SOLAR DECATHLON
MULTI-FAMILY HOUSING

MI CASA
CATERING FUTURE

TEAM MI CASA

D.Y.PATIL SCHOOL OF ARCHITECTURE

FINAL DESIGN REPORT - APRIL 2023

PROJECT PARTNER
NAVJEET INFRATECH LLP

INDUSTRY PARTNER
GODREJ AND BOYCE MFG.CO.LTD

2. TABLE OF CONTENTS

3. LIST OF FIGURES

4. EXECUTIVE SUMMARY

A net zero energy, multi-family home project is a niche area for the building and construction industry. Much more so is a design that uses net positive energy and net positive water. The Navjeet Infratech LLP multifamily housing building in Alibag was renovated by Team Mi Casa from Dr. Y. Patil University to a net positive design, which has net positive energy and net positive water as well as reduced waste is thrown out from the system. A multidisciplinary team from architecture and engineering disciplines developed the design.

The project was envisioned by Mumbai-based Navjeet Infratech LLP to serve both the local residential market and as vacation houses for urban dwellers. For middle-income groups and high-income groups, the property offers 1, and 2-bedroom homes. It is fairly unusual for a housing sector project to reach net-positive status in an area with high humidity.rocedure with the aid of industry partners and a data-driven, integrated design approach.

Residents of residential buildings are largely responsible for the energy and water use in those structures. For this research, information about potential building tenants was acquired from a variety of sources (e.g., Google search volume trends and publicly available demographic data). Since the project was designed as a vacation home, priority was given to recreational spaces and open areas which are designed such that they remain shaded throughout the day. To discourage the use of Artificial cooling, Green roof is provided and the placement of buildings is done such that daylight in units is maximized whilst the heat gain is minimized.

With careful consideration of principles of building science, affordability of users, market forces, and users' desire to upgrade their lifestyles, the project generates electricity on-site using solar photovoltaic systems. These have been placed over the parking, providing shade whilst also generating electricity. Given that the region receives abundant rainfall, rainwater harvesting is done on-site and is treated and reused for various purposes. With a higher percentage of softscape used on site, rainwater is also allowed to percolate into the ground recharging the water table. Greywater is also taken care of on-site and treated to use for non-potable purposes.
Waste management is another goal that was tackled by adding a compost pit for the organic waste produced on-site.

5. RESPONSE TO REVIEWERS COMMENTS

SECTION	REVIEWERS COMMENTS	OUR RESPONSE
ENERGY PERFORMANCE	1.Great Job. Your team has clarity in identifying the required indicators to analyse the energy performance. 2.Your team has listed the energy conservation measures and also attempted the energy load calculations. Although a little more clarity is desired in the calculations for renewable energy generation. You have set an impressive target EPI of 32 kWh/sqm. However, you have to demonstrate the reduction of load with annual energy analysis against a baseline scenario, and energy simulations are expected at this stage.	We have updated the energy load calculation also added the necessary simulations.
WATER PERFORMANCE	1.Great Job. The impressive part is that your team has not only focused on the macrolevel issues but tried to address them from micro-level and detail them out. Impressed with the water performance as well as the details of the fixtures. 2.In your report, the section on water consumption seems mixed up. A clear and concise representation of the source, consumption and storage calculations, highlighting the Net Zero aspect, will help put across your thoughts more effectively. Although you have made a water cycle diagram, it needs the actual calculations to make it comprehensive. Also, you have to consider all uses of water including HVAC systems. Do make it a practice to mention sources for all numbers, wherever you have taken a reference.	We have updated the water calculation also mentioned the references used. Revised this on page 10 - 11

5.RESPONSE TO REVIEWERS COMMENTS

SECTION	REVIEWERS COMMENTS	OUR RESPONSE
EMBOIDED CARBON	1.Its so unfortunate that your team missed this component/section in the report. I am pretty sure your team had worked on it and might have missed presenting it in the final report. From an optimistic perspective, Its a good learning, but unfortunately, cost your team a few points. 2.Your report states that you will be using locally available construction materials. Along with the narrative of the low embodied carbon materials and construction technologies used in the design, demonstration of reduction of embodied carbon, through calculations, is also expected at this stage.	Team has worked and has also added the additional required information in this part of our report.
RESILIENCE	1.Great Job. You are strong with your basics and attempted each indicated from the core and from a commonsense. Impressed with the comparison of the wind-load and seismic force data. 2.Your team's comprehensive approach towards resilient design is shown, through the risks defined and the strategies proposed. You have identified earthquake, cyclone, flood, food shortage, pandemic, heat waves and pollution as potential hazards and tried to address them with design interventions. Installation of warning systems and regular drills to help the residents adapt to it, is commendable.	No response.

5.RESPONSE TO REVIEWERS COMMENTS

SECTION	REVIEWERS COMMENTS	OUR RESPONSE
ENGINEERING AND OPERATIONS	1.Nice Job. Your team made a good attempt in consolidating all the relevant data while designing the engineering details. There are a couple of points missing in the structural details, yet you all addressed them through narrations. 2.Your team has presented a list of the selected appliances and fixtures. Solid waste management system flow is also shown. However, design and right-sizing of HVAC, electrical, water and structural system, and their integration into architectural design needs to be elaborated with calculations.	We have added structural details and also elaborated the calculations.
ACHITECTURAL DESIGN	1.Great Job. The video explainer is all that is enough to answer your architectural design. I am pretty impressed with the design and conceptualization. 2.The development of the Architectural design has been presented well. Going forward, make sure construction details, integration of engineering systems and services, etc. are integrated well in to the design.	No response.
AFFORDABILITY	1.Nice Job. Your team made a great effort to address the affordability. Unfortunately, you missed to detail a couple of points that you covered through your narrations. Remember tables and data gives additional points. 2.Your team has narrated the strategies for obtaining economy in construction. You need to demonstrate these, and also quantify the monetary benefits from energy and water reduction with actual figures from your design and operations. Construction cost analysis of the proposed design compared with a baseline design is expected at this stage.	We have added the construction cost analysis and also compared proposed and baseline costs.

5.RESPONSE TO REVIEWERS COMMENTS

SECTION	REVIEWERS COMMENTS	OUR RESPONSE
INNOVATION	1.Great Job. I am very impressed with the innovations. Especially the way you played with the materials (for example terracotta) and overall strategy with respect to the water and energy. 2.In this criteria of Innovation, you need to identify one specific problem and present one innovation as a solution to that problem. It is unclear how your proposed strategies will count towards any actual innovation. You have to demonstrate how your technology will solve the problem, what is the market for it, and also elaborate on its cost, benefits and impacts.	No response.
HEALTH AND WELL-BEING	1.Great Job. I am impressed with the idea of plantation and biodiversity that was narrated. Unfortunately, your team forgot to connect the earlier dots with health and wellbeing. Kindly spend some time on Health and Wellbeing, its the next big thing in the Housing and Public Housing Sector. 2.Your team has listed green spaces, native vegetation and low-VOC paints, as strategies to improve air quality. Going further, you need to identify the conditioned and nonconditioned areas in your project and demonstrate air flow/ air changes with calculation or simulation. Also, annual simulations demonstrating thermal comfort are expected at this stage.	We have worked on Health and wellbeing according to comments given
VALUE PROPOSITION	1.Great Job. You have given your best to address all the requirements given by your project partners. 2.This section is missing in your report.	We have updated our work according to comments given.

6. TEAM INTRODUCTION

A.TEAM NAME - MI CASA

B.INSTITUTION NAME - DY PATIL SCHOOL OF ARCHITECTURE, NAVI MUMBAI.

C.DIVISION NAME - MULTI FAMILY HOUSING

D. TEAM MEMBERS-

OJASVI KANDHIA (TEAM LEAD)
ARCHITECTURE STUDENT
4TH YEAR
ENERGY PERFORMANCE

PRATHAMESH PATIL
ARCHITECTURE STUDENT
5TH YEAR
ARCHITECTURE DESIGN

SEJAL KHAMKAR
ARCHITECTURE STUDENT
5TH YEAR
EMBODIED ENERGY

SAKSHI JOSHI
ARCHITECTURE STUDENT
4TH YEAR
RESILIENCE

MADIHA AZIZ
ARCHITECTURE STUDENT
4TH YEAR
AFFORDABILITY

RANIYA PATEL
ARCHITECTURE STUDENT
4TH YEAR
RESILIENCE

KAJAL GUHAGARKAR
ARCHITECTURE STUDENT
4TH YEAR
HEALTH AND WELL BEING

AKSHATA BANKOLLI
ARCHITECTURE STUDENT
4TH YEAR
VALUE PROPOSITION

DAKSHAYANI PUROHIT
ARCHITECTURE STUDENT
2ND YEAR
WATER PERFORMANCE

AMEY SHINDE
CIVIL ENGINEER STUDENT
3RD YEAR
ENGINEERING AND OPERATIONS

6. TEAM INTRODUCTION

E.APPROACH -

The Team has been brought together by taking in voluntary participation based on the different skills of the students from not just Architecture background but as well as from engineering backgrounds with a common goal and interest of creating a sustainable solution . A specific goal has been assigned to each member to ensure a comprehensive design strategy based on the individual's skillset and interest guided by the faculty lead,TRG and industry partners. The team's approach is based on discuss ,understand ,implement and test modules.

F. INSTITUTIONS -

D Y PATIL DEEMED TO BE UNIVERSITY SCHOOL OF ARCHITECTURE, NAVI MUMBAI

Is a 25 year old architecture institute determined to promote creativity and innovation in the fields of design and architecture.The goal of the institution is to inculcate the educational ecosystem that thrives on diverse choice-based learning, experimentation, critical thinking, innovation, collaboration, engagement with technological advancement; while empathizing with the socio-cultural and ecological systems, to bring about local and global transformation
and to focus on Excellence, Scholarship and Professionalism. The institution provides a 5 year bachelor course in architecture and 2 year master course in urban design.

VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE,MUMBAI

estd. in 1887 as Victoria Jubilee Technical Institute has pioneered India's Engineering education, research and training ecosystem. Pre-independence, VJTI had been instrumental in driving industrial growth throughout united India. Post-independence, VJTI played a pivotal role in setting up IITs and RECs of India and strengthened the technology excellence of the country.Located in South Mumbai, VJTI is an autonomous institution owned by Maharashtra State Government. The institute offers programs in engineering and technology at the diploma, degree, post-graduate and doctoral levels.

G. FACULTY LEAD-

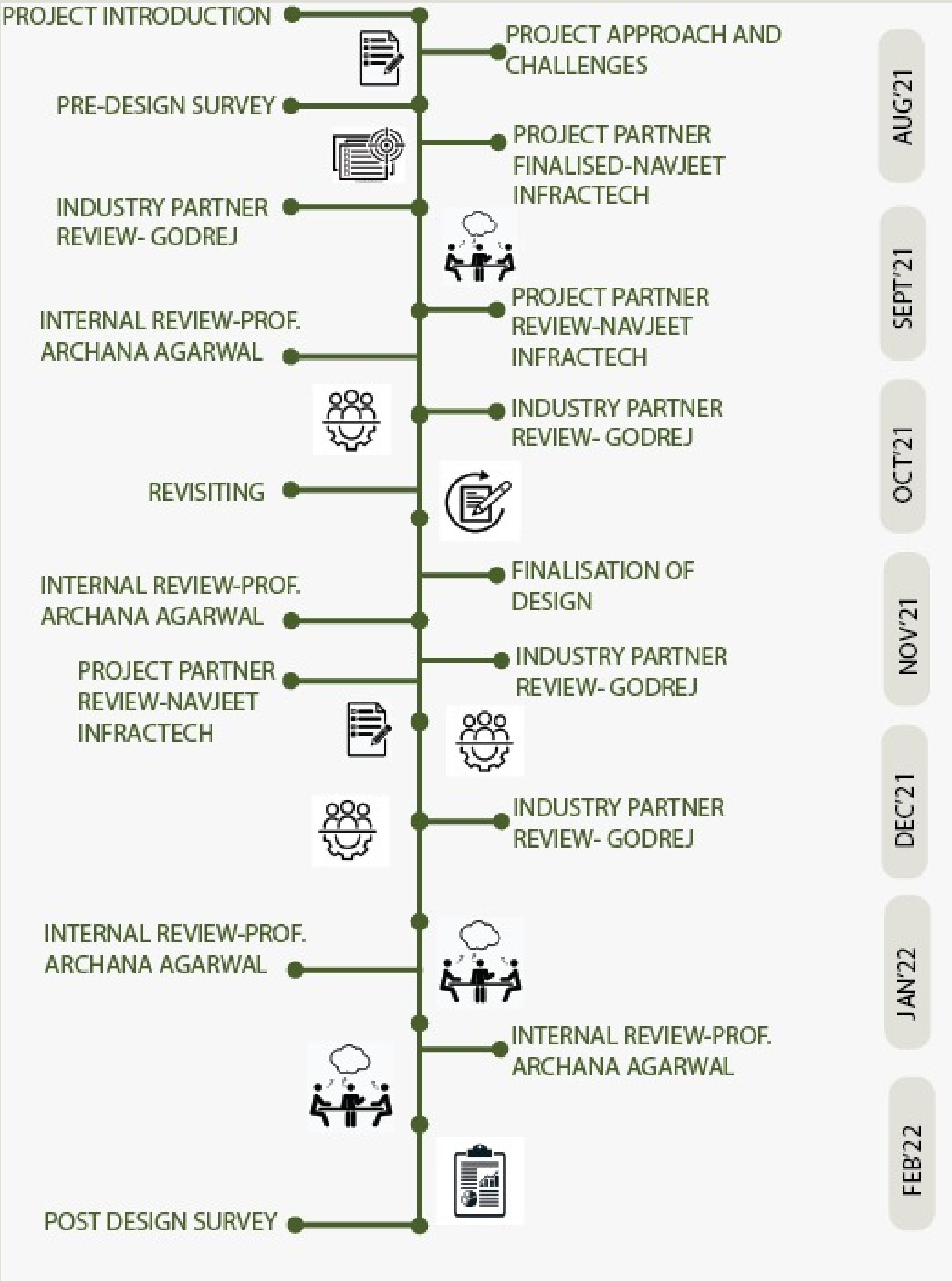
Archana Agarwal – Faculty Lead
Professor, DYPUSOA, Nerul
Archana Agarwal is an Architect whose experience covers a wide spectrum of the facets of Architecture. Besides teaching subjects related to Environmental Architecture and focusing on sustainability in design, she takes interest in encouraging and preparing students for participation in various design competitions.

H. INDUSTRY PARTNER -

Godrej green building consultancy team has been associated with green buildings since 15+ years . They have been a part of 500+ projects creating close to 300 Mn sqft of Green Building Footprint. They will be guiding us on how to design a green building and will check for GRIHA norms

6. TEAM INTRODUCTION

DESIGN DOCUMENTATION PROCESS



Softwares Used

7. PROJECT INTRODUCTION

A.PROJECT NAME

ECO EXOTICA

B.PROJECT PARTNER

NAVJEET INFRATECH LLP, Is a real estate development company run by Mr. Ashok C. Thakkar,he is founder and director partner of many companies amongst which is navjeet infratech. He is a successful businessman based in Mulund, Mumbai; involved in Property Develop ment along with Land banking. He has expertise in Land Acquisition & has mastered the skill over land banking, handling locals, legal expertise, registration works, Govt. Policy expertise and a great team of experts with him to handle any type of projects. The company already has an experience in developing a multifamily residential housing in alibag called CLIFF HAVEN CHSL.

C.BRIEF DESCRIPTION OF THE PROJECT

The project is located in the Alibag, spread over a small strip on the Arabian sea on the southern side of Mumbai, Alibag capital of Raigad district is a d destination well know for its beautiful beaches and tourists spots. in past couple of years Alibag has witnessed a lot of economic and commercial activity ,including emergence of large SEZ projects, making it an attractive investment with high rental returns and has also become a primary residential zone. he sprawl in the arena has already witnessed apartment typology buildings with 100 percent end users

The site is in a warm and humid climate zone ,the project is going to be phase wise development ,the site has a 9m wide front road, and is situated in the heart of the Alibag city

D.PURPOSE OF PROJECT

Build-Sell

E.PROFILE OF OCCUPANTS

100 % end user MIG AND HIG

F. HOURS OF OPERATION

24 hrs (primary residential)

G. LOCATION

Located in Alibag, in Raigarh district of Maharashtra, India

H. CLIMATE

WARM AND HUMID

I .AREA DETAILS

1. SITE AREA = 11,234 SQ.M
2. BASIC FSI -1.1 , ADDITIONAL: 0.3 + ANCILLARY FSI.
3. PERMISSIBLE BUILT UP AREA = 24388.8 SQ.M
4. PERMISSIBLE GROUND COVERAGE = 9,120 SQ.M
5. PROPOSED BUILT UP AREA =

FIG 7.1 LOCATION OF ALIBAG ZONE ON MAP OF INDIA

7. PROJECT INTRODUCTION

J. PROJECT SCOPE

The project is located in Alibag City, about 100 kms far from Mumbai and is a vacation getaway known for its beautiful beaches. Given its proximity to the city, this residential project was designed to cater as holiday homes for city dwellers. Since the project is designed to fulfill the needs as well wants of the tenants, therefore recreational spaces were a priority in the project. Furthermore, the project is Net-Zero Energy, the entire energy requirements of have been taken care of on site, through solar panels. Waste management has been done efficiently throughout the site, rain water harvesting has been doe as the region receives heavy rainfall. Resilience and affordability is also achieved in the project through design and materials used.

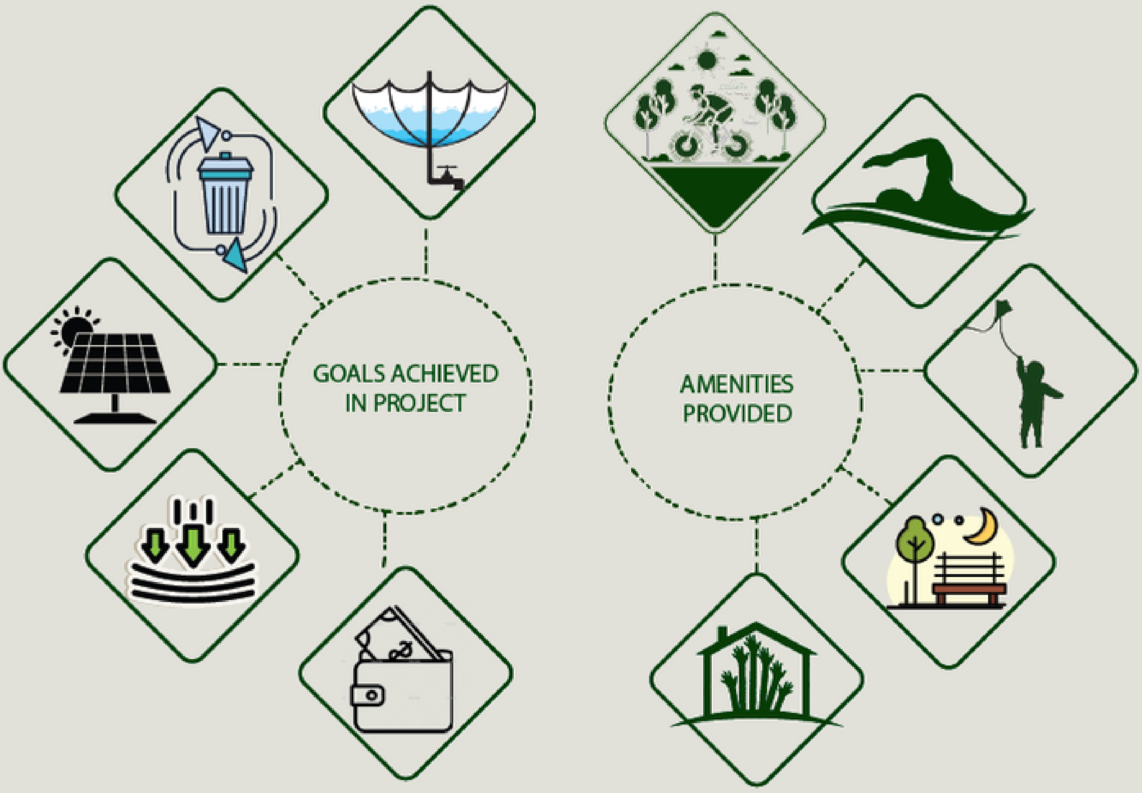


FIG 7.2 SCOPE OF PROJECT

K. TARGET EPI GOAL

32 KWh/M.SQ

L. ENERGY GENERATION POTENTIAL

1. SOLAR ENERGY = 183750 KWH

7. PROJECT INTRODUCTION

M. CONSTRUCTION BUDGET

EIGHTY SIX CRORES THIRTY EIGHT LACKS

S.No.	Particulars	Definition	Baseline Estimate (Project Partner / SOR basis)		
			Amount	%	Amount (INR per sqm)
1	Land	Cost of land purchased or leased by the Project Partner	120990180	14.00%	5276
2	Civil Works	Refer Item A, Civil works in Cost of construction worksheet	381882495	44.21%	16655
3	Internal Works	Refer Item B, Civil works in Cost of construction worksheet	88020417	10.19%	3839
4	MEP Services	Refer Item C, Civil works in Cost of construction worksheet	51827527	6.00%	2260
5	Equipment & Furnishing	Refer Item D, Civil works in Cost of construction worksheet	15548258	1.80%	678
6	Landscape & Site Development	Refer Item E, Civil works in Cost of construction worksheet	8637921	1.00%	377
7	Contingency	Amount added to the total estimate for incidental and miscellaneous e	6910337	0.80%	301
	TOTAL HARD COST		**673817135**	**78%**	**29386**
8	Pre Operative Expenses	Cost of Permits, Licenses, Market research, Advertising etc	82060251	9.50%	3,579
9	Consultants	Consultant fees on a typical Project	12956882	1.50%	565
10	Interest During Construction	Interest paid on loans related to the project during construction	95017133	11.00%	4,144
	TOTAL SOFT COST		**190034266**	**22%**	**8,288**
	TOTAL PROJECT COST		**863792117**	**100%**	**37674**

TABLE 7.3 CONSTRUCTION BUDGET

N. SITE ANALYSIS

- **GEOGRAPHICAL FACTORS** - site shape - irrregular kite shaped. topography - the site is a flat land. ground water - level is high since close to sea. soil type - alluvial soil , good for steeped, combined,raft foundation
- **SURROUNDING FEATURES**- arterial and sub arteliar roads nearby cre ating sound and noise pollution - good vegetation enebles good wind flows - development is majorly residential, apart ment typology buildings can be seen over here - site overlooks barrel land into the north and the west side which are the major direction of the wind too
- **CONNECTIVITY** - Sub arterial road of width 9m touches the site on the fornt side Highway connecting alibag and pen is at 200 m from the site - Pimpalbhat bus stop at 7m walking and panvel railway station 1.5 hrs by car.
- **ANALYSIS** - looking at the climate use of shading devices , cross ventilation, use of light colors on the building facade are passive startegies that can be used to minimize the load on the building

FIG 7.4 LOCATION OF SITE

8.GOALS AND STRATEGIES

ARCHITECTURAL DESIGN

Aim: Design a building which achieves a balance between form and function, have optimum massing and orientation which would impact our energy consumption.

