TEAM
NETshunya

FINAL DESIGN REPORT - APRIL 2023

COMMUNITY RESILIENCE SHELTER

VIVEKANAND EDUCATION SOCIETY
College of Architecture

VIVEKANAND EDUCATION SOCIETY'S
Institute of Technology

Solar Decathlon India

UN HABITAT
FOR A BETTER URBAN FUTURE

LIST OF CONTENTS

RESPONSE TO REVIEWERS COMMENTS

CONTEXT	REVIEW	RESPONSE
ENERGY PERFORMANCE	-Clear comparison between the base and proposed cases -Energy efficiency achieved after application of each strategy.	Kindly refer to page no. ----
	-Not clear how energy and comfort related analysis has been used to make design decisions. -sufficient daylight analysis to show glare free usable daylight in the space. -The natural ventilation strategy hasn't been explained.	Daylight simulation have been updated
WATER PERFORMANCE	- calculations to show percentage efficiency in water consumption.	Kindly refer to page no. ----
	-How compost toilets has been integrated in the design. -Please provide site level information and details relating to rainwater harvesting, collection and waste water treatment.	
EMBODIED CARBON	-Try including the emissions due to construction and practices adopted to reduce it.	Kindly refer to page no. ----
RESILIENT DESIGN	-Input conceptual drawings showing signages and fire extinguishers.	Plans have been updated with evacuation plan.
ENGINEERING AND OPERATIONS	-Should detail out electrical drawings and explore solid waste management.	Kindly refer to page no. ----
ARCHITECTURAL DESIGN	-Either revise your core or incorporate a 2nd staircase for emergency use.	Kindly refer to page no. ----
	-Show site context and surrounding . relate your design with site context.	
HEALTH AND WELLBEING	-Explain how Lighting loads can be reduced .Use an energy model to show how thermal comfort and indoor air quality is being achieved.	Kindly refer to page no. ----

The supposedly drastic climate changes not only cause floods, melting of glaciers, droughts, etc. but also do the work of shaking the ground beneath our feet; Even though such disasters keep destroying life and property along with mental health and peace of people around the world, there There are not enough resilient shelters to provide relief and reduce pain.-A disaster-resistant and community space structure will be designed with green and traditional materials with net-zero design strategies to blend with the existing traditional background of Nepal. The structure will fill the gap between urban and traditional settings which has evolved after the 2015 Nepal earthquake.

Our project 'Aashray' means creating shelter during danger we aimed to bring to life a disaster resilience shelter along with keeping the cultural and emotional values of the community alive. Our site near Ratho Machhendranath Temple (now destroyed) in Bungamati, Nepal lies in a cold region that was severely affected during the Gorkha Earthquake of 2015.

To tackle the problem of earthquake and fire, we opted for the age-old construction technique of rammed-earth construction with steel reinforcements. Use of collar bands at intervals, interlocking joineries, and tongue and groove joints, to ensure that the structure stands strong. We evolved our design around the concept of a strong; and heavy central core.

The Energy and Water Consumption in Aashray is heavily influenced by the number of occupants which is different during the disaster and non-disaster scenarios, During non-disaster days, Aashray caters to 200 people which primarily consists of tourists, artisans, and staff. The prime function-of-Aashray during this scenario is as a community center and workshop. Wood carving- has been an ancient art of Newari The community is promoted in Aashray. During disaster days, Aashray caters to 300 people. The administration staff and the artisans, who are the regular users, would be trained to assist others and maintain the decorum.

The design has evolved based on CFD, Simulation-and-Daylighting analysis. The EPI of Aashray-is-15.5. KWh/m²/yr. The solar PV array generates 38017.6 kWh/yr helping us attain a net positive design. Energy Consumption is reduced by using energy-efficient appliances. Bungamati faces the challenge of safe drinking water supply and sanitation: So we have reduced the water usage by using efficient fixtures. To generate safe drinking water, we have used VayuJal's Atmospheric Water Generator which generates 184KL, and rainwater harvesting system which generates 414K L.

2.0 TEAM SUMMARY

2.1 TEAM NAME : NETshunya

Shunya' is a Sanskrit word for zero meaning - emptiness or void. It is the balance between positive and negative forming an equilibrium. Alternatively, it is infinite with a beginning nor end. The way adding a zero to any integer brings a change to its value, our team 'NETshunya' aims to bring a change in the current environmental condition and concerns with innovation.

2.2 DIVISION : Community Resilience Shelter

2.3 INSTITUTION :

VIVEKANAND EDUCATION SOCIETY College of Architecture

Vivekanand Education Society College of Architecture (VESCOA) aims to sensitize the students towards building a sustainable human habitat and achieve excellence in education.

VIVEKANAND EDUCATION SOCIETY'S Institute of Technology

Vivekanand Education Society's Institute of Technology (VESIT) aims for providing professional education in the field of Engineering.

2.4 PROJECT PARTNER :

UN HABITAT FOR A BETTER URBAN FUTURE

The UN-Habitat's vision of "a better quality of life for all in an urbanizing world" is bold and ambitious. UN-Habitat works with partners to build safe, inclusive, resilient, and sustainable cities and communities. UN-Habitat promotes urbanization as a positive transformative force for people and communities, reducing inequality, discrimination, and poverty.

2.5 TEAM MEMBERS :

Dhruv Takale
3rd Year B.Arch
Team leader

Shravani Ghaware
3rd Year B.Arch
Team Member

Himisha Patel
2nd Year B.Arch
Team Member

Siddhesh Sinkar
2nd Year B.Arch
Team Member

Nidhi Nair
4th Year VESIT
Team Member

Ritesh Deogharkar
2nd Year B.Arch
Team Member

C.S Lakshmi
3rd Year VESIT
Team Member

Ishaan Sharma
4th Year VESIT
Team Member

2.6 FACULTY ADVISOR :

FACULTY HEAD
Ar. Ajit Nirmal
(Assistant Professor)

He has been involved in research,academics and professional work with scholarships and awards for academic excellence and commitment.

FACULTY ADVISOR
Prof. Shirish Deshpande

Practising as Energy and Green Building Consultant since 2002. Graduate in Chemical Engineering with an experience of 30 years, LEED-AP, Certified energy-auditor from Gov. of India.

FACULTY ADVISOR
Dr.Prof. Anand Achari
(Principal VESCOA)

His primary focus of teaching is towards environmental architecture and sustainability. Head of Department of Post Graduate course at University of Mumbai.

Special Thanks :

To Simulation Expert - Mr. Jayesh vora sir From ECPL

2.7 INDUSTRY PARTNER

VayuJal is an IIT Madras- incubated company that is dedicated to deliver quality drinkable water, extracted out of thin air. VayuJal's Atmospheric Water Generators (AWGs) nano-technology-based are personalized on-demand water generators that can generate and provide quality drinking water whenever required, eliminating dependance on any other water source.

2.8 TEAM APPROACH

UNDERSTANDING AND FINALISING OF SITE
Good knowledge of site history and mapping the surrounding with context.

RESEARCH AND FINALISING
Selection of site given by UN-Habitat(SDI)

GUIDANCE FROM FACULTY
Discussions at every step after progress exposure to newer technology.

WORK ALLOCATION
Distribution of work according to individual's forte.

APPROACH TOWARDS PROJECT
Introduction of team members discussions idea and inputs.

DATA COLLECTION
Going through research papers.

SOLAR DECATHLON GUIDANCE
Webinars with Q&As learning module with quizzes.

REPORT SUBMISSION
Presenting data in a concise manner for better understanding of the programme.

PRE-DESIGN AND DESIGN
Site , climate and user analysis, creation of volumes and massing to come up with multifunctional space making.

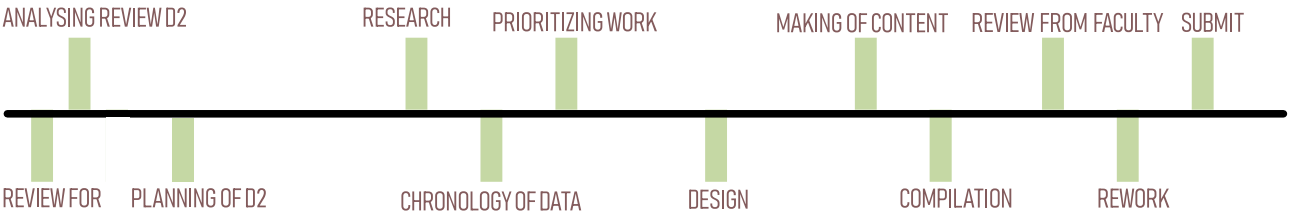
TRIAL AND ERROR
Going back and forth the process to identify errors.

INCLUSION OF 10 CONTEXT
Emphasis on water and energy, breaking the process into smaller bits to understand in every context.

COMPILATION OF DATA
Compilation of various calculation charts and write-ups.

PROCESS OF FREEZING THE DESIGN
Design with passive strategy implication with innovation and existing technology.

