

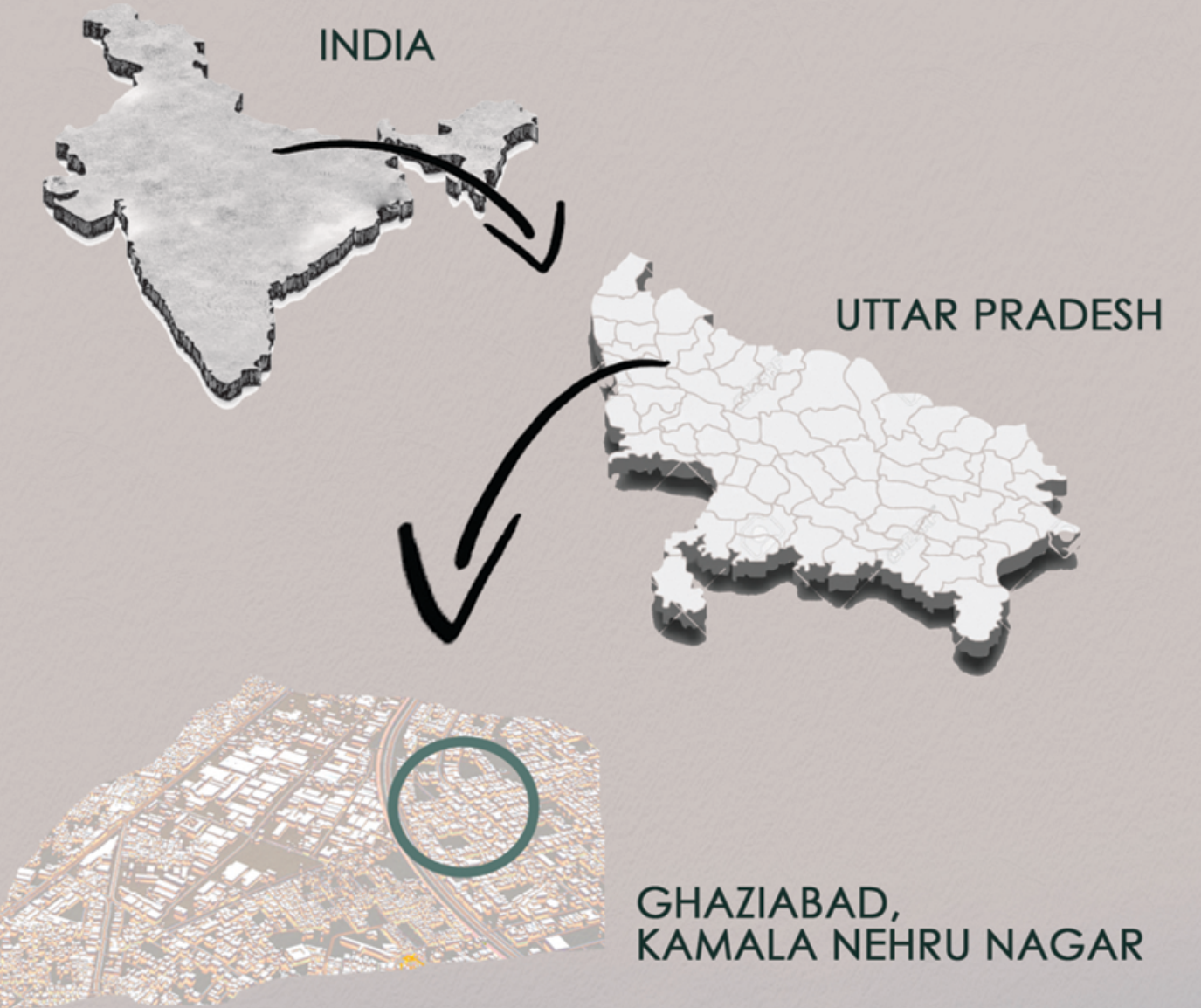
# G - D E C K B U I L D I N G

## Location

The site is located at Kamala Nehru Nagar, Ghaziabad, Uttar Pradesh. Ghaziabad is a part of National Capital Region in Uttar Pradesh. It has a population of about 2.8M(2020 census). It's the second fastest growing city in the world.

## Geographical context

Ghaziabad is located on the western edge of Uttar Pradesh between the Ganges and Yamuna river, the two main rivers of the country, and between 77° to 78° eastern longitude and 28° to 29° northern latitudes.



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Road and connectivity - well connected to other cities  
Benefit of Metro - connectivity



Environmental pollution  
Growing industries



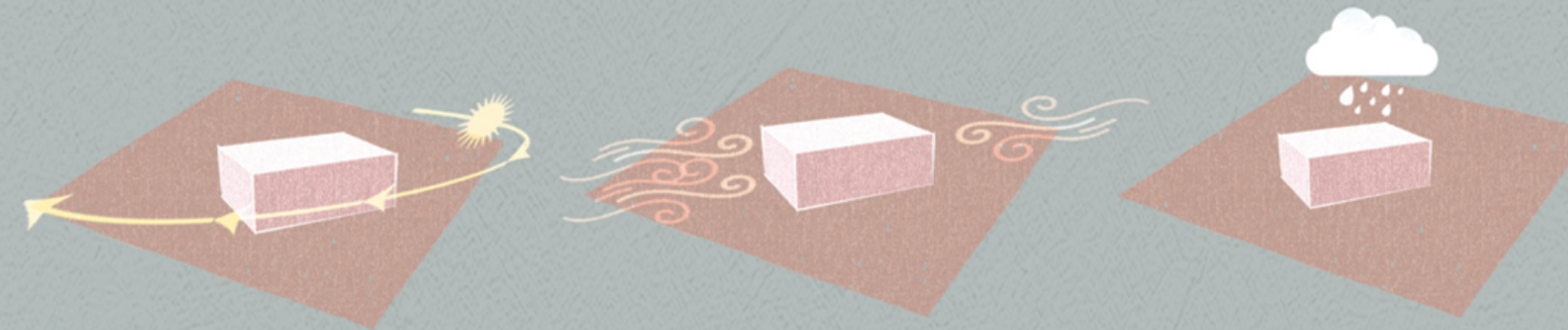
Industrial hub - Attracts large work force from all across the country



Second most polluted area in the World  
Smoke along with fog during winters form smog

## CONCEPT

The design utilizes data on the region's weather patterns and accounts for factors like seasonality, intensity of the sun, wind, rainfall and humidity



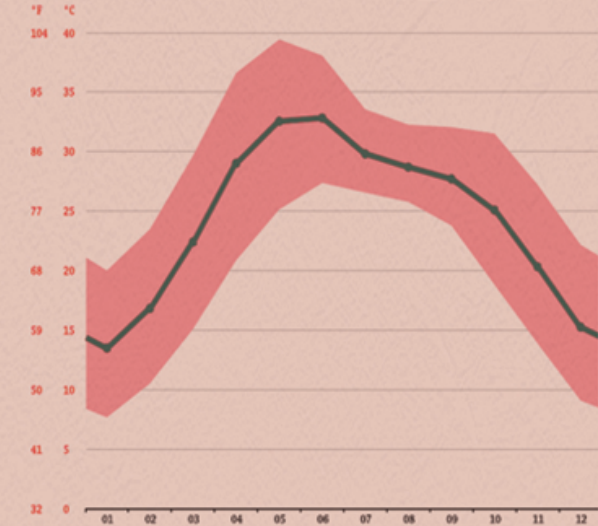
## RESOURCES AVAILABILITY



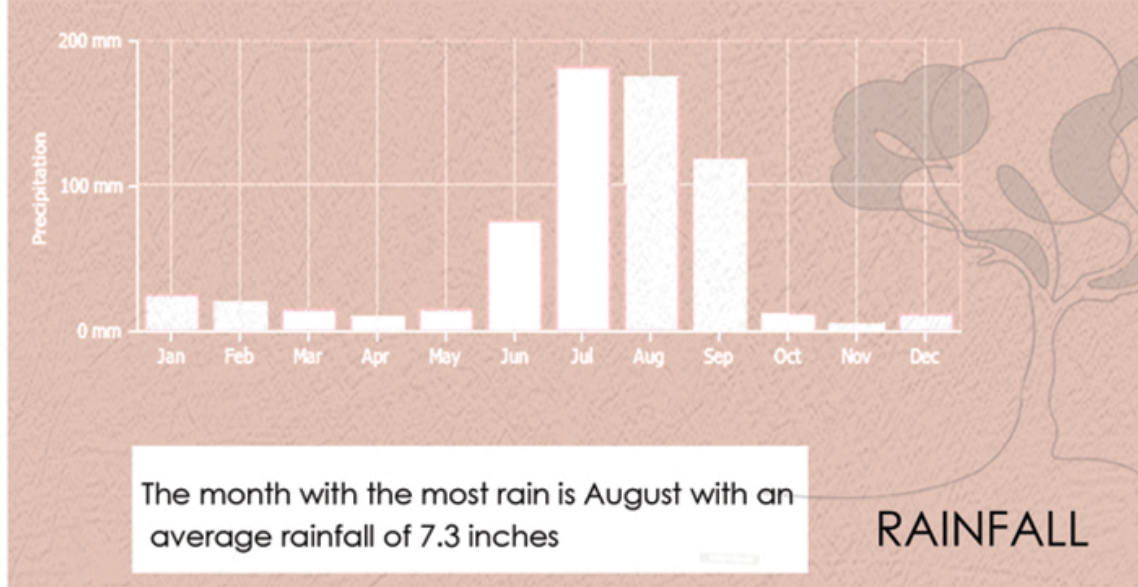
Uttar Pradesh has the largest area almost 50 per cent of the cane area in the country