Strategies: Orient the buildings to minimise solar exposure on vertical surfaces and for proper utilisation of wind flow for ventilation.
Selecting the building shape to minimise solar exposure on vertical surfaces Proper utilisation of the wind, buildings need to be oriented at an angle to the prevailing wind direction. Design and position windows to improve natural ventilation. Architectural features like wing walls, louvres, window shutters, and even well-placed vegetation can direct air into the room.
Common spaces such as corridors, staircases, should have suitable openings/access to ambient light so that the need for artificial lighting during daytime is reduced

WASTE REDUCTION

Aim: Zero waste discharge.

Strategies: Potential reuse of waste materials for construction.
Reduce, Reuse and recycle 80-100% of waste generated. 100% of grey water to be treated and reused
Use of bio gas plants for treating and generating organic waste.

LANDSCAPING

Aim: Design sufficient green in the site to reduce urban heat island effect

Strategies:
Using site design and landscaping for multi-fold purposes.(recreational spaces)
Bordering the building footprint with the green spaces so as to reduce urban heat island effect

ACCESSIBLE

Aim: Making the design universally accessible during all times.

Strategies: Step-free accessibility(use of ramp), visually and tactilel contrasting design.

MODULARITY OF SPACE

Aim: Design based on Prototype.

Strategies: Design spaces which are similar in shape and size, so they can be linked to each other for efficient and effective reuse.
Design the modular systems which can be used adaptively.

8.GOALS AND STRATEGIES

ENERGY PERFORMANCE

Aim: To achieve EPI benchmark of 32.

Strategies: Orienting the building facing on north and east sides.
Orienting solar panels majorly on south and west sides
Using solar heaters.
Use of smart appliance to reduce overall energy load

COMMUNITY INTEGRATION

Aim: designing the amenity space displalying the culture.

Strategies: Providing spaces for display of local art and crafts.
Displaying local architecture through design

AFFORDABILITY, SCALABILITY, MARKET POTENTIAL

Aim: Reducing operational costs and capital costs of the building. Cost effective design considering site constraints and strategic planning.

Strategies: Use of local materials will save the cost which might be needed transporting the material from longer distances.
Reducing operation cost by planning the execution stages.
Module base design (1,2,3,4 BHK).

COMFORT AND ENVIRONMENT

Aim : Designing the building envelope to achieve optimum indoor comfort both visual and thermal.

Strategies :Passive measures for walls and windows to reduce the cooling energy. Limit glazed area.
Window-to-wall ratio (WWR) of 10%–30% in bedrooms and 20%–30% in living rooms allow a good balance between adequate daylight and reduced heat gains. It is more important to shade the windows than increase wall insulation or use double-glazed units. Use of light colors on walls (absorptivity ≤0.4) + window shades with extended overhangs

WATER PERFORMANCE

Aim: Minimizing water consumption on site by 55 % and 100 % grey water recycling for secondary activities

Strategies: Incorporate energy-efficiency features in the design of community water pumping system. 100% Grey water generated shall be treated and reused for landscaping and flushing.Roofs can be modulated to transfer the rainwater towards the storage trenchesUse of STP.

9.DESIGN DOCUMENTATION

1.ARCHITECTURAL DESIGN

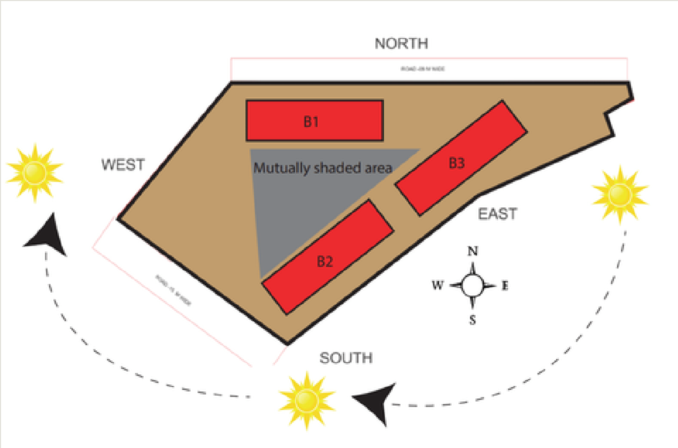


FIG.9.1.1 OPTION 1

OPTION 1-

TYPE - major of the buildings facing in the east

PROS-

- paves way for south western winds and north eastern winds too
- minimum surface are exposed to south and west .
- mutual shading reduces the sun exposed area.

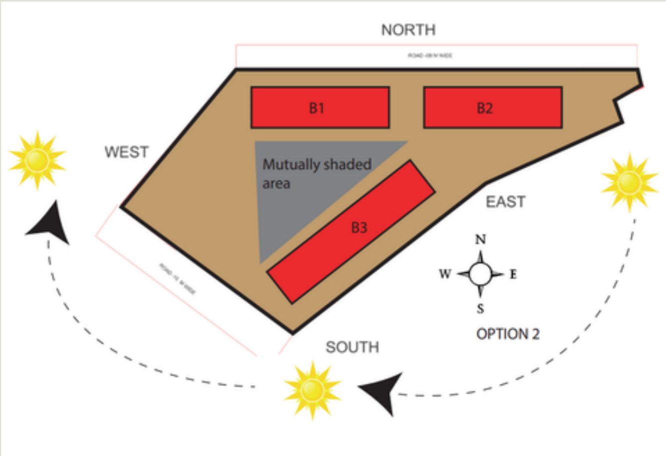


FIG.9.1.2 OPTION 2

OPTION 2-

TYPE - major of the buildings facing in the north

PROS-

- north side units has a pleasent temperature and ight
- paves way for south western winds

CONS-

- maximum of the parts face the west and the south
- It blocks northen winds

MASSING :

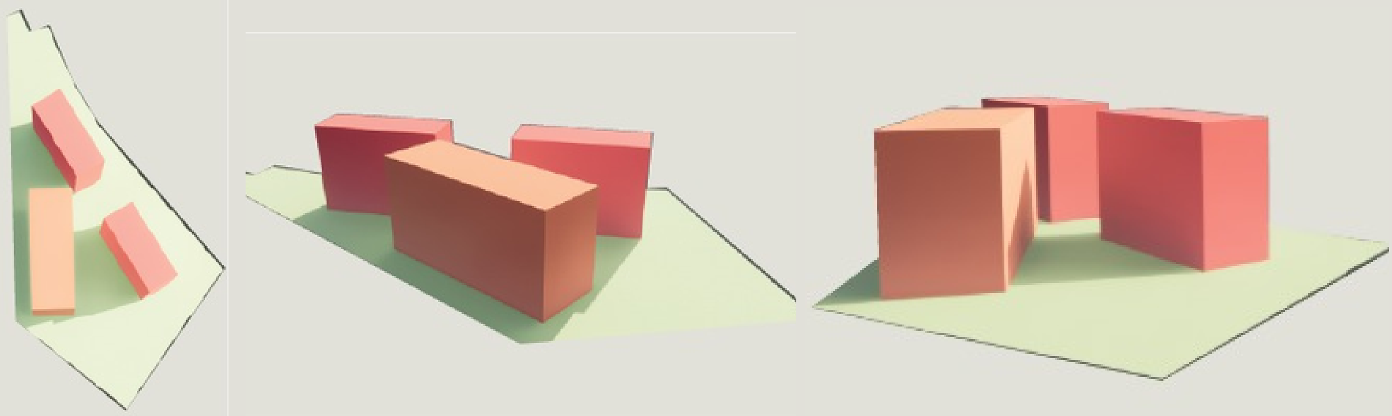


FIG. 9.1.3 MASSGING SHOWING MUTUAL SHADING

The buildings are placed in such a manner that mutual shading is observed as well as the central recreational area remains shaded throughout the day.

1. ARCHITECTURAL DESIGN

SPATIAL PLANNING:

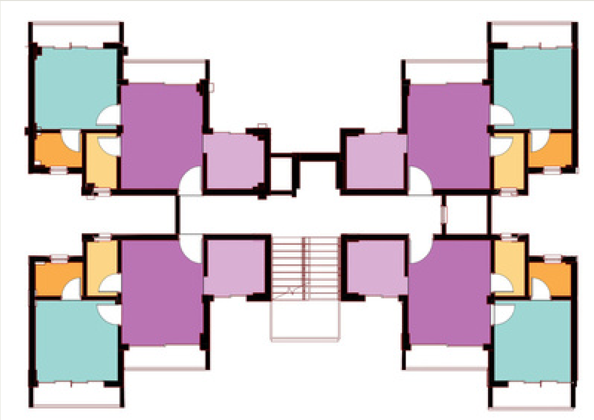


FIG.9.1.4 BUILDING 3 PLAN - 1 BHK

FIG.9.1.5 BUILDING 2 PLAN - 2 BHK

LEGEND

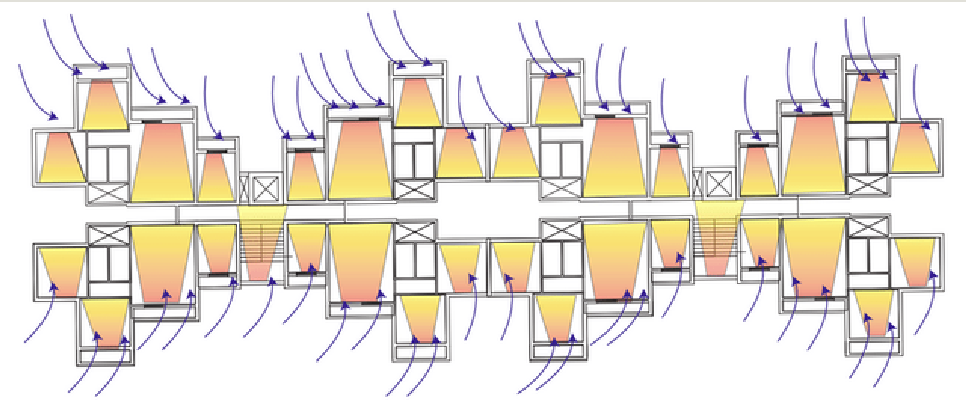


FIG.9.1.6VENTILATION

EVERY UNIT IS DESIGNED IN A VERY COMPACT MANNER BY USING MAXIMIM AREAS IN THE MOST FUNCTIONAL AREAS AND MINIMUM AREAS IN PASSAGE AREAS ,MAKING IT A ECONOMICALLY WORTH UNIT.EVERY UNIT IS STEPPED INSIDE SO AS IT CAST SHADOW ONTO THE PRIOR WALL WITHOUT HINDERING THE LIGHT AND WIND ENJOYED BY THE SPACE.

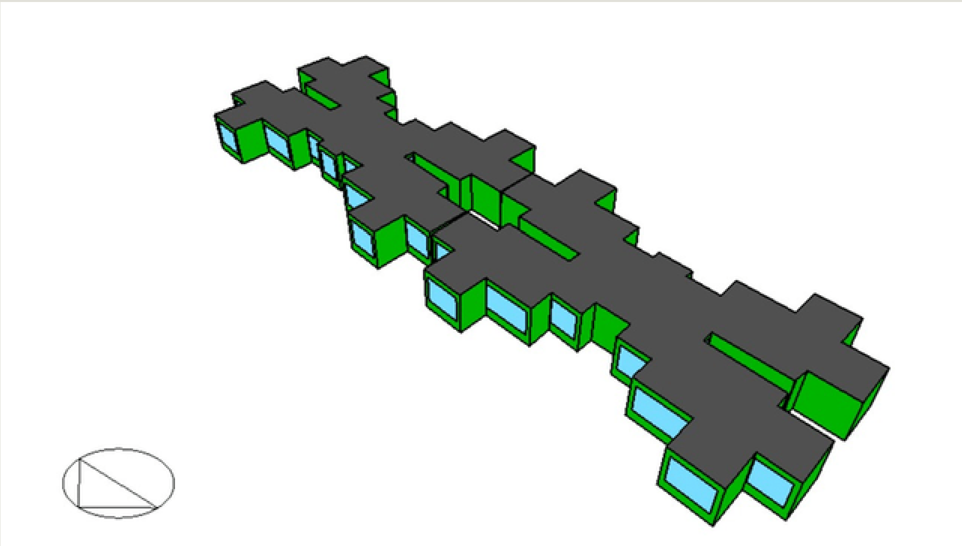


FIG9.1.7 DIAGRAM

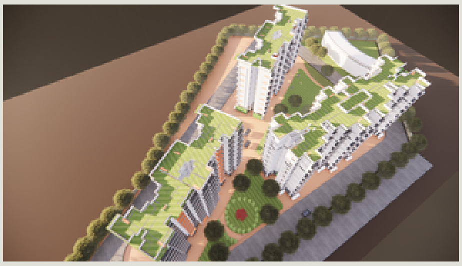


FIG.9.1.8 SITE PLAN

1. ARCHITECTURAL DESIGN

FIG 9.1.9 GROUND FLOOR PLAN WITH SITE

2. ENERGY PERFORMANCE

2.A CLIMATE AND PASSIVE STRATEGIES

Using passive design techniques is the first step towards designing a net zero energy building. A building's form and design are guided by passive design principles, which channel the available natural resources to provide thermal comfort. Designing net zero energy buildings is aided by these climate-specific strategies that take into account the sun, wind, light, and microclimate. The early design stage decisions made about the building's form, orientation, shading, and ventilation have the greatest influence on the building's energy usage. By choosing the right orientation, exterior shading, quantity of glazing, and natural ventilation, proposed passive design solutions seek to reduce the need for cooling during the summer and heating during the winter.

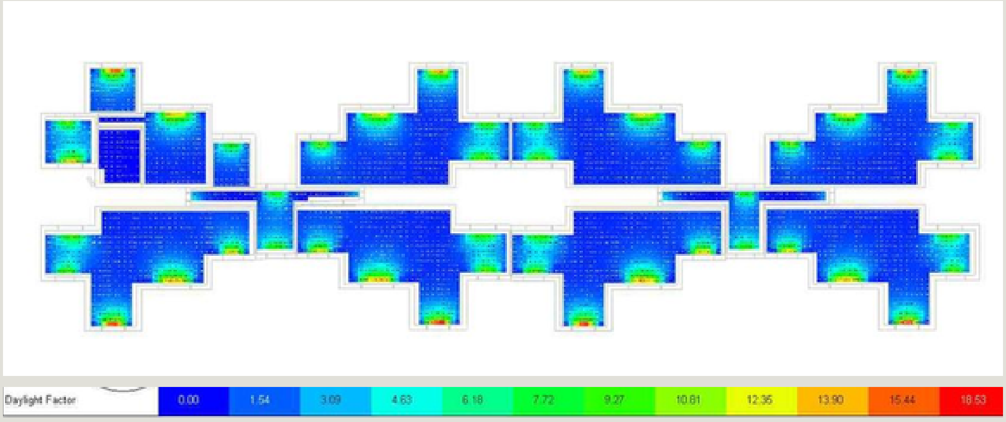


FIG 9.2.1 DAYLIGHT SIMULATION

LIGHTING

The lighting in the spaces was designed to comply with NBC 2016 and achieve 27% reductions over ECBC 2017 recommended lighting loads at the building level. The design strategy was to use efficient LED lights with Task lighting to optimize the lighting loads.

