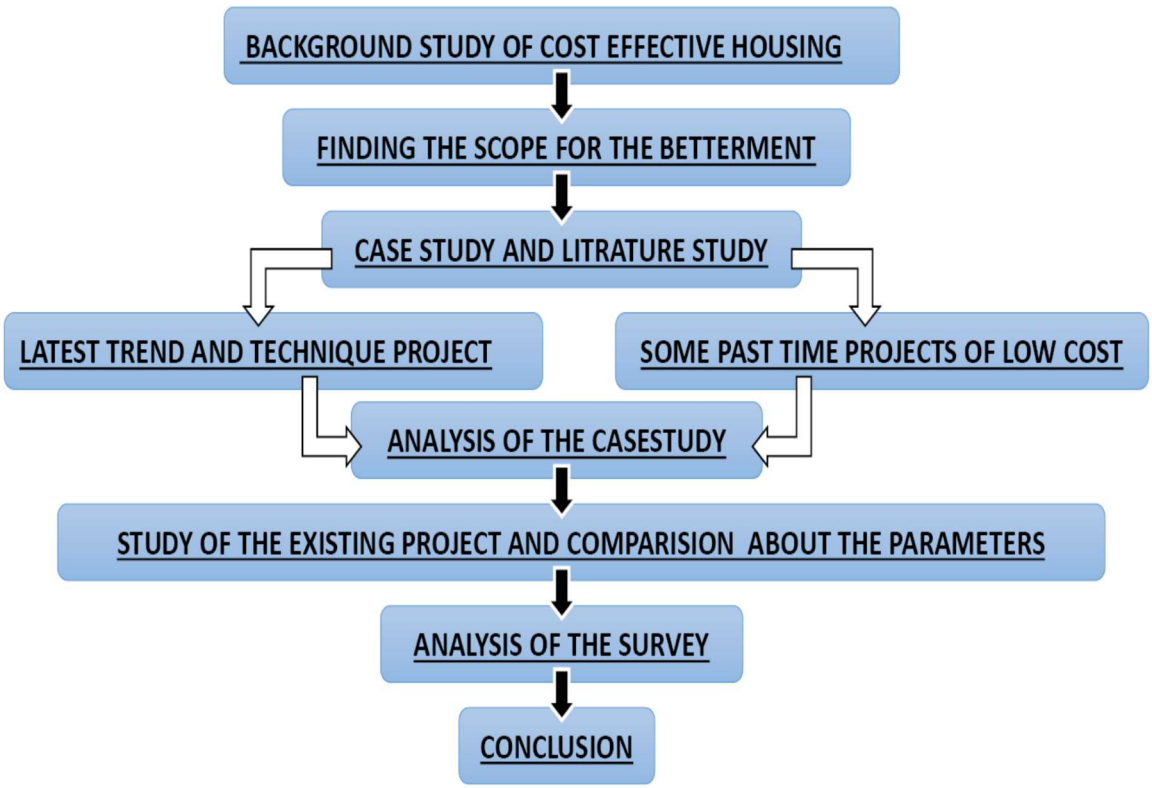
2.4 RESEARCH QUESTIONS:

- Which type of housing need to be constructed cost effective and where is the requirement?
- How can it be fast and time saving?
- Which type of latest construction techniques foe cost effective housings?
- Are these construction techniques can be Nature – Friendly?
- Is there any Climatic comfort and Durability factor in these techniques?
- How much maintenance required in these techniques?

2.5 METHODOLOGY:

For finding the facts of the topic, the Case study of the Latest Cost-effective housing project done with Modern and innovative technique, material and design is done along with some past but very popular project Low cost housing Literature study is done. Analysis of the parameters, purpose, designs, material, techniques is done and comparative data is prepared.

Some self-prepared question's survey is done with the users of such housing projects is done and actual needs, scopes and drawbacks are found. Thus, the final conclusion is generated to the further designing and implementation process.



CHAPTER –III: STUDY:

3.1 CASE STUDY: (LIGHT HOUSE PROJECT, LUCKNOW)

INTRODUCTION:

The LIGHT HOUSE PROJECT Lucknow is one of the six projects started in all around India, by our Prime Minister, Mr. Narendra Modi's vision,

"A fast, low cost and new technology to build houses for the poor and the middle class."

These light house projects will be constructed through modern technology and innovative processes. This will reduce the construction time and prepare the more resilient, affordable and comfortable homes for the poor.

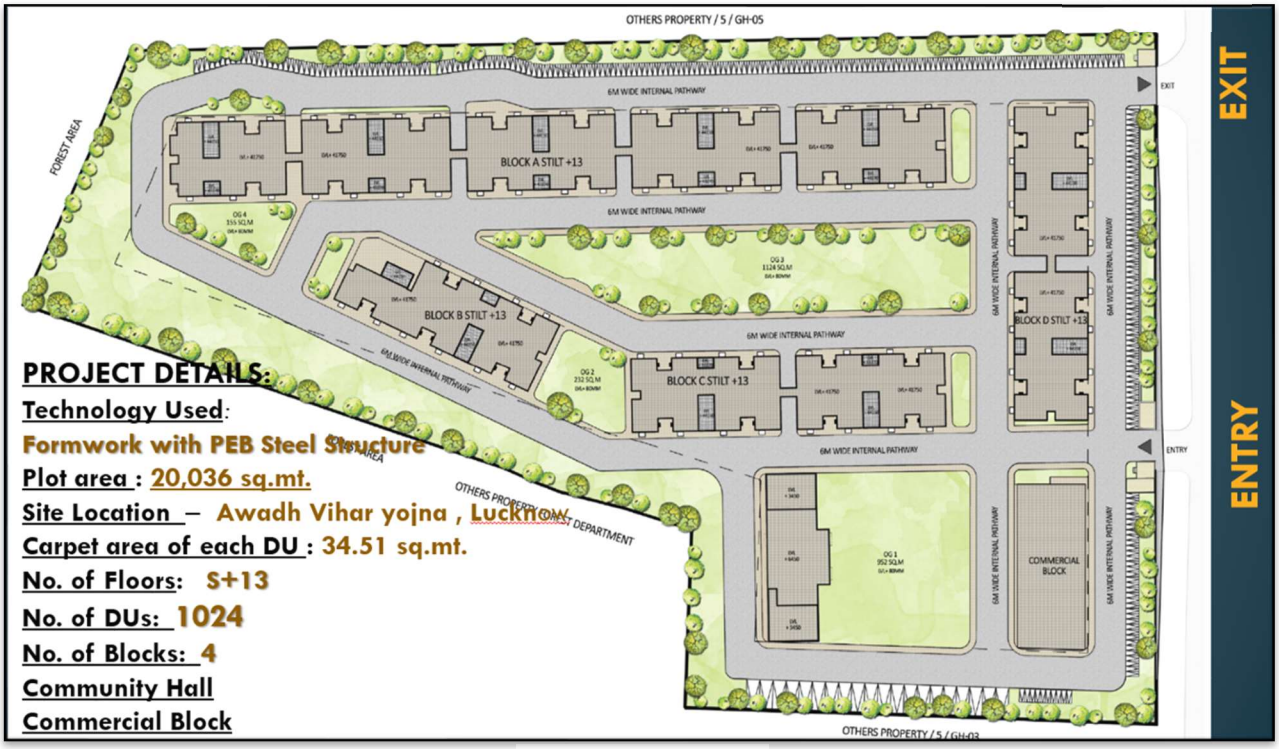
Six LHP's are in India are for same purpose.

- **Indore** (Prefab Sandwich panel),
- **Rajkot** (Monolithic concrete construction using tunnel formwork)
- **Chennai** (Precast concrete construction system assembled at the site)
- **Ranchi** (Precast concrete construction system-3d volumetric)
- **Agartala** (Light gauge steel and PEB)
- **Lucknow** (Stay in place formwork and PEB)

PROJECT 3D VIEW

PROJECT PRESENT VIEW

NORTH



PROJECT DETAILS:

Technology Used:

Formwork with PEB Steel Structure

Plot area : 20,036 sq.mt.

Site Location – Awadh Vihar yojna , Lucknow

Carpet area of each DU : 34.51 sq.mt.

No. of Floors: S+13

No. of DUs: 1024

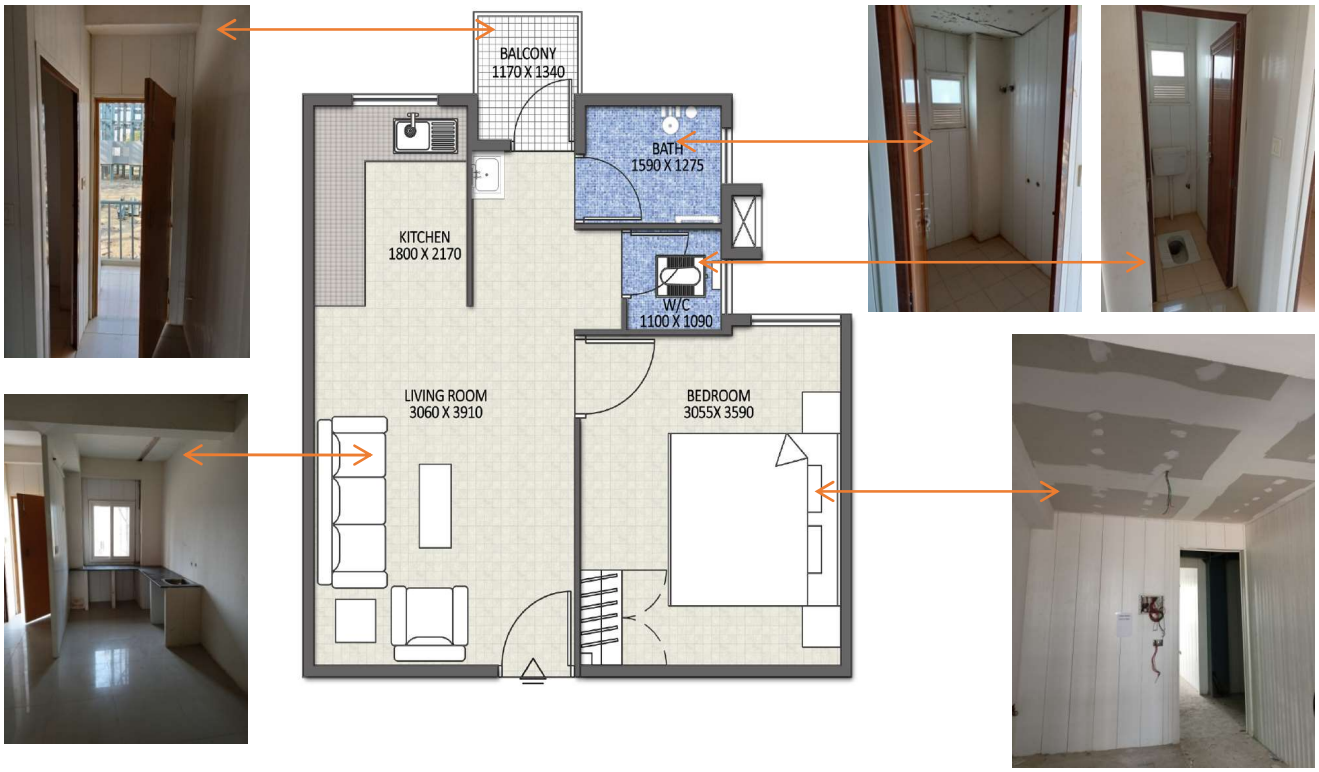
No. of Blocks: 4

Community Hall

Commercial Block

SITE PLAN

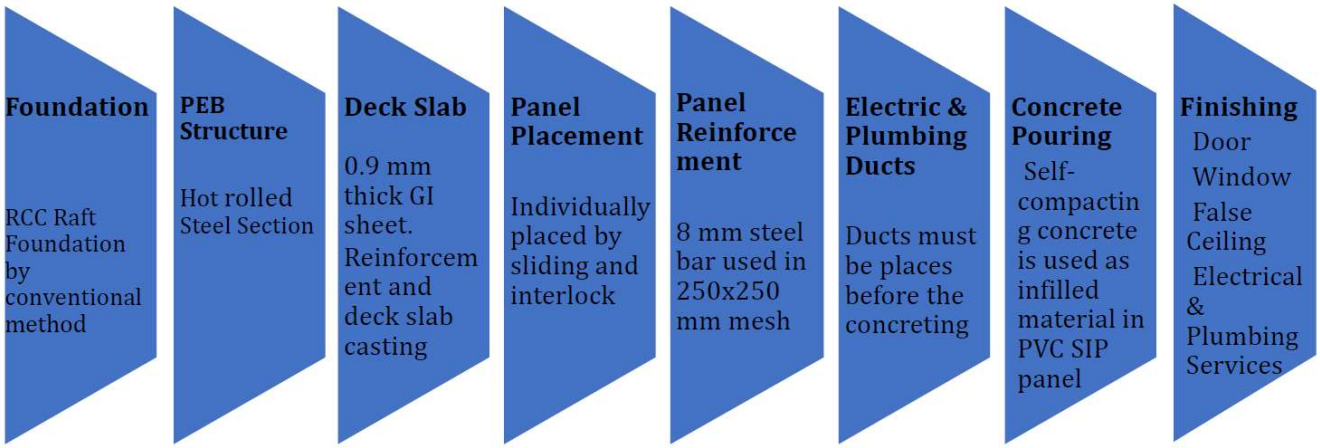
TYPICAL FLOOR PLAN



UNIT PLAN

(Carpet area = 34.51 Sq . m. / 372 Sq . ft.)

BUILDING ELEMENTS



FOUNDATION:

Conventional as per geo-technical investigations, Bearing capacity , soil strata, water table , etc.

•Raft foundation with RCC column up to plinth height.

•RCC plinth beam and grade slab at plinth level.

•All building blocks have Raft foundation with 500 mm thick M-25 Concrete.

•An additional thickness of 400 mm has been constructed around stair case and lift well.

•Anchor bolts have been cast with concrete at plinth level over which factory-made built-up columns with base plate will be erected.

•The reinforcement laying & shuttering work is in progress for shear wall construction of lift & staircase portion.

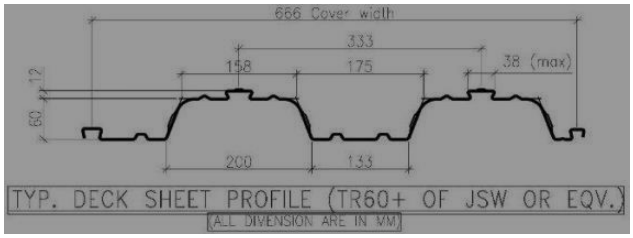
DECK SLAB:

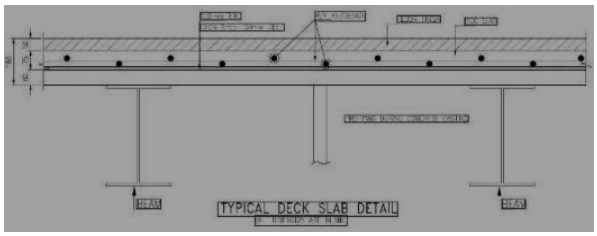
•After erection of steel beams and column (PEB Structure), Steel deck sheet of thickness 0.9 mm are placed with required bearing on the beams.