2.9 PROCESS



3.0 TOOLS USED

SketchUp · Design Builder · Photoshop · ArchiCAD · Adobe Premeire · PowerPoint · Google Earth Pro

Climate consultant · Enscape · CoralDRAW · QGIS · AutoCAD

3.1 PROJECT NAME: AASHRAY

'Aashray' is a project developed to provide rest shelter to people during and post disaster This project houses a community hall which is used as a centre for local carpenters and conduct workshops to help themselves economically and as a traditional community space for celebrating festivals. The place will become a tourist attraction because of the reconstruction of existing temple as well as exhibition of crafts and culture of Newari Community. Aashray is designed to be earthquake and fire resistant. During Disaster, the footfall is 700 while on regular days, it is 280.

CULTURE OF BUNGAMATI:

Bungamati - an ancient and historical newari village is filled with traditional houses. It is famous for its Community hall - Dyo-chen which was destroyed in 2015 earthquake. Houses are richly designed and it is renowned for skilled wood carving.

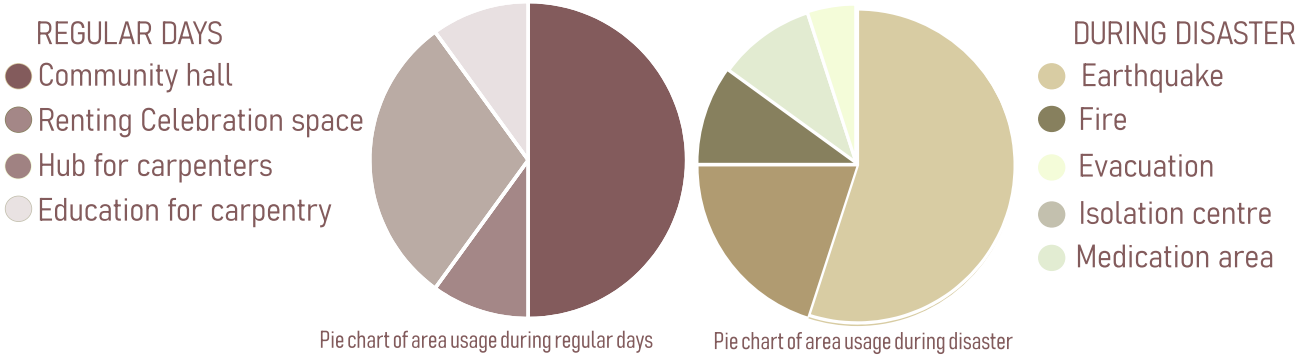
3.2 SITE TRANSFORMATION

SITE BEFORE 2015 EARTHQUAKE

SITE AFTER 2015 EARTHQUAKE

DEBRIS ON-SITE

3.3 USE OF SPACES DURING DISASTER AND ON REGULAR DAYS



Pie chart of area usage during regular days

Pie chart of area usage during disaster

USER ANALYSIS

After the 2015 Gorkha earthquake the existing structure on site got demolished due to the massive tremors this debris generated onsite can be used for construction.

3.4 RESOURCES AVAILABLE ON-SITE POST EARTHQUAKE

Proportion of on-site available resources post 2015 earthquake

Bungamati is a peri-urban region, it is known for it rich culture and heritage out of which the majority is Newari Community. Wood Crafting is the major occupation for this community. As Rato Machindranath is a major tourist attraction in the locality hence the chowk has high footfall throughout the year. Rice is the case crop of nepal and chowk being the only open area in the town rice husk shedding is done in the chowk.

3.5 PROJECT PARTNER REQUIREMENT

-Building Height-restricted to 35' maximum.
-The-roof-needs to be sloped with traditional clay-tiles. Only 33% of the roof area is allowed to be flat.
-Use of traditional/green-construction materials as far as applicable.
-Wooden Doors & Windows needs to be used - No Glazing...
-Preferably load-bearing structures however need to be earthquake resistant.
-Allowed 100% coverage on site.
-The design should not be limited to the building only. Approach to facilitate the neighbourhood "Chowk" is also preferred.
-Should embody a well-equipped fire-fighting system needs to be designed in the area as well.
-The main objective of the building is to re- construct the building in a traditional fashion giving high value to religious and cultural activities.
--The building needs to operate as an isolation center during emergencies.
-The building needs to be running 24x7 with the proposal of different activities.

3.6 BRIEF DESCRIPTION

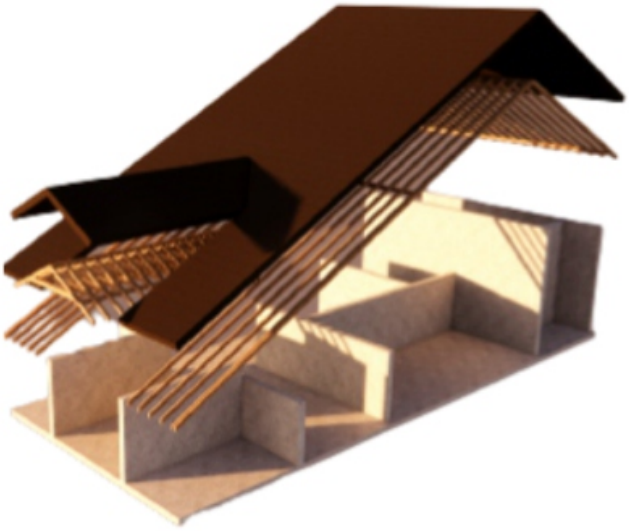
Site Area-304.2 m2
Permissible Build up Area - 805m2
Proposed Permissible Build-up Area- 805m2
Permissible Ground Cover - 91%

TARGET EPI: 30kWh/m2/year

WAYS OF REDUCING EPI: Building Orientation-Shading devices
-Using wooden windows which is an insulating material
-Multilayered wall which acts as an insulation.
- reducing the dependence on appliances.
-Using solar heaters and solar panels for energy generation..

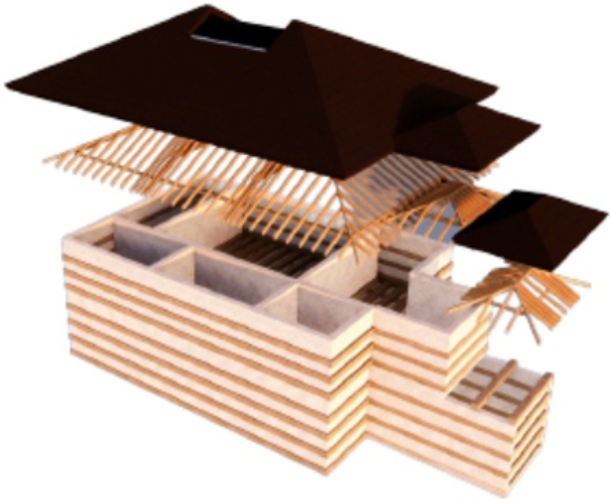
 RESILIENCE	AIM : **To provide resilience against Earthquake and Fire.** STRATEGIES : Proposing Rammed earth wall with steel reinforcement to resist the vibration during Earthquake, Also which provides Four Rating Fire Resistance. Provision of 0.09kg Non-perishable Food items to 700 occupants during earthquake.
 ENERGY PERFORMANCE	AIM : **To reduce the Energy Consumption of Aashray.** STRATEGIES : Providing Solar panels which would produce 38000.7 kWh Energy Annually. 38 % of EPI we reduced from base case to proposed case by providing openings and light shafts.
 WATER PERFORMACNCE	AIM : **To reduce the water dependancy on Municipal water supply.** STRATEGIES : Reducing 65% Water Usage by Providing compost toilets, Waterless urinals and water-efficient fixtures. Provision of 1,07,000 Litres capacity storage tank for rainwater harvesting. Using AWG, Producing __L of fresh drinking water.
 EMBODIED CARBON	AIM : **To reduce carbon emissions while constructing Aashray.** STRATEGIES : Analysing the bottle-neck diagram to locate down suppliers within 10km radius and using on-site debris for construction.
 ARCHITECTURAL DESIGN	AIM : **To design a space by considering the Users, Climate, Tradition and Culture of Nepal.** STRATEGIES : Designing habitable and non-habitable spaces with respect to climate and simulations. Creating joints which could be maintained and replaced by local carpenters if broken.
 ENGINEERING & OPERATIONS	AIM : **To provide Structural stability and Flexibility.** STRATEGIES : : Provision of separate foundations for central core and rammed earth wall after analysing shear force and BMD. Designing dampers for shock absorption during earthquake and joineries that can withstand.
 HEALTH AND WELL-BEING	AIM : **To provide thermal comfort and good quality air environment.** STRATEGIES : By following Ashrae 55 adaptive thermal comfort standard, encouraging Natural ventilation and Glare Free daylight, which would maintain inside operative temperature. Adding white pollen filters on openings to resist polluted air.
 INNOVATION	AIM : **To Innovate structural joineries resisting lateral vibrations.** STRATEGIES : Proposing light shaft for daylight as well as Collar bands at the corner of the walls. The concept of shinbashira in central core will be use for stability and penetrating light inside the structure.
 AFFORDABILITY	AIM : **To Reduce cost and enhance Affordability.** STRATEGIES : By Integration of passive heating strategies such as sun spaces, direct solar gain in room, Insulation layer in roof and wall, which avoids to use any Active strategy or HVAC system. Using local Cost effective materials.
 VALUE PROPOSITION	AIM : **To design a unique and sustainable structure.** STRATEGIES : Maintaining Wood carving Community at hierarchy. Using high footfall in chowk for generating revenue and Employment Opportunities.