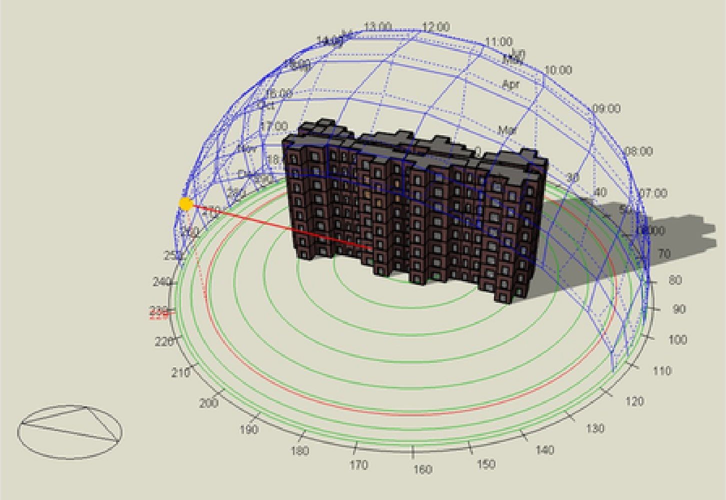


FIG 9.2.3 SUN PATH

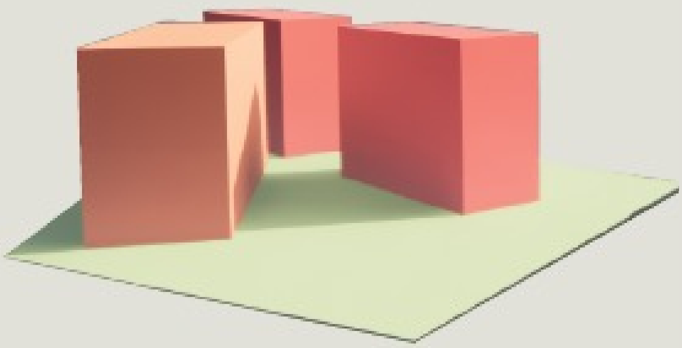


FIG 9.2.2 MUTUAL SHADING

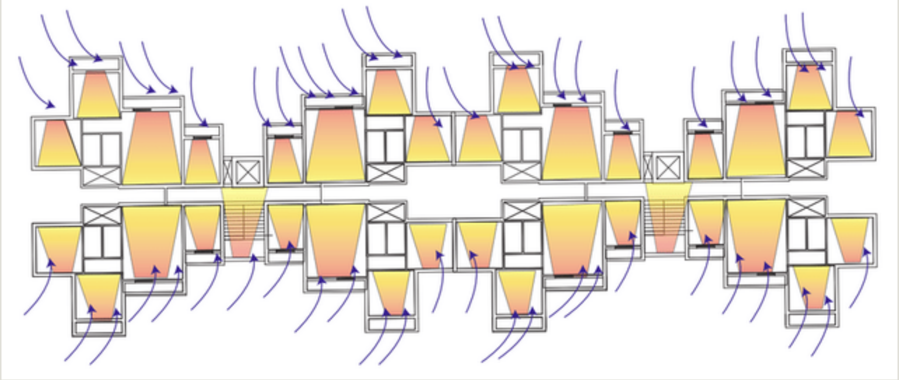


FIG 9.2.4 VENTILATION

2. ENERGY PERFORMANCE

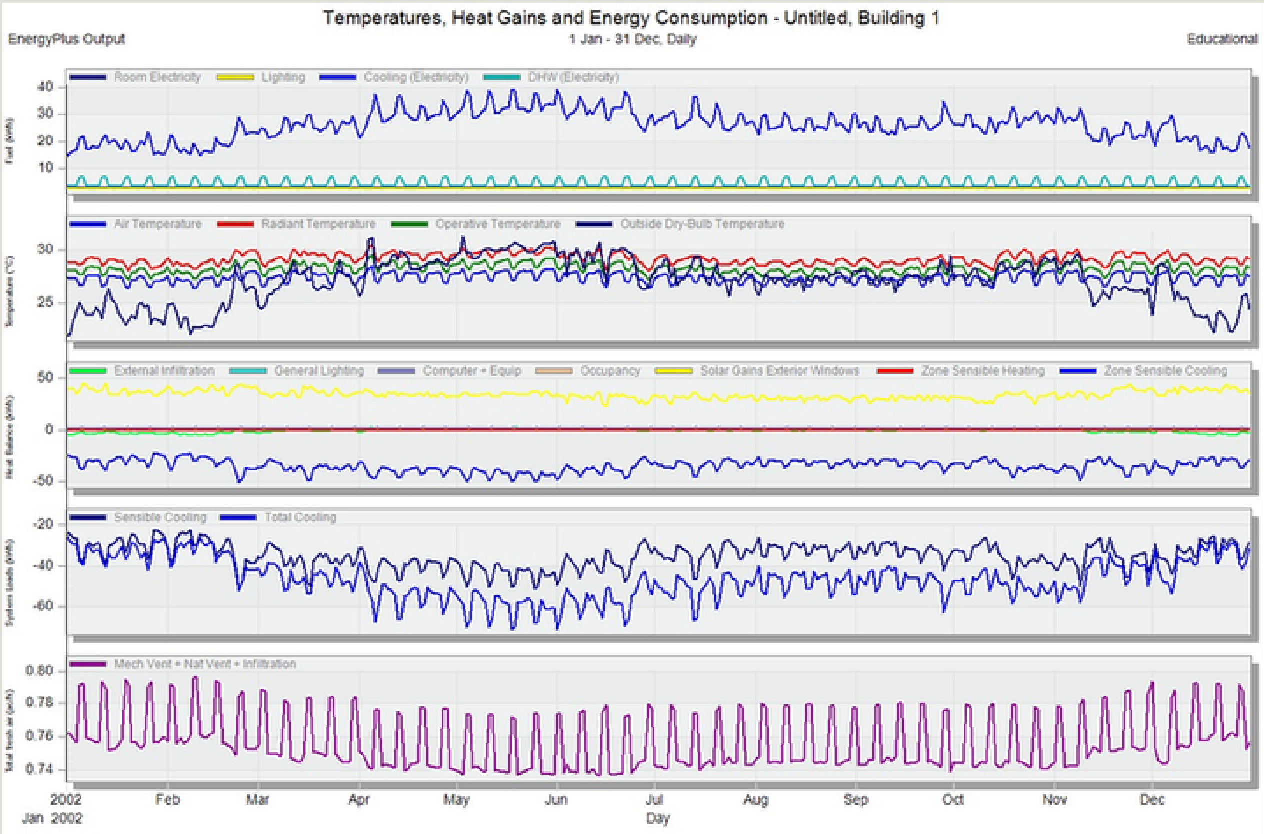


FIG 9.2.5 TEMPRATURE HEAT GAIN AND ENERGY CONSUMPTION

FACADE

Reducing the south and west side surface thus to decrease the solar heat gain and maximizing the north and east side surface to enhance good solar rays

ECBC in a prescriptive approach recommends a maximum WWR of 40% in this climatic zone

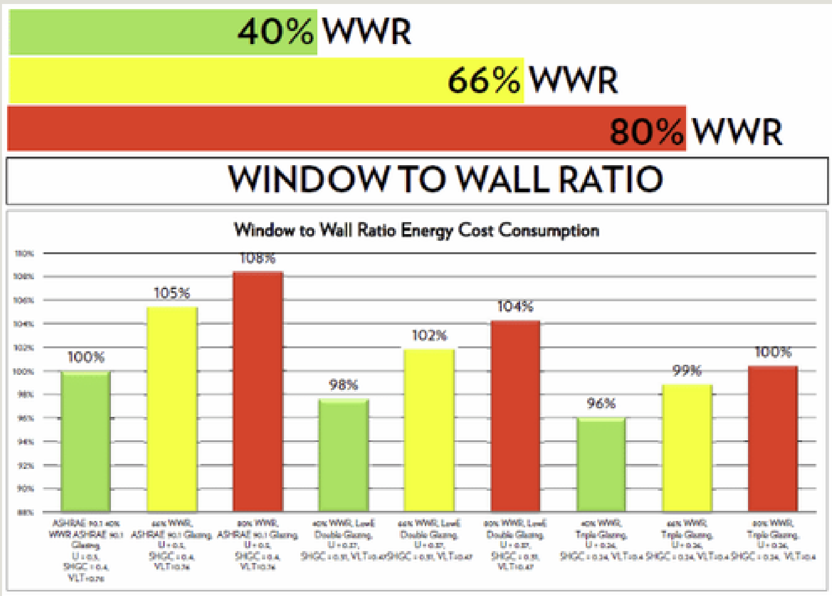
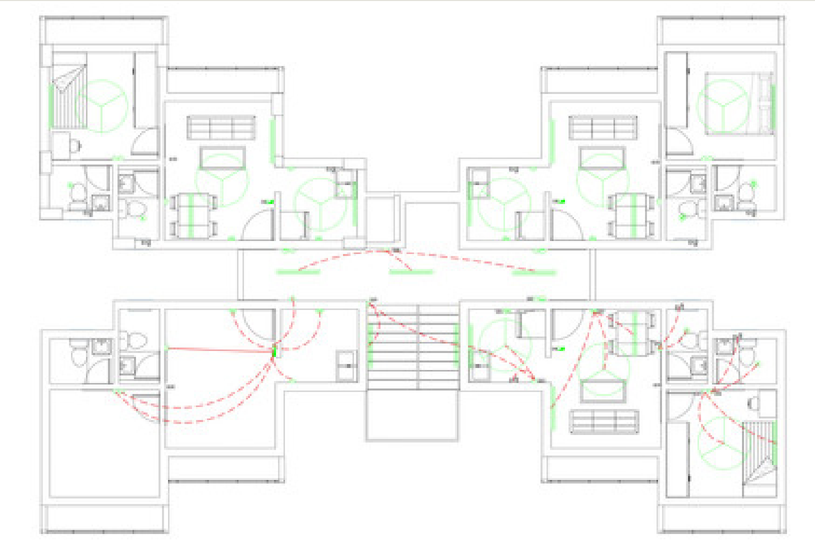


FIG 9.2.6 WINDOW WALL RATIO

2. ENERGY PERFORMANCE

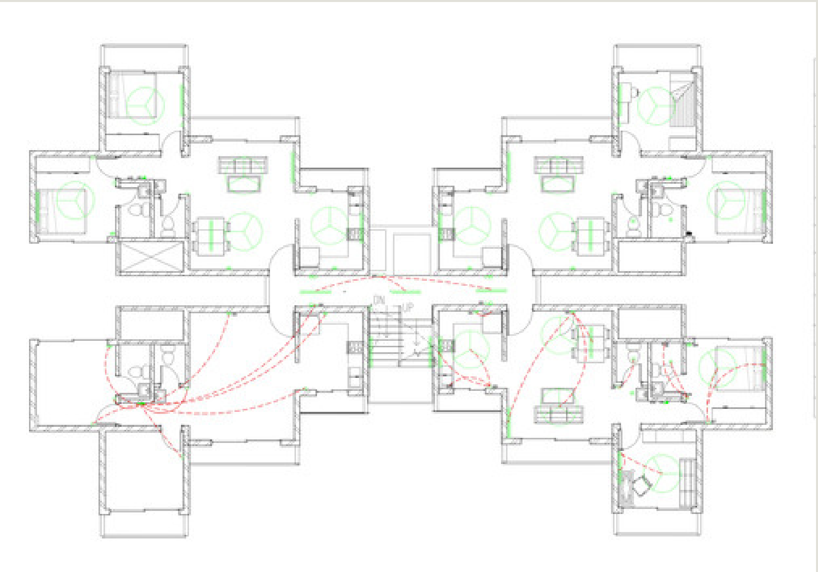
2.B ELECTRICAL LAYOUT



SWITCHBOARD SCHEDULE

NO.	NO. OF SWITCHES	NO. OF SOCKETS	HEIGHTS (MM)
SB01	- 1NOS 5A, BELL SWITCH.	0 NOS SOCKETS	1200
SB02	- 3 NOS 5A, SWITCH - 1NOS 5A, FLORESCENT LIGHT SWITCH - 1NOS 5A, FAN REGULATOR AND SWITCH - 1NOS 15A - TV POINT.	3 NOS SOCKETS	1200
SB03	- 1NOS 5A, FAN REGULATOR AND SWITCH - 1NOS 5A, SWITCH - 1NOS 5A, FLORESCENT LIGHT SWITCH	1 NOS SOCKETS	1200
SB04	- 2NOS 15A,MICROWAVE,MIXER GRINDER,INDUCTION SWITCH - 1NOS 15A,REFRIGETOR SWITCH	3 NOS SOCKETS	1200
SB05	- 1NOS 5A, LIGHT SWITCH - 1NOS 5A, SWITCH	1 NOS SOCKETS	1200
SB06	- 1NOS 5A, LIGHT SWITCH - 1NOS 5A, SWITCH	1 NOS SOCKETS	1200
SB07	- 1NOS 5A, FLORESCENT LIGHT SWITCH - 1NOS 5A, FAN REGULATOR AND SWITCH - 1NOS 5A, SWITCH	1 NOS SOCKETS	1200
SB08	- 3NOS 5A, FLORESCENT LIGHT SWITCH	0 NOS SOCKETS	1200
SB07	- 2NOS 5A, FLORESCENT LIGHT SWITCH	0 NOS SOCKETS	1200

FIG 9.2.7 ELECTRICAL LAYOUT FOR 1BHK AND SWITCH BORAD SCHEDULE



SWITCHBOARD SCHEDULE

NO.	NO. OF SWITCHES	NO. OF SOCKETS	HEIGHTS (MM)
SB01	- 1NOS 5A, BELL SWITCH.	0 NOS SOCKETS	1200
SB02	- 3 NOS 5A, SWITCH - 2NOS 5A, FLORESCENT LIGHT SWITCH - 2NOS 5A, FAN REGULATOR AND SWITCH - 1NOS 15A - TV POINT.	3 NOS SOCKETS	1200
SB03	- 1NOS 5A, FAN REGULATOR AND SWITCH - 1NOS 5A, SWITCH - 1NOS 5A, FLORESCENT LIGHT SWITCH	1 NOS SOCKETS	1200
SB04	- 2NOS 15A,MICROWAVE,MIXER GRINDER,INDUCTION SWITCH - 1NOS 15A,REFRIGETOR SWITCH	3 NOS SOCKETS	1200
SB05	- 1NOS 5A, LIGHT SWITCH	0 NOS SOCKETS	1200
SB06	- 1NOS 5A, LIGHT SWITCH - 1NOS 5A, SWITCH	1 NOS SOCKETS	1200
SB07	- 1NOS 5A, FLORESCENT LIGHT SWITCH - 1NOS 5A, FAN REGULATOR AND SWITCH - 1NOS 5A, SWITCH	1 NOS SOCKETS	1200
SB08	- 1NOS 15A, AC SWITCH AND SOCKET.	1 NOS SOCKETS	1000
SB09	- 2NOS 5A, SWITCH - 1NOS 5A, FLORESCENT LIGHT SWITCH - 1NOS 5A, LIGHT SWITCH	2 NOS SOCKETS	1200
SB10	- 3NOS 5A, FLORESCENT LIGHT SWITCH	0 NOS SOCKETS	1200
SB09	- 1NOS 5A, FLORESCENT LIGHT SWITCH	0 NOS SOCKETS	1200

FIG 9.2.8 ELECTRICAL LAYOUT FOR 2BHK AND SWITCH BORAD SCHEDULE

7.C SOLAR POTENTIAL

Our on-grid solar system generates an impressive 11,44,827 Wh of energy, which not only powers our site but also contributes to the grid, reducing our carbon footprint. Additionally, we have dedicated space for off-grid energy generation, allowing us to store energy for emergency purposes. This ensures that we are prepared for any power outages or emergencies and can continue to function sustainably.

ELECTRIC LOAD CONSUMPTION FOR 1 BHK (128 FLATS)					
SR NO.	LOAD TYPE	NOS	WATTAGE	HOUR/DAY	LOAD(WH)
1	Ceiling Fan	256	26	6	39936
2	TV	128	50	3	19200
3	Refrigerator	128	104	24	319488
4	Washing Machine	128	240	1	30720
5	Iron	128	1200	0.1	15360
6	Charging point	256	90	2	46080
7	Exhaust fan	128	10.5	2	2688
8	LED bulbs	384	8.5	4	13056
9	LED tubelights	256	20	4	20480
					507008

ELECTRIC LOAD CONSUMPTION FOR 2 BHK (64 FLATS)					
SR NO.	LOAD TYPE	NOS	WATTAGE	HOUR/DAY	LOAD(WH)
1	Ceiling Fan	192	26	6	29952
2	TV	64	50	3	9600
3	Refrigerator	64	104	24	159744
4	Washing Machine	64	240	1	15360
5	Iron	64	1200	0.1	7680
6	Charging point	192	90	2	34560
7	Exhaust fan	64	10.5	2	1344
8	LED bulbs	256	8.5	4	8704
9	LED tubelights	192	20	4	15360
					282304

LOBBY AND ANCILLARY SPACE						
SR NO.	LOAD TYPE	NOS	WATTAGE	HOUR/DAY	LOAD(WH)	
1	CCTV	39	7.5	24	7020	
2	Indoor LED bulbs	42	9	6	2268	
3	Outdoor LED bulbs	64	9	8	4608	
4	Lift	6	5000	2.5	75000	
5	RWH Pump	3	4500	2	27000	
6	Pumps	6	15	2	180	
					116076	
TOTAL LOAD CONSUMPTION					**905388**	
					905.388	KWh

FIG 9.2.9 ELECTRICAL LOAD OF THE PROJECT

FIG 9.2.10 SOLAR PANELS ABOVE PARKING

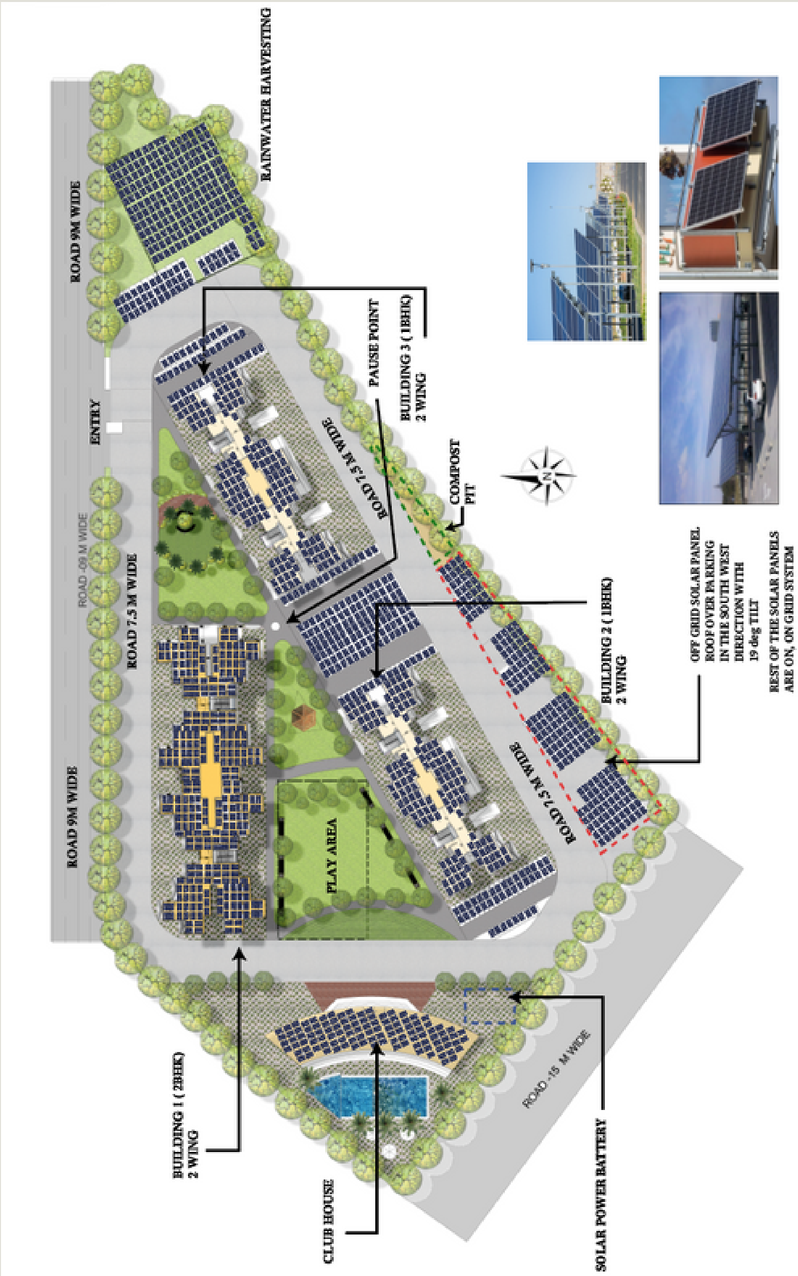


FIG 9.2.11 SITE PLAN SHOWING SOLAR ROOF, RAINWATER HARVESTING AND COMPOST PIT

3. WATER PERFORMANCE

EFFICIENT LOW FLOW WATER FIXTURES

Low flow efficient fixtures with flow restrictors which uses the high pressure technique are used to create same water pressure and uses less water. . These restrictors reduce water use by up to 80% without reducing flow. These fixtures enable us to use 46% less water, from 135 L/person/day to 72.9 L/person/day.

base case (per day liters)	proposed case (per day liters)	reduced percentage
146880	79424	54.07

FIG 9.3.1 BASE CASE V/S DESIGNED CASE

	USAGE(%)	Usage (litre)	QUANTITY (1088 people)	GREY WATER	BLACK WATER
BATHING	30	22	23827.2	23827.2	0
WASHING CLOTHES	20	15	15884.8	15884.8	0
COOKING	3	2	2382.72	0	2382.72
DRINKING	4	3	3176.96	0	3176.96
CLEANING	8	6	6353.92	6353.92	0
WASHING UTENSILS	16	12	12707.84	12707.84	0
TOILET	17	12	13502.08	0	13502.08
OTHERS	2	1	1588.48	794.24	794.24
TOTAL	100	73	79424	59568	19856

FIG 9.3,2A WATER USAGE

WATER TREATMENT

On-site water treatment facilities are set up to handle and repurpose the wastewater produced onsite. These are built to extract and reuse the treated sewage water as well as to convert the raw sewage into a waste that is easier to handle. Sludge and cleaned sewage water are the final products.