Bagasse is the dry pulpy fibrous material that remains after crushing sugarcane or sorghum stalks to extract their juice

## TEMPERATURE



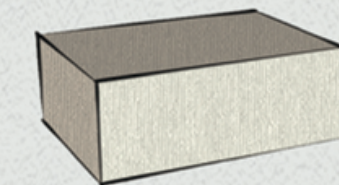
At an average temperature of 32.8 C / 91.1 F, June is the hottest month of the year. January is the coldest month with temperature average of 13.5 C / 56.3 F



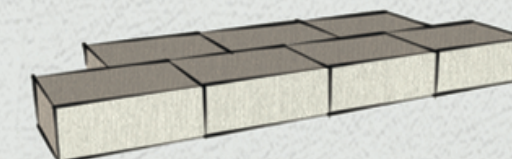
The month with the most rain is August with an average rainfall of 7.3 inches

## RAINFALL

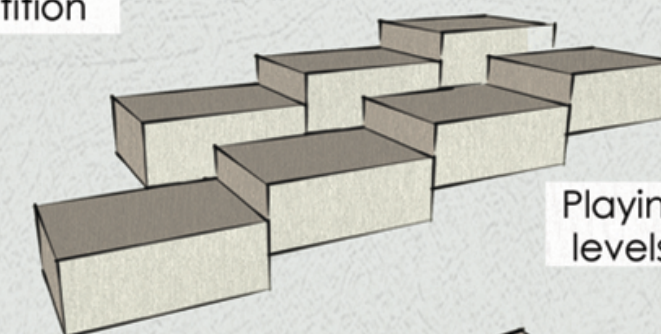
## FORM DEVELOPMENT



Creating block

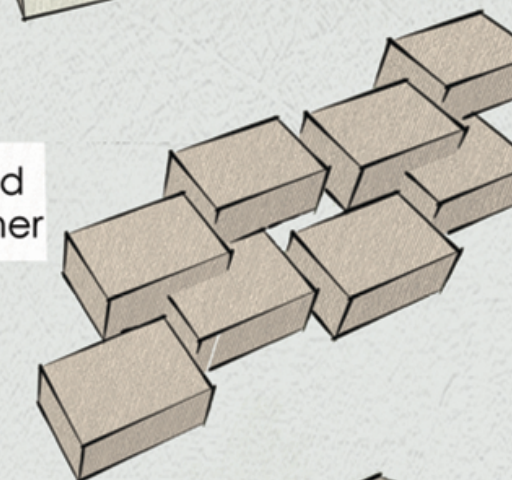


Repetition



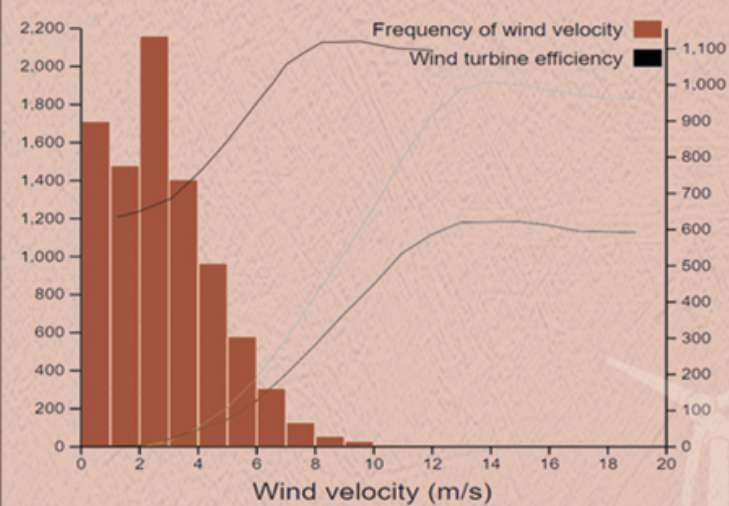
Playing with levels

Stacked together



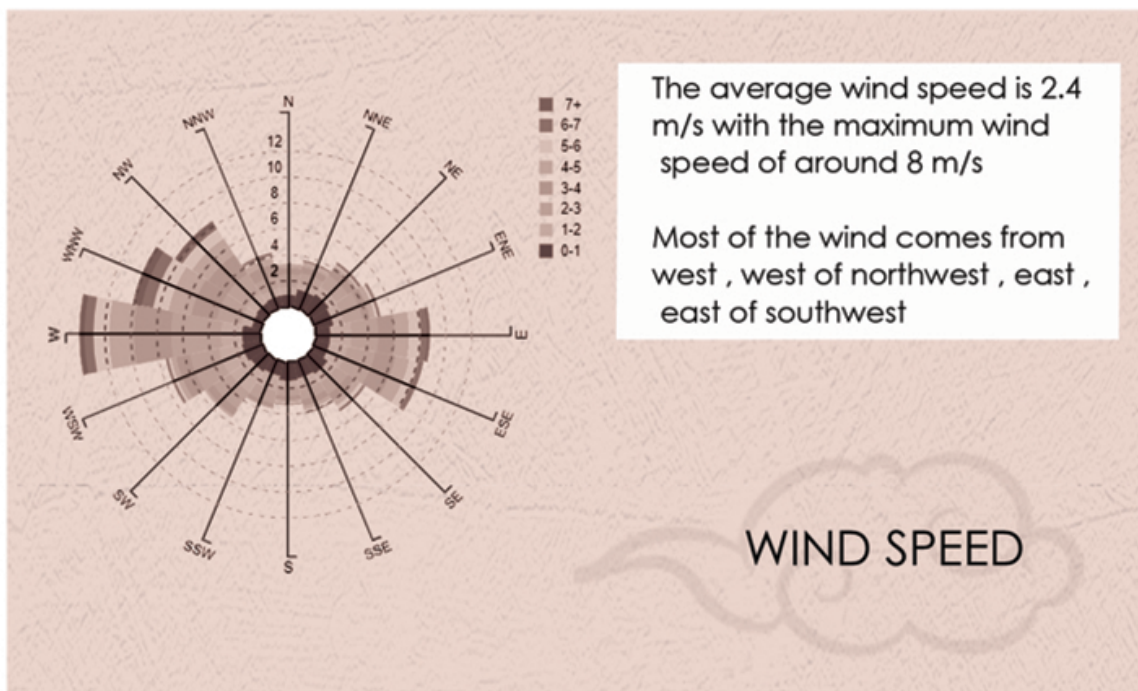
Openings and void

## WIND ENERGY

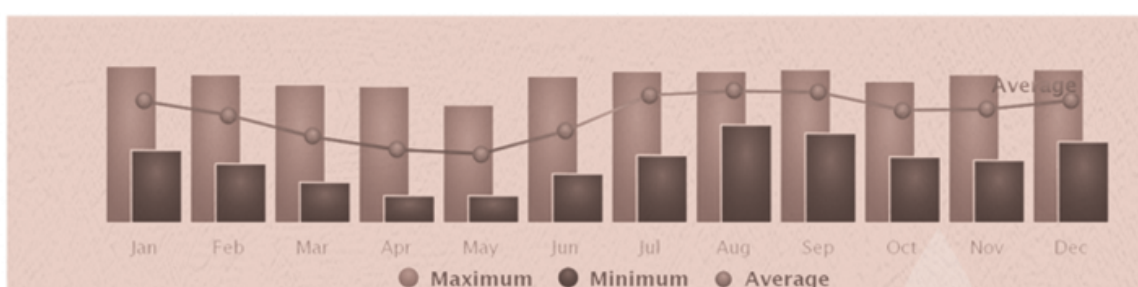


Frequency of wind velocities and electricity produced using the specified wind turbine in an urban setting