DESIGN DEVELOPMENT OPTIONS

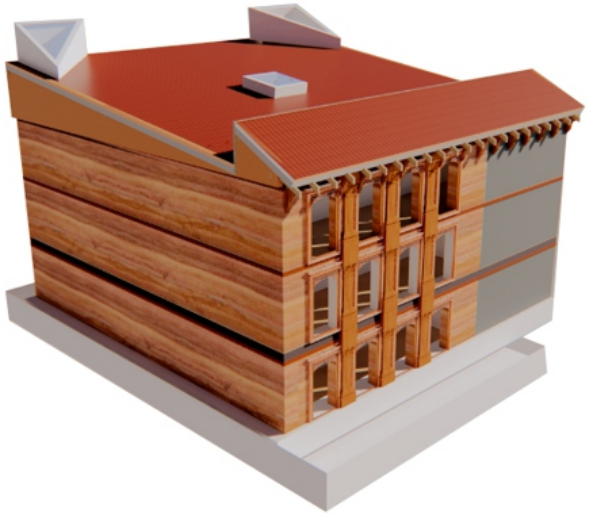


Option 1
- Lean-to-roof
- Massing not suitable for number of occupants.

Option 2
- Roof to store heat in attic
- Double height and massing not suitable for number of occupants.

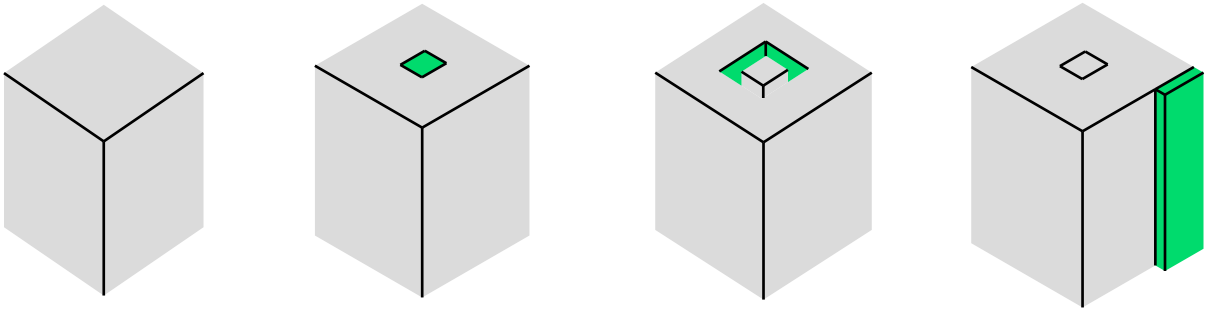


Option 3
- Grid for space and volume making not followed.



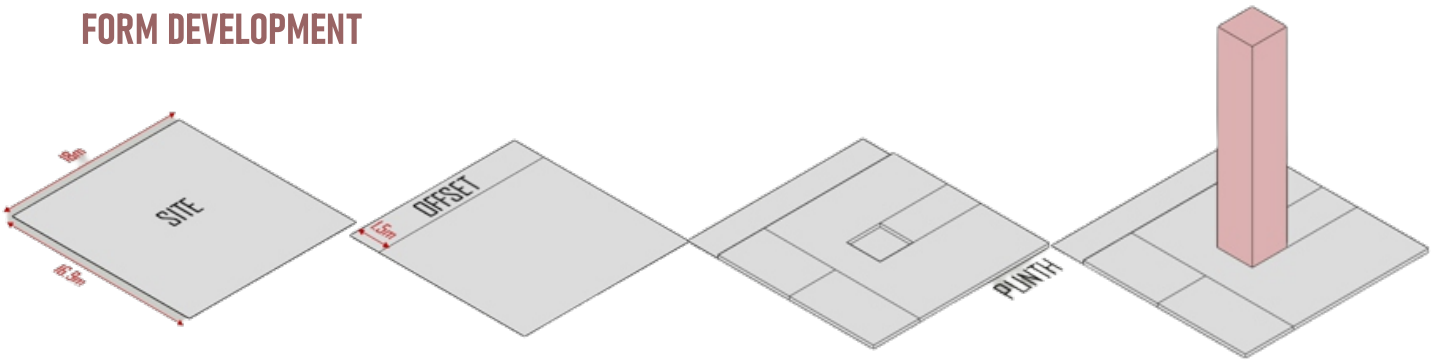
Option 4
- Roof for maintaining daylight in central core.
- Lean roof to maintain the architectural background of the place.

MASSING

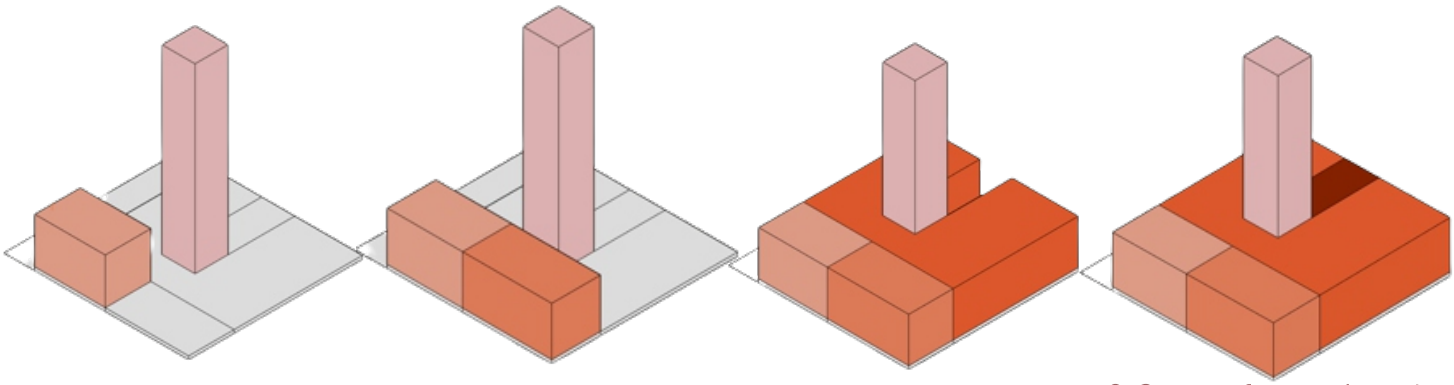


1. Cuboidal form
2. Central core formation
3. Buffer space for dampers
4. protruding form for toilet

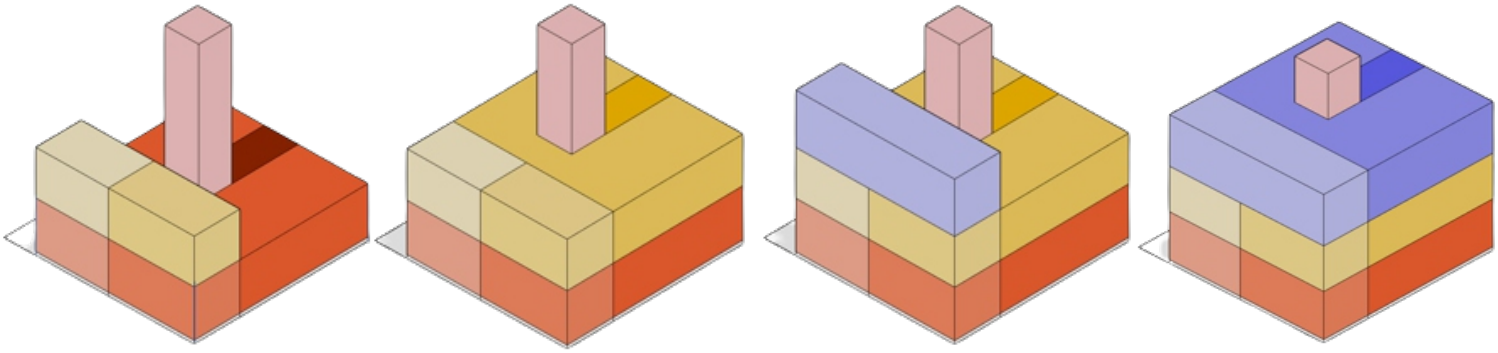
FORM DEVELOPMENT



1. Site boundary
2. Offset of 1.5m from existing building according to NBC.
3. Space and volume created according to the grid.
4. Central core acting as a vertical circulation and light shaft.



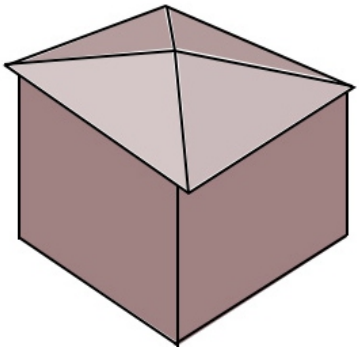
5. Entrance foyer
6. toilet bock
7. Community space
8. Storage for wood carving machinery and tools



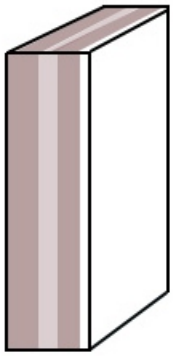
9. Balcony and toilet block
10. workshop area and kitchen with storage and seating
11. Admin block and balcony
12. Resting space with storage of goods.