Type of building	NO. of flats per floor	No. of floors	No. of wings	Total no. of flats	occupancy	total occupancy
1bhk	4	8	4	128	5	640
2bhk	4	**8**	**2**	**64**	**7**	448
					total	1088

FIG 9.3,3 OCCUPANCY

Requirement	Water Required per person(L)	Water Required for 1088 (L)	Total water required (L)	Total water required (KL)
Potable water	5	5559.68	2029283.2	2029.2832
Non Potable water	68	73864.32	26960476.8	26960.4768

FIG 9.3,4 TOTAL WATER REQUIRED

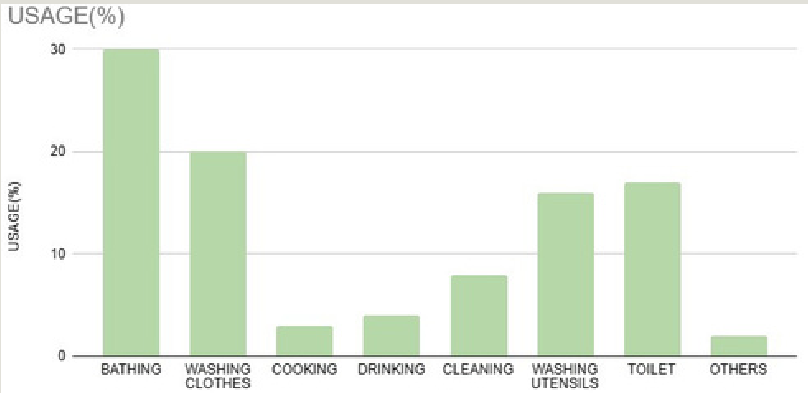


FIG 9.3,5 USAGE OF WATER

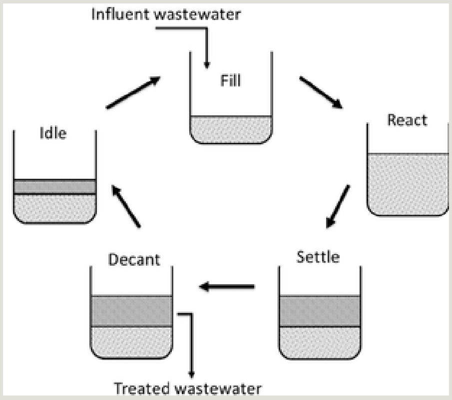


FIG 9.3.6WASTE WATER RECYCLE

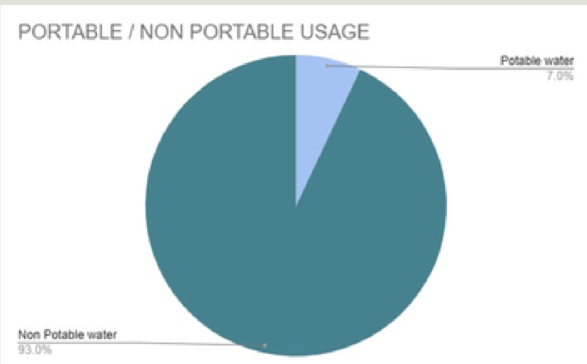


FIG 9.3.7WPORTABLE/NON PORTABLE WATER

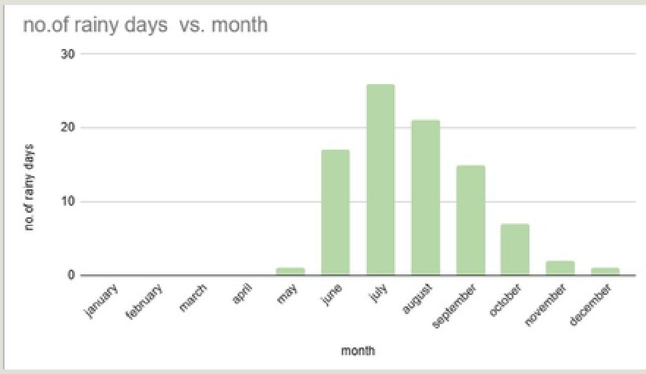


FIG 9.3.8 NO OF RAING DAYS VS MONTH

3. WATER PERFORMANCE

month	no.of rainy days	average precipitation (mm)	in mm	in m	non portable hardscape (KL)	softscape (Kl)	all (kl)
january	0	0.5	0	0	0		
february	0	0.2	0	0			
march	0	0.3	0	0			
april	0	0.1	0	0			
may	1	5.3	5.3	0.0053	14.23898	7.532625	22
june	17	187.5	3187.5	3.1875	3.028125	4530.234375	4533
july	26	353	9178	9.178	24657.6148	13044.2325	37702
august	21	223.3	4689.3	4.6893	12598.27338	6664.667625	19263
september	15	148.2	2223	2.223	5972.3118	3159.43875	9132
october	7	37.5	262.5	0.2625	705.2325	373.078125	1078
november	2	8.2	16.4	0.0164	44.06024	23.3085	67
december	1	2.5	2.5	0.0025	6.7165	3.553125	10
							71808

FIG 9.3.9 WATER CONSUMPTION

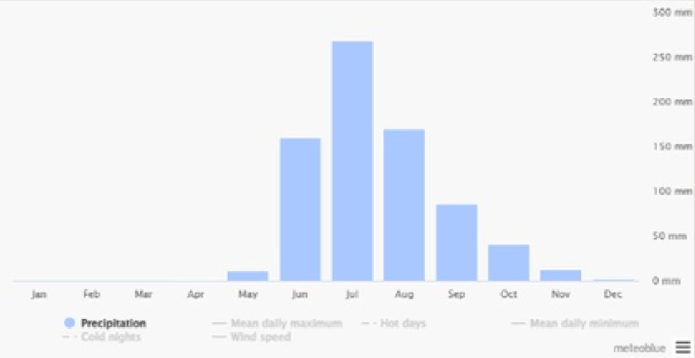


FIG 9.3.10

FIG 9.3.10

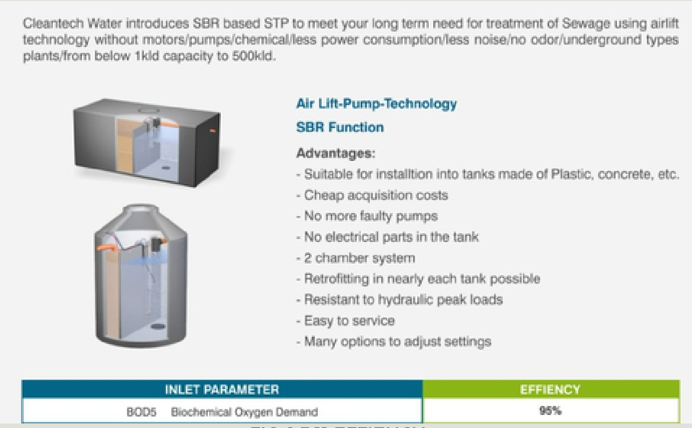


FIG 9.3.11 EFFIENCY

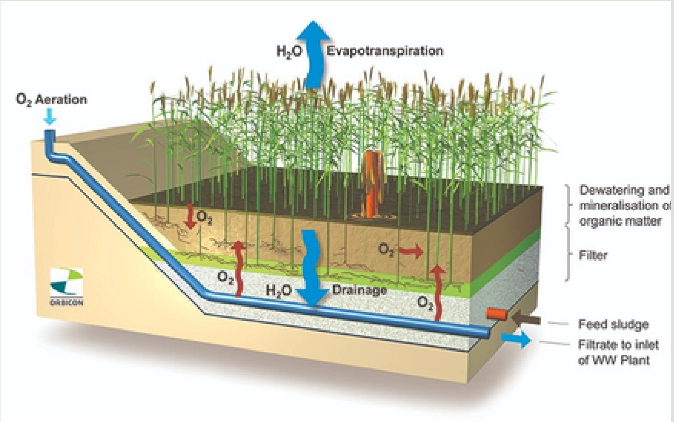


FIG 9.3.12 WATER FILTARATION


Jaquar Lyric Chrome Sink Mixer with Regular Swinging Spout.


Delta Faucet 22900-I ABS Health Faucet with SS-304 Grade 1.25 Meter Flexible Hose Pipe & Wall Hook, Jet Spray.


KHOLER shower, Features Racetrack Waterway that ensures equal distribution of water through the showerhead and delivers a revitalising spray with full coverage.


Wall Hung Toilet With Quiet-close.


Stainless Steel 5x5 inch SS Floor Trap.

The projected disposal or use of the treated sewage water and sludge is the most significant part of a sewage treatment facility from an environmental perspective. We have proposed SBR sewage treatment plant because of its affordability. The SBR is a fill and-draw activated sludge technology for wastewater treatment. The wastewater in this system is put to a single "batch" reactor, treated to get rid of unwanted elements, and then released.

3. WATER PERFORMANCE

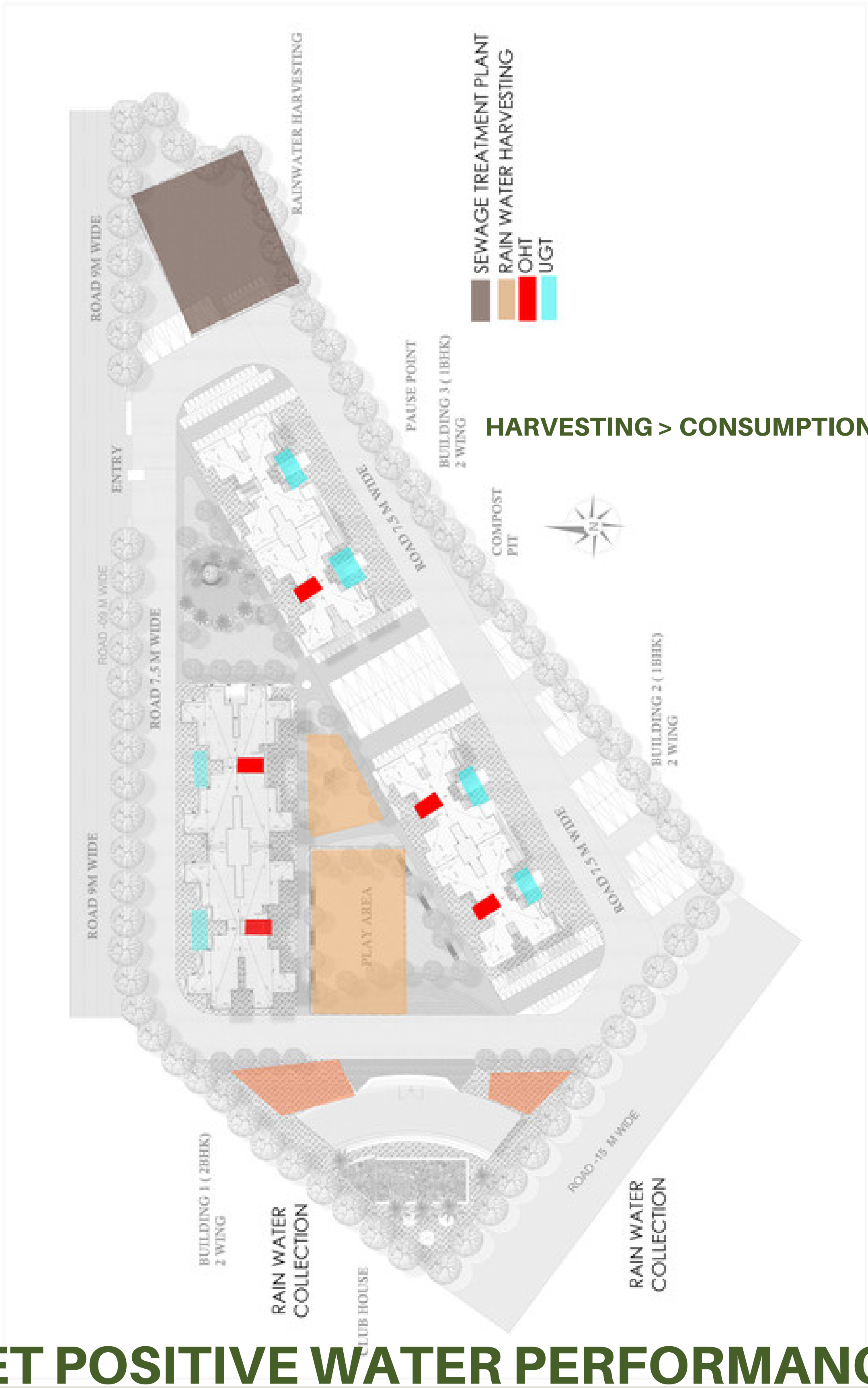


FIG 9.3.13 SITE PLAN SHOWING UTILITIES

HARVESTING > CONSUMPTION

NET POSITIVE WATER PERFORMANCE

3. WATER PERFORMANCE

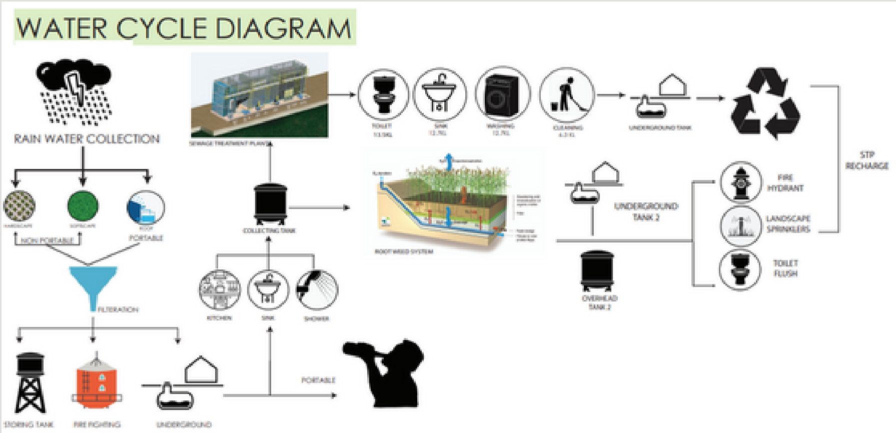


FIG 7.16 RAIN WATER HARVESTING

RAINWATER HARVESTING

Rainwater is gathered from roofs or other hard and soft surfaces and treated on-site for reuse, the water collected from the roof can be utilised for non-potable purposes such car washing, cooling tower make-up water, toilet flushing, and irrigation and is also made usable for residents' everyday needs by filtering before being used. Harnessing rainwater collected from roofs and surfaces reduces the quantity of municipal drinking water used and creates the potential to conserve a large amount of water annually in the event of a water crisis. The major source of rainwater collection comes from rooftops, hardscapes, and softscape sections. Our yearly rainfall, according to the last five years' records, is 1.91 m. Approximately 2635.30 kL/m³ of annual rainfall is collected from rooftops, 5104.54 m³ from hardscapes, and 2700.38 kL/m³ from softscapes.

4.AFFORDABILITY

One of the key problems with sustainable development and construction is the cost of construction for developing nations. Despite growing global awareness of the benefits of sustainable building, costs for resources and labour in the industry have been rising steadily. Owing to these increases, the methods to be employed to attain sustainable construction through effective and cheap procedures may be challenging to ascertain but may ultimately show to be useful. Buildings that use less energy have lower financial risks since they are more cost-effective to operate, which promotes stakeholder confidence.

The cost of fly ash brick is approximate 30%lower than clay brick. Fly ash bricks are cheaper than clay bricks. This is because fly ash is a waste material produced by coal-fired power plants and is abundantly available. In contrast, clay bricks require high-quality clay and involve an energy-intensive manufacturing process, making them more expensive.

Moreover, the use of fly ash bricks also has environmental benefits as it reduces the amount of waste sent to landfills and lowers the demand for clay bricks, which can help conserve soil resources.

	BASE CASE	PROPOSED CASE	NOTES
MONTHLY ELECTRICITY BILL	2248	209	Expense @Rs. 3.55/kWh
NET-POSITIVE WATER	0	19	10% OF CAPEX ANNUALLY
NET MONTHLY EXPENDITURE	2248	228	Σ EXPENSES - Σ EARNINGS
ANNUAL SAVINGS	0	2020	(2248-228)

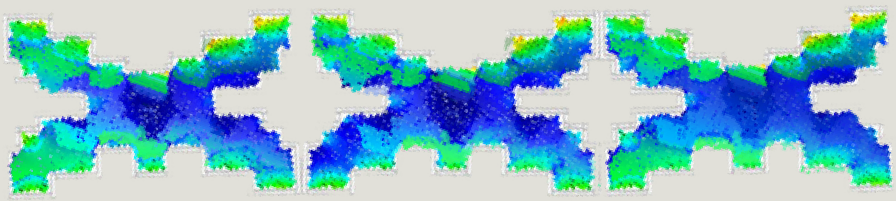


FIG .9.4.1 SIMULATION SHOWING DAYLIGHTING

Since the units are well lit, there is no need to use tubelights and light bulbs during the day. this reduces dependency on electricity

4.AFFORDABILITY

Time (Year)	Capital Cost (INR Million)	Annual Maintanance (INR Million)	Utility Cost (INR Million)	Replacement Cost (INR Million)	Total Cost (INR Million)		Time	Capital Cost	Annual Maintanance	Utility	Replacement	Total Cost (INR Million)
0	642.2				642.2		0	649.7				649.7
1		5	8		13		1		0.75	0.5		1.25
2		5	8		13		2		0.75	0.5		1.25
3		5	8		13		3		0.75	0.5		1.25
4		5	8		13		4		0.75	0.5		1.25
5		5	8		13		5		0.75	0.5		1.25
6		5	8	15	28		6		0.75	0.5		1.25
7		5	8		13		7		0.75	0.5		1.25
8		5	8		13		8		0.75	0.5		1.25
9		5	8		13		9		0.75	0.5		1.25
10		5	8		13		10		0.75	0.5	2	3.25
11		5	8		13		11		0.75	0.5		1.25
12		5	8	15	28		12		0.75	0.5		1.25
13		5	8		13		13		0.75	0.5		1.25
14		5	8		13		14		0.75	0.5		1.25
15		5	8		13		15		0.75	0.5		1.25
16		5	8		13		16		0.75	0.5		1.25
17		5	8		13		17		0.75	0.5		1.25
18		5	8	15	28		18		0.75	0.5		1.25
19		5	8		13		19		0.75	0.5		1.25
20		5	8		13		20		0.75	0.5	2	3.25
21		5	8		13		21		0.75	0.5		1.25
22		5	8		13		22		0.75	0.5		1.25
23		5	8		13		23		0.75	0.5		1.25
24		5	8		13		24		0.75	0.5		1.25
25		5	8		13		25		0.75	0.5	10	11.25
			Discount Rate		10%					Discount Rate		10%
			Life Cycle Cost		776.15					Life Cycle Cost		663.04

We see that although the initial cost is high, we save saved around 100 million rupees over the years.

FIG 9.4.2 COST ESTIMATION

5. VALUE PROPOSITION

Sr. No.	Particulars	Definition	Baeline Estimate (Project Partner/ SOR basis)		
			Amount (INR)	%	Amount per sq.m
1	Land	Cost of land purchased/ leased by the Project Partner	120990180	9.170453242	10770
2	Civil Works	Civil works in Cost of construction worksheet	381880308.4	28.94462602	16654.90464
3	Internal and Finishing Works	Internal and Finishing works in cost of construction work	160282735.1	12.14863328	6990.393611
4	Services	Services and IBMS work in cost of construction works	118268002.4	8.964125733	5158.009612
5	Site Establishment	Landscape and Site Development cost	12776723.23	0.9684120064	557.22985
6	Electrical and Water Charges	Electrical and Water charges during construction	10192216.12	0.7725192355	444.5120206
7	Contingencies for Temporary works	Amount for incidental and miscellaneous expenses	6794809.446	0.5150127251	296.3412903
8	Labour Cost	Cost of labour during construction	213125426.1	16.15384616	9295.016185
	TOTAL HARD COST		1024310401	77.63762841	50166.4072
1	Pre Operative Expenses	Cost of permits, licenses, market research (except land)	182459831	13.82954673	7957.600898
2	Consultants	Architectural, Structural consulting and plot surveying	16825886.67	1.275318435	733.8255777
3	Post Construction Expenses	Completion and Occupancy certification, advertising, etc.	92354351.3	7.000000002	4027.840346
4	EHS Budget	Environment, Health and Safety Budget	3397405.493	0.2575064209	148.1706787
	TOTAL SOFT COST		295037474.5	22.36237159	12867.4375
	TOTAL PROJECT COST		1319347875	100	63033.84471

FIG 9.5.1 TOTAL PROJECT COST

Life Cycle Cost (LCC)

BASE CASE (VAV System)					
Time (Year)	Capital Cost (INR Millon)	Annual Maintanance (INR Millon)	Utility Cost (INR Millon)	Replacement Cost (INR Millon)	Total Cost (INR Millon)
0	642.2				642.2
1		5	8		13
2		5	8		13
3		5	8		13
4		5	8		13
5		5	8		13
6		5	8	15	28
7		5	8		13
8		5	8		13
9		5	8		13
10		5	8		13
11		5	8		13
12		5	8	15	28
13		5	8		13
14		5	8		13
15		5	8		13
16		5	8		13
17		5	8		13
18		5	8	15	28
19		5	8		13
20		5	8		13
21		5	8		13
22		5	8		13
23		5	8		13
24		5	8		13
25		5	8		13
				Discount Rate	10%
				Life Cycle Cost	776.15

"Insert Row" above this row to add more years, and adjust formula in the rows below

PROPOSED CASE (Radiant System)					
Time	Capital Cost	Annual Maintanance	Utility	Replacement	Total Cost (INR Millon)
0	649.7				649.7
1		0.75	0.5		1.25
2		0.75	0.5		1.25
3		0.75	0.5		1.25
4		0.75	0.5		1.25
5		0.75	0.5		1.25
6		0.75	0.5		1.25
7		0.75	0.5		1.25
8		0.75	0.5		1.25
9		0.75	0.5		1.25
10		0.75	0.5	2	3.25
11		0.75	0.5		1.25
12		0.75	0.5		1.25
13		0.75	0.5		1.25
14		0.75	0.5		1.25
15		0.75	0.5		1.25
16		0.75	0.5		1.25
17		0.75	0.5		1.25
18		0.75	0.5		1.25
19		0.75	0.5		1.25
20		0.75	0.5	2	3.25
21		0.75	0.5		1.25
22		0.75	0.5		1.25
23		0.75	0.5		1.25
24		0.75	0.5		1.25
25		0.75	0.5	10	11.25
			Discount Rate		10%
			Life Cycle Cost		663.04

FIG 9.5.2 LIFE CYCLE COST

6. EMBODIED CARBON

Materials Embodied Carbon and Inventory	Area (m2)	Embodied Carbon (kgCO2)	Equivalent CO2 (kgCO2)	Mass (kg)
External Rendering	149.0	484.2	484.2	4842.3
Gypsum Plastering	7010.7	39961.0	42064.2	105160.4
Gypsum Plasterboard	3730.9	10073.4	10912.9	83945.2
MW Stone Wool (rolls)	149.0	675.4	720.4	643.2
XPS Extruded Polystyrene - CO2 Blowing	8272.0	66181.4	220145.0	22979.6
Concrete Block (Medium)	7010.7	78519.8	78519.8	981497.0
Cast Concrete	556.2	13348.3	13348.3	166853.7
Cast Concrete (Dense)	3744.3	62903.4	62903.4	786292.5
Brickwork Outer	7010.7	262199.9	274118.1	1191817.8
Fibreboard	705.2	1402.6	1457.6	2750.2
Asphalt 1	705.2	1406.8	1406.8	28136.4
Sub Total		537156.1	706080.6	3374918.4

FIG 9.6.1 .MATERIALS USED EMBOIDED CARBON AND INVENTORY

Constructions Embodied Carbon and Inventory	Area (m2)	Embodied Carbon (kgCO2)	Equivalent CO2 (kgCO2)
External floor - Energy code standard - Medium weight	149.0	1159.6	1204.6
Flat roof U-value = 0.25 W/m2K	705.2	11481.3	31710.6
Brick/block wall (insulated to 1995 regs)	7010.7	436508.2	580406.1
Lightweight 2 x 25mm gypsum plasterboard with 100mm cavity	1865.4	10073.4	10912.9
100mm concrete slab_Reversed	3744.3	62903.4	62903.4
Ground floor slab - Energy code standard - Medium weight	556.2	15030.2	18942.9
Sub Total	14030.7	537156.14	706080.57

FIG 9.6.2 CONSTRUCTION CALCULATION

Glazing Embodied Carbon and Inventory	Area (m2)	Embodied Carbon (kgCO2)	Equivalent CO2 (kgCO2)
Project external glazing	1078.2	20161.4	20161.4
Local shading		0.0	0.0
Window shading		53907.6	53907.6
Sub Total	1078.2	74069.0	74069.0
Building Total	**15108.9**	**611225.2**	**780149.6**

9.6.3 GLAZING EMBODIED CARBON AND INVENTORY

7. RESILIENCE

Alibag Project area falls under Seismic Zone-IV. It means that the area falls under “High Seismicity-hazard zone”. There were no records of any volcanic eruption in Alibag region of Raigad District.