•Concrete screed of 75 mm is poured on the deck sheet in M25 with reinforcement as per structural design.

•Structural design for reinforcement is as per IS 456-2000.

•Generally, nominal reinforcement is provided in concrete screed of deck slab to take care of shrinkage & cracking.





WALL ERECTION:

- Factory made PVC walls are used for walls and partitions. Outer wall is 126 mm. thick and inner wall is 66 mm. thick.
- Concrete core is filled with M-30 grade of concrete along with mild reinforcement between panels for support.
- Panels are stored with a defined pattern at store yards and used with as per size requirements with floor support.
- M.S. channels and panel joining brackets.

Electrical Switch Board

False Ceiling

Structure Cover with Cement Fiber Board

False Ceiling with Gypsum Board

False Ceiling with Gypsum Board

LIMITATIONS:

* Stay in Place PVC Form walls need pre planned installation of MEP services for concealed networks.

* Doors and windows position shall not be changed after pouring of concrete.

* Erection of panels shall be under the supervision of trained staff.

* High-intensity UV rays harm the outer envelope, so it is not advisable in the tropical region.

* Skilled worker needed for PEB Erection and SIP Installation.

ADVANTAGES:

- Gives very aesthetic finished surface in different color options without plastering.
- No curing is required. About 50% less use of water.
- Faster as compared to convention al buildings.
- About 40% Less usage of manpower as compared to conventional construction. As all panels are prefabricated in the factory.
- Light in weight as compared to other conventional materials.
- SIP does not corrode, chip, or stain & is resistant to UV, bacteria, fungi, etc.

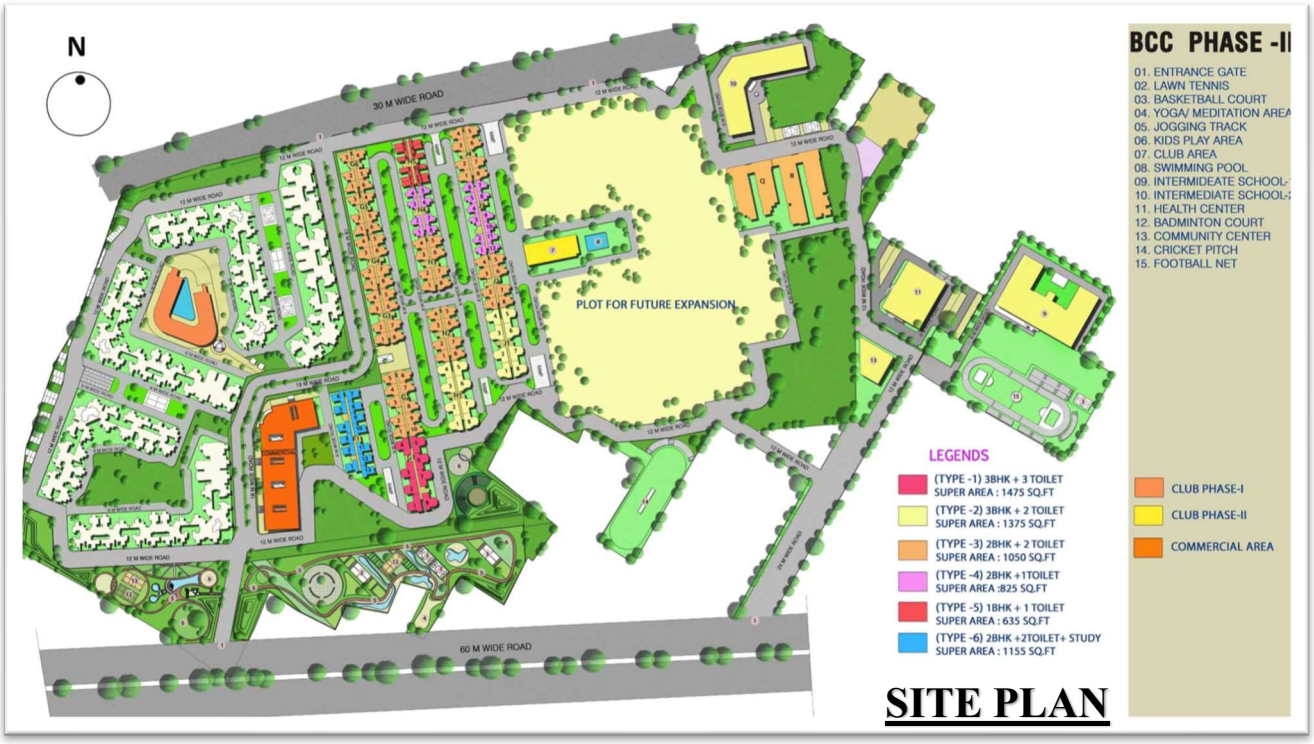
- The polymer content used in the manufacturing of form work is up to 55% recycled content an
- dis further recyclable, making it an eco-friendly material.
- The PVC system provides insulation from the surroundings and gives better thermal comfort to

occupants. Overall, this system is energy efficient as less water and operation energy requirements

are less as compared to conventional buildings.

3.2 LITRATURE STUDY

1. BHARAT CITY PHASE-II , GHAZIABAD



PICTURE 1 UNIT PLANS

BUILDING SYSTEM

In this project the foundations and basement structure are made entirely as conventional cast in-situ reinforced concrete structure. The basement areas below the towers are utilized for car parking while the driveways are situated in the extended basement areas. The apartment towers which come on top of the basement are made in load bearing precast concrete with the use of large precast elements like slabs and walls. The precast walls are considered to be shear walls and are part of the lateral load resisting system and are adequately connected to the floor diaphragm to achieve an earthquake resistant structure. Due to manufacturing and transportation limitations the precast wall panels are made as one story high elements and will be jointed at floor level (picture 2). The

horizontal and vertical connections between the precast walls are established at the building site only.

P2. PRECAST CONCRETE WALL ERECTION

Adequate buttressing of the external wall panels has been achieved by connecting the internal wall panels to the external wall panels by grouted shear key joints and reinforced wire loop connections. All load bearing elements at the corners of the building have been stiffened by jointing structural elements perpendicular to it (picture 3). The load bearing precast walls are placed on top of each other and are properly connected to each other at floor level and adequately connected to the floor slab with protruding reinforcements. The precast shear wall system is designed to emulate the behavior of cast in-situ concrete construction in terms of stiffness, strength, ductility and energy dissipation. Because of the provisions for car parking the layout of the basement structure is somewhat different from the superstructure and wherever possible the precast load bearing shear walls of the superstructure are supported by cast in-situ RCC walls at basement level and only at a few locations the precast walls are supported on short span transfer beams.

P3. PRECAST CONCRETE LOAD BEARING STRUCTURE ON TOP OF BASEMENT

Adequate buttressing of the external wall panels has been achieved by connecting the internal wall panels to the external wall panels by grouted shear key joints and reinforced wire loop connections. All load bearing elements at the corners of the building have been stiffened by jointing structural elements perpendicular to it (picture 3). The load bearing precast walls are placed on top of each other and are properly connected to each other at floor level and adequately connected to the floor slab with protruding reinforcements. The precast shear wall system is designed to emulate the behavior of cast in-situ concrete construction in terms of stiffness, strength, ductility and energy dissipation. Because of the provisions for car parking the layout of the basement structure is somewhat different from the superstructure and wherever possible the precast load bearing shear walls of the superstructure are supported by cast in-situ RCC walls at basement level and only at a few locations the precast walls are supported on short span transfer beams.

P3-A. PRECAST CONCRETE LOAD BEARING STRUCTURE ON TOP OF BASEMENT

The vertical dead loads and live loads are carried by the floors and transferred towards the load bearing structural elements. The floor slab system of the superstructure is made of precast concrete planks on which a reinforced cast in-situ concrete topping will be poured. This system is commonly known as the precast half slab system (picture 4). The precast planks are made as room sized slabs and are supported on the interior and exterior load bearing walls or beams. Due to continuation of the top reinforcement over the interior supports the slab system has structural behavior of continuous floor span system. The bottom reinforcement of the slabs will be anchored at interior supports by placing extra bottom reinforcement directly on top of the precast slabs. At exterior supports the extra bottom reinforcement shall be provided in the form protruding bars from the walls which will be bend down directly on top of the precast slab.

PICTURE 4. PRECAST HALF SLABS WITH LATTICE GIRDERS

All the balconies are cantilevered precast solid slabs and are connected by protruding reinforcement to the cast in situ RCC topping of the floor (picture 5). Bathroom slabs are also made a precast solid slabs to achieve a waterproof slab and are connected to the half slab system by protruding reinforcement at the slab edges.

PICTURE 5. CANTILEVER PRECAST BALCONIES

The lateral load path of the precast superstructure is formed by a large number of precast concrete shear walls which are placed in x-direction and y-direction. The precast shear walls are solid reinforced concrete panels and due to their large in plane stiffness most of the lateral forces are resisted by these structural elements. Load transfer at horizontal joints is achieved by fully filling the 20mm gap between the precast panels with non-shrink high strength grout. Furthermore reinforcement starter bars are passing through the horizontal joints which will ensure a proper connection between one precast wall panel to the next precast wall panel. The starter bars are placed in the center of the precast walls and are connecting inside oversized steel corrugated dowel tubes which are later fully filled with non-shrink grout (picture 6).

PICTURE 6. ERECTION OF LOAD BEARING PRECAST WALL PANEL

The starter bars are anchored inside both the precast walls and are lapping indirectly with the reinforcement meshes of the precast wall panels. At the horizontal joints the shear forces between the precast concrete wall panels are transferred by the friction of the joint interfaces and by the dowel action of the starter bars.

The staircases are made of precast solid slab landings at floor level and mid landing level. The flights are made as precast stair elements which are resting on the precast landings and connected by dowel connections (picture 8).

PICTURE 8. PRECAST STAIRCASE WITH LANDINGS AND STAIR FLIGHT

PICTURE 9. COMPLETED PRECAST BUILDING STRUCTURES OF BHARAT CITY PHASE 2

OVERVIEW OF PRECAST COMPONENTS FOR THE SUPER STRUCTURE:

ITEM	SPECIFICATIONS
Load bearing precast walls	160mm thick solid precast walls 200mm thick solid precast walls
Partition walls	100mm thick solid precast walls
Shaft walls	160mm thick L-shaped precast walls
Slabs	50mm thick precast half slab with lattice girders
Bathroom slabs	Solid precast slabs with protruding reinforcement
Balconies	Precast solid balcony slabs with protruding reinforcement
Staircase	Precast stair flights, Precast solid slab landings
Beams	Precast beams 200x600mm

PRECAST PLANT – FABRICATION, STORAGE AND TRANSPORTATION:

The precast plant is located within the boundaries of the project site which makes it easy and fast to transport and erect the precast elements. The precast plant has been designed in such a way that it can be dismantled in future and be relocated to another construction site. The plant has been divided in two parallel bays in which different activities take place. The first bay is utilized for the precast wall panel production and has two battery moulds of twenty cells each and several tilting tables. The battery mould system is used for manufacturing of precast walls in vertical position and the tilting tables are utilized for manufacturing complicated wall panels in horizontal position and tilting them later (pictures 10 to 12).

PIC. 10. BATTERY MOULD FOR VERTICAL PRODUCTION OF PRECAST WALL PANELS

PIC.11. PRECAST WALL PANEL REINFORCEMENT CAGE INSIDE BATTERY MOULD SYSTEM

PICTURE 12. TILTING TABLES FOR HORIZONTAL PRODUCTION OF PRECAST WALL PANELS

Bay two of the plant is used for manufacturing precast slabs, balconies, solid slabs, beams and L-shaped walls. This bay has two 40m long steel casting beds for the slab production and several customized moulds for the production of the other precast elements (picture 13).

PICTURE 13. STEEL CASTING BEDS FOR PRECAST SLAB PRODUCTION

Precast balconies are made in special customized moulds with form liners which will create a texture finish at the top surface of the balcony slabs. Both bays each have three overhead gantry cranes with 10 ton lifting capacity for activities like lifting rebar cages, lifting concrete casting buckets, and de moulding the precast elements. The gantry cranes have an extended rail system which leads in the stockyard to lift and store the precast elements. Precast walls are stacked vertically in steel storage racks while precast slabs are stored horizontally stacked on top of each other (picture 14). The precast half slabs with lattice girders are lifted by special lifting frames.

PICTURE 14. STOCKYARD FOR PRE-CAST ELEMENTS

The concrete batching plant is located just outside the precast plant and a trolley system transports the concrete casting buckets to the precast plant. Raw materials are stored in storage bays next to the batching plant. Rebar cages are prepared in an adjacent area to bay one and two and gantry cranes from both bays can access this area. The precast plant is equipped with an advanced laboratory for strict quality control. Precast walls are transported in vertical position on trailers with A-frames. All other precast elements are transported in horizontal position on flat trailers (pictures 15 and 16).

PICTURE 15. TRANSPORT OF PRECAST WALL PANELS

PICTURE 16. TRANSPORT OF PRECAST SLABS

(LITRATURE STUDY)

2. SOBHA DREAM ACRES, BANGALORE

This second project is located in Bangalore and is being developed by real estate developer Sabha Ltd. which is mainly operating in the middle segment and luxury housing segment. Due to major demand for affordable housing in the Bangalore region the developer started exploring the possibilities of diversifying in this field and attract new customers. The project is being developed on 81 acres of land where more than 6500 apartments will be constructed. Customers can choose from 3 different types of affordable housing units in the sizes 1BHK, 2BHK regular and 2BHK large. Before the start of the project a technical feasibility study was conducted to investigate the possible precast systems and to provide input regarding quantities and specifications of the precast construction materials. After final estimations the developer decided to set up a state-of-the-art precast plant for the production of the precast buildings.