REDUCTION IN CONSUMPTION :

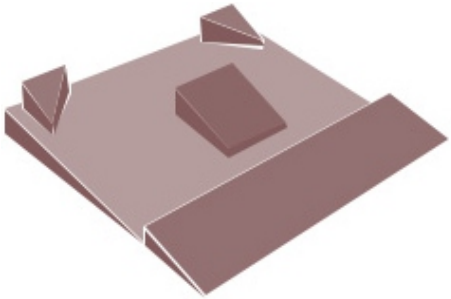
ECM(Energy conservation measures) - measures implemented at every step to reduce energy consumption in a building.



- Pitched roof to capture maximum solar radiation.
- rammed earth wall for high thermal mass(300mm thick).



- Rammed earth wall (optimum thermal mass) with XPS extruded polystyrene wood(70mm).
- internal finish with lime plaster.
- Better fixtures and appliances.



- Rammed earth wall (optimum thermal mass) with XPS extruded polystyrene wood(70mm).
- internal finish with lime plaster.
- Better fixtures and appliances.

ENERGY CONSUMPTION PER YEAR & REDUCTION IN EPI :

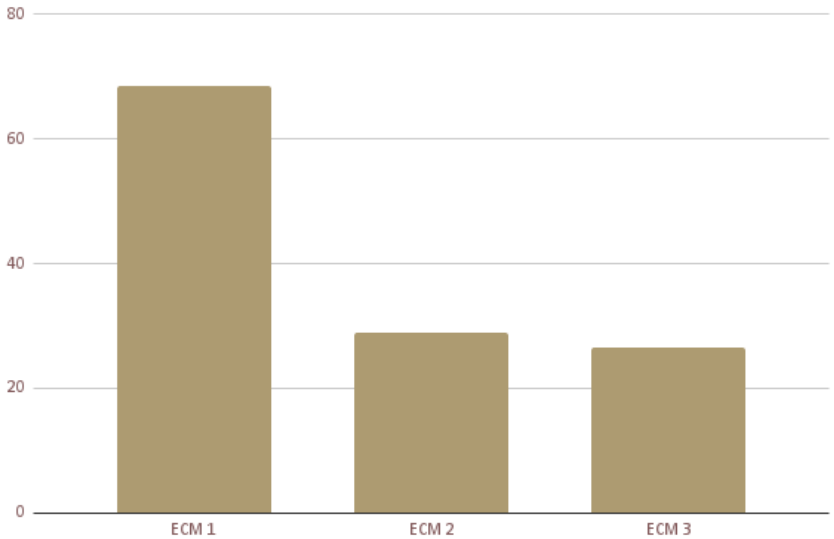
STEPS	BASE CASE (ECBC COMPLAINT)	PROPOSED CASE (ENERGY EFFICIENT APPLIANCES)	PROPOSED CASE (FINISHES)
ENERGY CONSUMPTION	48750 kWh/year	20500 kWh/year	18865 kWh/year
EPI REDUCTION	68.6 kWh/Year/m²	28.9 kWh/Year/m²	23.4 kWh/Year/m²

TARGET EPI - 30 kWh/m²

Measures taken to reduce EPI:
- Change in roof profile in order to generate solar energy.

-Use of light shaft and day lighting to reduce th dependance on fixtures wherever possible.

- Use of multilayered wall with insulation and finishes.



ECM Graph showing EPI reduction from base case to proposed case

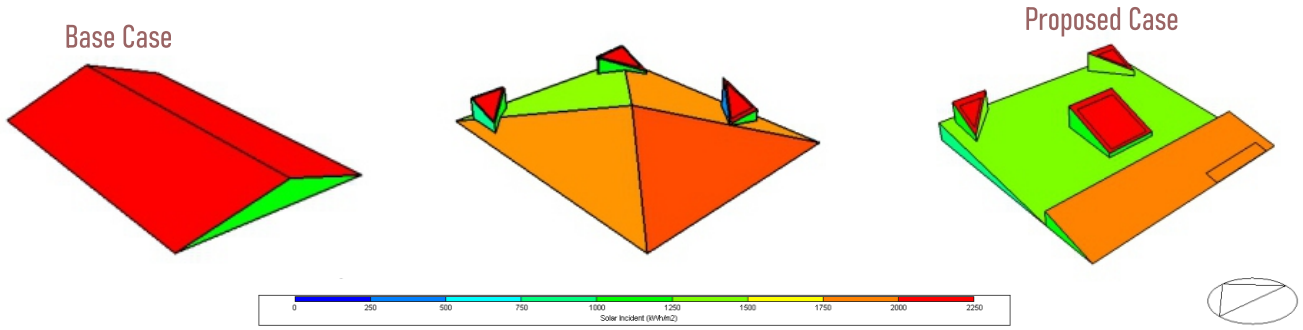
ENVELOPE OPTIMIZATION

	WALL	ROOF
STANDARD DESIGN	Rammed Earth(200mm +Lime Plaster(10mm) U-Value(w/m2-K) = 2.865	Clay Tile (25mm) + Wood(152.40mm) U-Value(w/m2 - K) = 0.726
PROPOSED DESIGN	Rammed Earth(200mm) + XPS Extruded polystyrene wood(70mm)+Rammed Earth(200mm) Lime Plaster(10mm) U-Value(w/m2-K) = 0.389	Clay Tile (25mm) + Straw bale (80mm) + XPS Extruded Polystrene (5mm) + Straw bale (80mm) + Oak Wood(20mm) + Lime Plaster (5mm) U-Value(w/m2 - K) = 0.179

*According to the ECBC standards U-value for assembly building is 0.34(w/m2-K)

Section of walling and roofing material with and without insulation

ROOF PROFILE OPTIMIZATION

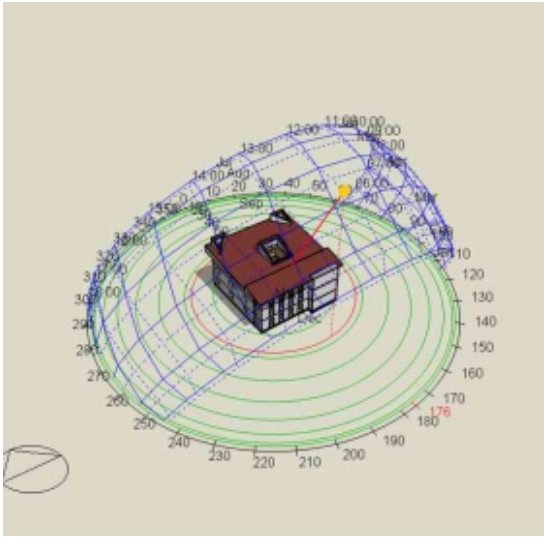


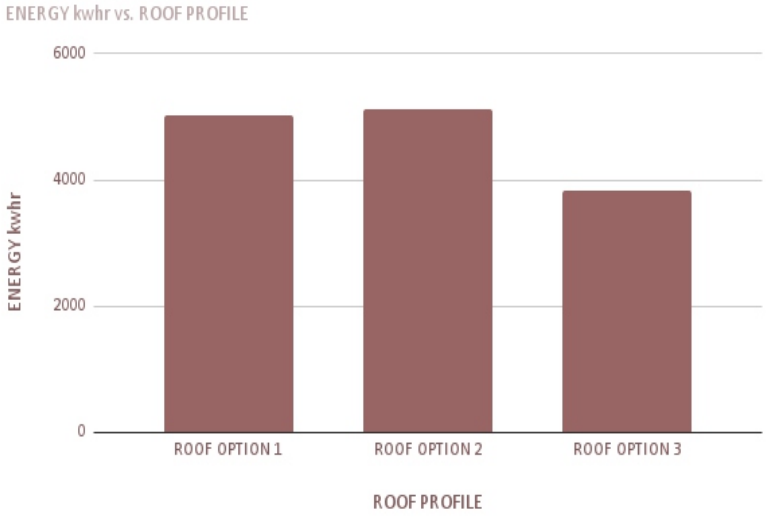
OPTION 1 - To capture maximum solar radiation.

OPTION 2 - Pitched roof to divide the weight of solar panels.
- Use of light shaft for incorporating daylight.

OPTION 3 - Use of lean-to-roof to maintain the traditional background.
- High efficiency solar panel around the skylight.
- Use of skylight for daylight to enter in central core.