Annual energy output, 309 kWh/year

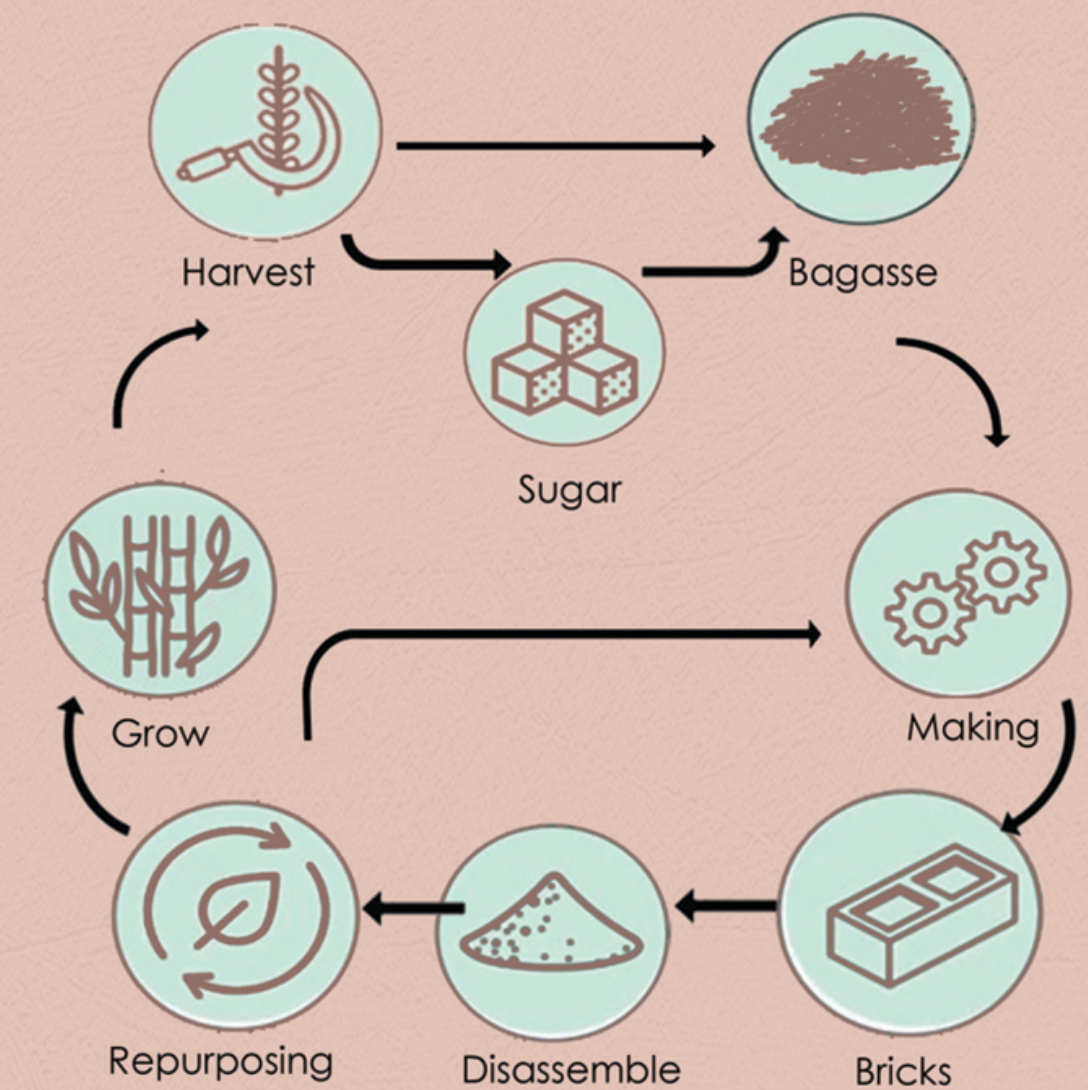


## WIND SPEED

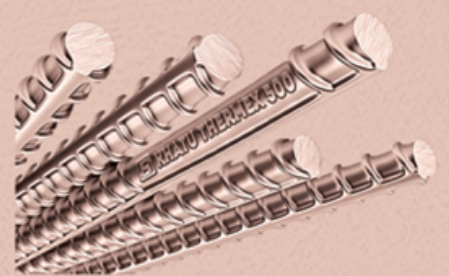


The average relative humidity remains around 67.7%, varies from 17% to 100%

## HUMIDITY



From the steel factories around Ghaziabad, we get slag which can be used as a Substitute for CEMENT



It increase strength, reduce permeability, improve resistance to chemical attack and inhibit rebar corrosion

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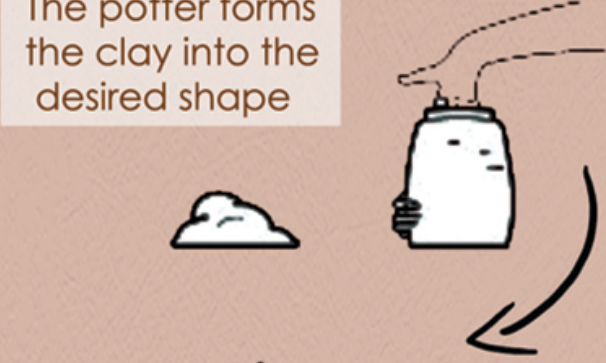
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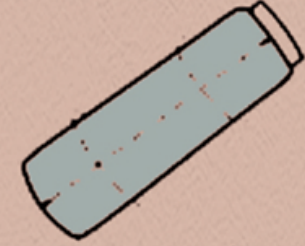


# TERRACOTTA

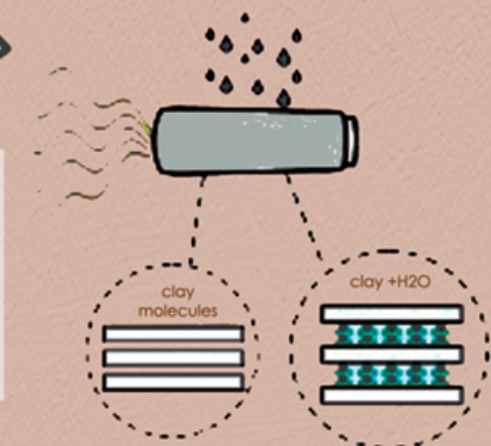
The potter forms the clay into the desired shape



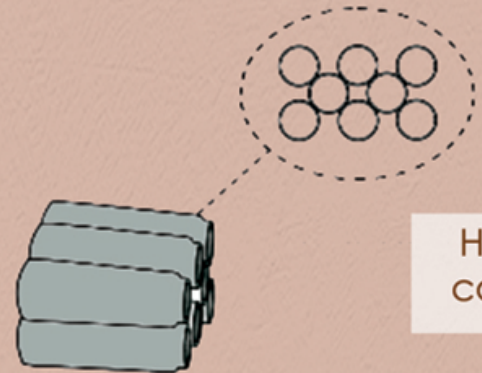
Terracotta tube is geometrically optimised for increased surface area



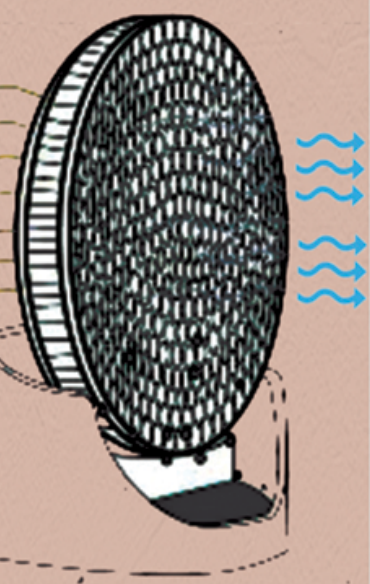
Effect on warm air upon passing through the wet tube



Honeycomb configuration



Water is circulated through the pump  
Terracotta is porous and stores water



Air that passes through this system cools down several degrees

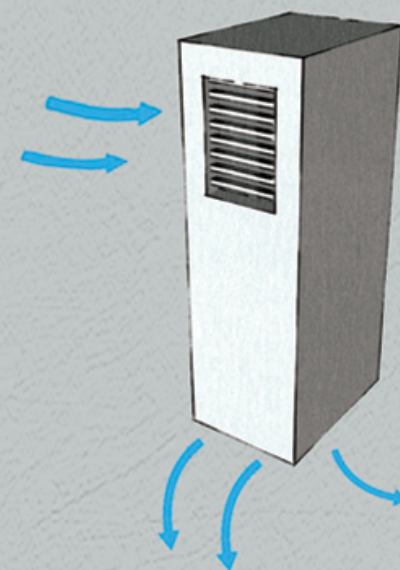
## MODULE GENESIS

### SOLAR LIGHT PIPE



Solar light pipe is a technology for daylight transportation and Energy efficiency. It has a Sunlight capturing system (Light collector), light transfer pipe and double glazed light diffuser. The light gets emitted through the water and terracotta tubes into the building space for a length of 12m and gives an aesthetically pleasing view