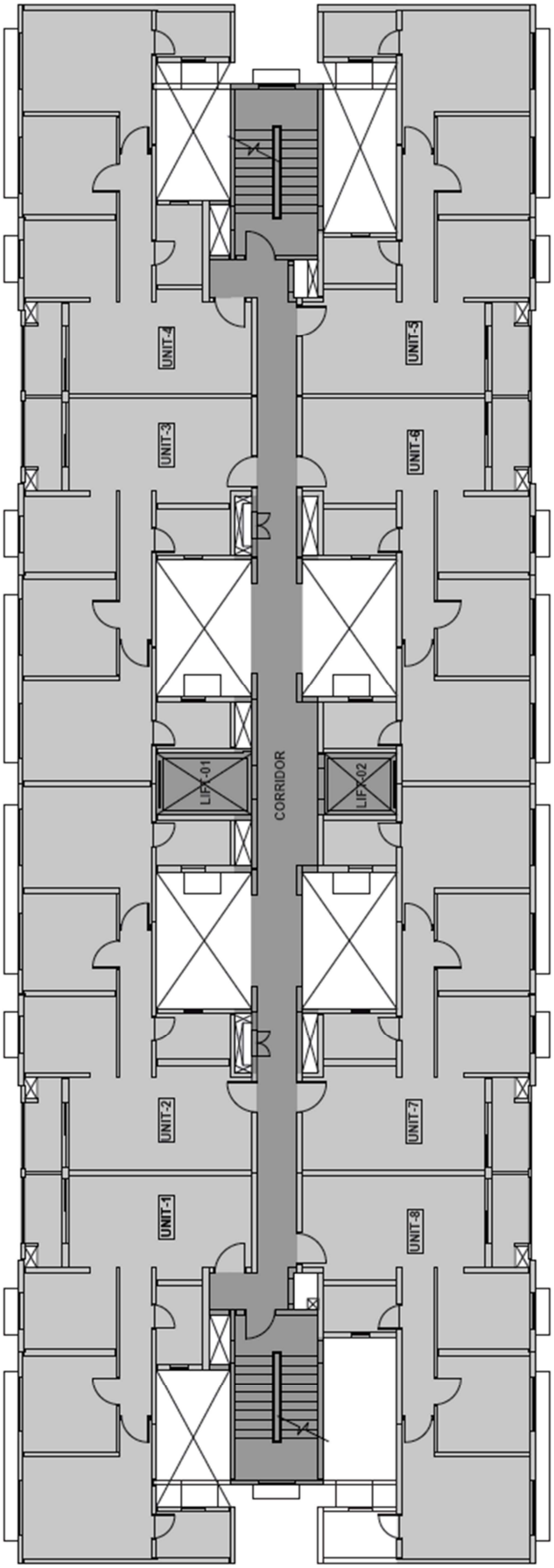
SITE PLAN

01. Entry/Exit
02. Reflexology Park
03. Seniors' Park
04. Play Area
05. Tree Court
06. Party Plaza
07. Clubhouse
08. Swimming Pool
09. OWC
10. Transformer Yard

1 BHK UNIT PLAN

1 BHK UNIT PLAN

1 BHK UNIT PLAN



CLUSTER PLAN

BUILDING SYSTEM

In this project only the foundation footings and rafts are made as cast in-situ concrete and the rest of the structure is precast concrete. The underground basements are made with load bearing precast walls, columns, beams and half slabs. The apartment towers which come on top of the basement are made in load bearing precast concrete with a similar precast system as explained in the first project. Reinforcement starter bars are protruding from the top of the foundations for the connection of the load bearing precast walls and columns (pictures 1 and 2). The starter bars are connecting inside oversized steel corrugated dowel tubes which are fully filled with non-shrink grout. The starter bars are anchored inside the precast elements and are indirectly lapping with the reinforcement.

P1. FOUNDATION RAFT WITH WALLS PICTURE STARTER BARS FOR PRECAST COLUMNS

P2. BASEMENT PRECAST WALLS AND COLUMNS

Because of the provisions for car parking the layout of the basement structure below the apartment towers is somewhat different but wherever possible the precast load bearing shear walls of the superstructure are supported by precast basement walls. Due to the increased basement height the precast basement walls had to be manufactured in different sizes with different joint locations as the superstructure. Driveways and additional car parking bays are situated in the extended basement areas which are constructed using a precast frame system with columns, half beams and half slabs. In this system the precast half slabs with lattice girders are making one-way spans from beam to beam thereby avoiding the use of secondary beams (pictures 3 and 4). The precast half beams top reinforcement has to be tied at site together with the half slab top reinforcement. At the ends of the precast half beams the bottom reinforcement is projecting out towards the column-beam junction which will be a wet joint and form a moment resistant connection.

P3. EXTENDED BASEMENT STRUCTURE WITH PRECAST COLUMNS AND HALF BEAMS

P4. EXTENDED BASEMENT STRUCTURE WITH PRECAST HALF BEAMS AND HALF SLABS

The basement retaining walls are made as solid precast wall panels with special joint connections to ensure the water tightness at these locations (picture 5). The bottom horizontal joint detail has the grout tube dowel connection with the foundation footing in combination with protruding reinforcement which is lapping with protruding reinforcement from the footing thereby creating a monolithic concrete connection. The vertical joints have groove shape profiles with wire loop connections with vertical locker bar which are filled with non-shrink grout and are later covered from the outside by bitumen sheets.

P 5. BASEMENT STRUCTURE WITH PRECAST RETAINING WALLS

PICTURE 6. PRECAST STAIRS WITH ATTACHED BOTTOM AND TOP LANDINGS

The superstructure has a similar precast system as explained in the first project however the staircases have precast stairs with attached top and bottom landings (picture 6). These precast stair elements are resting on corbels attached to the precast staircase walls.

OVERVIEW OF PRECAST COMPONENTS FOR THE BASEMENT STRUCTURE:

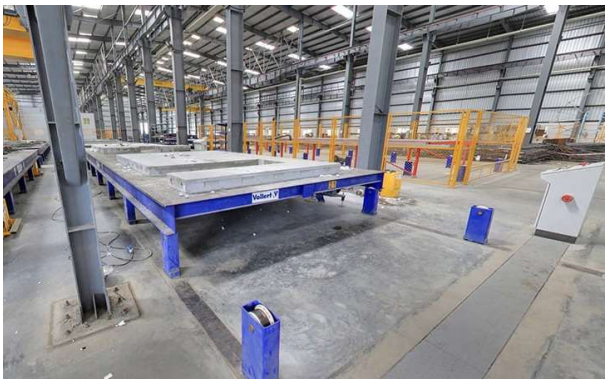
ITEM	SPECIFICATIONS
Load bearing precast walls	200mm thick solid precast walls
Shaft walls	200mm thick L-shaped precast walls
Retaining walls	250mm thick solid precast walls
Slabs	60mm thick precast slab with lattice girders
Staircase	Precast stair flights with attached bottom and top landings.
Columns (tower area)	300x750mm 300x1600mm
Columns (non-tower area)	350x750mm
Beams	Precast beams 300x600mm Precast half beams 750x370mm

OVERVIEW OF PRECAST COMPONENTS FOR THE SUPERSTRUCTURE

ITEM	SPECIFICATIONS
Load bearing precast walls	160mm thick solid precast walls 200mm thick solid precast walls Exterior walls with attached sunshades.
Partition walls	100mm thick solid precast walls
Shaft walls	160mm thick L-shaped precast walls
Slabs	60mm thick precast slab with lattice girders
Balconies	60mm thick precast slab with lattice girders
Staircase	Precast stair flights with attached bottom and top landings.

SOBHA PRECAST PLANT – FABRICATION, STORAGE AND TRANSPORTATION

This precast plant is located within the boundaries of the project site and is equipped with **an automated circulation system** for the horizontal production of precast wall panels and slabs. These precast elements are manufactured on **steel production pallets (moulds) of size 4m x 12.5m** which are mounted on a roller system which enables the pallets to move to various work stations inside the plant (picture 7). The plant has a total of 33 production pallets within the circulation system.

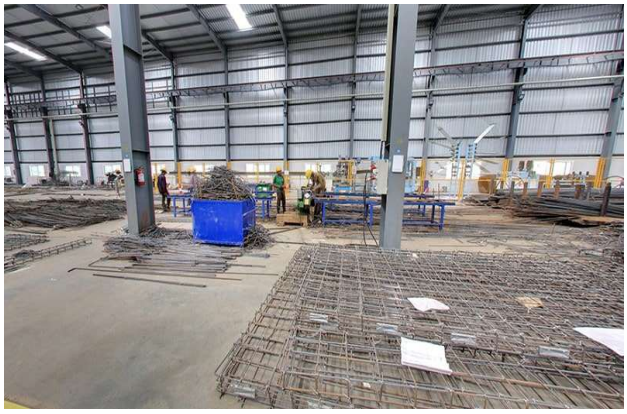


P 7. CIRCULATION SYSTEM FOR HORIZONTAL PRODUCTION OF PRECAST WALL PANELS AND SLABS

P 8. SPECIAL STATIONARY MOULD FOR L-SHAPED WALLS

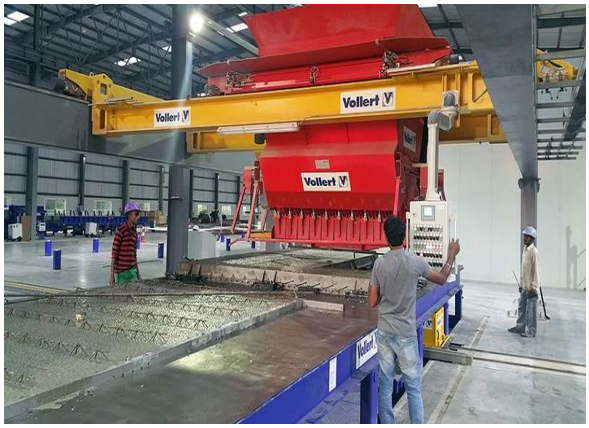
At each work station a standard activity takes place like cleaning of the pallets, fixing of shuttering, placing reinforcement cages, fixing inserts and provisions, pouring concrete, finishing of concrete, curing, de moulding and tilting. The system is equipped with a plotter which can plot with water-soluble markings the exact contours 1:1 of each precast element on the production pallets which makes it easy and quick to fix the shuttering. The plant has a separate bay with various stationary special moulds for the production of volumetric wall panels like L-shaped walls and external walls with attached cantilever sunshades (picture 8 and 9). Further more staircase moulds, column moulds and beam moulds which have been specially designed for this project are located in this area. This bay also has space for the preparation of the reinforcement cages and the automated welding machine for the fabrication of the lattice girder reinforcement (picture 10).

P 9. SPECIAL STATIONARY MOULD FOR PRECAST COLUMNS



P 10. REINFORCEMENT WORKSHOP AND LATTICE GIRDER WELDING MACHINE

EOT cranes run in each bay of the plant to perform the various lifting activities. The concrete batching plant is situated right next to the plant and has an extended overhead rail system through which a concrete spreader machine can move in and out the factory for the pouring of the concrete (picture 11).



P 11. CONCRETE SPREADER FOR POURING OF CONCRETE

In the stockyard the precast wall panels are stacked vertically in steel storage racks which can contain several panels. These racks can be lifted in a single operation by the 40 ton gantry crane. Slabs are stacked on top of each other in multiple layers (pictures 12. and 13.).

P 12. STOCKYARD FOR STACKING OF PRECAST ELEMENTS

PICTURE 13. STACKING OF HALF SLABS

3.3 INFERENCES:

After study of the three different types and of Cost effective housings of different time period, there are some inference found :

A) The first one **(LHP LUCKNOW)** is High rise (S+13) and high population density:

- Having fixed **carpet area = 34.51 Sq. m.** and compact 1 BHK. Unit.
- Used innovative and modular construction technique build with trained
- staff, energy efficient ,less water consumption construction .
- **CONSTRUCT MATERIALS** : PVC panels as wall, G.I. sheet based
- Deck slab , ISMB section framing
- **STRUCURE :** P.E.B. Structure
- Community and commercial space as per project scale .
- Parking is only for two wheeler .
- The actual cost of each flat is around Rs 12.59 lakh, but Rs 7.83 lakh will
- be given as a grant from the Central and the state government.

B) The second one **(BHARAT CITY ,PHASE –II ,GHAZIABAD)** is a Multi-storeyed housing :

- Having Low cost , EWS and only houses .
- Construction technique is Modular construction.
- Building structure element s are precast type.
- Pre-casting and stock yard both are in site campus and transportation arrangements are also with in the site.
- Share Walls, Stair, half casted slabs, are pre casted as per the structural design and requirements.
- In the whole process minimum material wastage, Less labor requirements, less water consumption , Cast saving , Time saving , and climate friendly construction is done.

C) The third one **(<u>SOBHA DREAM ACRES, BANGALORE</u>)**

is a Multi-storeyed housing :

- Having Low cost , EWS and only houses .
- Construction technique is Modular construction .
- Raft Foundation with starter bars for precast Column.
- Pre cast building elements (Columns Walls, Half casted Beams & Slab, Stair case).
- Casting and storage Yard Inside the site Campus.
- Casting, transportation & Installation within the site .
- Time & Cost saving with minimum wastage of materials.
- Less requirement of water and shuttering.
- Precast elements for one story height for easy to handle.

3.4 COMPARITIVE ANALYSIS:

PARAMETER	L.H.P. LUCKNOW	BHARAT CITY–II, GHAZIABAD	SOBHA DREAM ACRES, BANGALORE
1. UNIT SIZE	EWS 34.51 SQ.M.	58.99 SQ.M.	69.28 SQ.M.
2. COST	4.76 LAKH (CHARGABLE)	27 LAKHS	56 LAKHS
3.PLANNING TYPE	MULTI STORY APARTMENT(S+13)	MULTI STORY APARTMENT(B+13)	MULTI STORY APARTMENT(B+14)
4.SCOPE FOR EXTENSION	NO	NO	NO
5. LOCATION	IN THE URBAN CITY	IN THE URBAN CITY	IN THE URBAN CITY
6.OTHER SPACES	COMMERCIAL, COMMUNITY CENTRE	PARK, COMMERCIAL, CLUB, POOL, COMMUNITY CENTRE	PARK, COMMERCIAL, CLUB, POOL, COMMUNITY CENTRE
7. OWNERSHIP TYPE	SUBSIDIZED	SUBSIDIZED	NON-SUBSIDIZED
8. BUILDING MATERIALS	PVC PANEL, ISMB, GI SHEET, RCC.	PRE-CAST COLUMNS, WALL, STAIRS, BALCOBY, SLAB, BEAMS	PRE-CAST COLUMNS, WALL, STAIRS, BALCOBY, SLAB, BEAMS
9. STRUCTURE	PEB	PRE-FABRICATED	PRE-FABRICATED
10.TECHNIQUE	PREFABRICATION & MODULAR CONSTRUCTION	PREFABRICATION & MODULAR CONSTRUCTION	PREFABRICATION & MODULAR CONSTRUCTION
11. CLIMATIC CONSIDERATION IN DESIGN	YES	YES	YES
12. SERVICES AND AMINITIES	ALL REQUIRED	ALL REQUIRED	ALL REQUIRED
13. ECO FRIENDLY	YES	YES	YES

CHAPTER – IV: CONCLUSION

4.1 FINDINGS:

There are many points and aspects which are considered in study and some findings are as follows

- High rise housing is more effective in cost due to shortage land high cost of urban land.
- In pre cast construction (In site construction) Time, transport can be saved.
- Modular and precast Construction type is more cost effective than traditional.
- In PCC wastage of materials like Steel, Cement can be saved.
- In PCC water and other natural resources can be saved.
- Less requirement of Shuttering, curing and man power is also in PCC.
- Building Life and durability is more in PCC.
- Climatic consideration in design for user's comfort is also considered in PCC.
- Good building quality and low-cost maintenance is in PCC.