PROPOSED DESIGN ON SUN PATH(EQUINOX)

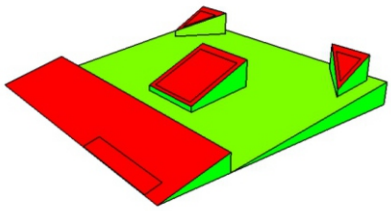




OPTIMIZED GENERATION

Solar Module Specification:
(Mono-crystalline -Photovoltaic modules).
Name: GPM250-290W(72)
Weight: 18.5kg
Dimension: 1575*992*35mm
-Module Area: 1.562m²
Module Efficiency: 15.52

Cell Efficiency: 17.12.
Frame Thickness: 35 mm
Quantity: 60 Modules
Frame Colour: Black



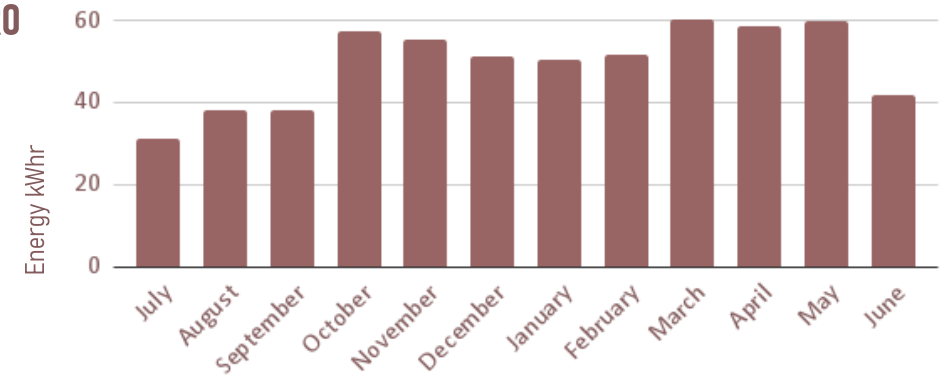
Months	Peak hours (hr)	Watt	Energy generated per day (kWhr)	Energy generated per month (kWhr)
July	4	250	1	31
August	4.9	250	1.225	37.98
September	5.1	250	1.275	38.25
October	7.4	250	1.85	57.35
November	7.4	250	1.85	55.5
December	6.6	250	1.65	51.15
January	6.5	250	1.625	50.38
February	7.4	250	1.85	51.8
March	7.8	250	1.95	60.45
April	7.8	250	1.95	58.5
May	7.7	250	1.925	59.68
June	5.6	250	1.4	42
Annual Generation by one module				594.025 kWh
Annual Generation by 64 modules				38017.6 kWh

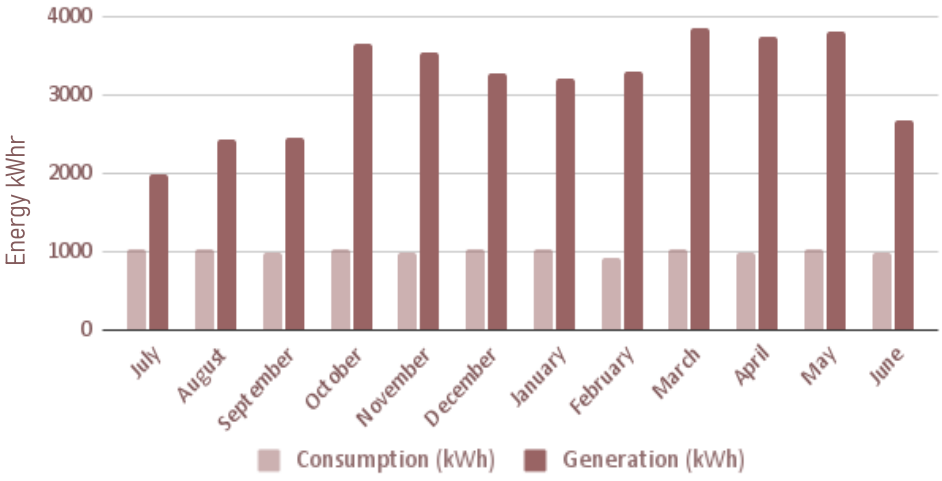
MEASURES TAKEN FOR NET-ZERO ENERGY :

- Surplus energy produced from solar panels.

- Energy efficient fixtures and appliances.

- Use of skylight and light shaft to reduce dependence on electricity.





WATER CONSUMPTION - PROPOSED CASE - NON-DISASTER SCENARIO

Muncipality Water Supply (L/day)	2,000

Occupants	280

Domestic Use (Fixed)	
Use LPD/Head	22
Number of people	24
Total LPD	528

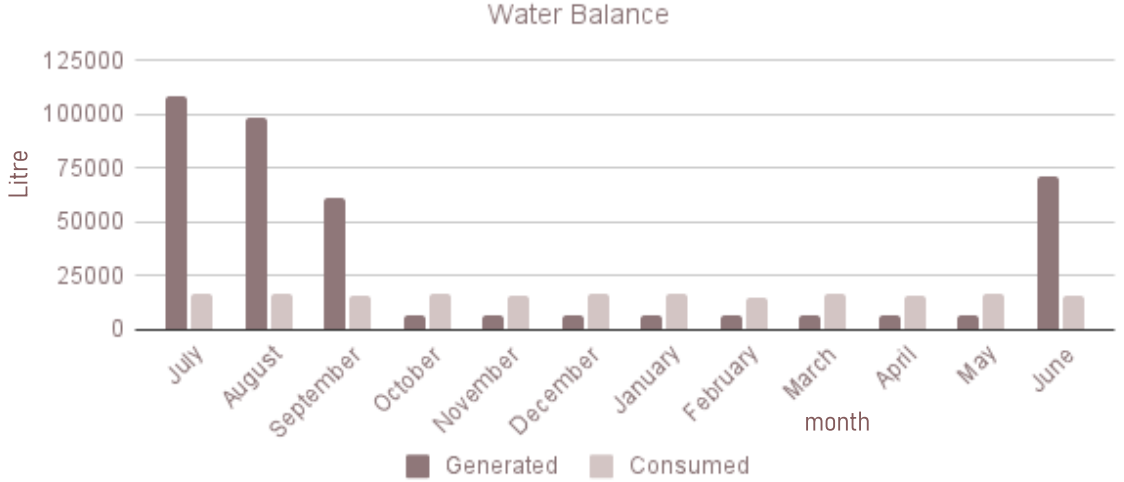
End Use	Percent Use	Use in LPD	Greywater in LPD	Blackwater in LPD
Cleaning	2%	11	11	
Washing Utensils	46%	243	243	
Basin	5%	26	26	
Drinking	23%	121		
Cooking	23%	121		
Health Faucet	2%	11		11
Toilet	0%	0		-
Total		533	280	11

Domestic Use (Visitors)	
Use LPD/Head	10.5
Number of people	256
Total LPD	2688

End Use	Percent Use	Use in LPD	Greywater in LPD	Blackwater in LPD
Cleaning	0%	0	-	
Washing Utensils	0%	0	-	
Basin	3%	81	81	
Drinking	48%	1290		
Cooking	48%	1290		
Health Faucet	1%	27		27
Toilet	0%	0		-
Total		2688	81	27

Detailed water consumption table

Months	Days in months	Domestic Use (kL)	Total Consumption (kL)	Municipal Water (kL)	Rainwater (kL)	Greywater (kL)	Blackwater (kL)	Total Stored (kL)
Jul	31	99.70	99.70	62.00	101.34	8.38	1.16	0.07
Aug	31	99.70	99.70	62.00	91.49	8.38	1.16	0.06
Sep	30	96.48	96.48	60.00	54.89	8.11	1.12	0.03
Oct	31	99.70	99.70	62.00	0.00	8.38	1.16	-0.03
Nov	30	96.48	96.48	60.00	0.00	8.11	1.12	-0.03
Dec	31	99.70	99.70	62.00	0.00	8.38	1.16	-0.03
Jan	31	99.70	99.70	62.00	0.00	8.38	1.16	-0.03
Feb	28	90.05	90.05	56.00	0.00	7.57	1.05	-0.03
Mar	31	99.70	99.70	62.00	0.00	8.38	1.16	-0.03
Apr	30	96.48	96.48	60.00	0.00	8.11	1.12	-0.03
May	31	99.70	99.70	62.00	0.00	8.38	1.16	-0.03
Jun	30	96.48	96.48	60.00	64.75	8.11	1.12	0.04
Total	365	1174	1174	730	312	99	14	-32.69



WATER CONSUMPTION - PROPOSED CASE - DISASTER SCENARIO

Muncipality Water Supply (L/day)	2,000
Occupants	700

Domestic Use (Fixed)	
Use LPD/Head	22
Number of people	24
Total LPD	528

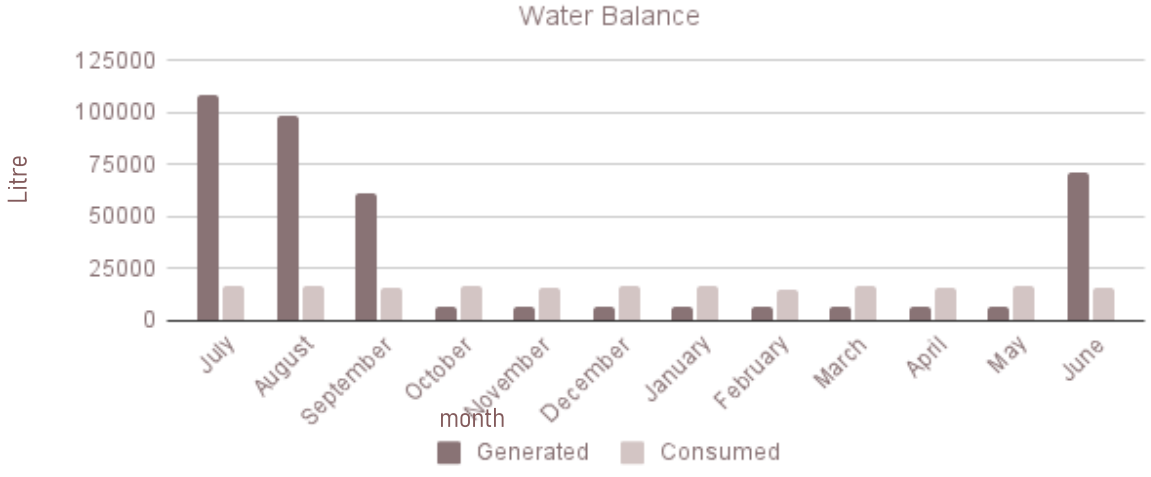
End Use	Percent Use	Use in LPD	Greywater in LPD	Blackwater in LPD
Cleaning	2%	11	11	
Washing Utensils	46%	243	243	
Basin	5%	26	26	
Drinking	23%	121		
Cooking	23%	121		
Health Faucet	2%	11		11
Toilet	0%	0		-
Total		533	280	11