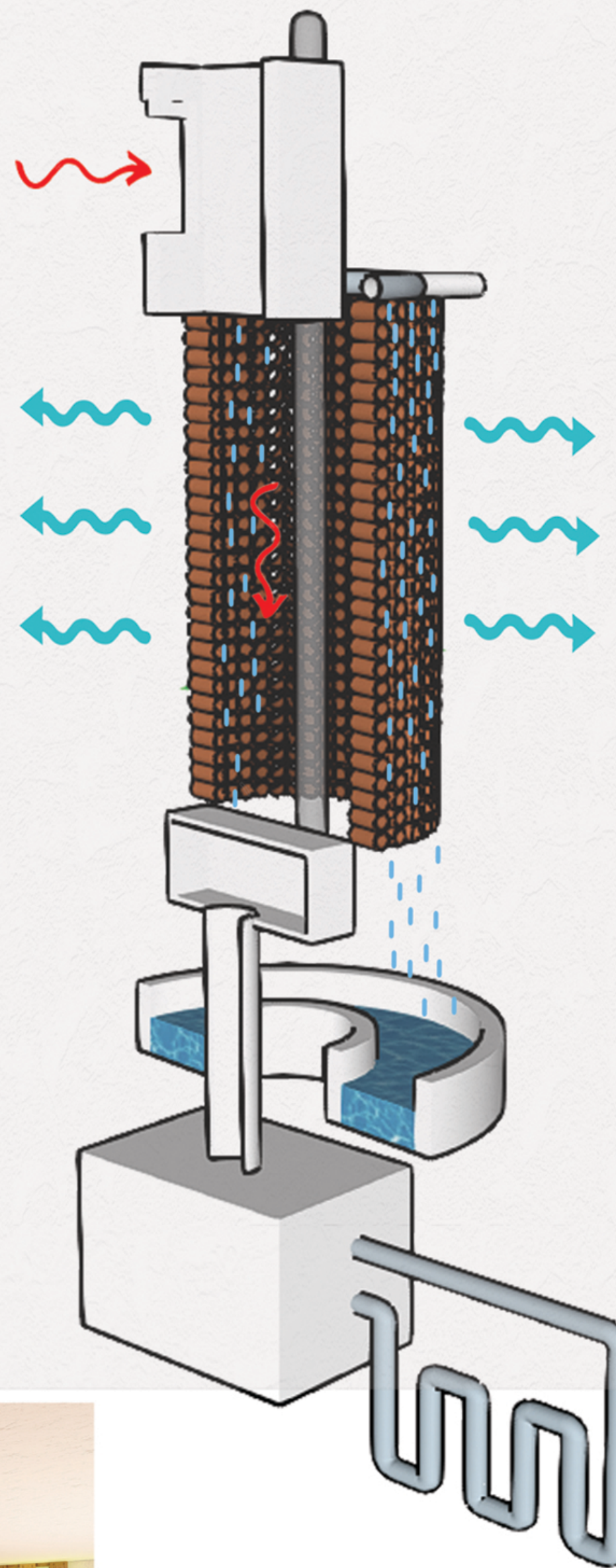
### WIND CATCHER



the wind catcher is used to disperse the heat accumulating indoor amidst the prevailing hot, sunny days. It consists of a hollow square tower constructed with the building fabric, with top side openings and internal partitioning to allow catching the wind from any direction, creating an air stream in the tower's shaft leading to the occupied building space to be ventilated. Here the wind catcher has an open and closable technology so that it can be closed during winter

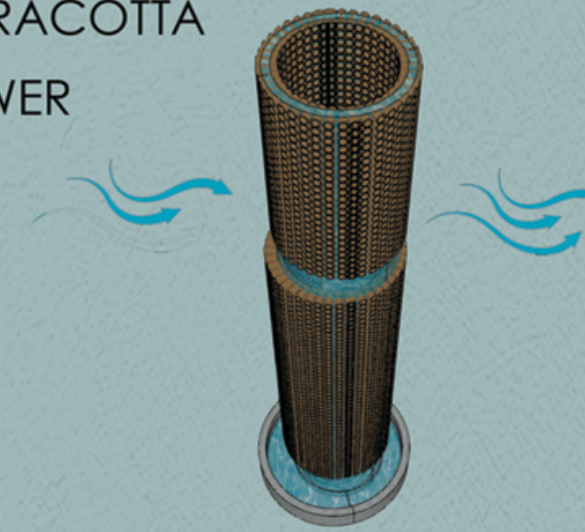


## TERRACOTTA TOWER



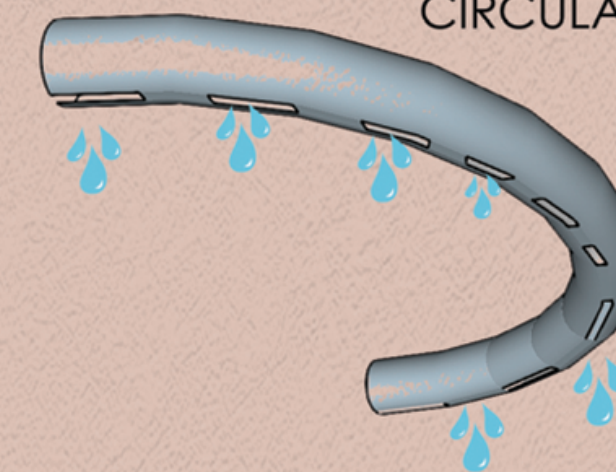
SECTION OF THE MODULE

### TERRACOTTA TOWER



The tower is designed in a circular shape so that the air from wind catcher is spread evenly in all direction  
Also, the air from outside enters the building space after crossing two layers of terracotta which provides extra cooling and more decreased temperature

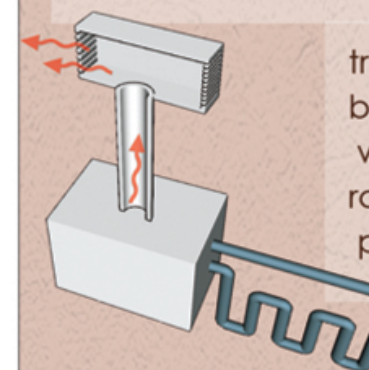
### CIRCULAR PIPE



Water The water passes through a channel into the water pipe. It has small holes under it to allow the water to drip on the terracotta tubes

### GEO THERMAL HEAT PUMP

The geothermal heat pump, is a highly efficient renewable energy technology used for space heating and cooling, as well as water heating. Here, we are using it during winter to heat up the air inside the room. A ground source heat pump absorbs heat from the ground – by circulating water through piping in the ground – and



transfers the heat into the building by circulating hot water through radiators, or underfloor piping circuits

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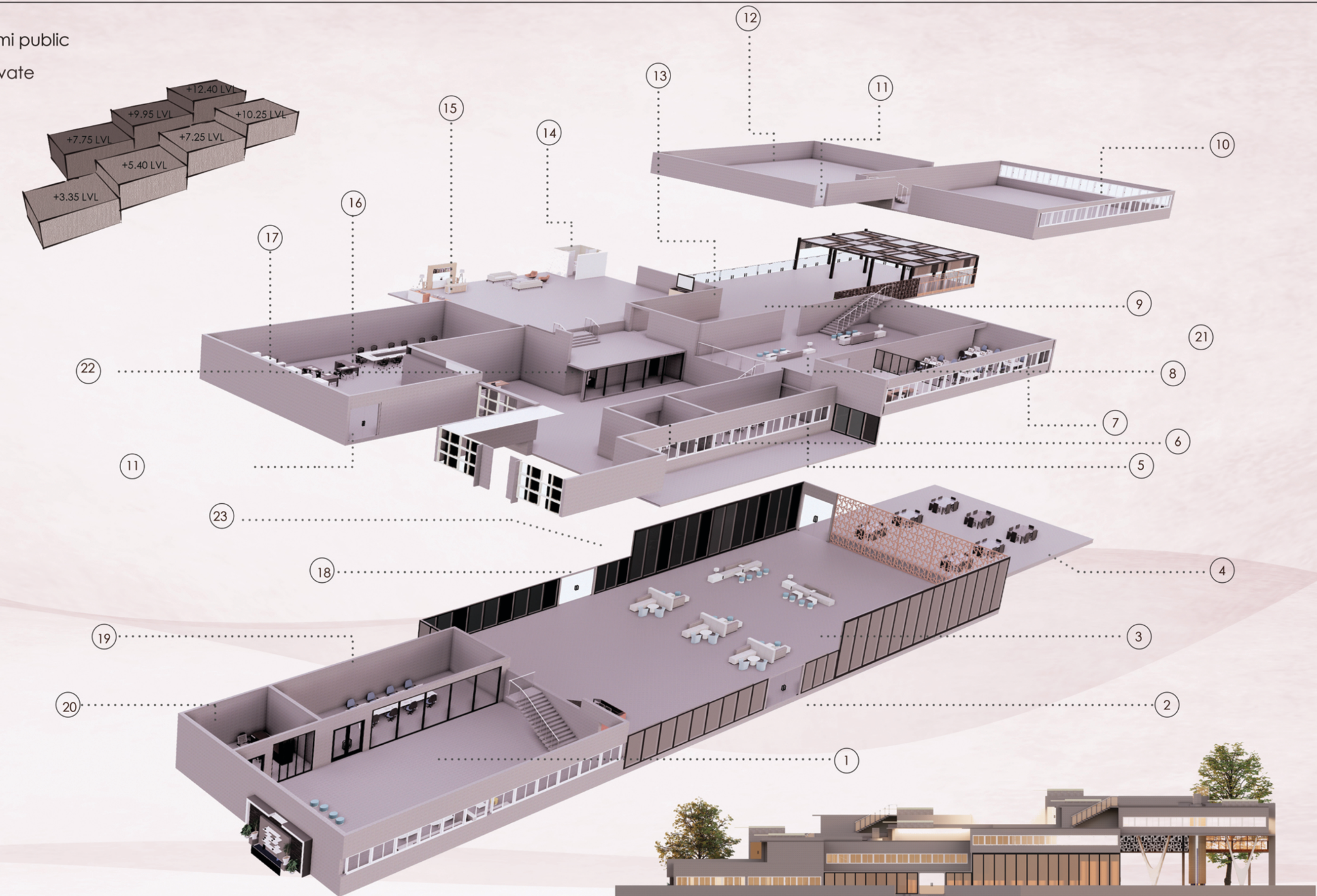
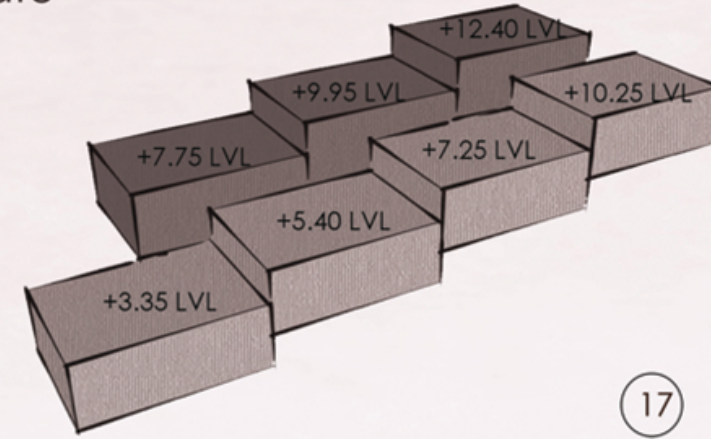
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# AREA STATEMENT