4.2 CONCLUSION:

- After the study and analysis there are some points which came as a conclusion for the research in low cost housing techniques, that:
- It is not mandatory that the cost-effective housing is bounded with the use of traditional materials, designs, and techniques but new methods can also be effective to make the housing Cost effective for EWS and LIG categories.
- Use of pre-fabricated building elements can make housing cost effective, Time saving, easy to construct, climatically comfortable and user friendly.
- Pre-casting and storage yard with-in the site campus can save time and travel cost along with the quality control, site testing aspect.
- The innovative and Modular type construction and designing of such project make the project having less waste generator, Nature friendly.
- Being pre designed and tested structural elements it more Durable and safer for the project.
- By use of some innovative materials like PVC wall panels and windows, less requirement of maintenance is in the project.

CHAPTER –V: REFERENCES (BIBLIOGRAPHY)

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CHAPTER-VI

DESIGN

6.1 NEED OF THE PROJECT:

The Ministry of Housing and Urban Affairs **(Mo HUA)** through its flagship mission **"Pradhan Mantri Awas Yojana"** – Urban (PMAY-U) ensures a PUCCA HOUSE to all eligible urban house-holds. PMAY-U aims to achieve Urban Development through Transformation, Innovation and Sustainable Inclusions. Due to Rapid increase in urbanization and believing it as an opportunity to reduce poverty.

HOUSING PROJECTION & SHORTAGE (Lucknow)

At an average household size of 5.8 persons and assuming 2% as dilapidation rate per decade, the projected housing requirement for Lucknow city for the year 2016 would be 544270, in 2021 it would be 625011 and 717730 in the year 2026. The housing shortage for the city is calculated based on census data, estimations and assumptions pertaining to existing housing stock in the city, dilapidated housing structures, vacant houses, slum households. The housing shortage for the city is estimated for the next 15 years under two circumstances

A) Taking into account the existing slum household stock and assuming they will remain same in future.

B) assuming that all the existing slum households are developed into a decent affordable housing under **PMAY-U** and other slum development programmes. The Housing requirement and shortage projections for the city is shown in

Table 1: **Projection of Housing & Housing shortage in Lucknow city**

Year	2016	2021	2026
Projected housing	544270	625011	717730
Housing shortage*	236227	316968	409687
Housing shortage**	-	168851	261570

Note: * - Estimated housing shortage of the city if existing slums in the city are not improved in the city **- Estimated housing shortage, considering that all the slums in the city are improved under slumdeveloped programmes like RAY.

EWS/LIG HOUSING

Working towards slum free Lucknow city, there is need to build up EWS and LIG housing stock . EWS housings are meant for people whose annual income is below Rs 60, 000 while LIG housing are meant for people whose annual income is less than Rs 1,20,000. As mentioned in City Development Plan 2006, estimates that there is need to create at least 7000 housing units per annum. Most BPL/EWS and LIG households in cities live in informal settlements/slums on encroached public lands. There is no data on numbers of poor families without adequate housing in cities. Census of India provides estimates of number of poor in each city and they also project future population growth for cities using an urban growth rate.

City Master Plans etc. make estimates on housing demand on the basis of Census information. Considering the past census data and development plans of the city it is assumed that 30% of the Lucknow households belongs to either EWS or LIG population.

In Lucknow city Slums, 68% of the slum households are living under below poverty line (BPL), which accounts 21% of the total city households. Assuming the other 9% of the households live in other parts of the city, the EWS/LIG housing projections are calculated for the next 15 – 20 years.

Table 2-: **Future Housing projection pertaining to EWS/LIG**

Year	2011	2016	2021	2026
EWS/LIG HOUSING	143358	163281	187503	315319

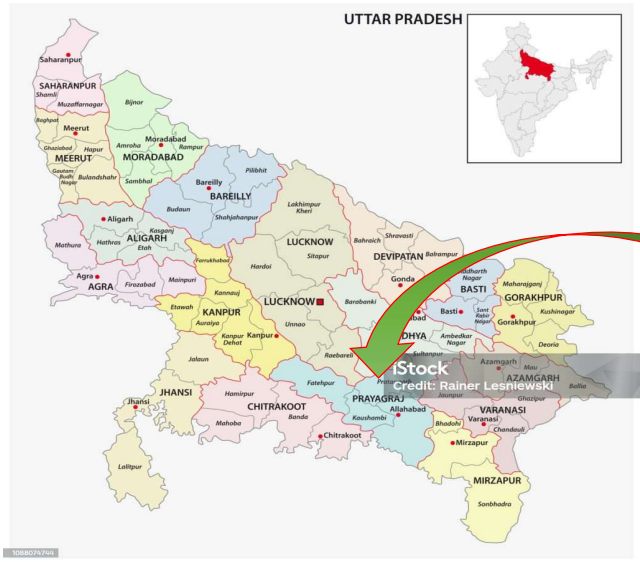
DESIGN CONSIDERATION:

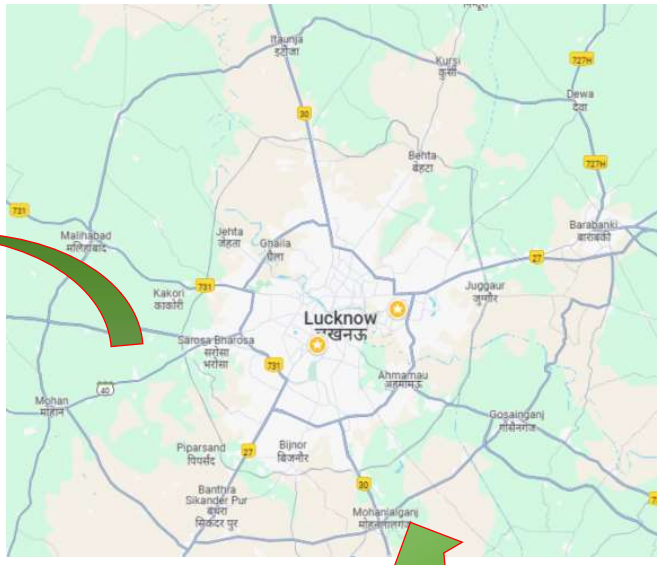
There area many points and aspects which are considered in Designing the project as per Study are as follows :

- High rise housing is more effective in cost due to shortage land high cost of urban land.
- Pre cast construction (in site construction) time , cost and transport can be saved .
- Less wastage of materials like steel , cement in Pre Cast construction .
- Saving of water and other natural resources in pre cast construction.
- Saving of shuttering , curing and man power in pre cast construction
- More building life and durability
- Climatic consideration in design for user's comfort .
- Good building quality and low cost maintenance

6.2 SITE ANALYSIS:

SITE MAP AND LIOCATION:





*** SITE LOCATION :**

AWADH VIHAR YOJNA , LUCKNOW

*** SITE AREA :**

31286.825 SQ.M.

*** SITE NEIGHBOURHOOD :**

- **PMAY (G+4 HOUSES)**
- **SBI HOUSING**
- **MIG AND LIG ROW HOUSING SITE**
- **PROPOSED CHILD CARE / PHC.**

***ROAD AND CONNECTIVITY:**

Site location is connected with Amar shahid path Awadh-vihar entrance gate by 1.5 k.M. and 13.4 k.M. From Charbagh Railway station.

*** TOPOGRAPHY AND AMENITIES:**

Site topography is mostly Leveled and average level is .5 to 1 m.

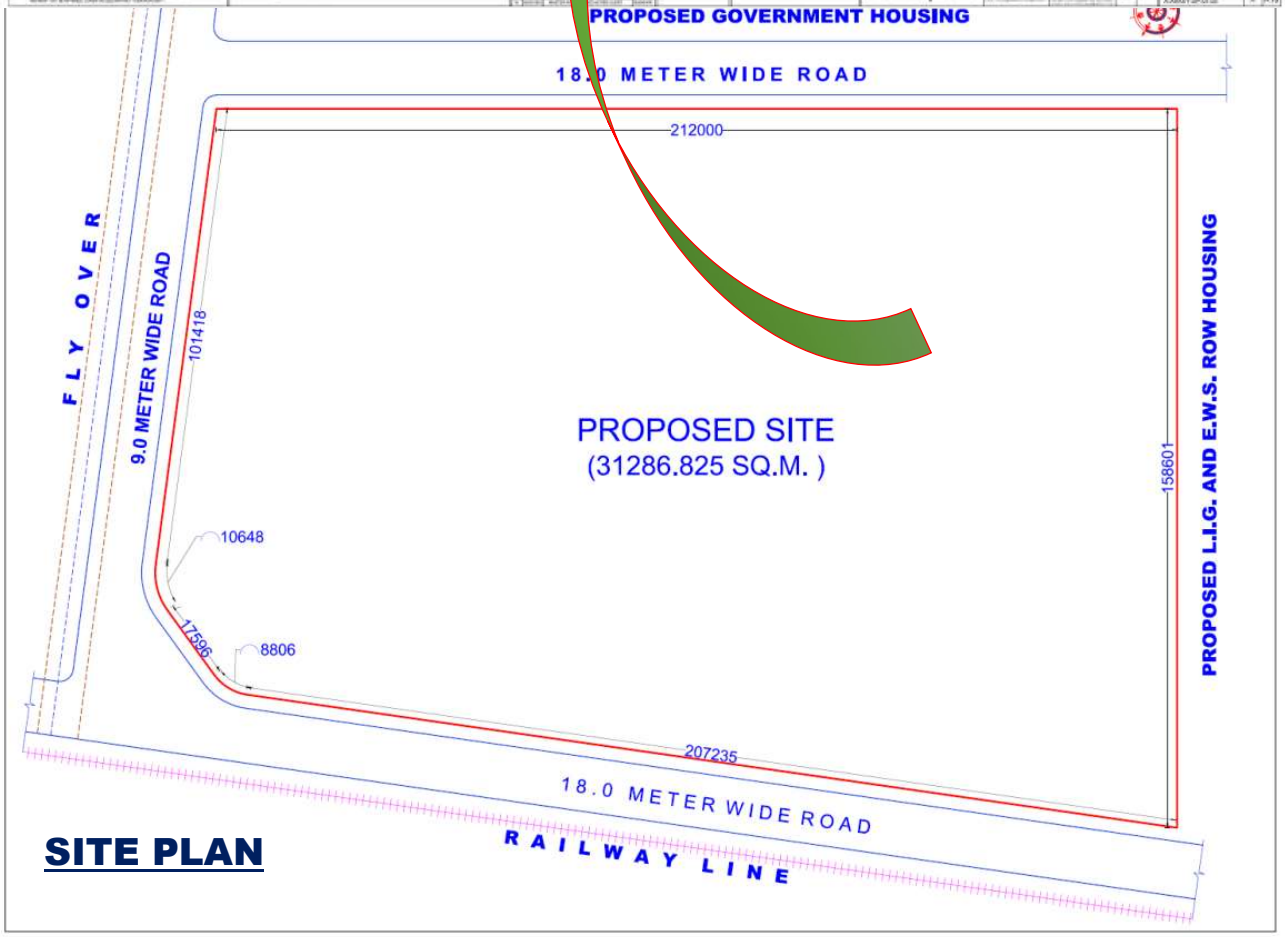
Storm water drains , metaled roads , Sewer line , Street light are available at all around the site.

VIABILTY OF SITE FOR THE PROJECT :

The site is suitable for the Cost effective housing project because :

- Land use is EWS and LIG housing .
- Site is surrounded by PMAY housing , SBI housing , Proposed LIG Row housing development .
- In Awadh vihar yojna EWS housings are in scope because of Housing development board planning and sites are separately planned.
- Demand of the project is very high in location due to similar projects surroundings and locality.
- Site has all required amenities and services to develop the project easily.
- Connectivity , Location and topographical condition of site is favorable to the project .

SITE LAND-USE PLAN



SITE PLAN

6.3 CLIMATE ANALYSIS:

Lucknow has an extreme tropical climate with very cold and dry winters from December to Mid February and dry, hot summers from April to Mid June. The rainy season is from mid-June to mid-September, when it gets an average rainfall of 1000 mm mostly from the south-west monsoon winds. During extreme winter the maximum temperature is around 25 degrees Celsius and the minimum is 3 to 4 degrees Celsius range. Fog is quite common from late December to late January. Summers can be quite hot with temperatures rising to the 40 to 45 degree Celsius range.

The average wind speed in Site location (Lucknow) is 2.6 m/s with the maximum wind speed of around 10 m/s.

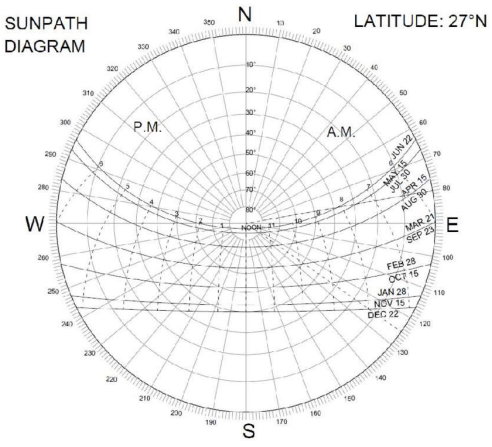
- The average ambient temperature remains 25.3°C, varies from 6.2°C to 41.9°C.
- The average relative humidity remains around 68.6%, varies from 17.5% to 99.7%.
- The station pressure varies from 995 hPa to 976 hPa, averaged around 1011 hPa.
- Windrose of Lucknow shows that predominantly wind blow from the WNW - about 24.75% of all wind directions.