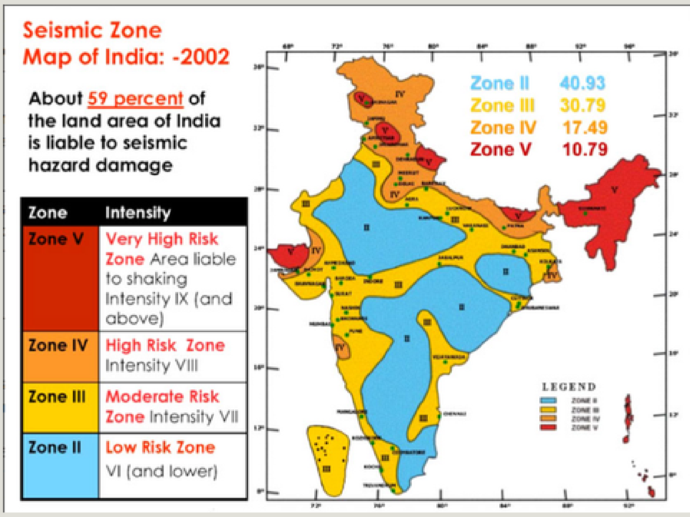


FIG.9..7.1SEISMIC ZONE MAP OF INDIA

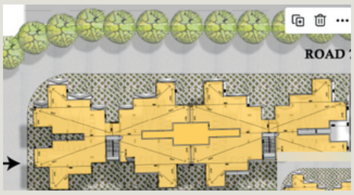


FIG.9.7.2 CATERING WIND AND CYCLONE HAZARD

WIND AND CYCLONE HAZARD.

Trees are not present close to the building. Hence uprooting trees will not damage the building.

FIG.9.7.3 CATERING FLOOD HAZARD

FLOOD HAZARD

Plinth of 0.9 is provided This ensures that the living spaces are safe from floods, stilt floor for parking is also given

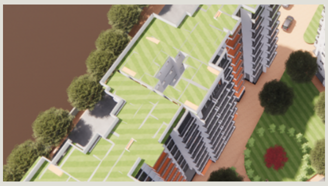


FIG.9.7.4 CATERING FOOD SHORTAGE

FOOD SHORTAGE

Terrace garden is provided where garden crops can be grown

FIG. 9.7.5 ADAPTING TO THE PANDEMIC

ADAPTING TO THE PANDEMIC

Community spaces are provided

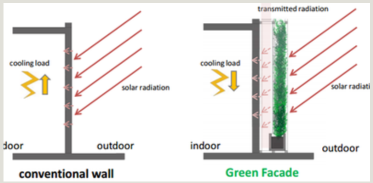


FIG. 9.7.6CATERING TO HEAT WAVES

HEAT WAVES

Roof and wall sections with reduced U-values are provided to reduce heat gain inside the building.

FIG. 9.7.7CATERING TO POLLUTION RESISTANCE

POLLUTION RESISTANCE

Placement of trees along the periphery of site, ensuring better air quality on site

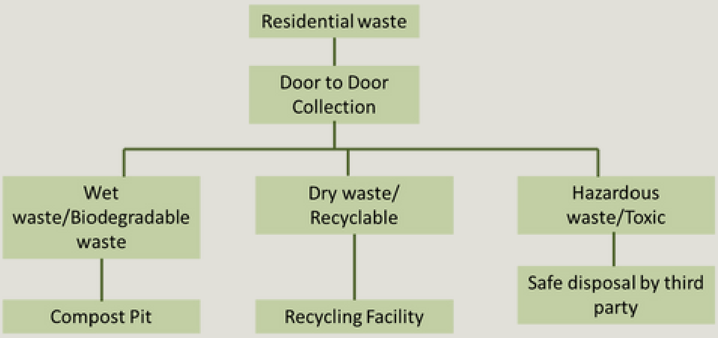


FIG. 9.7.8WASTE MANAGEMENT ON SITE

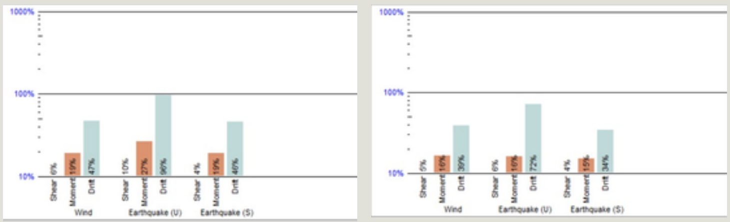


FIG. 9.7.9 A COMPARISION BETWEEN SEISMIC FORCES

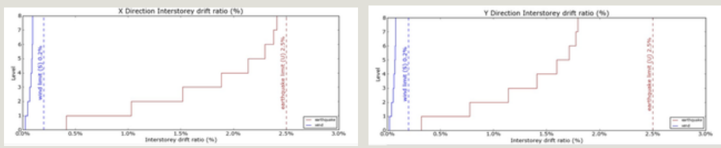


FIG. 9.7.10 B COMPARISION BETWEEN WIND LOAD

7.RESILIENCE

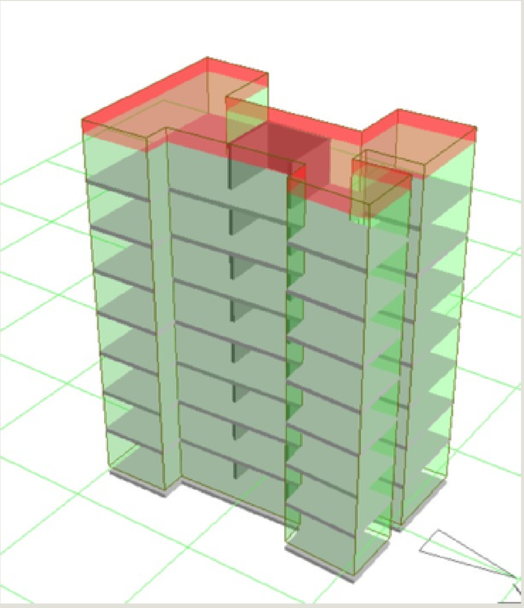


Fig.9.7.11 Earthquake resistant model software

Grid layout is maintained while placing the columns so that maxiumn structural strength is acheived hence making the structurally sound and earthquake resistant, which was requirement given that the site fall under Seismic Zone IV

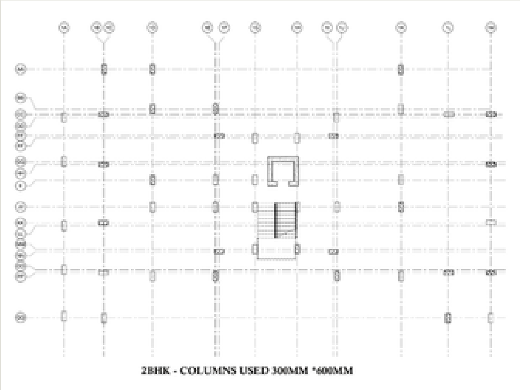


Fig.9.7.12 Column Grid Layout

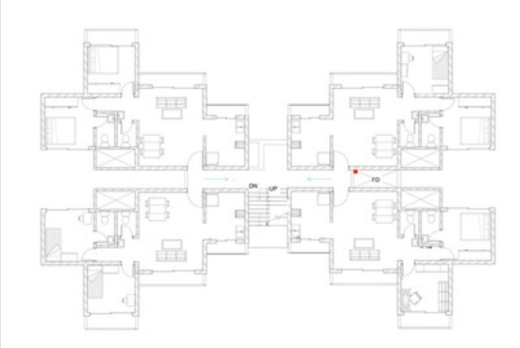


Fig.9.7.13 Fire Safety Layout

SR NO.	FIRE PROTECTION	DESCRIPTION
1	FIRE EXTINGUISHER	1 PER FLOOR
2	WET RISER	PROVIDED AT ALL FLOORS
3	AUTOMATIC SPRINKLER SYSTEM	PROVIDED FOR THE ENTIRE BUILDING
4	AUTOMATIC ALARM AND DETECTION SYSTEM	PROVIDED FOR THE ENTIRE BUILDING
5	SITE HYDRANT	PROVIDED AT 30 M THROUGHOUT THE SITE
6	BUILDING HYDRANT	PROVIDED AT 15 M CLOSE TO BUILDING EDGE

SR NO.	RISKS	PREVENTIVE MEASURES
1	Natural disasters	Preventive actions are considered for hazard resistant construction as mentioned earlier.
2	Slips and trips	All areas are well lit including stairs to prevent slips and trips. Usage of anti-slip materials in lobbies and staircases
3	Lack of preparation during a risk	Installation of a warning system and required drills for its use.

8.HEALTH AND WELL BEING

Community Health: Provision of green open spaces as well as green roofs, which can promote interaction amongst the residents The community spaces are placed such that their usage is ensured by locating them centrally, ensuring that the area remains in view while still being private, and having it shaded throughout the day. The internal roads are made entirely pedestrian and the ramps to stilt parking are on the peripheral road

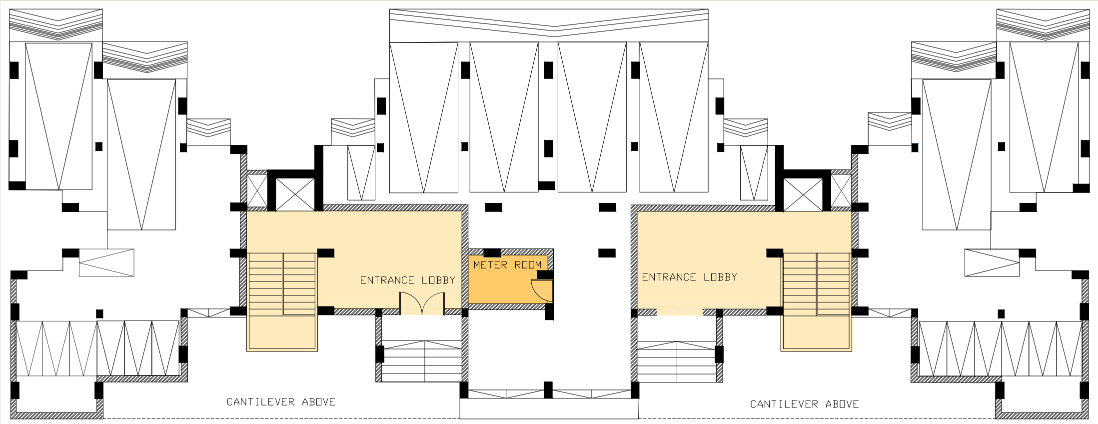


FIG 9.8.1 Stilt showing ramp on outerside

8. HEALTH AND WELL BEING

INDOOR AIR QUALITY

Indoor air quality can have a significant impact on the health and wellbeing of residents in apartments. Following are the some of the methods used in the design to improve the indoor air quality

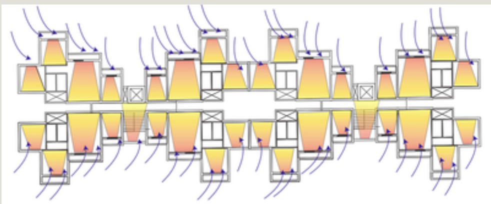


FIG 9.8.2 VENTILATION LAYOUT

Ventilation : Proper ventilation is crucial for maintaining good air quality. It is ensured that each unit gets a proper ventilation. This helps in removing pollutants and keep the air fresh

MINIMIZING OZONE DEPLETING

Use of alternative energy sources, such as solar helps in reducing the need for fossil fuels that contribute to ozone depletion. Hence maximum use of solar panels is done on site

FIG 9.8.4 SOLAR PANELS ON PARKING

LOW VOC PAINTS

Use of Eco friendly paint by Asian Paints as the company has substantially reduced the VOC content in its paints to comply with international standards, as specified by the Green Seal Standard for Paints & Coatings.

FIG 9.8.3 PLANTATION

Plants: Most of the trees and plants planted on site are the ones locally available. Certain plants can help purify the air by removing pollutants and adding oxygen. Hence it is a sustainable and responsible way to beautify and improve an area's ecosystem, and can help create a more resilient and healthy environment.

GREEN BARRIERS

We have provided green roofs and green walls in our design which can play a significant role in improving the health and wellbeing of people

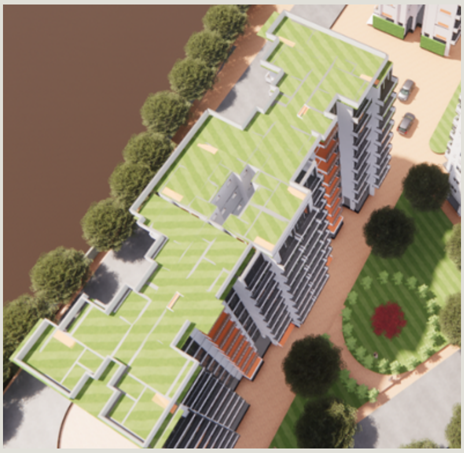


FIG 9.8.5 GREEN ROOF MODEL

FIG 9.8.6 GREEN WALLS MODEL

Green Roofs: The use of green roofs on buildings can help mitigate the urban heat island effect and reduce energy consumption in buildings. Green roofs can also provide additional space for community garden.

Green Walls: Green walls, also known as vertical gardens, can help to purify the air and regulate temperature in buildings. They can also provide a sense of nature and improve mental health.

SEPERATE SMOKE ZONE

Separate smoke-free zones in apartments are provided and they certainly improve the health and well-being of residents.

9. INNOVATION

GREEN WALLS

Green walls are part of the strategy for more sustainable buildings and, because of their ability to absorb heat (sunlight) and water, they are excellent solutions for heat management, reduction of building energy costs, and water management.

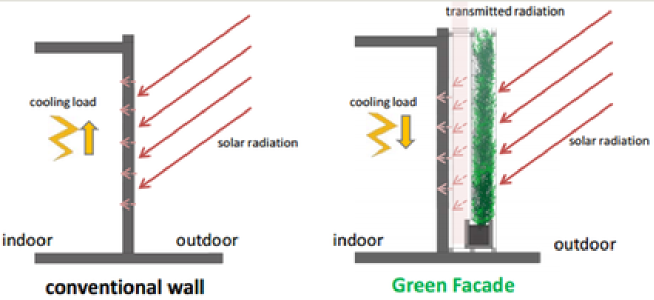


FIG 9.9.1 SECTION OF GREEN WALL

FIG 9.9.2 GREEN WALL

FIG 9.9.3 GREEN WALL

GREEN ROOF

Green roofs offer added benefits such as reducing and filtering stormwater runoff; absorbing pollutants and carbon dioxide; providing natural habitat; and in the case of intensive green roofs, serving as recreational green space.

FIG 9,9,4 GREEN ROOF

TERACOTTA BLOCKS

These prefabricated blocks can be integrated into the 115mm thick walls, facing the direction of the wind, speeding up construction and adding more aesthetically attractive effects to the facade, breaking up the monotonous appearance of the structure.

FIG 9.9.5 STAIRCASE ELEVATION

10.SCALABILITY AND MARKET POTENTIAL

MARKET POTENTIAL

.The projects site is fortunately located in Alibaug which has immense scope due to its proximity to the metropolitian city and its natural beauty, opening a large market for second homes to the HIG as well as MIG groups. The scalability of the project increases as it is catering to both HIG and MIG due to its affordabilty

Alibaug is connected via roadways through Pen. Many state transport buses are available to reach directly to Alibaug Beach from major cities like Mumbai, Pune, Nashik, Goa. Traveling from Pune to Alibaug via road, one can take the Lonavala route, which is the shortest, or the Mulshi route. Pune to Alibaug is 140km and Mumbai to Alibaug is 110km via roadways

The land market in Alibaug has seen a 150% development in the most recent decade itself. The greatest bit of leeway of putting resources into a home in Alibaug is that you get the opportunity to move away from the confined and rushed way of life of the city , hence most of the people consider buying second homes in alibaug .

Though the project was initially planned for a target audience looking for second homes for holiday retreats or investment homes, the project still caters to the needs and wants of local residents looking to improve their quality of life

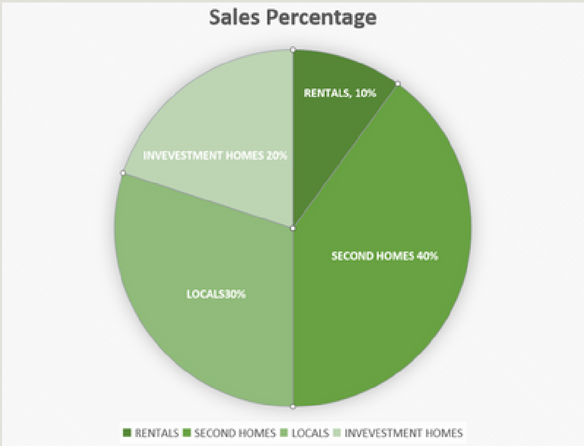


FIG 9.10.1 PIE CHART SHOWING SALE

Potential target market

FIG 9.10.2 TENANTS

FIG 9.10.4 INVESTORS

FIG 9.10.5 CONTRACTORS

FIG 9.10.6 LOCAL PEOPLE

SCALABILITY

The current idea, which has the potential to serve as the prototype model for a residential building, has developed through careful examination of previous design iterations. Regardless of being client-specific, the concept addresses both the current needs of the residential complex and the demands of its residents on a larger scale.