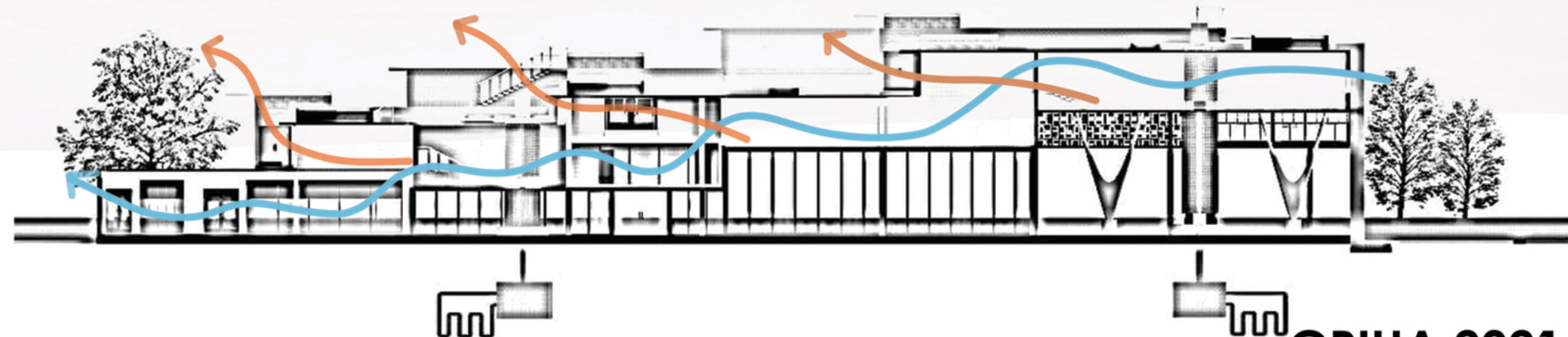
Ground floor - 2393 m.sq.  
 Administration - 750 m.sq.  
 Officials rooms - 5x30m.sq.  
 Staff rooms - 3x72m.sq.  
                   2x50m.sq.  
 Conference room - 105m.sq.  
 Documents room - 42m.sq.  
 Library - 160m.sq.  
 Cafeteria - 180m.sq.  
 Dinning - 324m.sq.  
 Toilets - 5x42m.sq.  
                   2x84m.sq  
 Car parking - 950m.sq.  
 Visitors parking - 550m.sq.  
 Sit out - 70m.sq.  
 Landscape and road - 5946m.sq  
 Ground coverage - 33.6%  
 FAR - 1.50

- Semi public
- Private



- 1 - Lounge
- 2 - Main entry
- 3 - Reception and Administration
- 4 - Outdoor dining area
- 5 - Officials room
- 6 - Secretary room
- 7 - officials room 2
- 8 - Lounge
- 9 - Cafeteria
- 10 - Joint secretary
- 11 - Door to roof garden
- 12 - Library
- 13 - Atrium
- 14 - Toilet
- 15 - Minister of state room
- 16 - Conference room
- 17 - Document room
- 18 - Entry from parking
- 19 - Officials room 3
- 20 - OSD room
- 21 - Deputy secretary room
- 22 - Restrooms
- 23 - Office Parking and Refreshing rooms

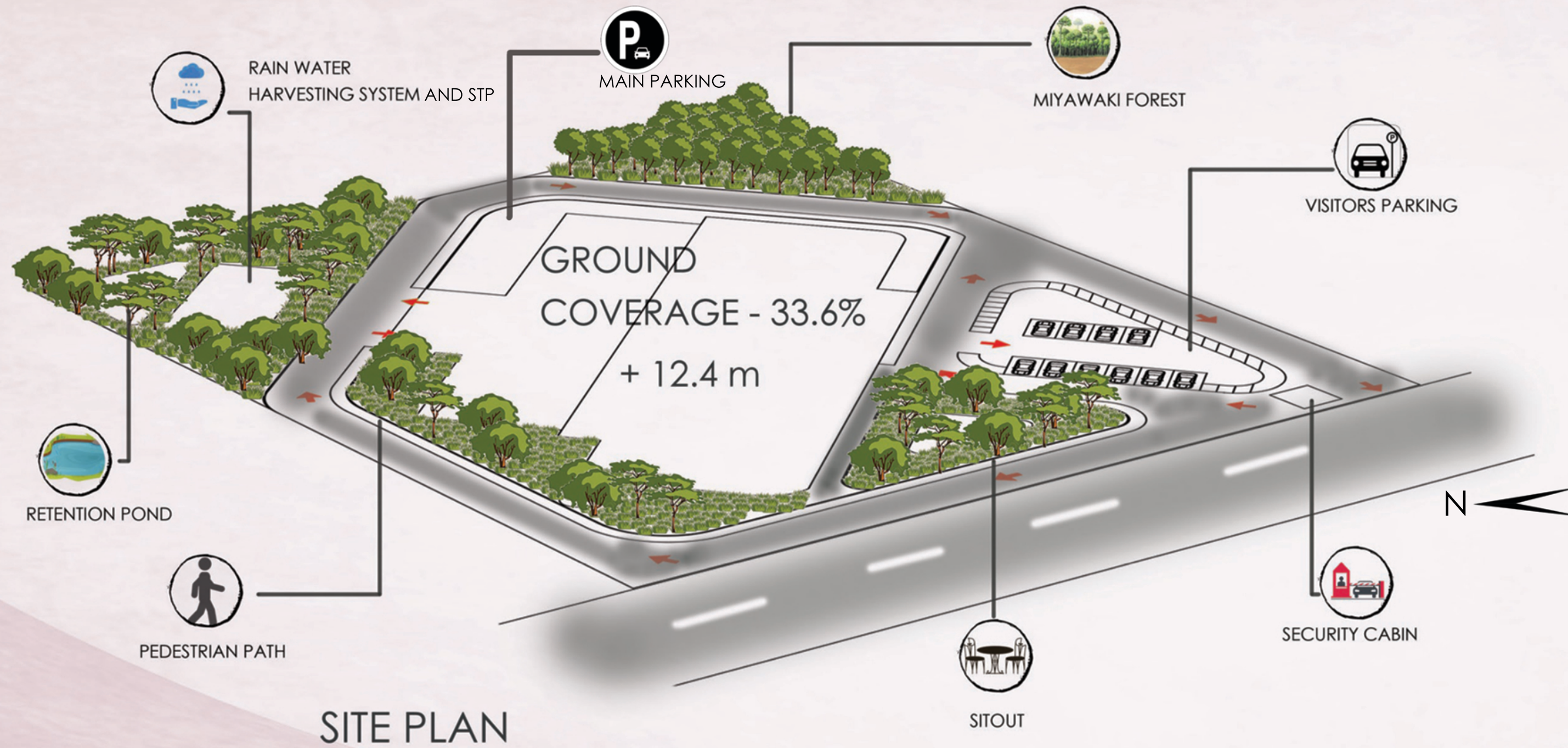
FRONT ELEVATION



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NORTH WEST ELEVATION



NORTH WEST SECTION



#### NATIVE VEGETATION IN LANDSCAPE



*Albizia lebbeck*  
Siris tree



*Cycus revolute*  
Sago palm



*Albizia saman*  
Rain tree



*Dalbergia sissoo*  
North indian rose wood

#### OUTDOOR PLANTS THAT REQUIRE LESS WATER



*Lagerstroemia*  
Banaba tree



*Butea monosperma*  
Sacred tree



*Bauhinia monandra*  
Orchid tree

#### INDOOR PLANTS



Moneyplant



*Dracaena trifasciata*  
Snake plant



Areca palm

#### CHINNI KHANNAS

Chini khanas are vernacular element where cascade falls against a lit arched niches behind them to give an exotic look during night time.