SUN-PATH ANALYSIS:

Shadow analysis is a crucial aspect of architectural and urban design, involving the study of how shadows cast by buildings, structures, or natural elements change over time. This analysis provides valuable insights into various aspects of design, urban planning, and environmental considerations. Here are some key aspects and significance of shadow analysis:

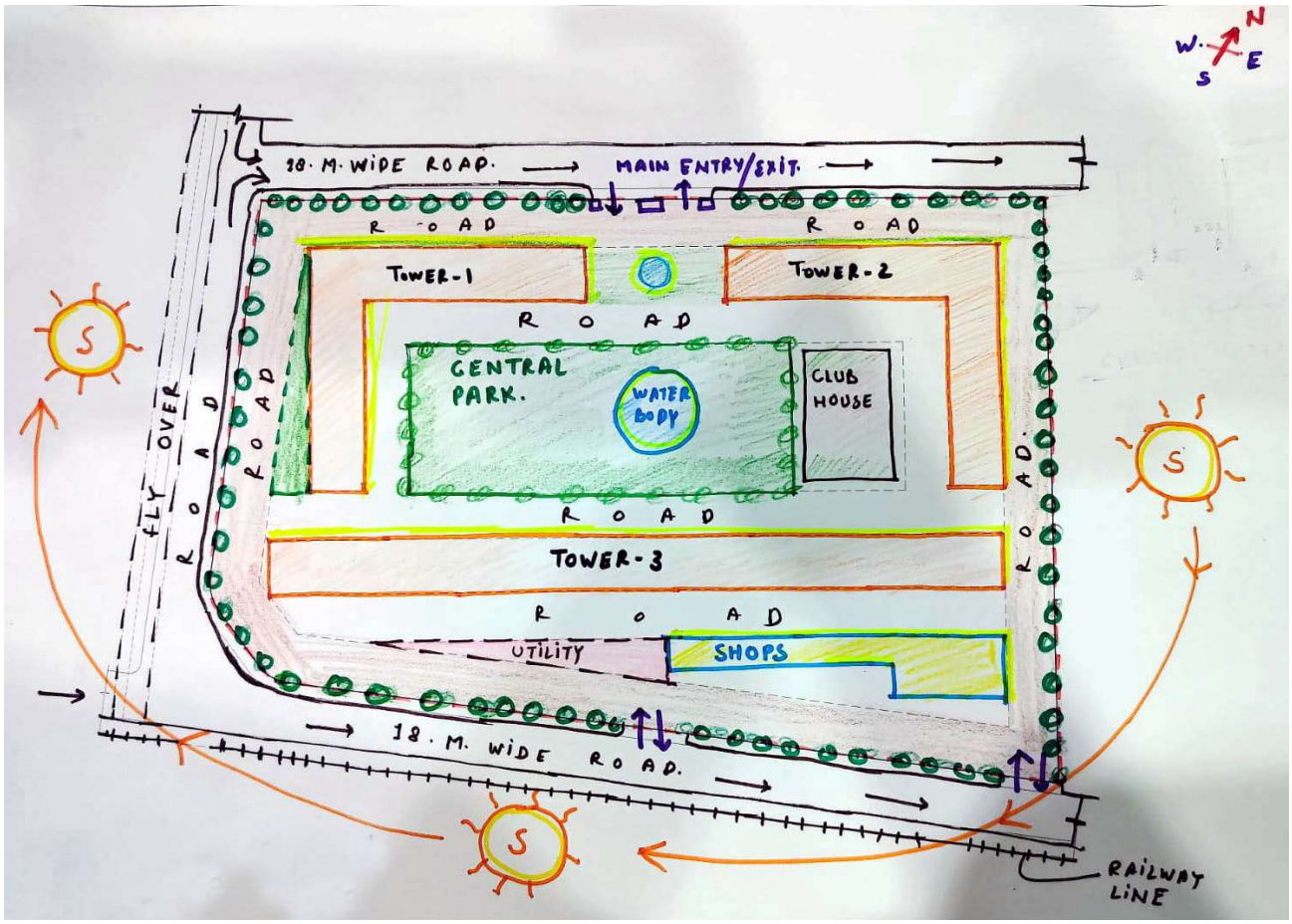
1. **Daylight and Sunlight Studies:**
2. **Energy Efficiency:**
3. **Urban Planning:**
4. **Building Orientation:**
5. **Seasonal Variations:**

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature °C (°F)	14.9 °C (58.9) °F	18.6 °C (65.4) °F	24.3 °C (75.7) °F	30.3 °C (86.6) °F	32.8 °C (91.1) °F	32.3 °C (90.2) °F	29 °C (84.1) °F	28.4 °C (83.1) °F	27.7 °C (81.8) °F	25.5 °C (77.9) °F	21.2 °C (70.1) °F	16.4 °C (61.6) °F
Min. Temperature °C (°F)	9.1 °C (48.3) °F	12.2 °C (54) °F	16.9 °C (62.4) °F	22.6 °C (72.6) °F	26.1 °C (78.9) °F	27.5 °C (81.5) °F	26.2 °C (79.2) °F	25.8 °C (78.4) °F	24.5 °C (76.2) °F	20 °C (68) °F	14.9 °C (58.8) °F	10.3 °C (50.6) °F
Max. Temperature °C (°F)	21.3 °C (70.3) °F	25.2 °C (77.4) °F	31.5 °C (88.8) °F	37.7 °C (99.9) °F	39.2 °C (102.6) °F	37.1 °C (98.9) °F	32.3 °C (90.2) °F	31.7 °C (89) °F	31.4 °C (88.5) °F	31.1 °C (88) °F	27.7 °C (81.9) °F	23.1 °C (73.5) °F
Precipitation / Rainfall mm (in)	19 (0)	25 (0)	14 (0)	9 (0)	17 (0)	129 (5)	310 (12)	265 (10)	165 (6)	34 (1)	2 (0)	10 (0)
Humidity(%)	67%	60%	44%	30%	38%	54%	79%	82%	80%	66%	58%	64%
Rainy days (d)	2	2	2	2	3	8	18	18	13	2	0	1
avg. Sun hours (hours)	8.4	9.6	10.6	11.5	11.9	10.7	8.4	8.0	8.4	9.6	9.6	9.0



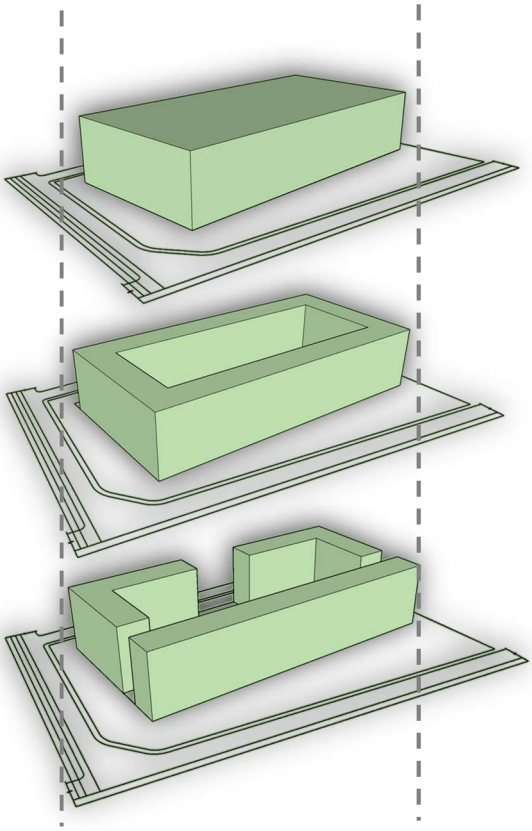
SITE SUNPATH DIAGRAM

6.4 DESIGN CONCEPT:

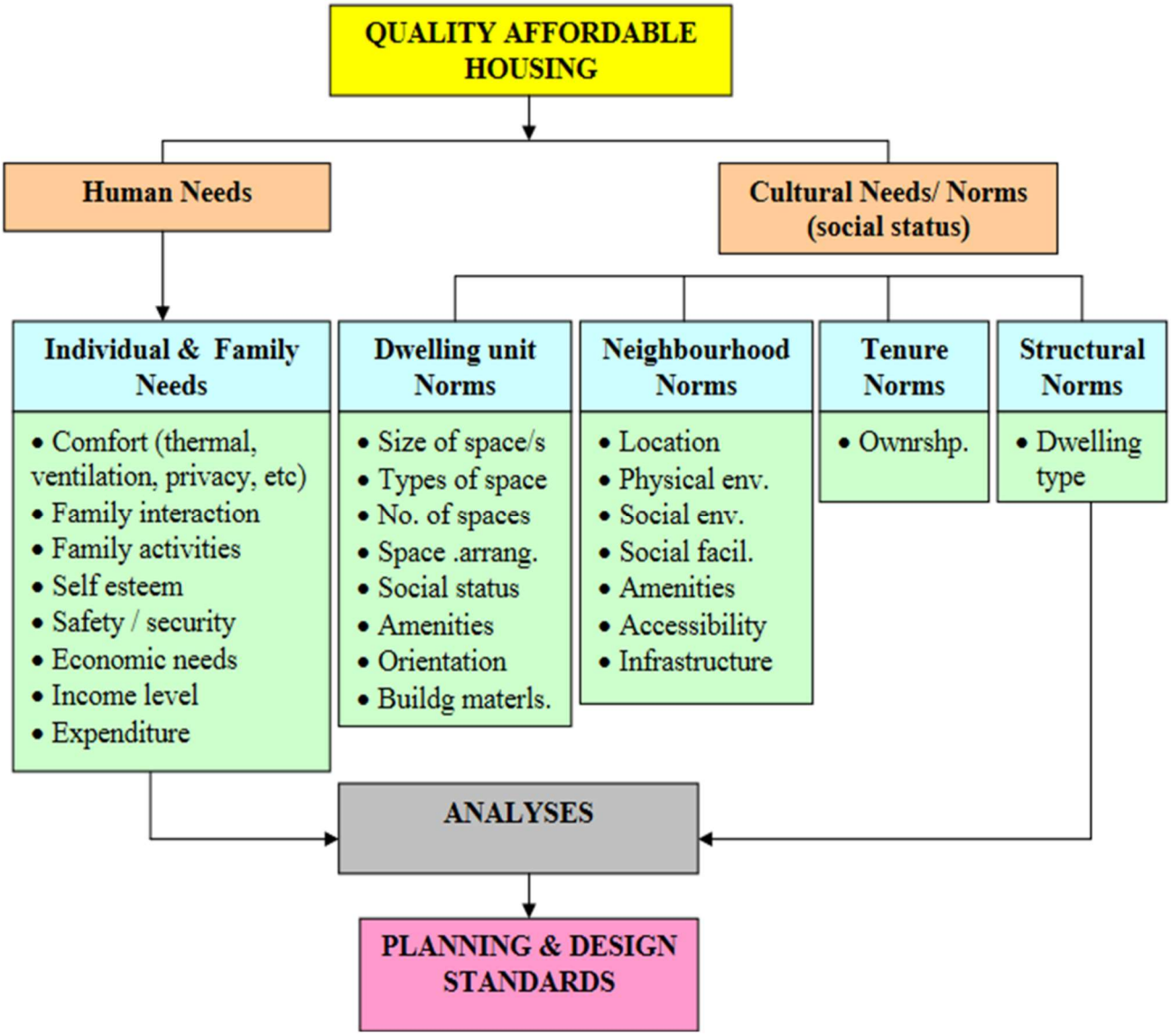


ZONING AND CONCEPT SITE PLAN

FORM EVOLUTION



6.5 PLANNING CONSIDERATION AND PROCESS



6.6 CONSTRUCTION TECHNIQUES:

1.MODULAR CONSTRUCTION DESIGN:

Modular construction is a process in which a building is constructed off-site, under controlled plant conditions, using the same materials and designing to the same codes and standards as conventionally built facilities – but in about half the time. When these modules are put together on site, it reflects the identical design intent and sophisticated specifications. Advantages of this technique are, it is a sustainable practice (green practice), faster and smarter ways of constructing a house.

ADVANTAGES: Modular construction has the following advantages:

- Weather delays can be eliminated.
- Materials are less wasted.
- Can be reused and has greater flexibility.
- It is the safest method of construction.

2. PASSIVE DESIGN TECHNIQUES:

- Passive design techniques use the naturally available sources of energy like sun and wind for the purposes of heating, cooling, lighting and ventilation.
- This will reduce the energy bills in a building and also the heating load on a building.
- A building can be made comfortable for the people to live in, by naturally reducing the fluctuations
  in temperature and also it improves the indoor air quality.
- There is no need to incorporate much heavy external loads on a building to keep it cool.
- Hence it reduces the cost of HVAC systems or cost of air conditioners in a normal building.
- Passive design can be achieved only if a building is oriented properly so that it allows good ventilation and sunlight into the rooms.

3.PRECAST TECHNIQUES:

ADVANTAGES WITH PRECAST STRUCTURAL ELEMENTS:

- If many numbers of houses (mass housing) are constructed with precast elements, then cost reduction can be observed.
- Installation of precast elements is an easy process. While conventional construction takes lot of time for the construction. It requires less movement of materials in the construction site. There is no need to maintain inventory of cement, sand and coarser materials in the site, except for smaller works.
- Also, a conventional construction requires lot of equipment's and also lot of labours. But in a precast method of construction, it requires only few skilled personnel to install the various concrete elements.
- Acoustic performance of the precast elements is high as they contain hollow spaces and allows for sound dispersion.
- Flexible designs can be obtained. Even designs with long spans are also possible with the help of precast technology.
- Most of the precast elements are recyclable. Used elements can be crushed in a crusher and can be used again for various purposes like road filling, basement filling, or road bases, etc.
- Even doors and window frames can also be replaced by precast frames which will reduce the cost of material and also cost of maintenance.

DESIGN TECHNIQUES ADOPTED IN PROJECT

PREFABRICATED OR PRE-CAST STRUCTURE SYSTEM:

India is the world's fastest developing country. We are currently on the verge of large-scale urbanisation hence facing a huge demand for building houses. The construction industry contributes to about 10% of Gross Domestic Production (GDP) of the Nation. Housing is the primary need of every human being. With the rapidly growing population, and to fulfil the housing demand, **a more reliable, faster, sustainable method of construction** is deemed necessary by the construction industry. The concept of "built it fast" in the most economical way has not changed since the beginning; however, new technologies have been developed to suit the modern world construction. One such solution is **Precast concrete construction technology.** Precast technologies are not only helping contractors and builders get their buildings faster and more economically but it also helps to reduce construction waste and produce high quality, energy efficient buildings which results in long term benefits to projects. Precast constructions have been a common construction method in United States of America and many European countries. On the other hand, Precast for residential construction has been used in India for only less than a decade, but it has been growing very fast in the past 5 years.