Keeping this is mind, few inovations has been introduced such as green roof, green facade, teracotta facade

10.SUSTAINABLE BUILDING MATERIALS

Locally available **fly ash** bricks are used for construction
They are light in weight Fly ash bricks absorb less heat and considering the Indian climate, it makes it better when compared to clay bricks.
It is environmentally friendly and hence allows your business to take a step towards sustainable development.
Double glazed glass windows are used. The unique design of double-glazed products insulates against heat and cold up to four times more effectively than single-glazed windows and doors.
The space between the two panes of glass acts as a thermal barrier between home and the outside environment
Bamboo flooring is used as bamboo is easily available in alibaug. Bamboo is a recyclable, sustainable material which can be grown and regrown. B
It is an easy-to-maintain and durable material. It is an easy-to-maintain and durable material.
Concrete is used in interior walls of the rooms which maximizes energy efficency
Wooden doors are used as they are durable and enery efficient
Teracotta blocks are used in facade as it reduces temperature and maximizes air flow

FIG 9.10.7 FLYASH BRICKS

FIG 9.10.8 BAMBOO

FIG 9.10.9 DOUBLE GLAZED WINDOWS

R VALUE OF THE MATERIALLS USED

- FLY ASH BRICKS -0.52m2K/W
- CONCRETE PLASTERING - 1.35 m2K/W
- WOODEN DOORS - 0.64m2K/W
- DOUBLE GLAZED GLASS - 0.7 m2K/W
- BAMBOO FLOORING - 0.072m2K/W
- TERACOTTA BLOCKS - 0.04m2K/W

U VALUE CALCULATIONS

U value = 1/(0.52+1.35+0.64+0.7+0.072+ 0.04)
= 0.30 m2K/W

FIG 9.10.10 TERACOTTA BLOCKS

11.APPENDIX

1. BUILDING AREA PROGRAM

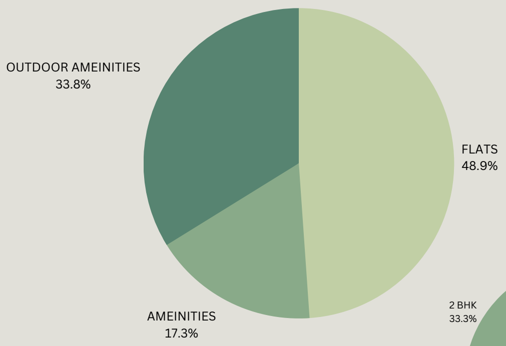


FIG 9.11.1 PIE CHART SHOWING SPACES CONSUMED

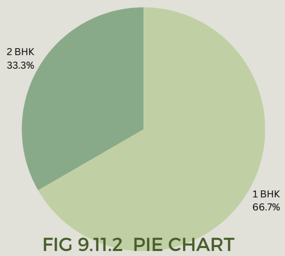


FIG 9.11.2 PIE CHART SHOWING SPACES CONSUMED

BRIEF		
FLATS	**AREA**	**NOS**
1 BHK	31.37	128
2 BHK	56.28	64
AMEINITIES		
GYM	266	1
INDOOR GAMES	80	1
BANQUETS	120	1
UNBUILT		
CHILDREN'S PLAY AREA	553.34	1
SWIMMING POOL	157.24	1
SIT OUTS	220.22	MULTIPLE
OPEN GYM	76.39	1

FIG 9.11.3 BRIEF

	1 BHK	2 BHK
LOBBY	12.61	11.3
NO. OF STAIRCASES	4	2
STAIRCASE	9.3	8.83
TOTAL STAIRCASE AREA	334.8	158.94
ANCILLARY BUA	1241.6	1094.4
NO OF FLATS	128	64
NO OF BUILDINGS	2	1
TOTAL CARPET AREA	9967.14	3772.16
TOTAL BUA	11208.74	4866.56

FIG 9.11.4 AREA DISTRIBUTION IN 1BHK AND 2BHK

	1 BHK	2 BHK
PERCENTAGE	66.66	33.33
LOBBY	-	2.94
LIVING ROOM	10.98	18.38
KITCHEN	3.92	7.37
TOILET 1	2.08	1.71
TOILET 2	2.18	2.29
BEDROOM 1	8.34	8.99
BEDROOM 2	-	8.34
BALCONY 1	1.83	1.48
BALCONY 2	2.04	2.54
BALCONY 3	-	2.24
TOTAL CARPET AREA	31.37	56.28

FIG 9.11.5 AREA DISTRIBUTION IN 1BHK AND 2BHK INTERNAL

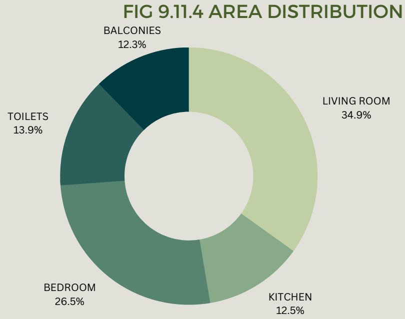


FIG 9.11.7 AREA DISTRIBUTION IN 1BHK

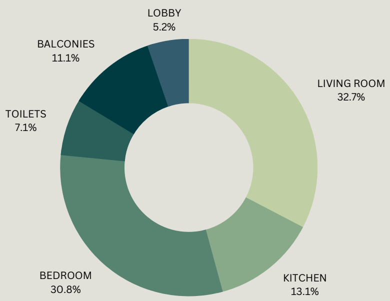


FIG 9.11.8 AREA DISTRIBUTION IN 2BHK

SITE AREA	11100	*As received by the project partner*
FRONT ROAD	9M WIDE	
HEIGTH RESTRICTION	24 M	*Exculding the stilt height*
NO. OF FLOORS FOR EACH BUILDING	G + 8	
Less AREA UNDER ROAD	1980	
NET PLOT AREA	9120	
OPEN SPACE(10%)	912	
AMINITY SPACE	0	*Plot area less than 20,000 sqm*
BASIC FSI - 1.1	10032	
ANCILARY FSI (60%)	6019.2	
ADDITIONAL FSI DUE TO ROAD	3960	
TOTAL BUA	20011.2	
FRONT MARGIN	3 M	*H/5*
REAR	5.4 M	*H/5*
SIDES	5.4 M	
ESTIMATED PROPOSED BUILTUP	16591.3	*All areas are in sqm*

FIG 9.11.6 FSI CALCULATION

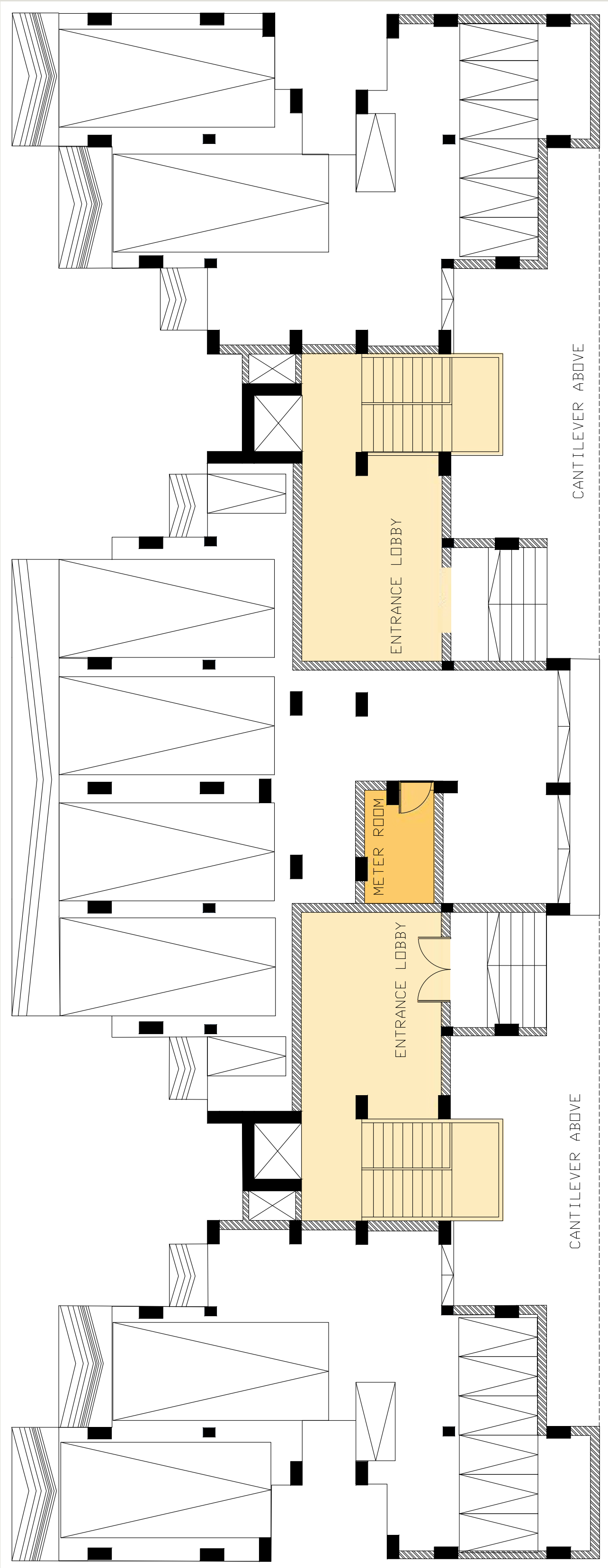
11.APPENDIX

2. ARCHITECTURAL DRAWINGS

FIG 9.11.9 GROUND FLOOR PLAN WITH SITE

11.APPENDIX

3. ARCHITECTURAL DRAWINGS



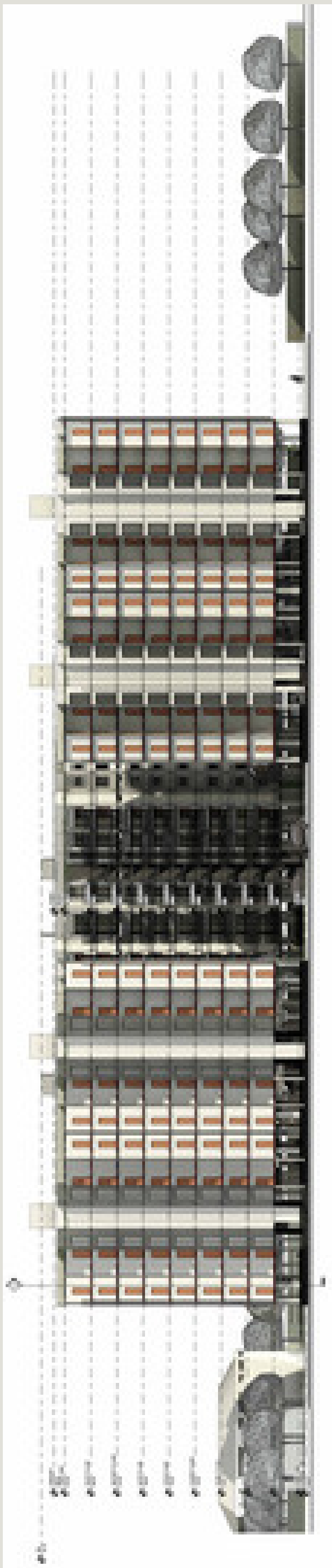


FIG 9.11.10 SITE SECTION (2BHK BULDING)

11.APPENDIX

3. ARCHITECTURAL DRAWINGS

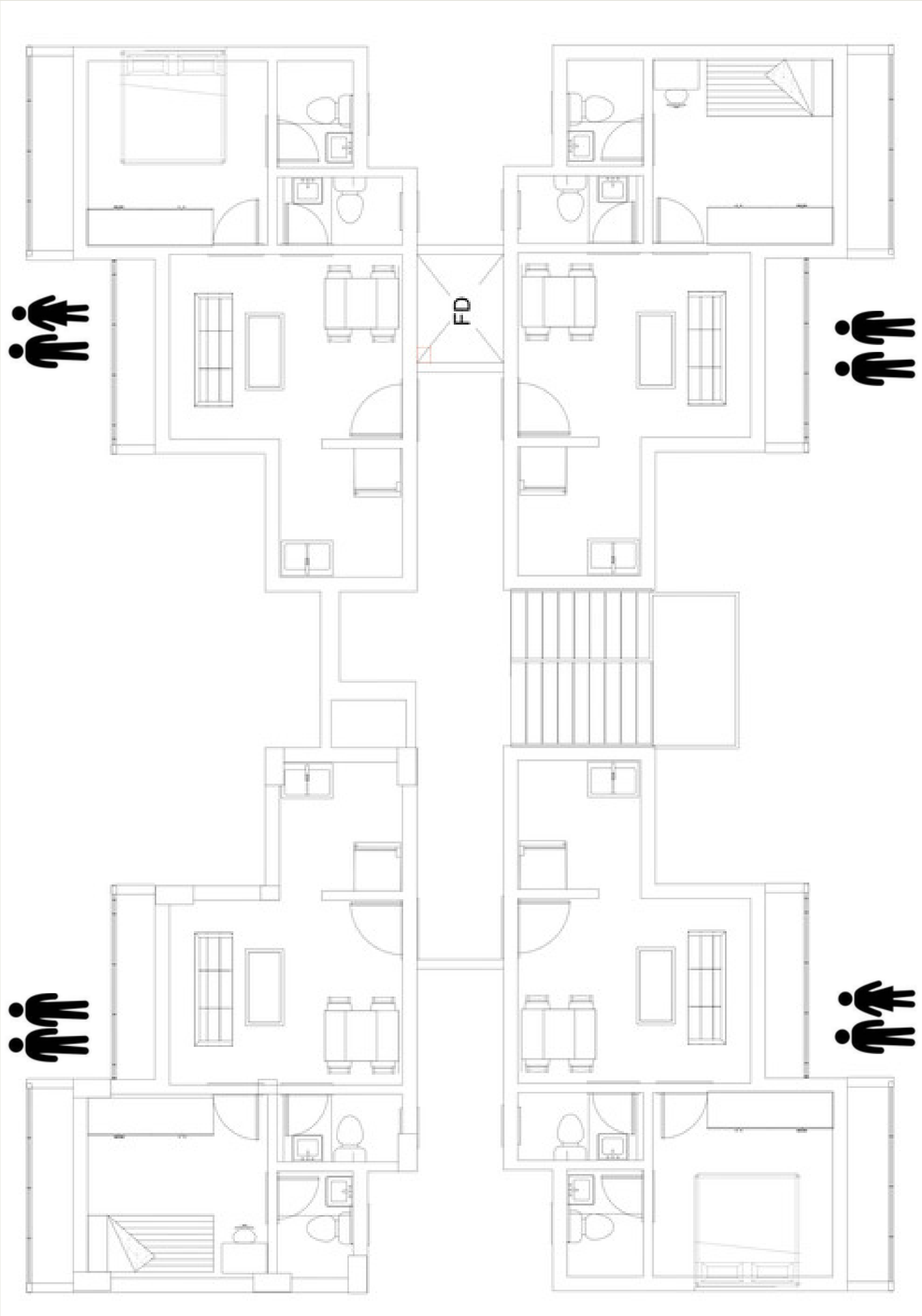


FIG 9.11.11 1BHK FURNITURE LAYOUT ACCORDING TO USER GROUP

11.APPENDIX

3. ARCHITECTURAL DRAWINGS

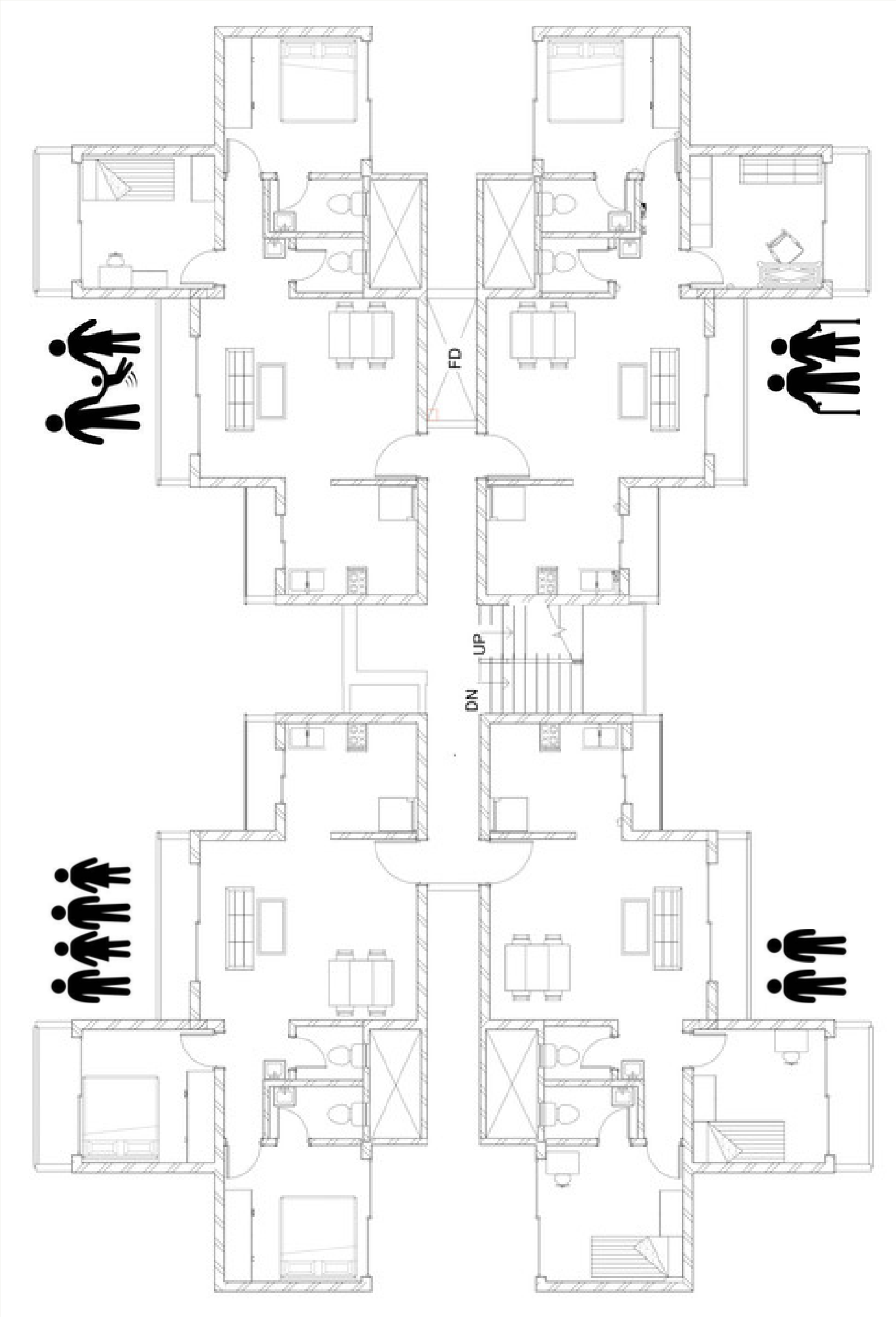


FIG 9.11.12 2 BHK FURNITURE LAYOUT ACCORDING TO USER GROUP

11.APPENDIX

3. ARCHITECTURAL DRAWINGS

FIG 9.11.13 NORTHEN ELEVATION

3. ARCHITECTURAL DRAWINGS

FIG 9.11.14 2BHK SECTION

11.APPENDIX

3. ARCHITECTURAL DRAWINGS

FIG 9.11.15 SECTION

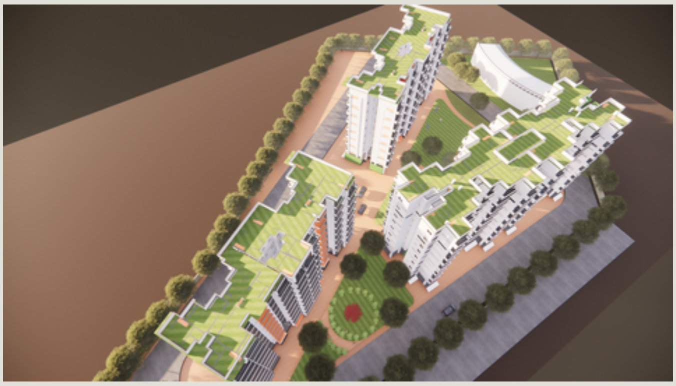
11.APPENDIX

3. ARCHITECTURAL DRAWINGS

FIG 9.11.15 VEIWS (BUILDING 2 AND 3)