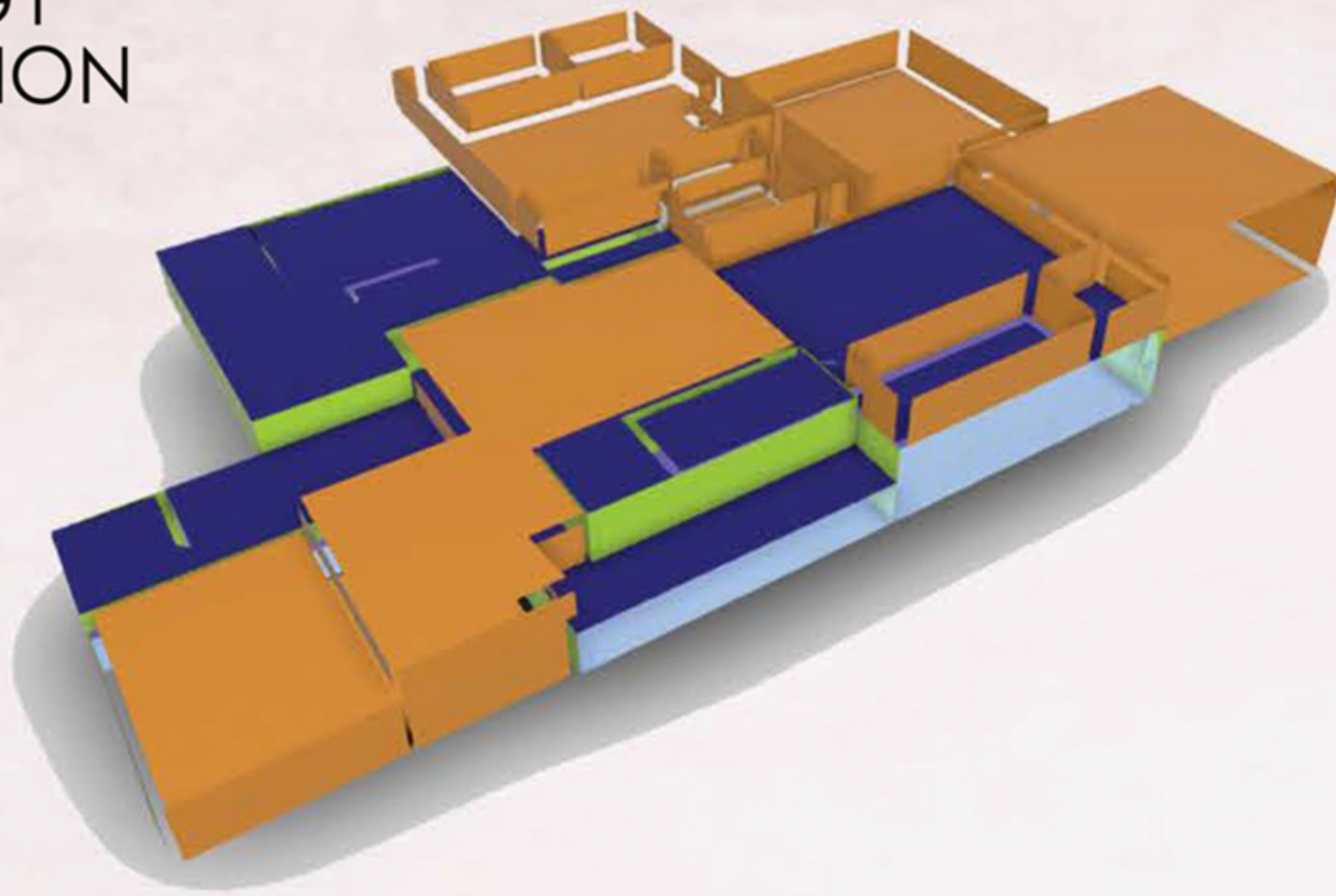
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## ENERGY SIMULATION



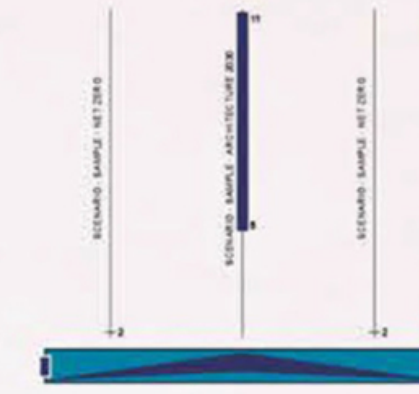
## BENCH MARK COMPARISON

Current setting -  
R 38 Construction



## MODEL HISTORY

Current setting -  
R 38 Construction



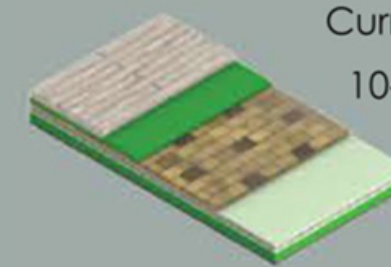
## BUILDING ORIENTATION

CURRENT SETTING : 225



## ROOF CONSTRUCTION

Current setting -  
10-25 inch SIP



## INFILTRATION

Current setting -  
BIM



## WALL CONSTRUCTION

Current setting -  
R 38 Construction



## WWR - NORTHERN WALLS

Current setting -30%

## WWR - SOUTHERN WALLS

Current setting -30%

## WWR - WESTERN WALLS

Current setting -15%

## WWR - EASTERN WALLS

Current setting -15%

## WINDOW SHADES - NORTH

Current setting -2/3 win  
height

## WINDOW - SOUTH SHADES

Current setting -2/3 win  
height

## WINDOW SHADES - WEST

Current setting -2/3 win  
height

## WINDOW SHADES - EAST

Current setting -2/3 win  
height

## WINDOW GLASS - NORTH

Current setting - Trp loE

## WINDOW GLASS - SOUTH

Current setting - Trp loE

## WINDOW GLASS - WEST

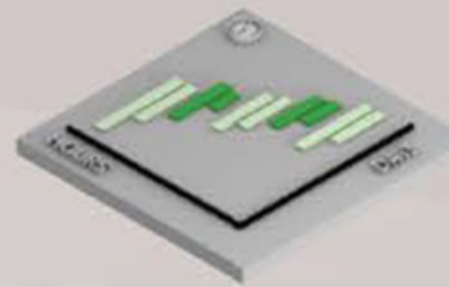
Current setting - Trp loE

## WINDOW GLASS - EAST

Current setting - Trp loE

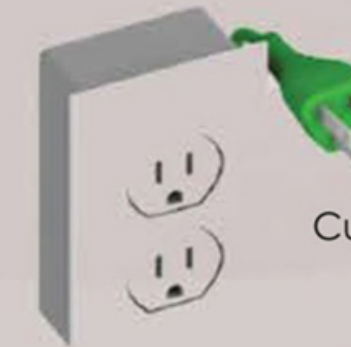
## OPERATING SCHEDULE

Current setting - BIM



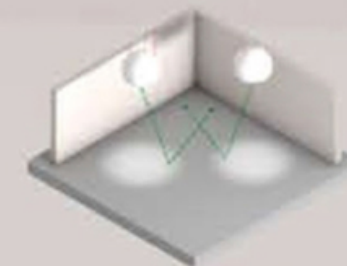
## PLUG LOAD EFFICIENCY

Current setting -  
10.76 W/m2



## LIGHT EFFICIENCY

Current setting -  
7.53 W/m2



## DAYLIGHTING AND OCCUPANCY CONTROLS

Current setting -  
occupancy controls



## PV - PAYBACK LIMIT

Current setting - 30 yr

## PV - SURFACE STORAGE

Current setting - 90%

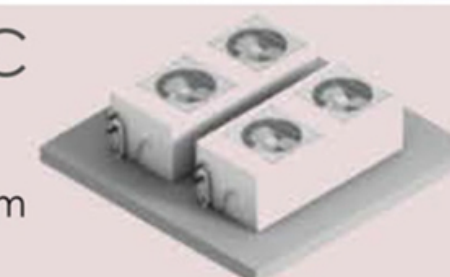


## PV - PANEL EFFICIENCY

Current setting - 20.4%

## HVAC

High efficient  
package system



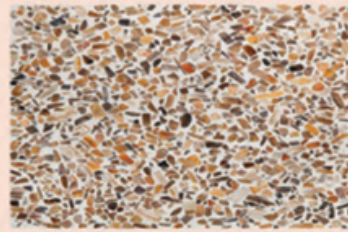
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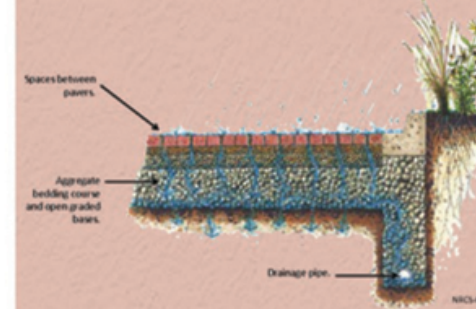


## MOSAIC FLOORING



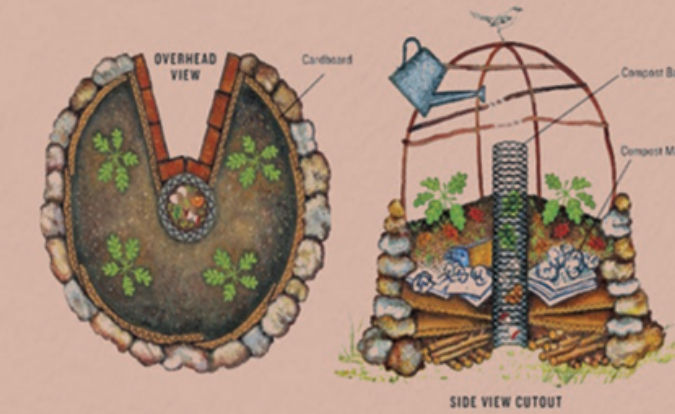
Mosaic has a rich history that dates thousands of years, and is one of the original sustainable products to create low resource, low maintenance, high visual impact mosaic imagery and durability

## PERMEABLE PAVEMENT



Permeable pavement is provided to allow water infiltration through surfaces, rain and snow may then recharge the groundwater table, and air may pass through to nourish the roots of grass and trees.