Domestic Use (Visitors)	
Use LPD/Head	10.5
Number of people	676
Total LPD	7098

End Use	Percent Use	Use in LPD	Greywater in LPD	Blackwater in LPD
Cleaning	0%	0	-	
Washing Utensils	0%	0	-	
Basin	3%	213	213	
Drinking	48%	3407		
Cooking	48%	3407		
Health Faucet	1%	71		71
Toilet	0%	0		-
Total		7098	213	71

Detailed water consumption table

Months	Days in months	Domestic Use (kL)	Total Consumption (kL)	Municipal Water (kL)	Rainwater (kL)	Greywater (kL)	Blackwater (kL)	Total Stored (kL)
Jul	31	99.7	99.7	62	101.3	8.4	1.2	0.072
Aug	31	99.7	99.7	62	91.5	8.4	1.2	0.062
Sep	30	96.5	96.5	60	54.9	8.1	1.1	0.027
Oct	31	99.7	99.7	62	-	8.4	1.2	-0.029
Nov	30	96.5	96.5	60	-	8.1	1.1	-0.028
Dec	31	99.7	99.7	62	-	8.4	1.2	-0.029
Jan	31	99.7	99.7	62	-	8.4	1.2	-0.029
Feb	28	90.0	90.0	56	-	7.6	1.0	-0.026
Mar	31	99.7	99.7	62	-	8.4	1.2	-0.029
Apr	30	96.5	96.5	60	-	8.1	1.1	-0.028
May	31	99.7	99.7	62	-	8.4	1.2	-0.029
Jun	30	96.5	96.5	60	64.7	8.1	1.1	0.036
Total	365	1,174	1,174	730	312	99	14	-32.69



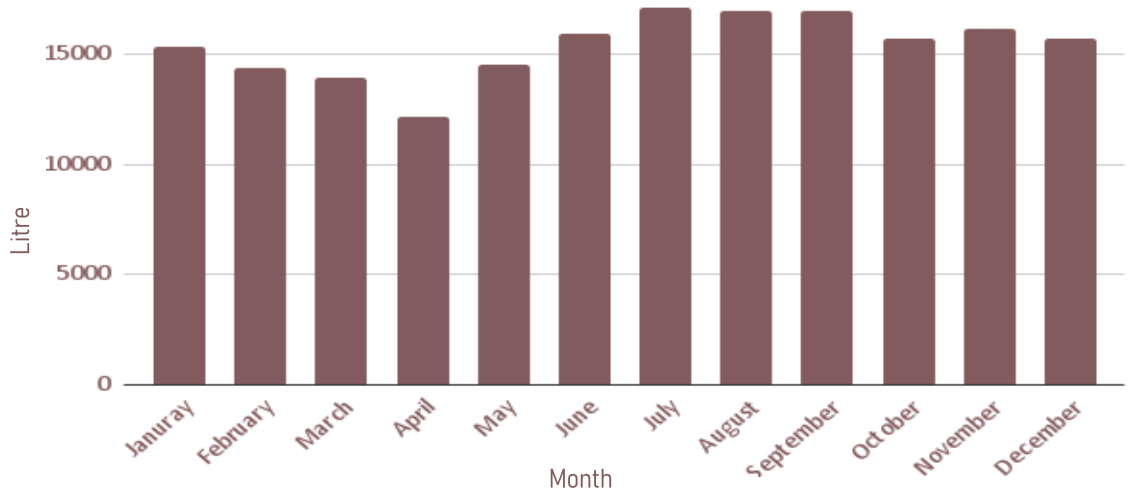
WATER GENERATION

AWG SPECIFICATION: we have provided 3 AWG systems.

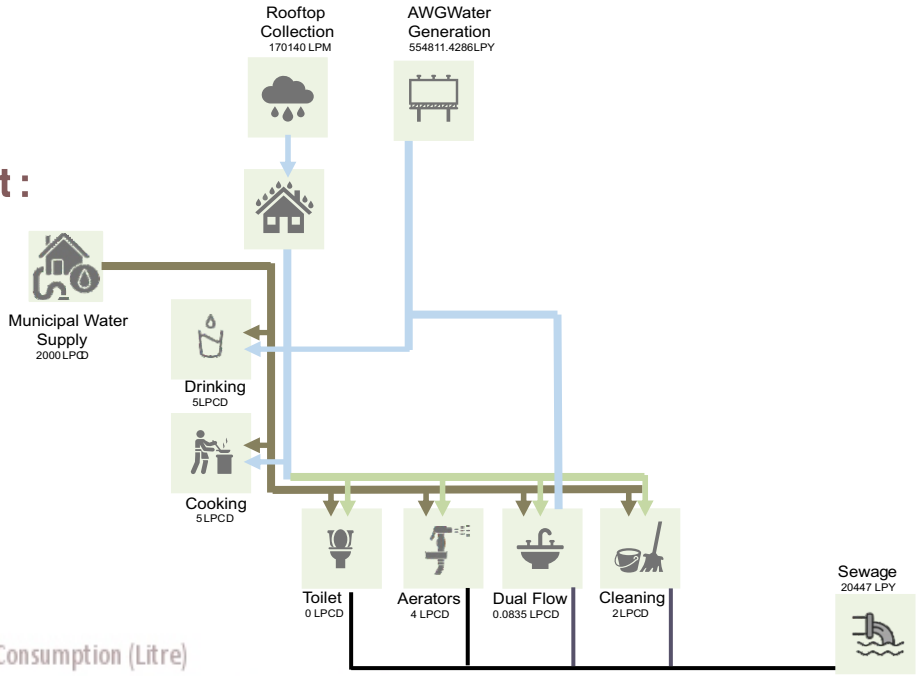
VAYUJAL HOME - 40 LPD

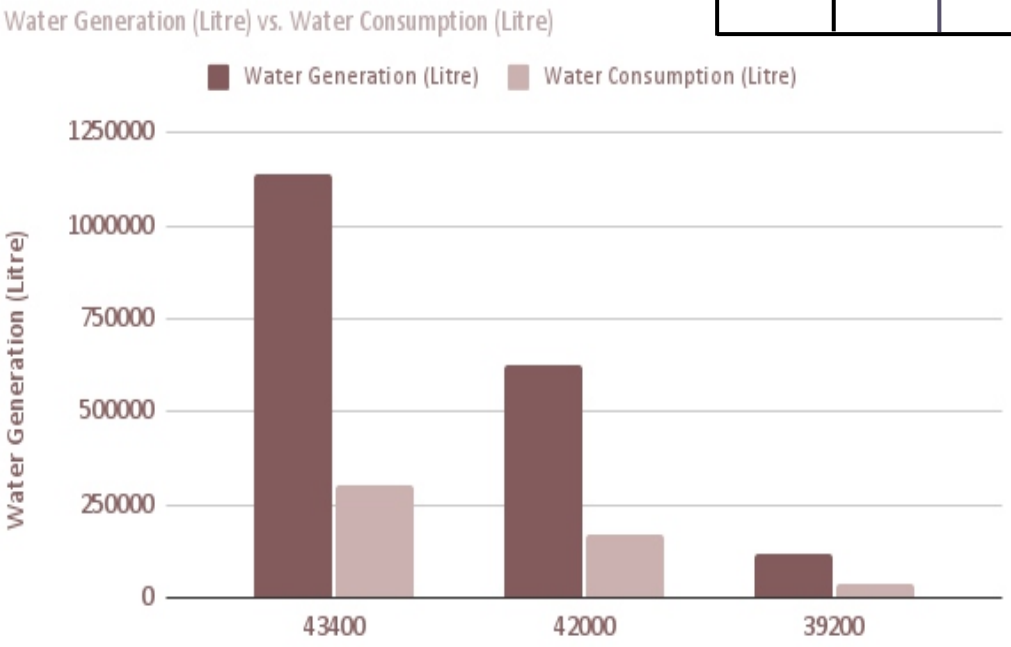
Actual size (LxWxH) : 45 x 55 x 85 (cms)
Power Efficiency : 0.42 kWh / ltr (at 70% RH and 30 °C)
Built-in storage capacity: 16 ltrs. (SS 304)
Power supply & rating : 230 V, 1 Ph, 50 Hz & 0.7 kW
Air Purification : 10 Micron-Al mesh supported HDPE fabric
Water Purification:7 Stage filtration, including ozonizer, UV, membrane

Months	Relative Humidity (%)	Daily Generation(L)	Monthly Generation(KL)
July	86	552.8	17KL
August	85	546.4	16KL
September	85	546.4	16KL
October	79	507.8	15KL
November	81	520.7	16KL
December	79	507.8	15KL
Januray	77	495	15KL
February	72	462.8	14KL
April	70	450	13KL
March	61	392	12KL
May	73	469	145KL
June	80	514	15KL
Generation by 1 AWG			184KL
Generation by 3 AWG			184KL x 3 = 552KL