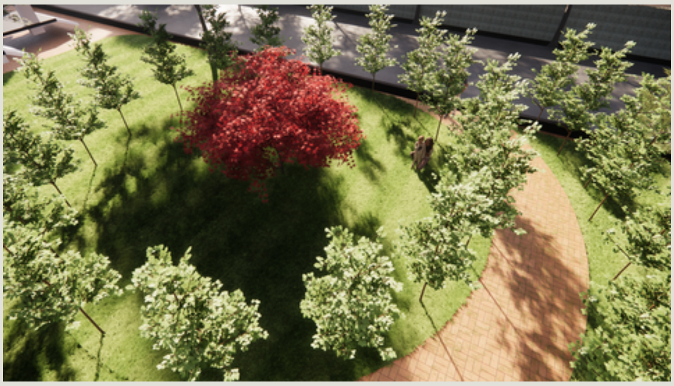
11.APPENDIX

3. ARCHITECTURAL DRAWINGS










11.APPENDIX

3. ARCHITECTURAL DRAWINGS

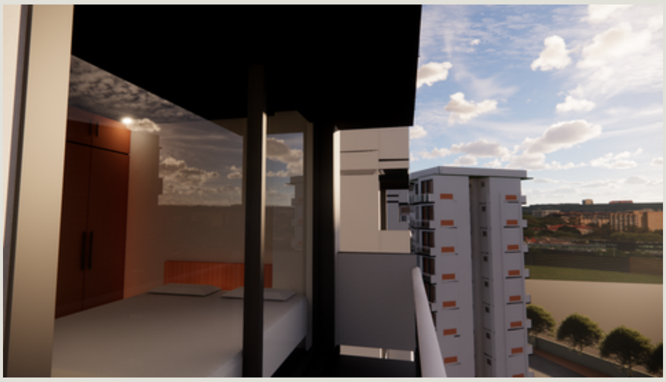


FIG 9.11.16 VIEWS OF THE PROJECT

FIG 9.11.16 VIEWS OF THE PROJECT

4.ENGINEERING DRAWINGS

Sr. No.	Contract Code and Name	percentage of total cost	Cost
A	CONSULTANTS		
1	Architectural Designing	1.2	3448275.862
2	Structural Designing	0.4	1149425.287
3	Services	0.7	2011494.253
4	Model Making	0.06	172413.7931
5	Plot Survey	0.007	20114.94253
	Total	2.367	6801724.138
B	CIVIL WORKS		
1	Excavation	0.87	25,00,000
2	Anti Termite Treatment	0.006	17241.37931
3	Sub-structure and Waterproofing	0.22	632183.908
4	works, Block work, Plaster, Misc Civil	52.66	151321839.1
	Total	53.756	154471264.4
C	FINISHING WORKS		
1	Flooring	7.74	22241379.31
2	Kitchen Platform with Sink	1.15	3304597.701
3	Entrance Lobby & signage	0.5	1436781.609
4	Wood works	3.69	10603448.28
5	Waterproofing	0.69	1982758.621
6	Gypsum Plaster	1.99	5718390.805
7	P.O.P false ceiling	0.35	1005747.126
8	External Painting	1.134	3258620.69
9	Internal Painting	1.158	3327586.207
10	Staircase Painting	0.104	298850.5747
11	Lift Shaft Painting	0.019	54597.70115
12	Duct Painting	0.138	396551.7241
13	Ceiling Painting	0.41	1178160.92
14	Aluminium Window	2.51	7212643.678
15	M.S Railing	0.608	1747126.437
16	Facade work	0.334	959770.1149
	Total	22.525	64727011.49
D	SERVICES		
1	Plumbing and Pumping	2.81	8074712.644
2	CP Sanitary	2.42	6954022.989
3	Firefighting	1.27	3649425.287
4	Electrical	4.16	11954022.99
5	Lifts	4.5	12931034.48
6	IBMS	0.89	2557471.264
7	Solar water system	0.24	689655.1724
8	DG Set	0.36	1034482.759
	Total	16.65	47844827.59
	Initial Total (A+B+C+D)	95.298	273844827.6
	Site Establishment	1.8	5172413.793
	Electrical and Water Charges	1.434	4120689.655
	Contingencies for temporary works	0.956	2747126.437
	EHS Budget	0.512	1471264.368
	CONSTRUCTION COST	100	287356321.8
	LABOUR COST	30 p.c. of Construction cost	86206896.55
	TOTAL CONSTRUCTION COST	XXX	373563218.4
Sr. No.	Project Execution Stages	p.c. of project cost	Cost
1	Pre-construction Stage	23	122742200.3
2	Construction Stage	70	373563218.4
3	Post-construction stage	7	92354351.3
	Total Project Cost	100	533661740.6

11.APPENDIX

4.ENGINEERING DRAWINGS

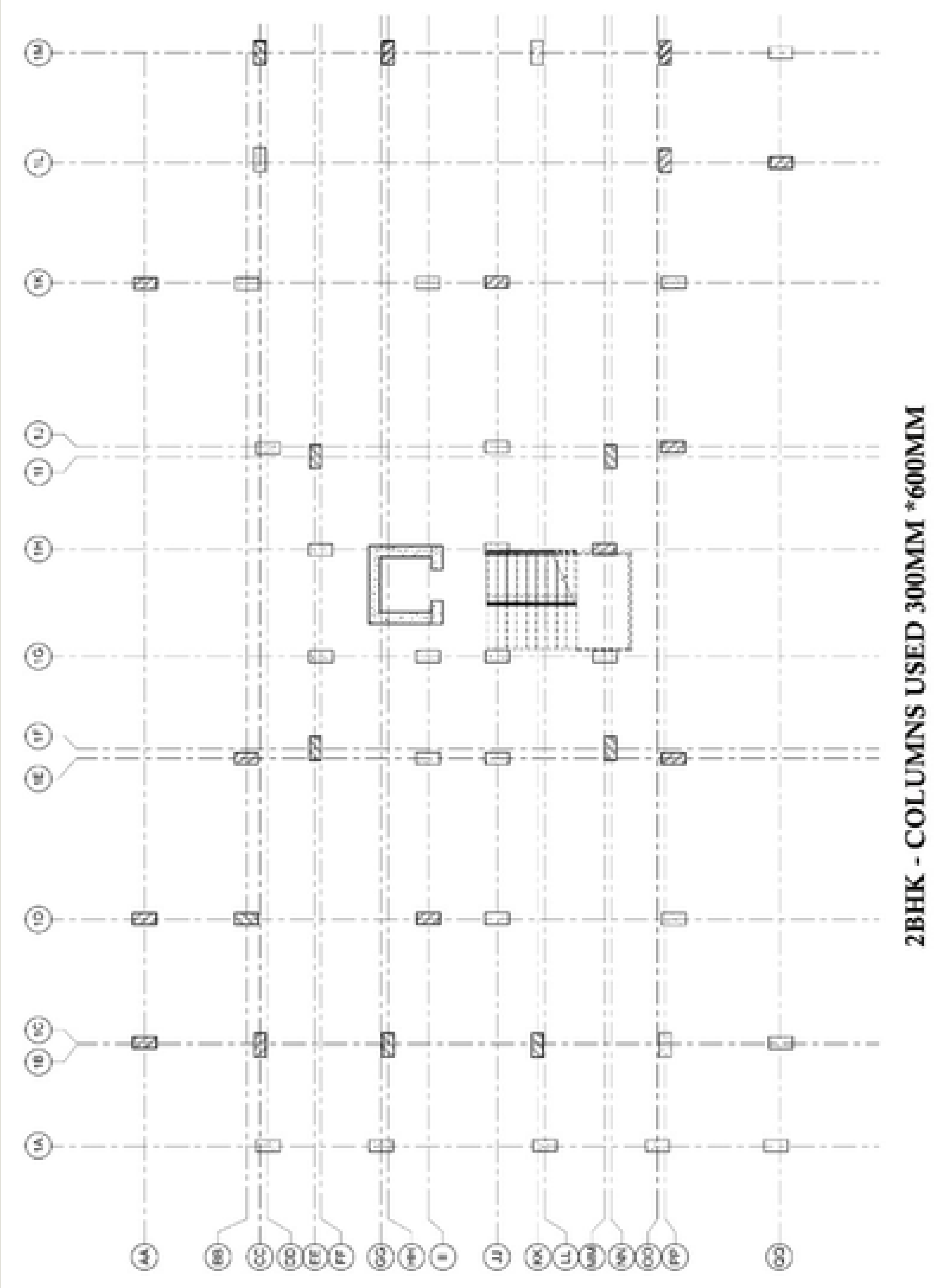
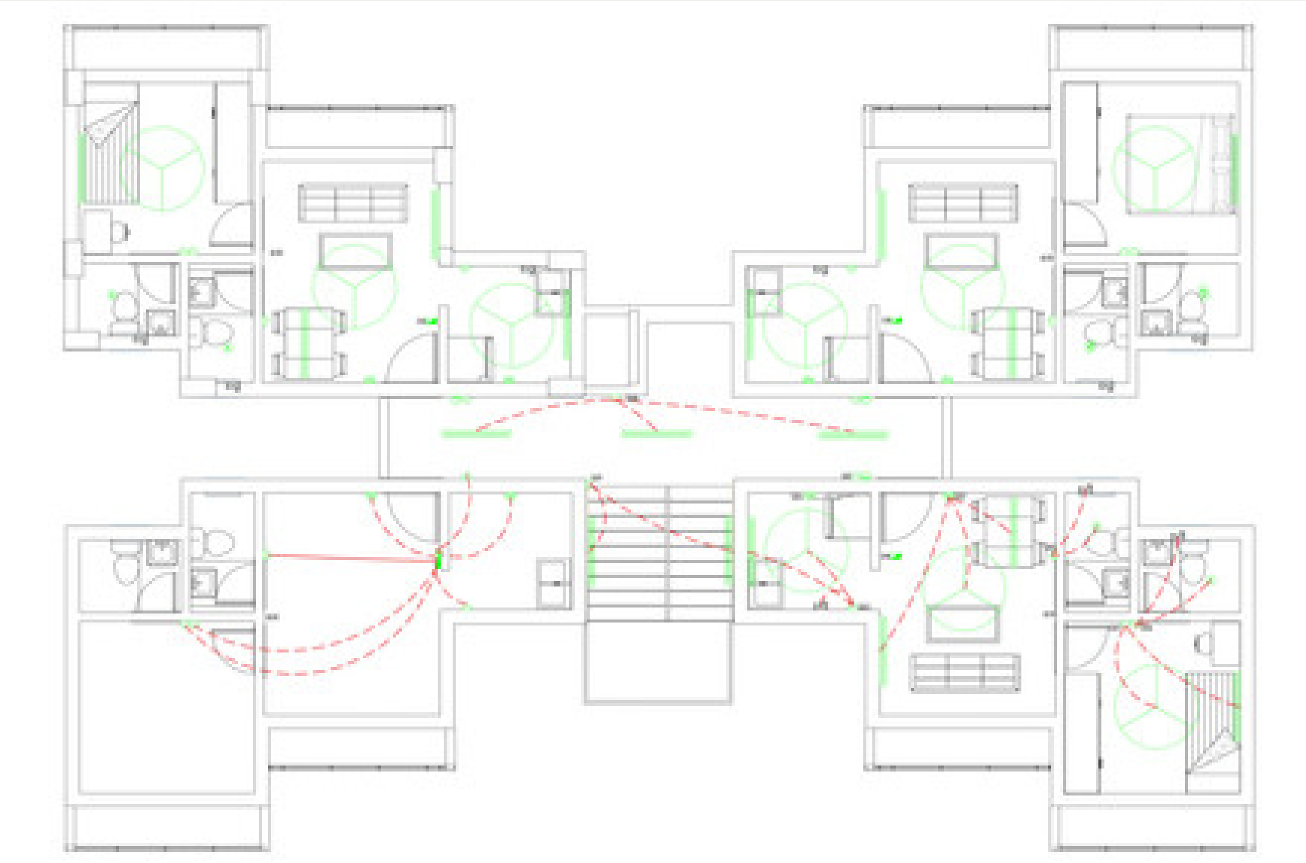


FIG 9.11.17 2BHK COLUMNS LAYOUT

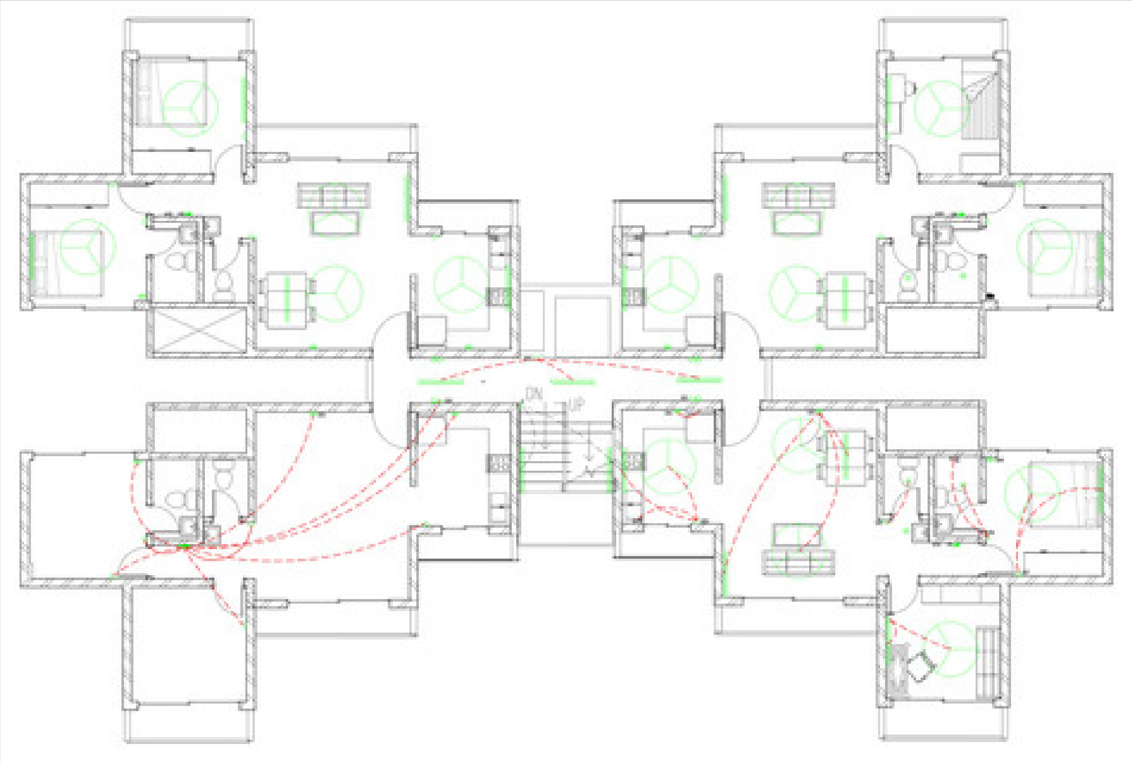
4.ENGINEERING DRAWINGS



SWITCHBOARD SCHEDULE			
NO.	NO. OF SWITCHES	NO. OF SOCKETS	HEIGHTS (MM)
SB01	- 1NOS 5A, BELL SWITCH.	0 NOS SOCKETS	1200
SB02	- 3 NOS 5A, SWITCH - 1NOS 5A, FLORESCENT LIGHT SWITCH - 1NOS 5A, FAN REGULATOR AND SWITCH - 1NOS 15A - TV POINT.	3 NOS SOCKETS	1200
SB03	- 1NOS 5A, FAN REGULATOR AND SWITCH - 1NOS 5A, SWITCH - 1NOS 5A, FLORESCENT LIGHT SWITCH	1 NOS SOCKETS	1200
SB04	- 2NOS 15A,MICROWAVE,MIXER GRINDER,INDUCTION SWITCH - 1NOS 15A,REFRIGETOR SWITCH	3 NOS SOCKETS	1200
SB05	- 1NOS 5A, LIGHT SWITCH - 1NOS 5A, SWITCH	1 NOS SOCKETS	1200
SB06	- 1NOS 5A, LIGHT SWITCH - 1NOS 5A, SWITCH	1 NOS SOCKETS	1200
SB07	- 1NOS 5A, FLORESCENT LIGHT SWITCH - 1NOS 5A, FAN REGULATOR AND SWITCH - 1NOS 5A, SWITCH	1 NOS SOCKETS	1200
SB08	- 3NOS 5A, FLORESCENT LIGHT SWITCH	0 NOS SOCKETS	1200
SB07	- 2NOS 5A, FLORESCENT LIGHT SWITCH	0 NOS SOCKETS	1200

FIG 9.11.18 ELECTRICAL LAYOUT FOR 1BHK AND SWITCH BORAD SCHEDULE

4. ENGINEERING DRAWINGS



SWITCHBOARD SCHEDULE			
NO.	NO. OF SWITCHES	NO. OF SOCKETS	HEIGHTS (MM)
SB01	- 1NOS 5A, BELL SWITCH.	0 NOS SOCKETS	1200
SB02	- 3 NOS 5A, SWITCH - 2NOS 5A, FLORESCENT LIGHT SWITCH - 2NOS 5A, FAN REGULATOR AND SWITCH - 1NOS 15A - TV POINT.	3 NOS SOCKETS	1200
SB03	- 1NOS 5A, FAN REGULATOR AND SWITCH - 1NOS 5A, SWITCH - 1NOS 5A, FLORESCENT LIGHT SWITCH	1 NOS SOCKETS	1200
SB04	- 2NOS 15A,MICROWAVE,MIXER GRINDER,INDUCTION SWITCH - 1NOS 15A,REFRIGETOR SWITCH	3 NOS SOCKETS	1200
SB05	- 1NOS 5A, LIGHT SWITCH	0 NOS SOCKETS	1200
SB06	- 1NOS 5A, LIGHT SWITCH - 1NOS 5A, SWITCH	1 NOS SOCKETS	1200
SB07	- 1NOS 5A, FLORESCENT LIGHT SWITCH - 1NOS 5A, FAN REGULATOR AND SWITCH - 1NOS 5A, SWITCH	1 NOS SOCKETS	1200
SB08	- 1NOS 15A, AC SWITCH AND SOCKET.	1 NOS SOCKETS	1000
SB09	- 2NOS 5A, SWITCH - 1NOS 5A, FLORESCENT LIGHT SWITCH - 1NOS 5A, LIGHT SWITCH	2 NOS SOCKETS	1200
SB10	- 3NOS 5A, FLORESCENT LIGHT SWITCH	0 NOS SOCKETS	1200
SB09	- 1NOS 5A, FLORESCENT LIGHT SWITCH	0 NOS SOCKETS	1200

FIG 9.11.19 ELECTRICAL LAYOUT FOR 2BHK AND SWITCH BORAD SCHEDULE

11.APPENDIX

5. OUTLINE SPECIFICATIONS

EXCAVATION			
TOTAL PLINTH AREA	1588.45		
EXCAVATION	1588.45	4.5	7148.025 m^3
PCC FOR FOUNDATION (COLUMN)	242	0.225	54.45 m^3
RCC FOR FOUNDATION (CONCRETE)	242	1.8	435.6 m^3

RCC M35 GRADE (COLUMNS)	1590 m^3
STAIRS	1200 m^3
RCC M 30 GRADE (BEAMS AND SLABS)	4360 m^3
REINFORCEMENT (ALL COMBINED)	580 M TONS
16MM	71.02 M TONS
PRIMARY STEEL FOR BEAM	58.32 M TONS
SECONDARY STEEL FOR BEAM	19.14 M TONS
SLABS (STAIRS)	431.52 M TONS

TOTAL BRICKWORK	9500 m^3
TOTAL PLASTERING AREA	76710 m^3
TOTAL PAINT AREA	69450 m^3

11.APPENDIX

6. ENERGY SIMULATION INPUTS

Input Parameters	Units	Proposed Design Values
General		
Building Area	m²	16,075.30
Conditioned Area	m²	0
Electricity Rate	INR/kWh	4.17
Natural Gas Rate	INR/GJ	If Applicable
Building Occupancy Hours	-	24 Hours
Average Occupant Density	m² / person	14.77
Internal Loads		
Interior Average Lighting Power Density	W/m²	3.72
List of Lighting Controls	-	Manual and Motion sensors
Average Equipment Power Density	W/m²	0.7
Envelope		
Roof Assembly U value	W/m².K	1.35
Roof Assembly SRI		0
Average Wall Assembly U value	W/m².K	1.87
Window to Wall Area Ratio (WWR)	%	40%
Windows U value	W/m².K	0.5
Windows SHGC		0.6
Windows VLT	%	0.5
Infiltration Rate	ac/h	0.53
Describe Exterior Shading Devices		Chajjas are used for shading

FIG 9.11.20 ENERGY STIMULATIONS

7. NET-ZERO WATER CYCLE DESIGN AND CALCULATIONS

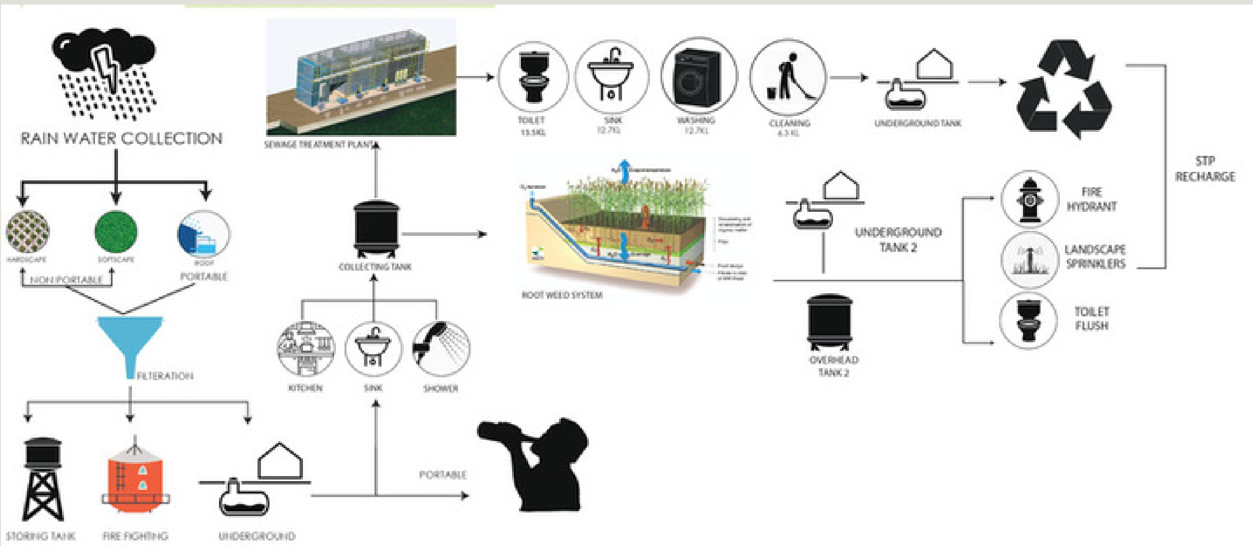


FIG 9.11.21 NET ZERO WATER CYCLE

11.APPENDIX

7. NET-ZERO WATER CYCLE DESIGN AND CALCULATIONS

	USAGE(%)	Usage (litre)	QUANTITY (1088 people)	GREY WATER	BLACK WATER
BATHING	30	22	23827.2	23827.2	0
WASHING CLOTHES	20	15	15884.8	15884.8	0
COOKING	3	2	2382.72	0	2382.72
DRINKING	4	3	3176.96	0	3176.96
CLEANING	8	6	6353.92	6353.92	0
WASHING UTENSILS	16	12	12707.84	12707.84	0
TOILET	17	12	13502.08	0	13502.08
OTHERS	2	1	1588.48	794.24	794.24
TOTAL	100	73	79424	59568	19856

base case (per day liters)	proposed case (per day liters)	reduced percentage
146880	79424	54.07