## KEYHOLE GARDEN



Keyhole gardens allow gardeners to add uncooked vegetable scraps, greywater, and manure into a composting basket that sits in the centre of the bed converted into manure and nutrients.

## MIYAWAKI MOVEMENT



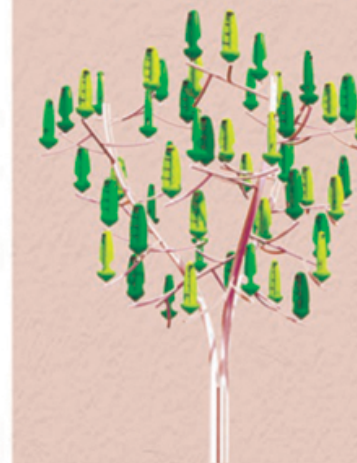
The Miyawaki forests grow in two to three years and are self-sustaining. This helps to reduce the temperatures heat islands like Ghaziabad, reduce air and noise pollution, attract local birds and insects, and create carbon sinks.

## FILLER SLAB



Filler slab is the portion of concrete replaced by low cost, light weight filler material like mangalore tile, clay pots etc to maintain the temperature lower than the outdoor area.

## WIND TREE



Wind energy Tree uses tiny blades housed in the aero leaves to generate power from wind energy. This is used for the lamp post of the premises

## GEO THERMAL HEAT PUMP

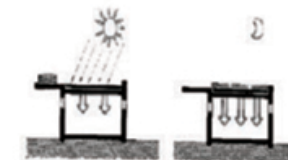


Geothermal heat pumps are used for space heating and cooling, as well as water heating

## ROOF POND SYSTEM

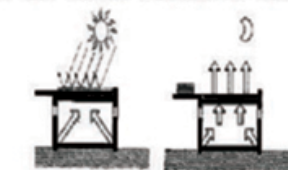
As Ghaziabad has extremely hot summer and cold winter, we need to adapt both the climate. The roof pond is a system that passively incorporates water elements to passively cool and heat the building.

### Winter heating cycle



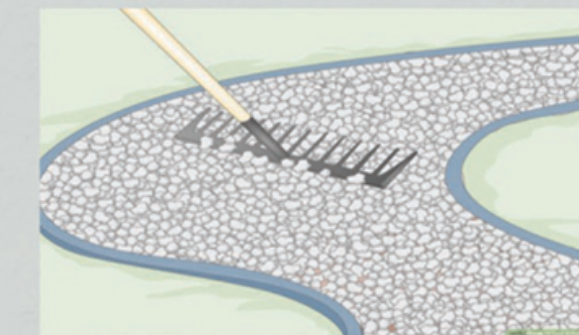
The uncovered roof draws heat during day time to collect solar heat in the water bags. The covered roof then radiates the heat from the water bag to the interior of the house during night time.

### Summer cooling cycle



The uncovered roof expose the water bag to the sky. The water bag radiates absorbed heat into the air during night time. The uncovered roof keeps heat out and the indoor space cool during day time.

## TOP SOIL PRESERVATION



Laying pebbles over soil makes sure that the soil doesn't get eroded by rain or damaged from over-exposure to sunlight. When vehicles enter into the building, the pollutants or any other contaminants gets filtered through the pebbles and the soil fertility is retained. Gardening pebbles also last longer than grass and they are easier to manage

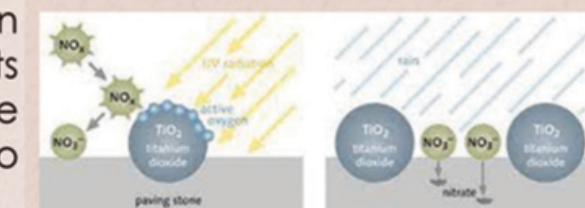
## WHEEL CHAIR LIFT



A stair lift is a sufficiently wide mechanical stairs, where a rail is mounted to the treads of the stair with a chair attached to it. Handicapped people gets onto the chair and is lifted up or down the stairs by the chair which moves along the rail

## SMOG EATING CONCRETE

A photocatalytic additive, dioxide, in the presence of sunlight gets activated and reacts with the pollutants to neutralize them into harmless salts.



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## SOLAR PANELS



VRooftop panels supply electricity to buildings, so they need to buy less electricity from the grid thereby saving on energy costs.

## LED LIGHTING



## LED lighting

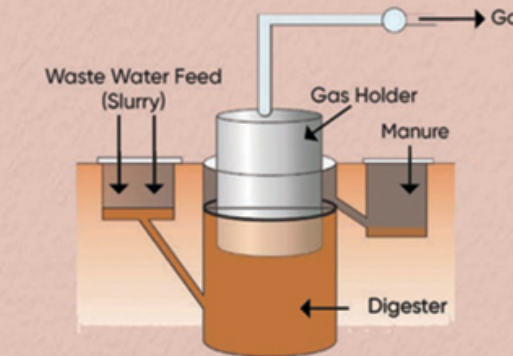
LED lights are up to 80% more efficient than traditional lighting such as fluorescent and incandescent lights and are used for interiors.

## GREEN WALLS



The interior and exterior living green walls acts as insulation during the summer and winter to maintain the cooler and hotter temperatures respectively.

## BIOGAS PLANT



Biogas is a renewable fuel produced by the breakdown of organic matter such as food scraps and animal waste which is converted into electricity and is used as vehicle fuel.

# BUILDING ENERGY MANAGEMENT SYSTEM



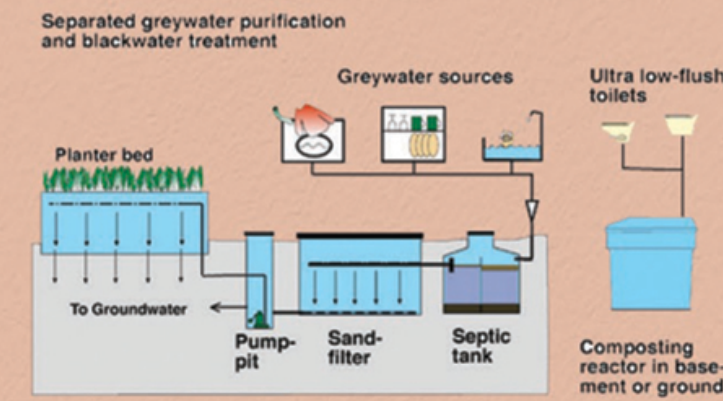
A Building Energy Management System (BeMS) monitors and controls energy powered services, such as air-conditioning, heating and ventilation, to ensure the building is operating at maximum levels of efficiency, whilst removing wasted energy usage and, in turn, associated costs.

## CATEGORISED DUSTBINS



To minimize soil pollution, the wastes such as paper, plastics, metals, glasses, organics, petroleum products and industrial effluents etc should be recycled and reused by categorised dustbins

## WATER TREATMENT



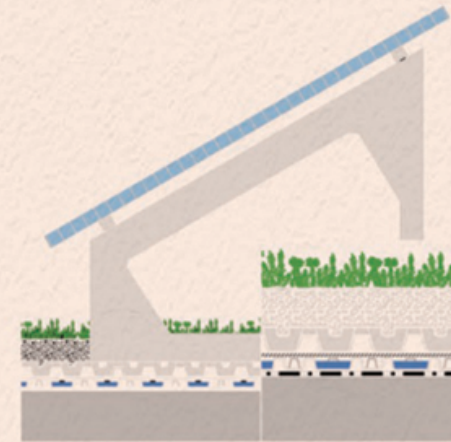
Grey water and black water are separately treated through dual plumbing system and used for suitable activities such as flushing, irrigation etc.

## PERMEABLE PAVEMENT



Permeable pavement is provided to allow water infiltration through surfaces, rain and snow may then recharge the groundwater table, and air may pass through to nourish the roots of grass and trees.

## SOLAR PANELS WITH GREEN ROOF



Solar panels incorporate solar energy into green roofs and create synergies. The performance of photovoltaic modules depends on the temperature of the modules and the surrounding ambient air temperature. The rule of thumb is: "the warmer the module, the lesser the performance". However, if combined with a green roof, solar modules will perform better. Through the cooling effect caused by evaporation at plant level, the ambient air temperature is cooler and photovoltaic cells improve their performance.

## SAFETY AND SECURITY



Construction workers are provided with proper safety measures like helmets , goggles , etc. for their safety in Site. Post construction building has installed CCTV cameras for the safety of office going people. Smoke detectors and fire alarm are set.