BACKGROUND AND SCRIPT OF PRE-CAST:

Precast is the necessity of today's construction industry, it refers to the making of parts in an offsite of in-site workshop or factory prior to the installation at the site. "The primary purpose of precast construction is to produce building components in an efficient work environment with accesses to specialized skills and equipment in order to reduce cost and time expenditures on the site while enhancing quality and consistency". It is clear that most new construction will have to use more and more precast. From primary structures to small architectural ornaments, precast has become a major part of building construction. In the near future, precast is expected to play a vital role in Indian construction, especially, in the residential building construction.

Over the past 15 years, India has experienced the huge increase in housing demand in a very short period of time, requiring a massive production of residential buildings with the changing face of realty market. This fast-growing economy forced builders to build faster and affordable with high quality. To meet high demand, some builders tried to innovate and bring about transition from the conventional cast-in-situ (CIS) construction and move to precast construction by making building components off-site, and then install them on site. Precast technology, the so-called unconventional method in Indian arena can facilitate both speed and quality and exploit the advantages that projects offer in terms of repetitions and volume. Today, the world agrees that precast/prefab construction makes significant impact on both time and budget.

ADAPTATION TOWARDS PRE-CAST:

The current practice in India is the cast-in-situ (CIS) reinforced concrete structures. In this line, Indian construction industry now marches towards high-rise construction in housing & commercial buildings. Especially, for commercial and residential building construction, precast is increasingly seen as an economic, and high-quality option.

The present economic growth demands faster construction without losing quality aspects and without project delay, project cost outfit in labour shortage or similar related construction uncertainties. Precast can also be successfully used in all structural elements of building such as columns, beams and slabs. This is made possible with the help of modern automatic/semi-automatic factory installed concrete handling and placing units. Precast is made feasible with the advancement of production and equipment for transportation and erection.

ADVANTAGES OF PRE-CAST STRUCTURE SYSTEM:

There are many advantages use of precast concrete components. Of course, these require proper design, use of the correct materials and manufacturing processes with skilled and knowledgeable personnel. Properly designed and specified precast concrete go a long way toward reducing and eliminating many common utility construction problems, while the economics of precast translate into faster, more cost-effective projects. Benefits available include:

- Fast construction
- Cost and time saving
- Required less man power
- Great finishing and durability
- Less maintenance
- Climate friendly
- Less wastages of materials
- Less uses of transportation and other natural resources

PRECAST COMPONENTS & CONNECTIONS:

Structural precast elements can largely be classified into two categories based on their production methodology, namely tilts and hollow core. For a typical residential unit construction, the major elements are columns, beams, canopy, wall panels, cladding, balcony, staircase, slabs etc. Out of these columns, beams, canopy, wall panels, cladding and balcony, stair case, landings are tilts and slabs are hollow core of varying thickness. The common area of a building has many

other precast elements such as lift core, boundary walls, curb stones, etc. Figure 1 shows the typical precast elements and their assembly for a residential unit.

PRECAST COMPONENTS:

PRECAST SLABS:

Main types of slabs used in precast frames are: hollow core slab and solid slab. The details of hollow core slabs are shown in the Figure 2 The hollow core slabs are prestressed, precast concrete slabs, with hollow portions in the zones of zero stresses. They reduce the overall concrete dead load, concrete requirement and provides for better insulation.

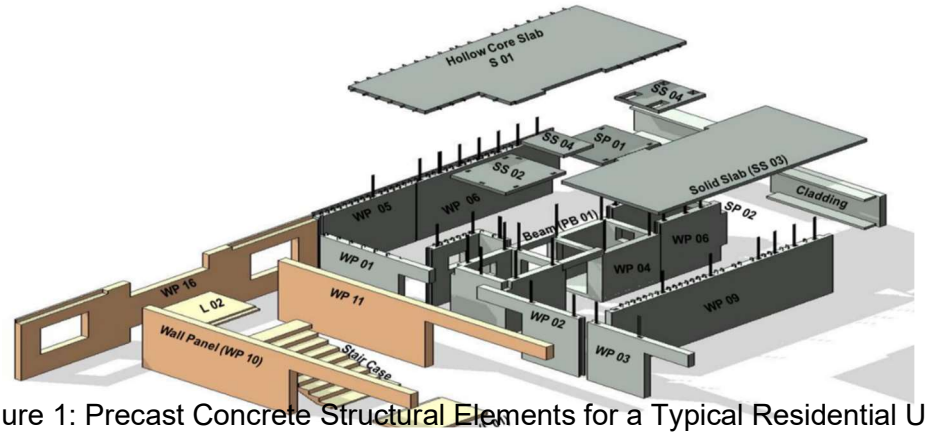


Figure 1: Precast Concrete Structural Elements for a Typical Residential Unit

It is possible to achieve larger unsupported spans. Their general thickness used are 150, 200, and 265 mm. These slabs are casted 140m long at a time, with a fixed width of 1.2m. After steam curing the slabs are cut into smaller pieces as per site requirement. They are then delivered to site and installed in position using tower cranes. After installation as per drawings, a thin reinforcement screening of 50-75mm is laid on the top, to seal the joints. Another common type of slab used are solid slab. These slabs are casted on a tilting bad with lateral and longitudinal reinforcement. These slabs are generally used for long span in the common areas and toilets where it is required to facilitate for various MEP services. They are helpful to reduce weight thus easy for site crane handling. It also eliminates the shuttering cost, and helps to attain a superior slab soffit.

Figure 2: Precast half Slab

PRECAST COLUMNS:

Figure3: Typical Precast Column Details

Columns (Shear walls) in precast construction can either be done in CIS or precast. They are most suited in commercial, industrial bay buildings where thicker sections are needed. Precast columns are provided with corbel for simple beam column connections. Precast also allows for casting of triple height columns, thus faster erection.

PRECAST BEAMS:

Figure4: Typical Precast Beams

There are two main categories of beams used in a precast structure. Internal beams are used where floor loading is approximately symmetrical, and external beams are used where floor loading is predominantly non-symmetrical. The use of precast beams with proper designed connections ensure higher structural stability.

PRECAST WALL PANELS:

Precast wall panels and claddings are smart substitute for conventional infill blockwork or brick walls. These walls offer superior finish surface, eliminates the plaster and touch ups, facilitate for desired & accurate openings of doors, windows, ventilators etc. These wall panels also improve the overall lateral stability of the structure.

Figure5: Precast wall panels

PRECAST STAIR-CASE:

Precast staircase eliminates the complicated-on site shuttering & reinforcement, and provides high quality finish. They can either be a single precast unit containing all flights and landings or separate precast flights & landings.

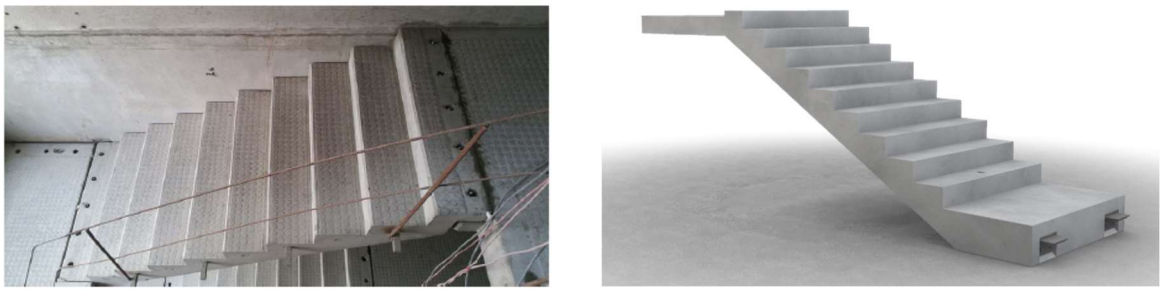


Figure 6: Precast stair case

SOME OTHER MATERIALS:

FACTORY MADE PVC WALL PANELS:

Factory made PVC walls are used for walls and partitions. Outer wall is 126 mm. thick and inner wall is 66 mm. thick. Concrete core is filled with M-30 grade of concrete along with mild reinforcement between panels for support. Panels are stored with a defined pattern at store yards and used with as per size requirements with floor support M.S. channels and panel joining brackets.

Figure7: PVC Wall panels

CONVENTIONAL V/S PRECAST CONSTRUCTION TECHNIQUES

CONVENTIONAL CONSTRUCTION SYSTEM:

LOAD BEARING STRUCTURE

In this system, walls are constructed using bricks/stone/block masonry and floor/roof slabs are of RCC/stone/composite or truss. It is cast in-situ system and called load bearing system as load of structure is transferred to foundation and then to ground through wall

RCC FRAMED STRUCTURE

In this cast in-situ system, the skeleton of a structure is of RCC column and beam with RCC slab. The infill walls can be of bricks/blocks/stone/panels. The load of the structure is transferred through beam and column to the foundation.

STEEL FRAMED STRUCTURE

Here RCC beam and columns are replaced by hot rolled steel sections.

CONVENTIONAL CONSTRCTION SYSTEMS

There is too much of dependency on cement, aggregates and water in these traditional constructions. In particular, the fine aggregate (sand) and water today are quite scarce.

• It is also seen that, on account of shortage of skilled labour, these constructions today, in general, are not up to the mark in terms of quality.

• In addition, traditional construction cannot be green buildings normally. But green buildings are the order of the day, in view of energy scarcity and, fast depletion of precious natural materials.

(This system is Slow track construction)

BUSSINESS AS USUAL APPROACH:

BUILDINGS CONSUME	BUILDINGS ACTIVITIES CONTRIBUTE
* 40% OF ENERGY	* 50% OF AIR POLLUTION
* 25% OF WATER	* 42% OF GHG EMISSION
* 40% OF RESOURCE	* 50% OF WATER POLLUTION
* 35% OF MANPOWER	* 48% OF SOLID WASTES

SUSTAINABLE BUILDINGS

- 30%-50% REDUCTION IN ENERGY USE
- 40% REDUCTION IN WATER USE
- 35% REDUCTION IN GHG EMISSION
- 75% REDUCTION IN WASTE

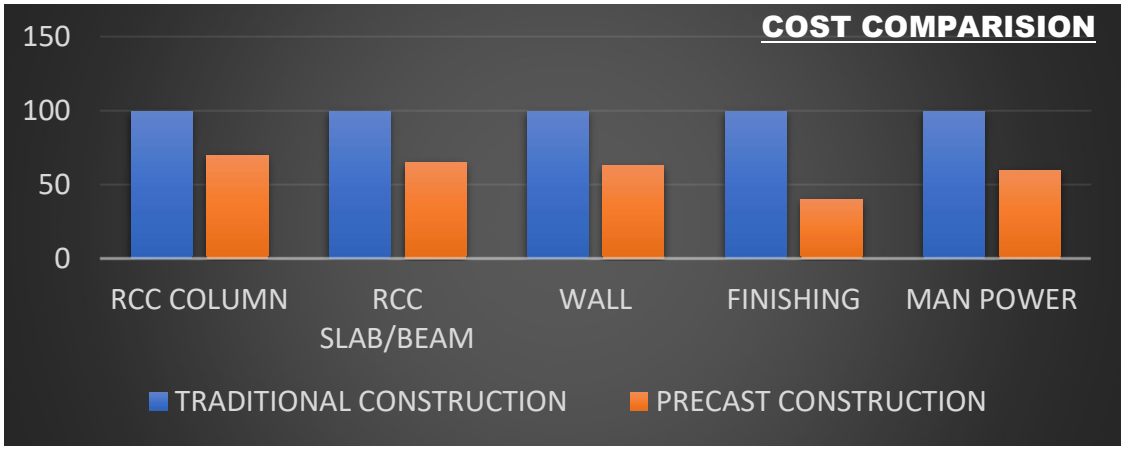
PRECAST CONSTRUCTION AS SUSTAINABLE SOLUTION:

Precast uses little water during production and hardly any at the construction site. Quick erection minimizes noise and pollution impact on the neighbourhood. At the same time, the site remains clean and in order because precast elements are ready to install and storage need is negligible. Precast concrete encourages environmental sustainability by creating durable and energy-efficient structures. It promotes downcycling and product reuse, which contribute to economic sustainability. It also promotes social sustainability by promoting safer working conditions.