Water balance chart :





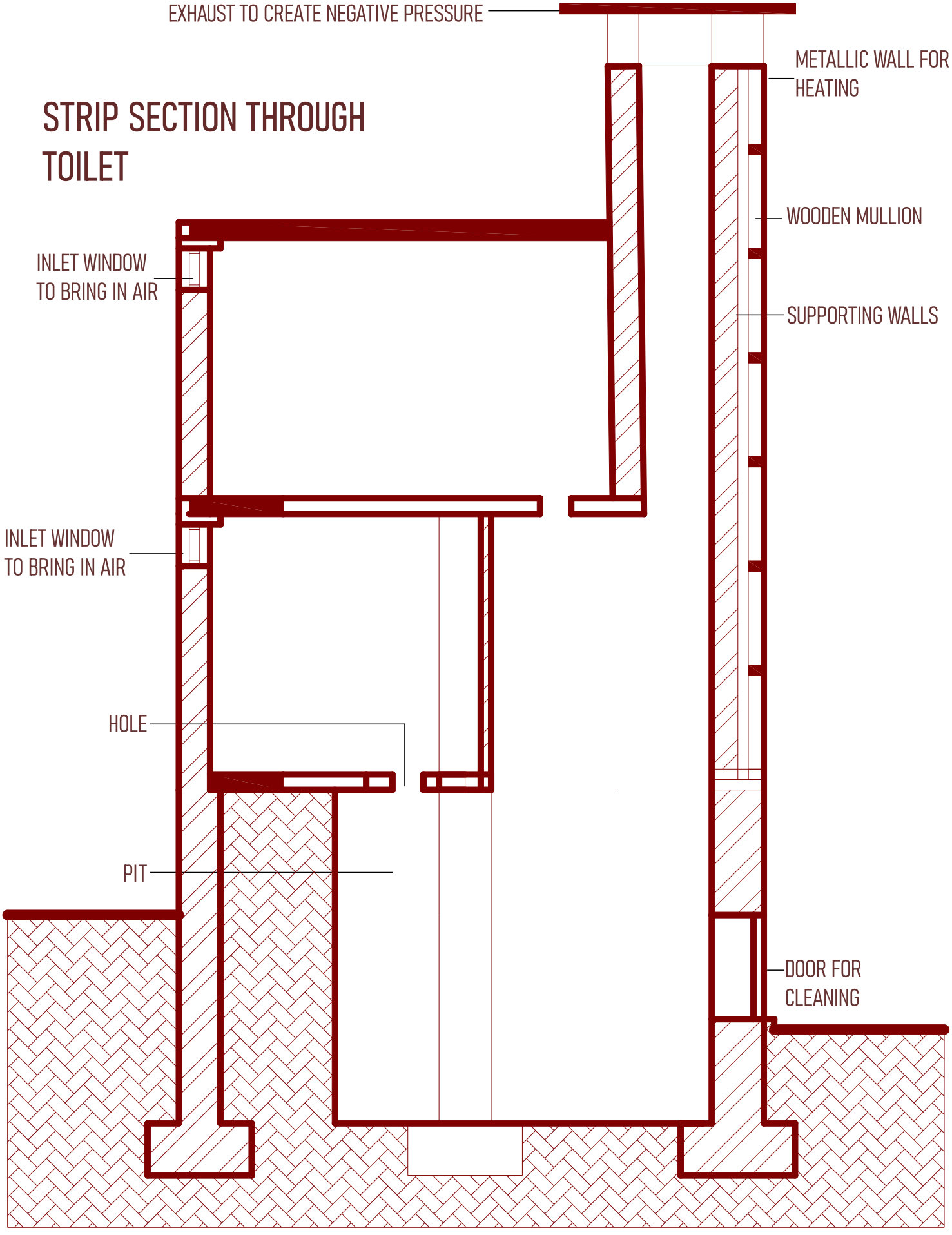
CONVENTIONAL METHOD

WC Full Flush : 6 LPF Urinal : 3.8 LPF Wash Basin : 8 LPF Bathing : 10 LPF Health Faucet : 8 LPM
WC Half Flush : 3 LPF

HIGH EFFICIENCY METHOD

WC Full Flush : 0 LPF Urinal : 0 LPF Wash Basin : 1.2 LPF Bathing : 10 LPF Health Faucet : 1.2 LPM
WC Half Flush : 0 LPF

STRIP SECTION THROUGH TOILET



COMPOST TOILET - SECTION

EMBODIED CARBON

Embodied carbon is the carbon dioxide emissions associated with materials and construction processes throughout the whole lifecycle of a building or infrastructure. It includes any carbon-di-oxide created during the manufacturing of building materials (material extraction, transport to manufacturer, manufacturing), the transport of those materials to the job site, and the construction practices used.

DURING CONSTRUCTION CARBON EMISSION

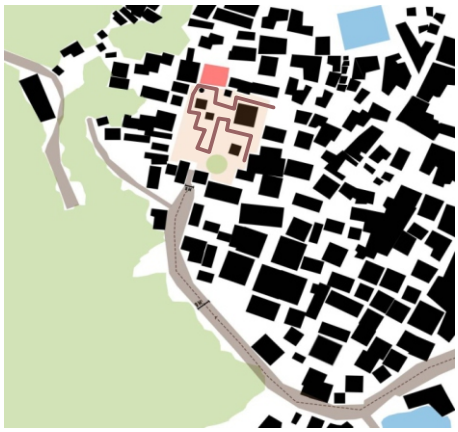
OPERATIONAL CARBON EMISSION

POSTLIFE CARBON EMISSION

SUPPLIERS LOCATION

Most of the suppliers are based in lalitpur district in kathmandu which is approximately 30 - 50kms away from site.

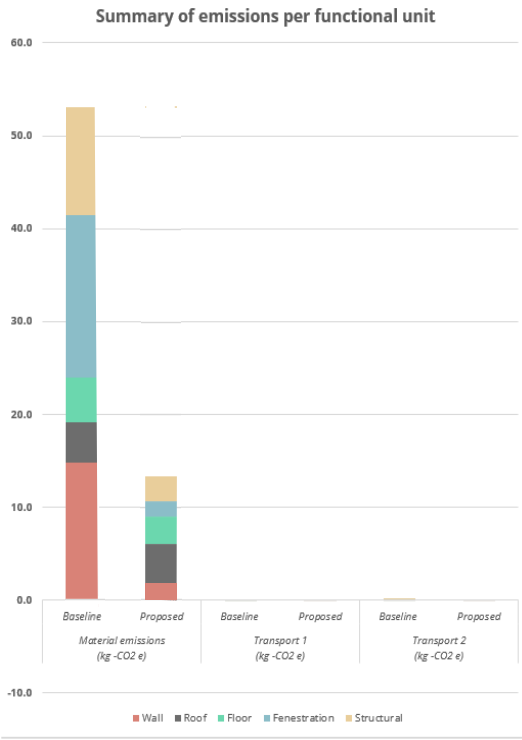
BOTTLE-NECK DIAGRAM

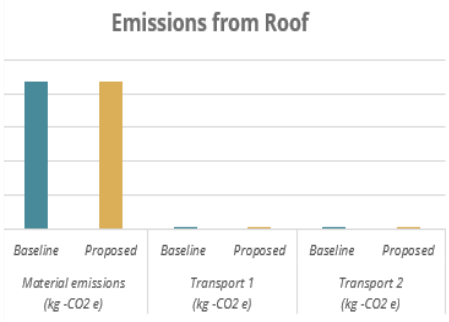


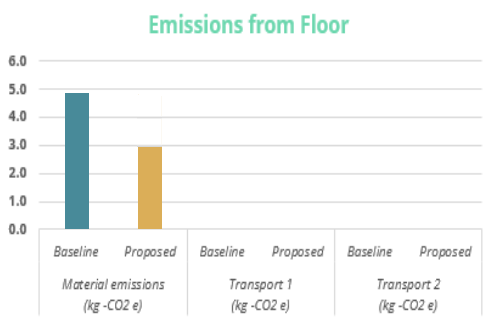
Bottle neck diagram helps us to understand that vehicular movement to site is not completely accessible, manufactures might face some difficulty in reaching the material to the site directly, they will have to transport material by carrying or loading it in smaller size vehicle to reach the site directly. majorly pedestrain movement is available on site.

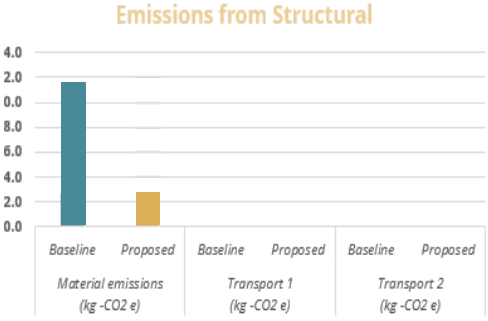
REDUCTION OF EMBODIED CARBON BY USING MATERIALS AVAILABLE ON SITE.	
MATERIALS	USUAGE
STONES	FOUNDATION
EARTH/MUD	WALLS
WOOD	PILLARS & PIERS

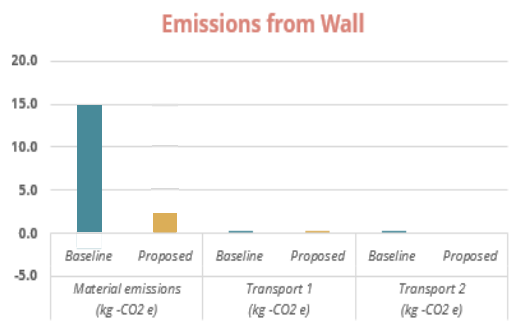
ANALYSIS OF EMBODIED CARBON GRAPH.