FIG 9.11. 22 NET ZERO WATER CYCLE CALCULATION

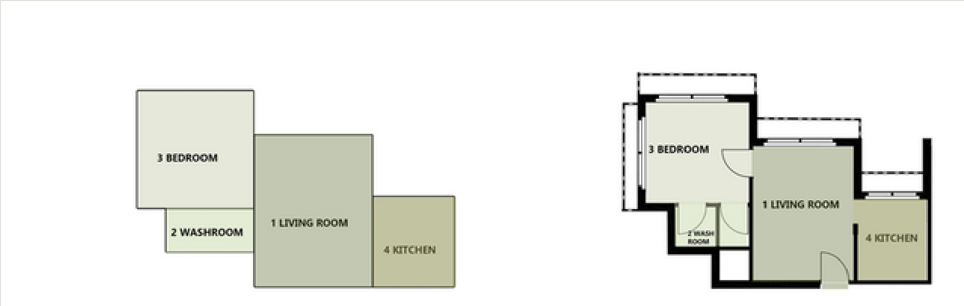
8.EMBODIED CARBON CALCULATIONS

Materials Embodied Carbon and Inventory	Area (m2)	Embodied Carbon (kgCO2)	Equivalent CO2 (kgCO2)	Mass (kg)
External Rendering	149.0	484.2	484.2	4842.3
Gypsum Plastering	7010.7	39961.0	42064.2	105160.4
Gypsum Plasterboard	3730.9	10073.4	10912.9	83945.2
MW Stone Wool (rolls)	149.0	675.4	720.4	643.2
XPS Extruded Polystyrene - CO2 Blowing	8272.0	66181.4	220145.0	22979.6
Concrete Block (Medium)	7010.7	78519.8	78519.8	981497.0
Cast Concrete	556.2	13348.3	13348.3	166853.7
Cast Concrete (Dense)	3744.3	62903.4	62903.4	786292.5
Brickwork Outer	7010.7	262199.9	274118.1	1191817.8
Fibreboard	705.2	1402.6	1457.6	2750.2
Asphalt 1	705.2	1406.8	1406.8	28136.4
Sub Total		537156.1	706080.6	3374918.4

Constructions Embodied Carbon and Inventory	Area (m2)	Embodied Carbon (kgCO2)	Equivalent CO2 (kgCO2)
External floor - Energy code standard - Medium weight	149.0	1159.6	1204.6
Flat roof U-value = 0.25 W/m2K	705.2	11481.3	31710.6
Brick/block wall (insulated to 1995 regs)	7010.7	436508.2	580406.1
Lightweight 2 x 25mm gypsum plasterboard with 100mm cavity	1865.4	10073.4	10912.9
100mm concrete slab_Reversed	3744.3	62903.4	62903.4
Ground floor slab - Energy code standard - Medium weight	556.2	15030.2	18942.9
Sub Total	14030.7	537156.14	706080.57

FIG 9.11.22 EMBOIDED CARBON

12. LOAD SIMULATIONS FOR 1 BHK UNIT



Name		Program	Area[m²]	Volume[m³]	EnergyUse[kWh]	Cool[kWh]	Light[kWh]	Equip[kWh]	HotWater[kWh]
Zone	1 LIVING ROOM	MultifamilyHousing	13.02	39.07	3868	2794	677	121	277
Zone	2 WASHROOM	MultifamilyHousing	2.83	8.49	1303	1069	147	26	60
Zone	3 BEDROOM	MultifamilyHousing	10.01	30.02	2818	1993	520	93	212
Zone	4 KITCHEN	MultifamilyHousing	5.4	16.21	2020	1574	281	50	115

FIG 9.12.1 FLAT LAYOUT

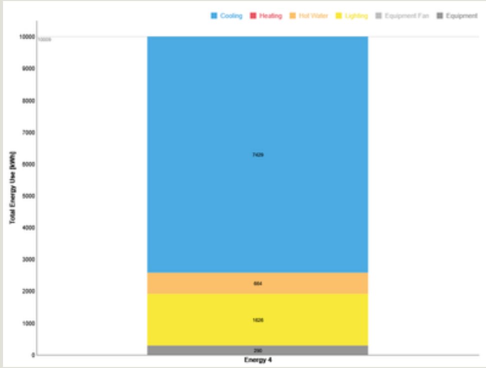


FIG 9.12.2 STIMULATION 1

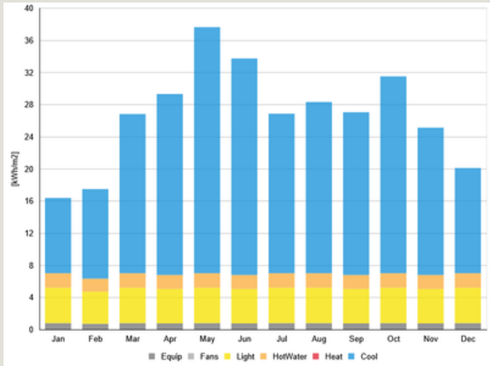


FIG.9.12.3 STIMULATION 2

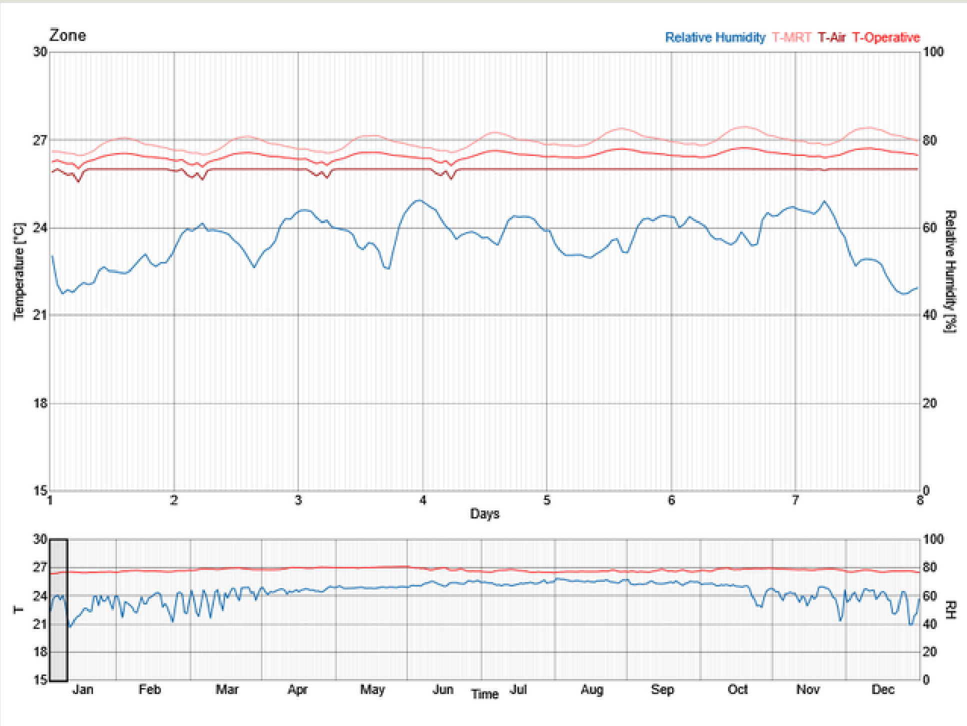


FIG.9.12.4.GRAPH OF STIMULATION

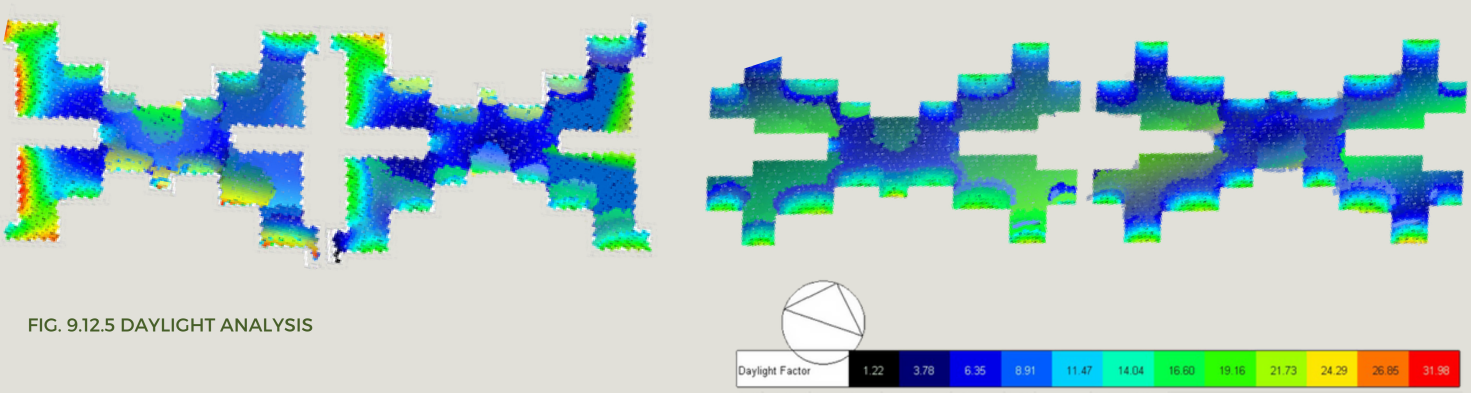


FIG. 9.12.5 DAYLIGHT ANALYSIS

FIXTURE	CONVENTIONAL	HIGH EFFECIENCY
SINK MIXER	₹ 5,225	₹ 3,846
JET SPRAY	₹ 1,109	₹ 1,346
FLUSH	₹ 1,700	₹ 1,036
SHOWER	₹ 2,181	₹ 2,730
TOILET	₹ 10,500	₹ 9,540
NAHANI TRAP	₹ 65	₹ 310

FIG 9.12.6 .FIXTURE TABLE 1

FIXTURE	CONVENTIONAL	HIGH EFFECIENCY
TUBELIGHT	₹ 80	₹ 45
CEILING FAN	₹ 5,000	₹ 5,980
LED BULB	₹ 137	₹ 98
SWITCH BOARD	₹ 75	₹ 845
DOOR BELL	₹ 108	₹ 140
POWER UNIT	₹ 1,792	₹ 1,892

FIG 9.12.7 .FIXTURE TABLE 2

Tubelight FTL 14W – T5/065 Fluorescent LED Tubular Lamps.

Jaquar Alive Chrome Finish Control Flush Plate.

Least power consuming fan - 26 W per hour only, 65% power saving as compared to a regular fan of 75 W power consumption.

SYSKA 9W B22D Led Cool Day Light Bulb

Palfrey Electric Extension Board - 16A/20A + 16A/20A with Two Switch and Heavy Duty 3 Meter Wire (2200W).

6 AX BELL PUSH WITH IND. SWITCH.

25 A POWER UNIT Complete package for AC, geysers, inbuilt Overload Protection, Suitable for 4 Module.

FIG 9.12.8 FIXTURE TABLE 3

13.REFERENCES

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14.LETTER OF CONFIRMATION

NAVJEET INFRATECH LLP

LLPIN: AAK-5332

15[th] September 2022

To,

The Director,

Solar Decathlon India

Dear Sir,

This is to inform you that our organization **Navjeet Infratech LLP** has provided information about our **Upcoming project in Alibaug** to the participating team led by **Dr. D Y Patil Deemed to be University School of Architecture**, Nerul so that their team **Mi Casa** may use this information for their Solar Decathlon India 2022-23 Challenge entry.

As a Project Partner to this team for the Solar Decathlon India 2022-23 competition, we are interested in seeing the Net-Zero-Energy, Net-Zero-Water, resilient and affordable solution this student team proposes and the innovation that results from this. We intend to have a representative from our organization attend the Design Challenge Finals event in April, if the team is selected for the finals.

We would like our organization's name to be displayed on the Solar Decathlon India website, recognizing us as one of the Project Partners for the 2022-23 Challenge.

With warm regards,

NAVJEET INFRATECH LLP

Name of Representative: Ashok C. Thakkar

Designation: Partner

Email: ashok@[illegible].com

Phone: 98231[illegible]

Godrej & Boyce Mfg. Co. Ltd.
Regd. Office: Pirojshanagar,
Vikhroli, Mumbai 400 079, India
Tel.: +91-22-6796 1700 / 1800
info@godrej.com
www.godrej.com
CIN: [illegible]

Date: 30-September-2022

To,

The Director,
Solar Decathlon India

Dear Sir,

This is to inform you that our organization, Godrej & Boyce Mfg. Co. Ltd., is collaborating with the participating team led by **Dr. DY Patil Deemed to be University School of Architecture, Nerul, Navi Mumbai** on an **Multi Family Housing** Building project for their Solar Decathlon India 2022-23 competition entry.

The nature of our collaboration will be guiding and mentoring the students throughout the Solar Decathlon India 2022 project completion.

We would like to have a representative from our organization attend the Design Challenge Finals event in April/May, if this team is selected for the Finals.

We would like our organization's logo to be displayed on the Solar Decathlon India website, recognizing us as one of the Industry Partners for the 2022-23 competition.

With warm regards,

Sumesh G. Nair
Deputy General Manager - GCEM Dept
Godrej & Boyce Mfg. Co. Ltd
sgn@godrej.com
98[illegible]

Godrej

D Y PATIL
DEEMED TO BE
UNIVERSITY
SCHOOL OF
ARCHITECTURE
NAVI MUMBAI

Date: 04 OCT 2022

TO WHOMSOEVER IT MAY CONCERN

This to certify that below mentioned are bonafied students from Bachelor of Architecture from the **D Y Patil Deemed to be University School of Architecture, Nerul** during the academic year 2022-2023.

Student Names:

1. DAKSH KANDHIA
2. PRATHAMESH B PATIL
3. SHEJAL KHAMKAR
4. KAJAL GURNGARKAR
5. RAMIYA FACEL
6. SAKSHI JOSHI
7. AKSHATA BANSOLI
8. MADIHA AZIZ
9. DIYA KHAIRE
10. DAKSHYANI PUROHIT

This certificate is issued for the Entry purpose of Solar Decathlon India Competition.

Ar. Aparna Surve
Dean

Sector 7, Nerul,
Navi Mumbai - 400706
Maharashtra, India.

Tel.: +91 22 27709594 / 27709454
office.soa@dypatil.edu
principal.soa@dypatil.edu

VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE
MUMBAI
H R Mahajani Marg, Matunga east, Mumbai, Maharashtra 400019

BONAFIDE CERTIFICATE

This is to certify that Mr/Ms SHINDE AMEY SANJAY

is/was a bonafide student of this institute attending ***Third Year***

of the ***Four Year Degree Course*** *in* ***B.Tech in Civil Engineering***

His/Her Character and conduct have been good

His/Her Roll No. is/was ***201010009 Year*** *2022-23*

Date & Place of Birth ***23.12.2002***

Date: 07.10.2022

Registrar
VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE MUMBAI
H R Mahajani Marg, Matunga east, Mumbai, Maharashtra 400019

Note : This is computer generated certificate
Printed Date: 07.10.2022 04:40PM
Page 1 of 1

14.LETTER OF CONFIRMATION

BONAFIDE CERTIFICATES

DR. D Y PATIL COLLEGE OF ARCHITECTURE Navi Mumbai

D Y Patil University Campus, Vidyanagar, Sector -7, Nerul, Navi Mumbai - 400 706
Tel 91 22 27709454
Tel Fax 91 22 27709594
E-mail : principaldypca@gmail.com

Date : 21/04/2023

BONAFIDE CERTIFICATE

This is to certify that

~~Mr.~~ / miss Rasiya Patel

is a bonafide student of this college. ~~He~~ / She is / was studing in ~~FY / SY / TY~~ / Forth Year / ~~Fith Year~~ B. Arch during the Academic Year 2022 to 2023

His / Her Date of Birth as per our record is 02/06/2001

Principal
Dr. D.Y. Patil College Of Architecture
Nerul, Navi Mumbai

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BONAFIDE CERTIFICATE

This is to certify that

~~Mr.~~ / miss madiha Aziz

is a bonafide student of this college. ~~He~~ / She is / was studing in ~~FY / SY / TY~~ / Forth Year / ~~Fith Year~~ B. Arch during the Academic Year 2022 to 2023

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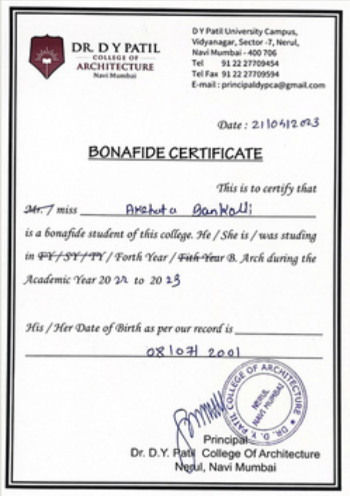

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This is to certify that

~~Mr.~~ / miss Arshuta Bankolli

is a bonafide student of this college. He / She is / was studing in ~~FY / SY / TY~~ / Forth Year / ~~Fith Year~~ B. Arch during the Academic Year 2022 to 2023

His / Her Date of Birth as per our record is 08/07/2001

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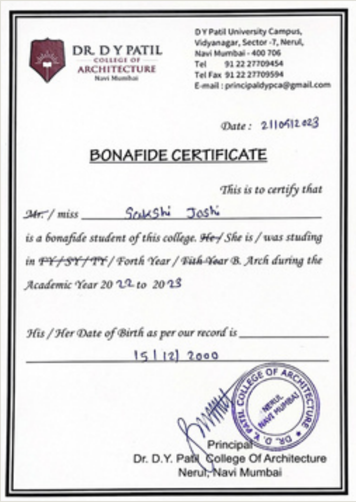

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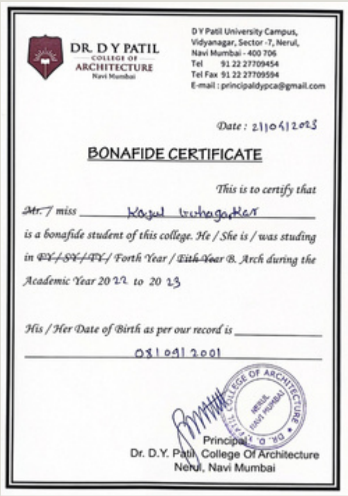

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is a bonafide student of this college. He / She is / was studing in ~~FY / SY / TY~~ / Forth Year / ~~Fith Year~~ B. Arch during the Academic Year 2022 to 2023

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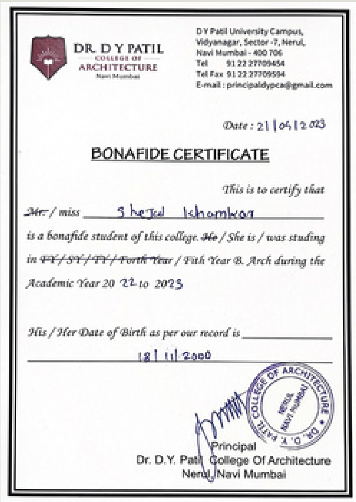

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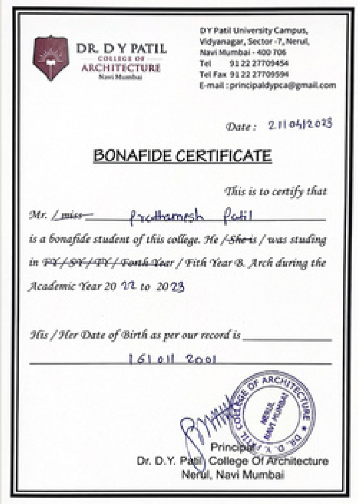

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This is to certify that

Mr. / ~~miss~~ Prathamesh Patil

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BONAFIDE CERTIFICATE

This is to certify that

~~Mr.~~ / miss Dakshayani Randhir

is a bonafide student of this college. ~~He~~ / She is / was studing in ~~FY~~ / SY / ~~TY / Forth Year / Fith Year~~ B. Arch during the Academic Year 2022 to 2023

His / Her Date of Birth as per our record is ~~29/0~~ 29/12/2003

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