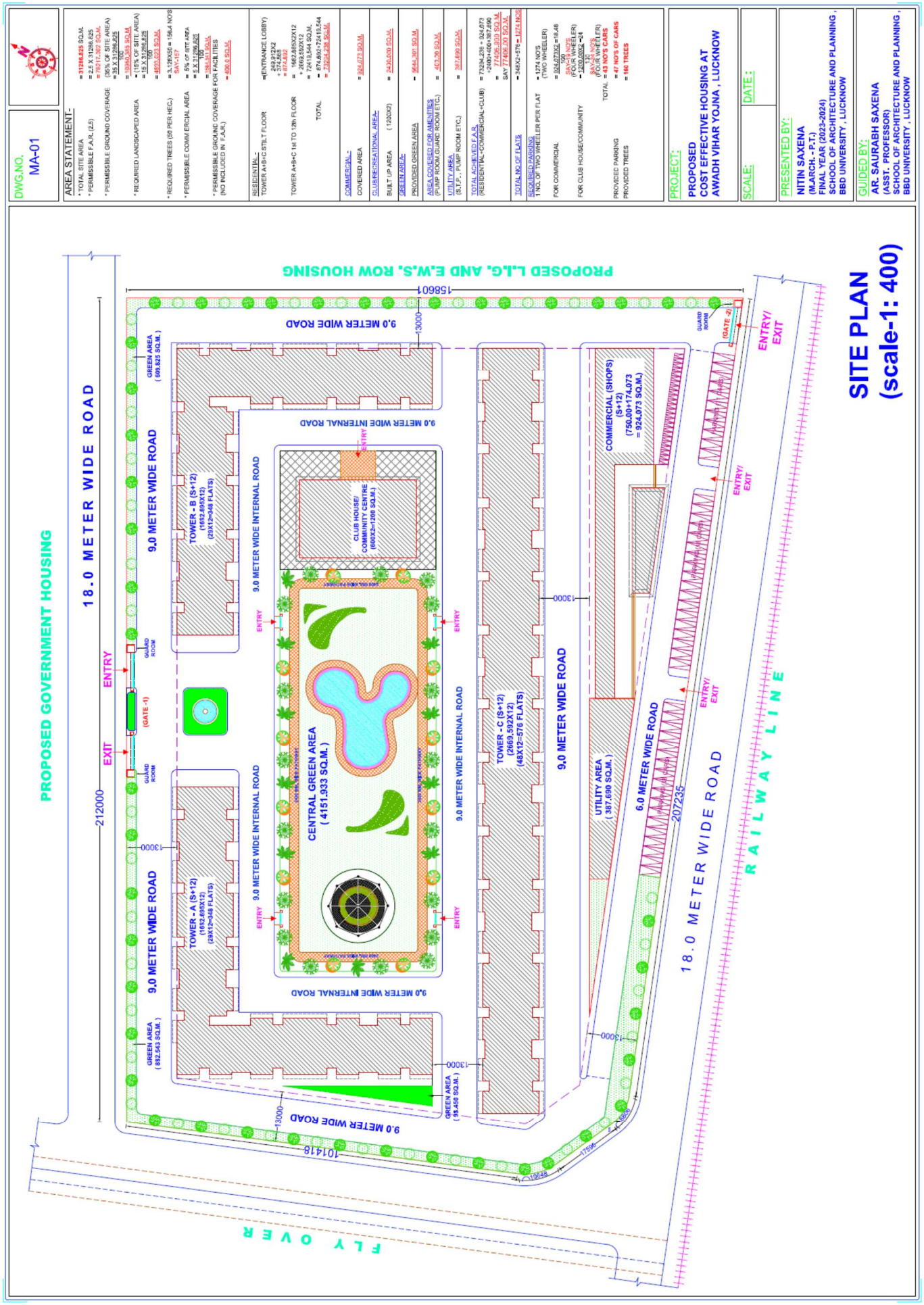
COMAPRISION OF CONVENTIONAL AND PRECAST CONSTRUCTION SYSTEM

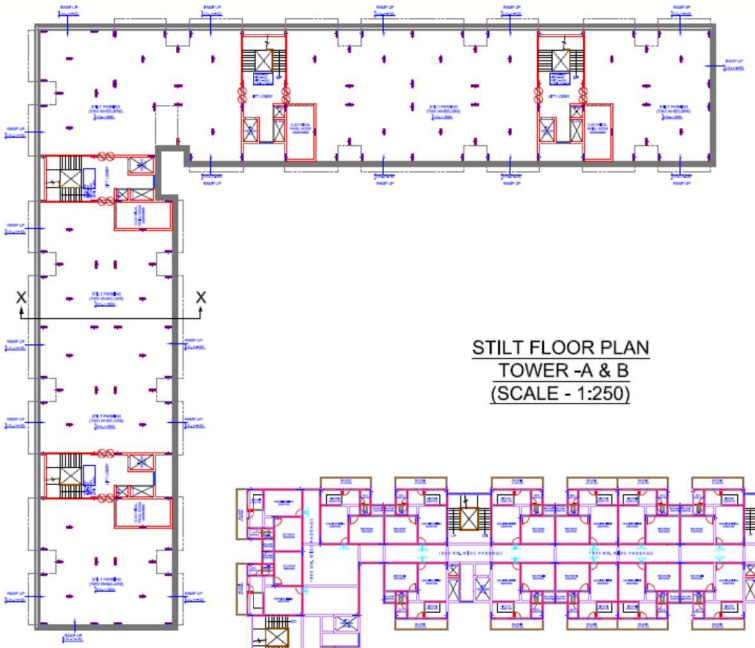
Conventional Construction Systems	Alternate Construction Systems
Slow	Fast
Maximum Use of Natural Resources	Optimum use of Resources
Waste Generation	Minimum Waste
Air/Land/Water Pollution	Minimum Pollution
Labour Intensive	Industrialized System
Prescriptive Design	Cost-effective Design
Unhealthy Indoor Quality	Better health & Productivity
Regular Maintenance	Low Life Cycle Cost
Energy Intensive	Energy Efficient
Cast-in-situ Poor Quality	Factory Made Quality Products
High GHG Emissions	Low GHG Emissions
Unsustainable	Sustainable

PROCESS COMPARISION

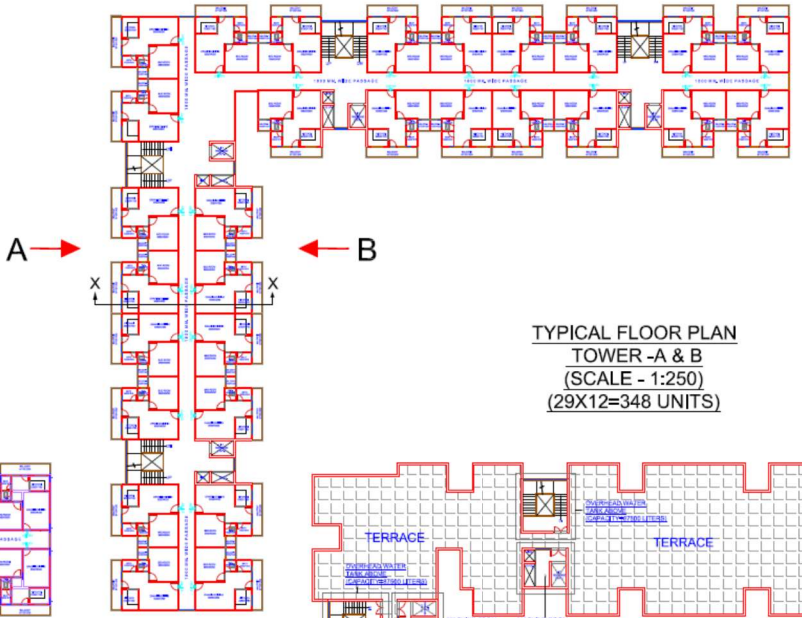


DRAWINGS

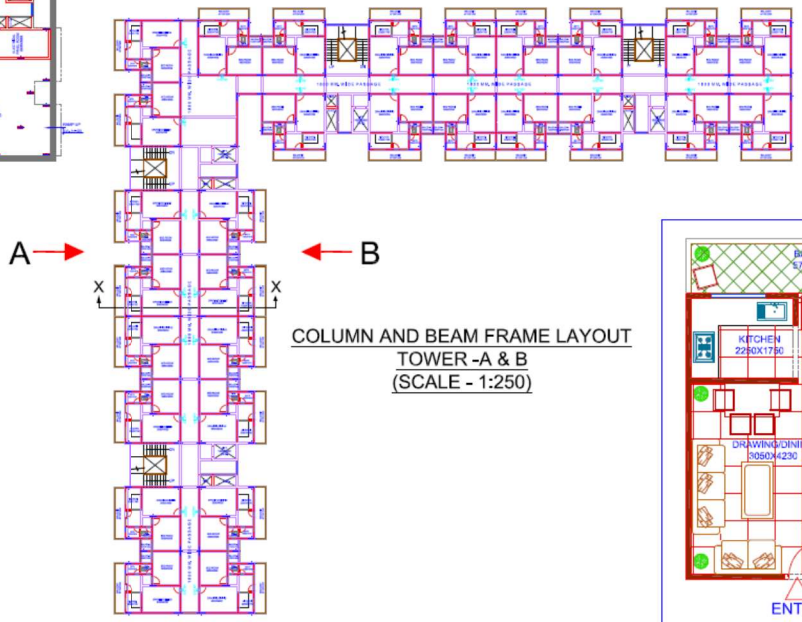

DWG.NO. MA-01
AREA STATEMENT-
* TOTAL SITE AREA = 31286.625 SQ.M.
* PERMISSIBLE F.A.R. (2.5) = 2.5 X 31286.625 = 78217.362 SQ.M.
* PERMISSIBLE GROUND COVERAGE (35% OF SITE AREA) = 35 X 31286.625 = 10950.319 SQ.M.
* REQUIRED LANDSCAPED AREA = (15% OF SITE AREA) = 15 X 31286.625 = 4693.023 SQ.M.
* REQUIRED TREES (50 PER HEC.) = 3.1286X50 = 156.4 NOS SAY-157
* PERMISSIBLE COMM ERCIAL AREA = 5% of IIIT AREA = 5 X 31286.625 / 100 = 1564.331 SQ.M.
* PERMISSIBLE GROUND COVERAGE FOR FACILITIES (NO INCLUDED IN F.A.R.) = 400.0 SQ.M.
RESIDENTIAL-
TOWER A+B+C STILT FLOOR =(ENTRANCE LOBBY) 249.912X2 + 374.868 + 674.832
TOWER A+B+C 1st TO 12th FLOOR = 1662.695X12 + 2669.592X12
TOTAL = 724.19.544 SQ.M. = 674.892+724.10.544 = 73294.236 SQ.M.
COMMERCIAL-
COVERED AREA = 924.073 SQ.M.
CLUB/RECREATIONAL AREA-
BUILT UP AREA (1200X2) = 2400.000 SQ.M.
GREEN AREA-
PROVIDED GREEN AREA = 9644.301 SQ.M.
AREA COVERED FOR AMENITIES (PUMP ROOM GUARD ROOM ETC.) = 453.90 SQ.M.
UTILITY AREA (S.T.P., PUMP ROOM ETC.) = 387.690 SQ.M.
TOTAL ACHIEVED F.A.R. (RESIDENTIAL+COMMERCIAL+CLUB) = 73294.236 + 924.073 + 2400+406+387.690 = 77406.399 SQ.M. SAY 77406.00 SQ.M.
TOTAL NO OF FLATS = 346X2+576 = 1274 NOS
REQUIRED PARKING
1 NO. OF TWO WHEELER PER FLAT = 1274 NOS (TWO WHEELER)
FOR COMMERCIAL = 924.073X2 = 18.48 SAY 19 NOS (FOUR WHEELER)
FOR CLUB HOUSE/COMMUNITY = 1200/100X2 =24 SAY 24 NOS (FOUR WHEELER)
TOTAL = 43 NOS OF CARS
PROVIDED PARKING = 47 NOS OF CARS
PROVIDED TREES = 160 TREES
PROJECT:
PROPOSED COST EFFECTIVE HOUSING AT AWADH VIHAR YOJNA , LUCKNOW
SCALE:
DATE :
PRESENTED BY:
NITIN SAXENA (M.ARCH. - P.T.) FINAL YEAR (2023-2024) SCHOOL OF ARCHITECTURE AND PLANNING , BBD UNIVERSITY , LUCKNOW
GUIDED BY:
AR. SAURABH SAXENA (ASST. PROFESSOR) SCHOOL OF ARCHITECTURE AND PLANNING , BBD UNIVERSITY , LUCKNOW
SITE PLAN (scale-1: 400)
PROPOSED GOVERNMENT HOUSING
18.0 METER WIDE ROAD
PROPOSED L.I.G. AND E.W.S. ROW HOUSING
9.0 METER WIDE ROAD
9.0 METER WIDE INTERNAL ROAD
CENTRAL GREEN AREA (4151.933 SQ.M.)
CLUB HOUSE/ COMMUNITY CENTRE (600X2=1200 SQ.M.)
TOWER - A (S+12) (1662.695X12) (28X12=348 FLATS)
TOWER - B (S+12) (1662.695X12) (28X12=348 FLATS)
TOWER - C (S+12) (2669.592X12) (48X12=576 FLATS)
COMMERCIAL (SHOPS) (S+12) (750.00+174.073 = 924.073 SQ.M.)
UTILITY AREA (387.690 SQ.M.)
6.0 METER WIDE ROAD
RAILWAY LINE
FLY OVER
GREEN AREA (809.825 SQ.M.)
GREEN AREA (882.543 SQ.M.)
GREEN AREA (55.450 SQ.M.)
GUARD ROOM
(GATE -1)
(GATE -2)
ENTRY
EXIT
ENTRY/ EXIT
212000
15860
13000
10141.8
207235



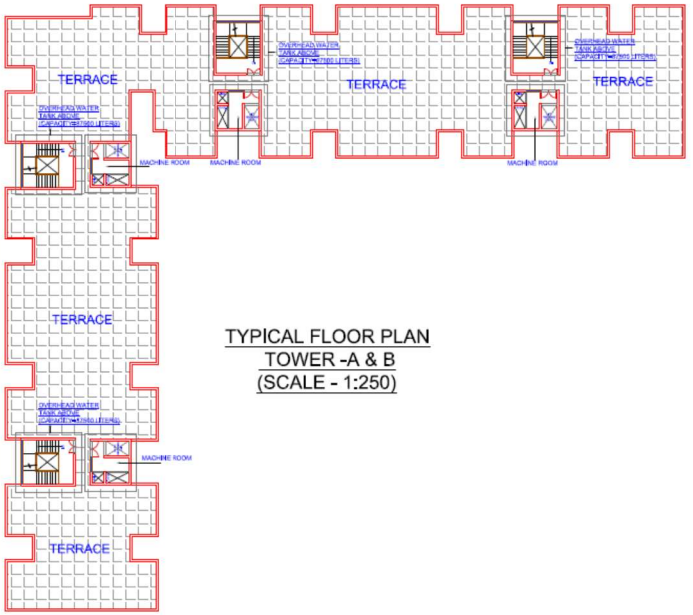
STILT FLOOR PLAN
TOWER -A & B
(SCALE - 1:250)



TYPICAL FLOOR PLAN
TOWER -A & B
(SCALE - 1:250)
(29X12=348 UNITS)



COLUMN AND BEAM FRAME LAYOUT
TOWER -A & B
(SCALE - 1:250)

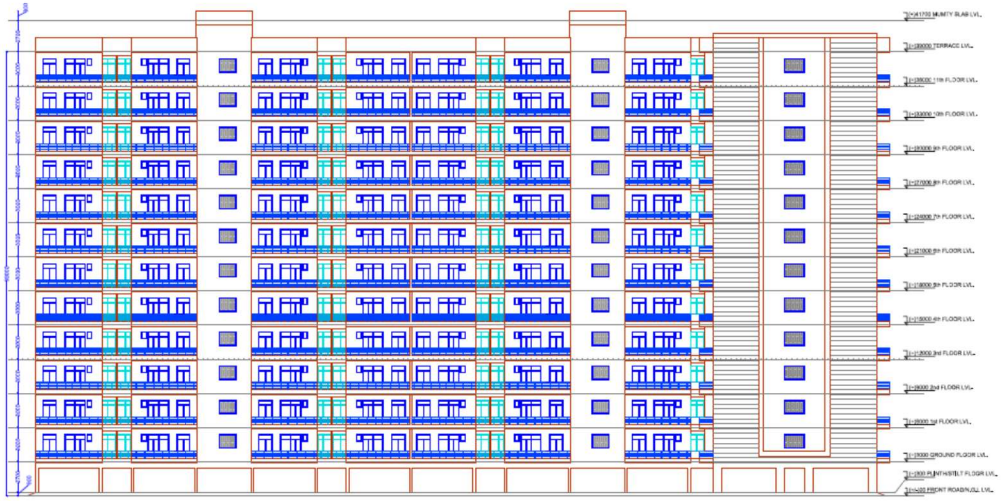


TYPICAL FLOOR PLAN
TOWER -A & B
(SCALE - 1:250)

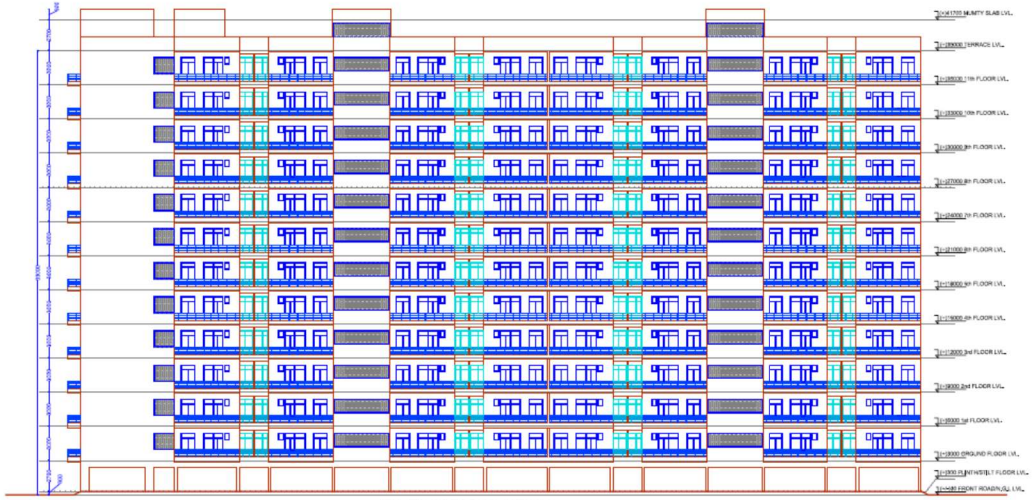
TYPICAL UNIT PLAN
(SCALE - 1:50)
(BUILT UP AREA =40.648 SQ.M.)