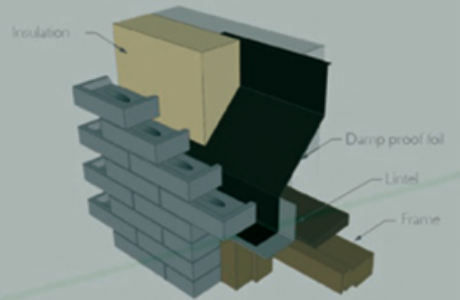
## MATERIALS THAT WOULD BRING CHANGE

### ECO Surfaces - Recycled rubber floor

Its low life cycle cost and ease of maintenance have made ECO surfaces products a alternative to VCT and carpeting. It has recycled content. ECO surfaces flooring is made from from post industrial waste and organic fillers. The result is an environmentally responsible commercial flooring that passes the strictest tests for indoor air quality, low VOC emissions and is recyclable.



### ZERO - Brick masonry without jointing



The new facing brick allows the use of traditional masonry to achieve a homogenous brick facade with almost no jointing. In addition to the clean aesthetic look, ZERO is also cost effective, given that jointing is no longer needed. Due to the lack of jointing, the facade will age more slowly. Also less mortar is required.

### Antimicrobial panels

It can be used in toilets and other crowded areas during this pandemic time to provide an efficient and long lasting protection against bacteria, mildew and acid.



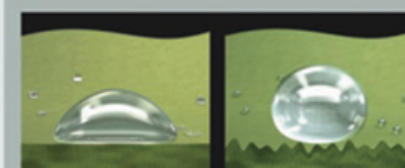
### Handloomed fabrics



This handloomed fabrics comprised of natural fibres . from wide variety of bamboo and grasses This creates a two dimensional fabric of polished finish and geometric refinement. This can be used for acoustics or window screen

### Protective textile finish

The natural non stick and cleaning process also known as the self cleaning effect helps repel water and stains, stay clean for longer need less care and .have a longer service life



## SUSTAINABLE SITE PLANNING

- ✓ Criteria 1 : Site Selection
- ✓ Criteria 2 : Preservation & Protection of Landscape during Construction
- ✓ Criteria 3 : Soil Conservation ( Post Construction )
- Criteria 4: Design to include existing site features.
- ✓ Criteria 5 : Reduce hard paving on site.
- ✓ Criteria 7 : Optimize on site circulation efficiency.

## WATER MANAGEMENT

- ✓ Criteria 10 : Reduce landscape water requirements.
- ✓ Criteria 11 : Reduce building water use.
- ✓ Criteria 12 : Efficient water use during construction.
- ✓ Criteria 20 : Waste water treatment.
- ✓ Criteria 21 : Water recycle and reuse.

## ENERGY OPTIMIZATION

- ✓ Criteria 6 : Enhance outdoor lighting system efficiency.
- ✓ Criteria 13 : Optimize building design to reduce conventional energy demand.
- ✓ Criteria 14 : Optimize energy performance of building within specified comfort limits
- ✓ Criteria 18 : Renewable energy utilization
- ✓ Criteria 19 : Renewable energy based hot water system.

## SUSTAINABLE BUILDING MATERIALS

- ✓ Criteria 15 : Utilization of fly-ash or equivalent industrial/agricultural waste as recommended by BIS in building structures.

- ✓ Criteria 16 : Reduce embodied energy of instruction by adopting material efficient technologies and low-energy materials.

- ✓ Criteria 17 : Use low energy materials for interiors.

## WASTE MANAGEMENT

- ✓ Criteria 22 : Reduction of waste during construction.
- ✓ Criteria 23 : Efficient waste segregation.
- ✓ Criteria 24 : Storage and disposal of waste
- ✓ Criteria 25 : Resource recovery from waste

## HEALTH AND WELL-BEING

- ✓ Criteria 8 : Provide safety for construction workers.
- ✓ Criteria 9 : Reduce air-pollution during construction
- ✓ Criteria 26 : Use Low VOC paints and adhesives
- ✓ Criteria 27 : Minimise ozone depleting substance
- ✓ Criteria 28 : Ensure water quality
- ✓ Criteria 29 : Ensure acceptable noise levels
- ✓ Criteria 30 : Tobacco and smoke control
- ✓ Criteria 31 : Universal accessibility

## BUILDING OPERATION AND MAINTENANCE

- ✓ Criteria 32 : Energy audit and validation
- ✓ Criteria 33 : O & M protocol for operation and maintenance of the various systems in the building.

## INNOVATION

- ✓ Criteria 34 : Innovation.



# DETAILED LCC CALCULATION

DESCRIPTION	LENGTH	WIDTH	HEIGHT	QUANTITY	TOTAL	UNIT	RATE	GRAND TOTAL
EXCAVATION	2.2	2.2	2.1	10.164	50	M 3	75	38115
PCC	1.2	1.2	0.1	0.144	50	M 3	2500	18000
FOOTING	1	1	0.5	0.5	50	M 3	4000	100000
PEDESTAL	0.3	0.3	2.5	0.225	50	M 3	4000	45000
PLINTH BEAM								
PB 1	72	0.3	0.5	10.8	2	M 3	4000	86400
PB 2	18	0.3	0.5	2.7	7	M 3	4000	75600
PB 3	7	0.3	0.5	1.05	2	M 3	4000	8400
PB 4	6	0.3	0.5	0.9	1	M 3	4000	3600
FLOOR SLAB								
G.F. SLAB	72	18	0.1	129.6	1	M 3	4000	518400
G.F. SLAB	18	7	0.1	12.6	1	M 3	4000	50400
FLOOR SLAB COLUMN MINUS	0.3	0.3	0.1	0.009	50	M 3	4000	1800
GF COLUMN	0.3	0.3	3.5	0.315	50	M 3	4000	
ROOF BEAM								
RB1	72	0.3	0.1	2.16	2	M 3	4000	17280
RB2	18	0.3	0.1	0.54	7	M 3	4000	15120
RB3	7	0.3	0.1	0.21	2	M 3	4000	1680
RB4	6	0.3	0.1	0.18	1	M 3	4000	720
ROOF SLAB								
GF ROOF SLAB	72	18	0.18	233.28	1	M 3	4000	933120
GF ROOF SLAB	18	7	0.18	22.68	1	M 3	4000	90720
BRI CKWORK								
WALL 1	150	0.1	3.5	52.5	1	M 3	5,000	262500
WALL 2	110	0.1	3.5	38.5	1	M 3	5,000	192500
WINDOW DEDUCTION								
RIBBON WINDOW	17.53	0.1	1.2	2.1036	1	M 3	5000	10518
DOOR	3.15	0.1	2.6	0.819	4	M 3	5000	16380
GLASS PANEL 1	7.113	0.1	2.5	1.77825	1	M 3	5000	8891.25
GLASS PANEL 2	7.113	0.1	2.5	1.77825	2	M 3	5001	17786.0565
GLASS PANEL 3	7.113	0.1	2.5	1.77825	3	M 3	5002	26684.4195
PLASTER								
OUTER PLASTER	122		4	488	1	M 2	150	73200
INNER PLASTER	180		3.5	630	1	M 2	150	94500
WINDOW DEDUCTION								
RIBBON WINDOW	17.53	0	1.2	21.036	1	M 3	150	3155.4
GLASS PANEL 1	7.113	0.1	2.5	1.77825	1	M 3	5000	8891.25
GLASS PANEL 2	7.113	0.1	2.5	1.77825	2	M 3	5001	17786.0565
GLASS PANEL 3	7.113	0.1	2.5	1.77825	3	M 3	5002	26684.4195
TILES	72	33.236		2392.992	1	M 2	250	598248
DOOR	3.15	0.02	2.6		4	M 3	1600	6400
RIBBON WINDOW	1	0.02	1.2		17	M 3	600	10200
GLASS PANEL					6	M 3	1000	6000

TOTAL CALCULATION		
GL		3170527
LVL 1		528000
LVL 2		333400
LVL 3		950000
LVL 4		424000
LVL 5		460382
LVL 6		361990
TOTAL		6228299
TOTAL BUILDING COST		62,28,299 RS
SIXTY TWO LAKHS TWENTY EIGHT THOUSAND TWO HUNDRED NINETY N		
ELECTRICITY DESCRIPTION	NOS	KW/YEAR
AIR CONDITIONER	22	2772
STAIR LIFT	8	69.12
L.E.D LIGHTS	175	55125
E.E FANS	34	1292
LIFT	1	3000
OTHER [MORTARS, BEMS, ETC]		33482
TOTAL		95740.12
TOTAL ENERGY CONSUMED		95740.12 KW/YEAR
TOTAL ENERGY CONSUMED BY OTHER BUILDINGS		1436100 KW/YEAR
ENERGY REDUCTION		
SOLAR PANELS	849720 KW/YR	648 PANELS {300W}
TERRACOTA TOWER		40% ENERGY REDUCTION
GEO THERMAL HEAT PUMP		20% ENERGY REDUCTION
WIND ENERGY TREE		10% ENERGY REDUCTION
HYDRO POWER		10% ENERGY REDUCTION

## CONCLUSION

- The GST building of Ghaziabad is designed by using GRIHA V-Rated system satisfying most of the criterias.
- The total energy consumption of our building is reduced by 80%.
- Sustainable vernacular elements are also used to help decrease the energy consumption.
- We have played in levels and the building is being orientated with respect to the site's climate analysis.