TOWER A & B PLANS

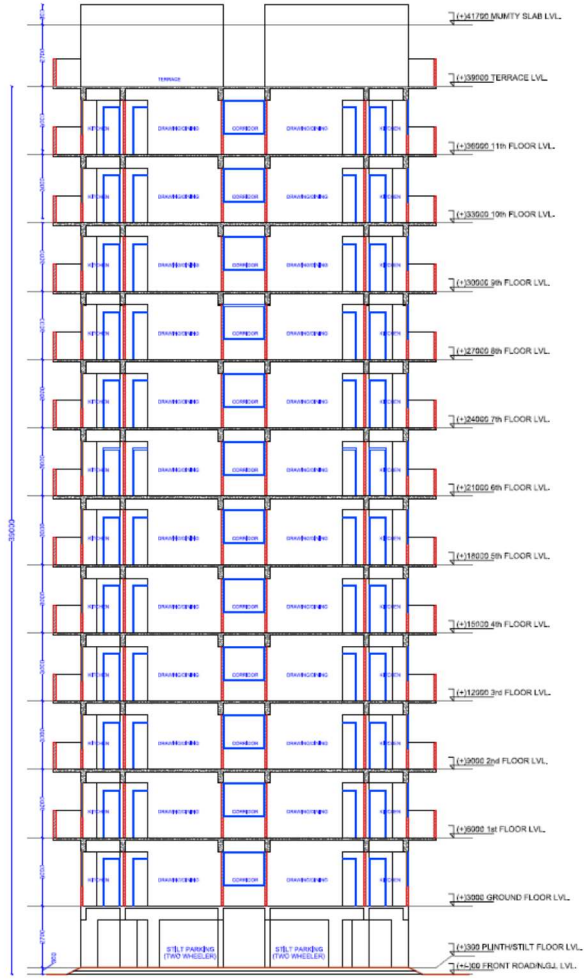
PROJECT: **PROPOSED COST EFFECTIVE HOUSING AT AWADH VIHAR YOJNA , LUCKNOW**	Dwg. title: PROPOSED LAYOUT PLAN Date: MAY-2024 Scale: AS SHOWN		Presented by: **NITIN SAXENA** (M.ARCH. - P.T.) FINAL YEAR (2023-2024) SCHOOL OF ARCHITECTURE AND PLANNING , BBD UNIVERSITY , LUCKNOW	Guided by: **AR. SAURABH SAXENA** (ASST. PROFESSOR) SCHOOL OF ARCHITECTURE AND PLANNING , BBD UNIVERSITY , LUCKNOW	**SHEET A-01/04**



ELEVATION AT 'B'
SCALE (1:200)



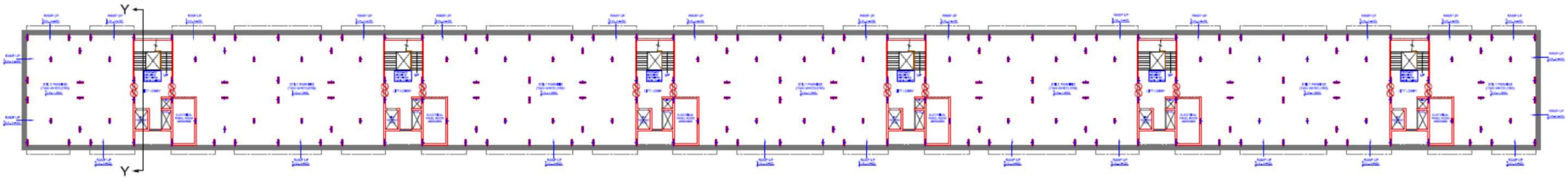
ELEVATION AT 'A'
SCALE (1:200)



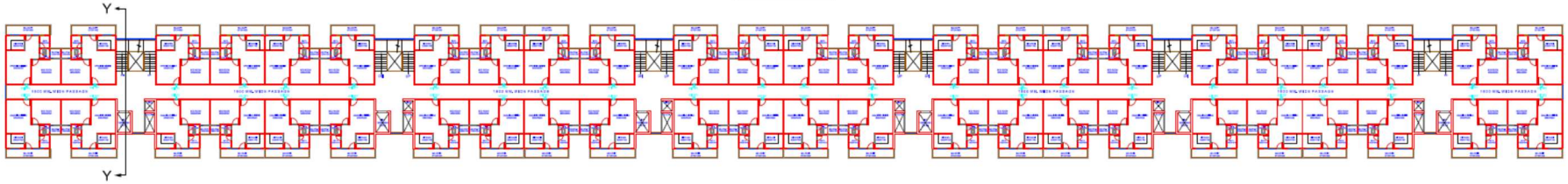
SECTION AT 'X-X'
SCALE (1:100)

TOWER A & B ELEVATIONS AND SECTIONS

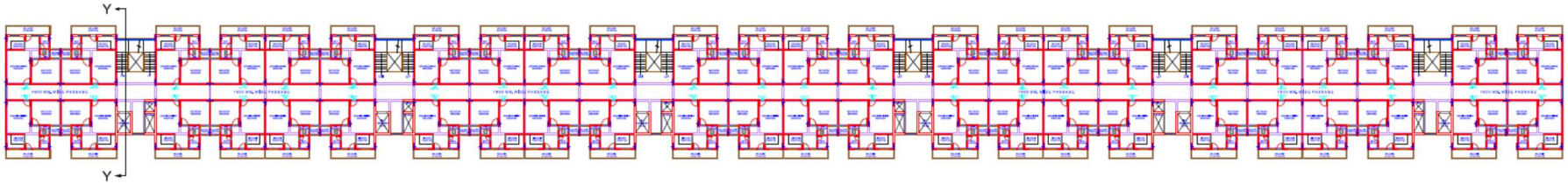
PROJECT:	Dwg. title:		Presented by:	Guided by:	
PROPOSED COST EFFECTIVE HOUSING AT AWADH VIHAR YOJNA , LUCKNOW	PROPOSED LAYOUT PLAN		**NITIN SAXENA (M.ARCH. - P.T.) FINAL YEAR (2023-2024) SCHOOL OF ARCHITECTURE AND PLANNING , BBD UNIVERSITY , LUCKNOW**	**AR. SAURABH SAXENA (ASST. PROFESSOR) SCHOOL OF ARCHITECTURE AND PLANNING , BBD UNIVERSITY , LUCKNOW**	**SHEET A-02/04**
	Date: MAY-2024	Scale: AS SHOWN			



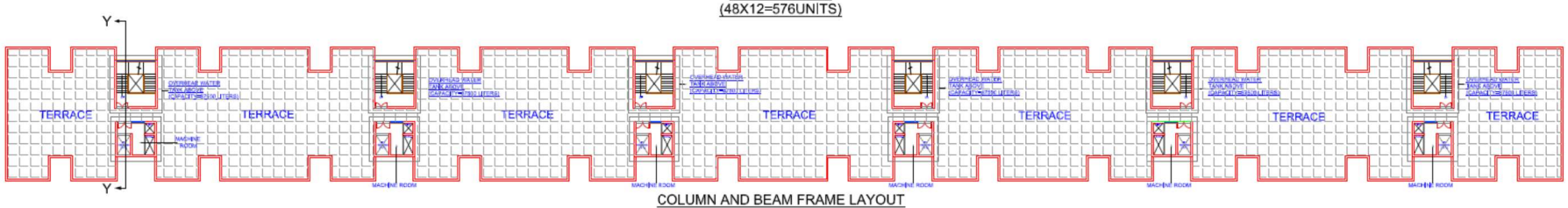
STILT FLOOR PLAN
TOWER -C
(SCALE - 1:250)



TYPICAL FLOOR PLAN
TOWER -C
(SCALE - 1:250)
(48X12=576UNITS)



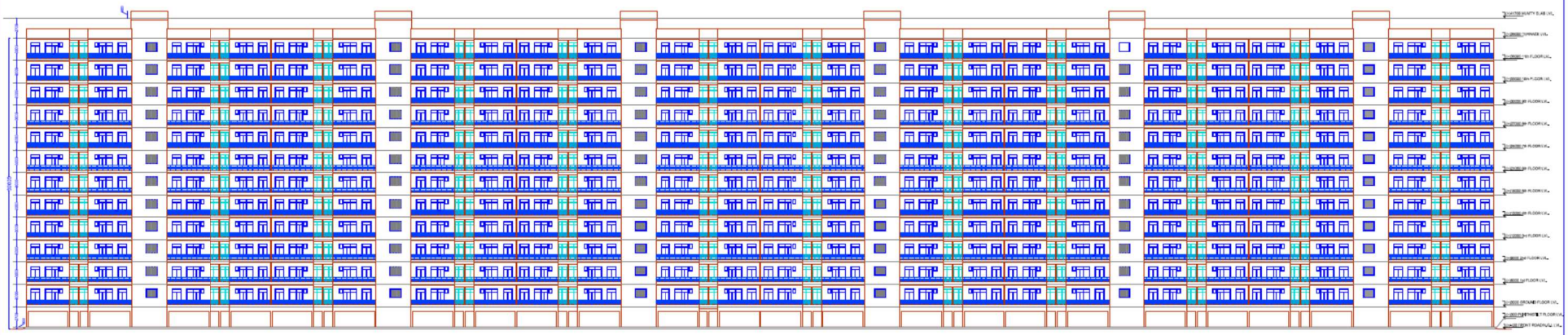
TYPICAL FLOOR PLAN
TOWER -C
(SCALE - 1:250)
(48X12=576UNITS)



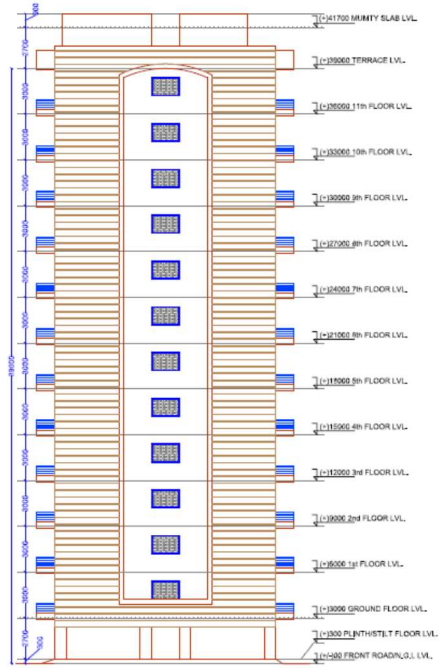
COLUMN AND BEAM FRAME LAYOUT
TOWER -C
(SCALE - 1:250)

TOWER-C PLANS

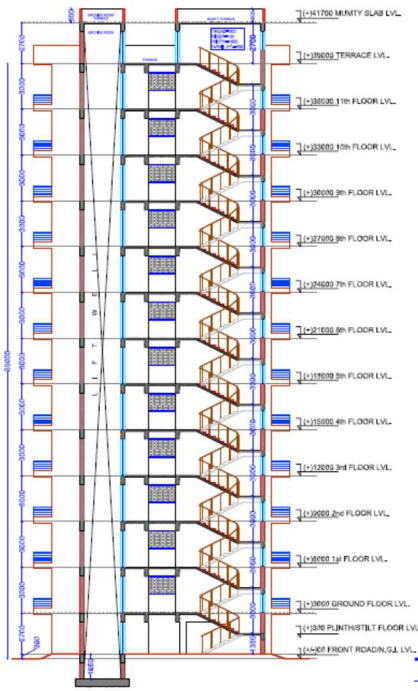
PROJECT:	Dwg. title:		Presented by:	Guided by:	
PROPOSED COST EFFECTIVE HOUSING AT AWADH VIHAR YOJNA , LUCKNOW	PROPOSED LAYOUT PLAN		**NITIN SAXENA** (M.ARCH. - P.T.) FINAL YEAR (2023-2024) SCHOOL OF ARCHITECTURE AND PLANNING , BBD UNIVERSITY , LUCKNOW	**AR. SAURABH SAXENA** (ASST. PROFESSOR) SCHOOL OF ARCHITECTURE AND PLANNING , BBD UNIVERSITY , LUCKNOW	**SHEET A-03/04**
	Date: MAY-2024	Scale: AS SHOWN			



FRONT ELEVATION
(TOWER-C)
SCALE (1:250)



SIDE ELEVATION
(TOWER-C)
SCALE (1:150)



SECTION AT Y-Y
(TOWER-C)
SCALE (1:150)

TOWER -C ELEVATIONS AND SECTIONS

PROJECT:	Dwg. title:		Presented by:	Guided by:	
PROPOSED COST EFFECTIVE HOUSING AT AWADH VIHAR YOJNA , LUCKNOW	PROPOSED LAYOUT PLAN		**NITIN SAXENA** (M.ARCH. - P.T.) FINAL YEAR (2023-2024) SCHOOL OF ARCHITECTURE AND PLANNING , BBD UNIVERSITY , LUCKNOW	**AR. SAURABH SAXENA** (ASST. PROFESSOR) SCHOOL OF ARCHITECTURE AND PLANNING , BBD UNIVERSITY , LUCKNOW	**SHEET A-04/04**
	Date: MAY-2024	Scale: AS SHOWN			

3D VIEWS

MAIN ENTRANCE SIDE VIEW

67

MARKET SIDE VIEW