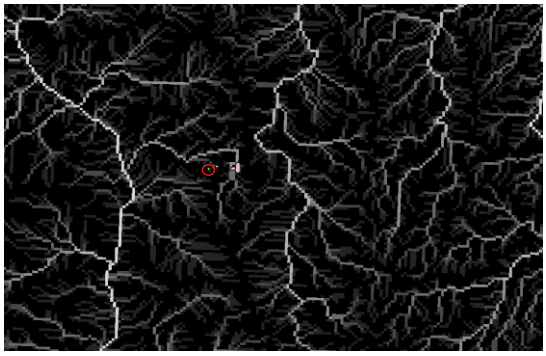




RESILIENCE

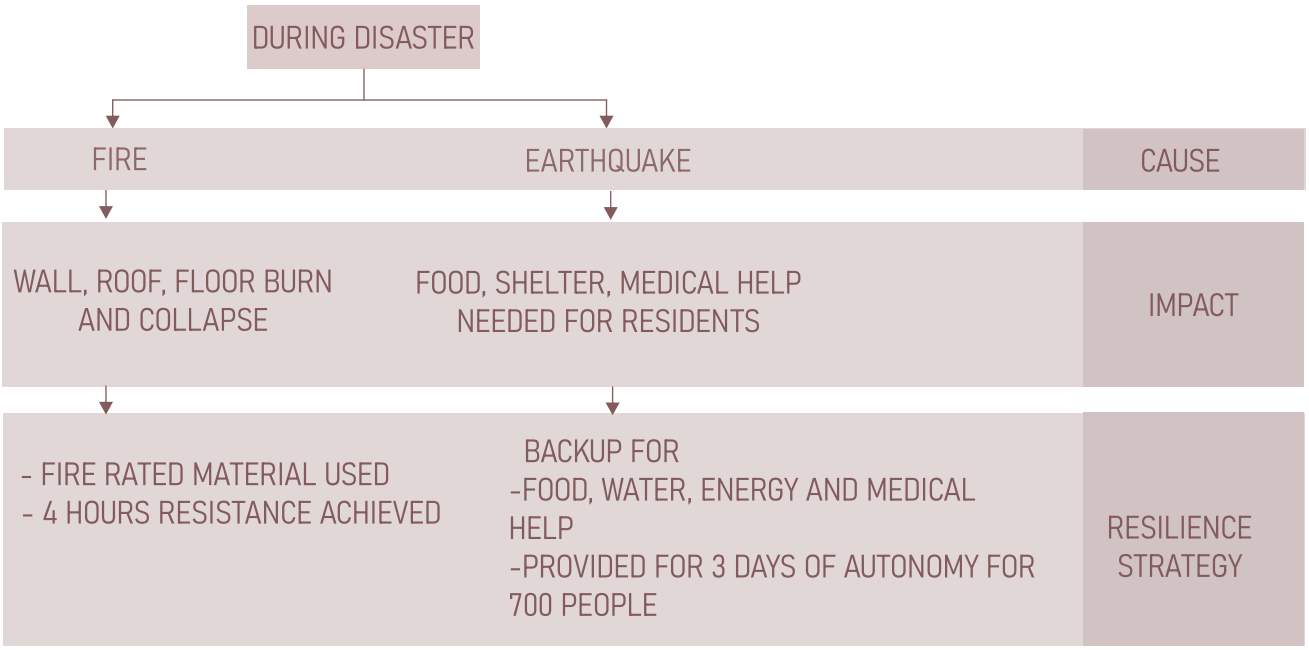
- Easy to re-build and maintain the structure.
- wooden joineries can be replaced time to time .
- Achieving food and water requirement for 3 days of disaster.
- Energy supply stored and achieved with solar panels.

○ - Site zone
● - Site



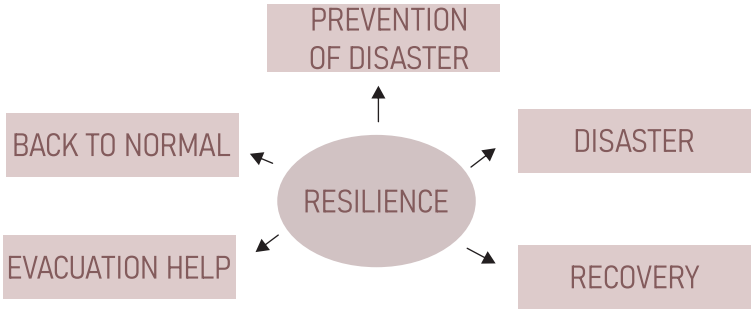
Streamline analysis

MEASURES FOR RESILIENCE



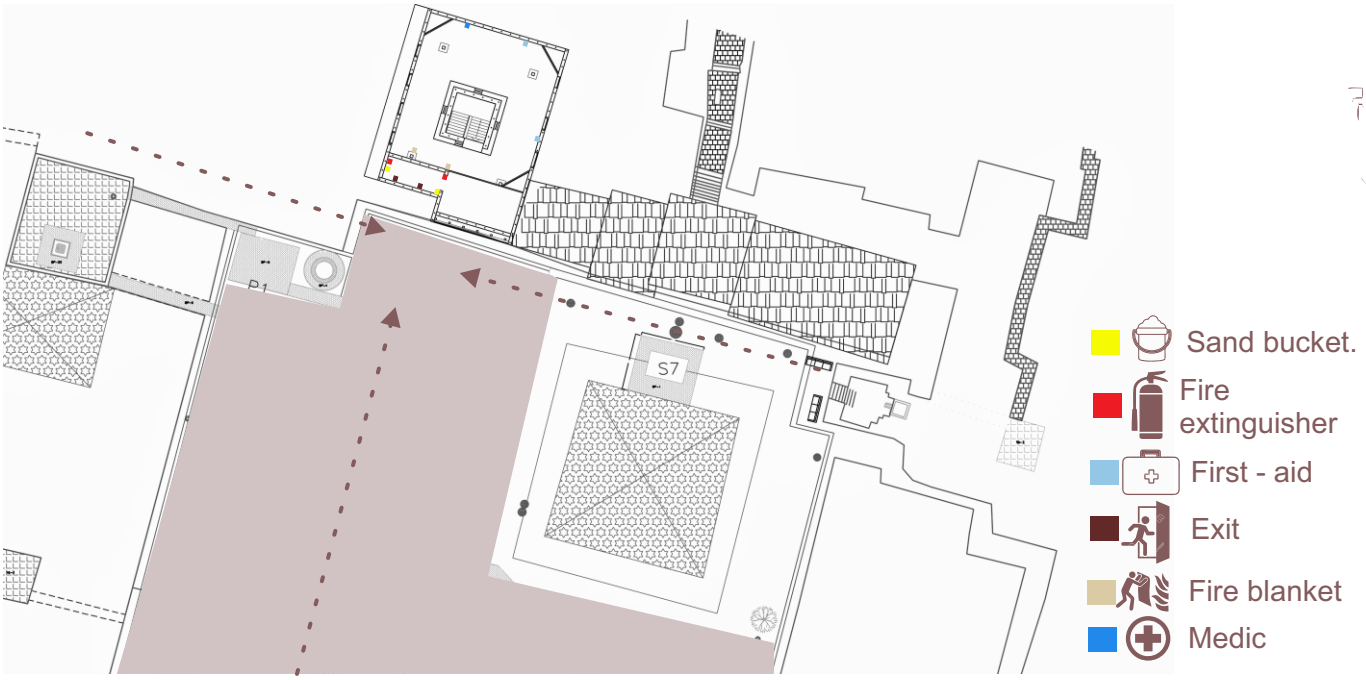
WATER AND ENERGY

WATER	ENERGY
- Use of AWG. - No water needed for wc and urinals.	- Use of solar panel - Energy storage in batteries in storage room.



MEASURES TAKEN FOR RESILIENCE

PRE-DISASTER	DURING DISASTER	POST-DISASTER
- Forecasting Zone. - Material Maintenance (Painting Wood with Enamel in Time Intervals) Arches With Universally Accessible entrance foyer. - Fire Extinguishers. - Signage at strategic locations. - Mock Drills and training. - Earthing and Maintenance Of Wiring System. - Food Security. - Seismometers to warn about earthquake waves and alarming system.	- Thermal Comfort. - Reducing Stress Level by Interior White Colour Walls. - Traditional Elements in Interiors. - Smoke Chambers in Attic. - Dampers in Central Core. - Large spaces for accommodation.	- Provision of Tents (In Chowk Area) . - Medical Help in Ground Floor (Universal Accessible). - Non-Perishable / or quick cooked food.

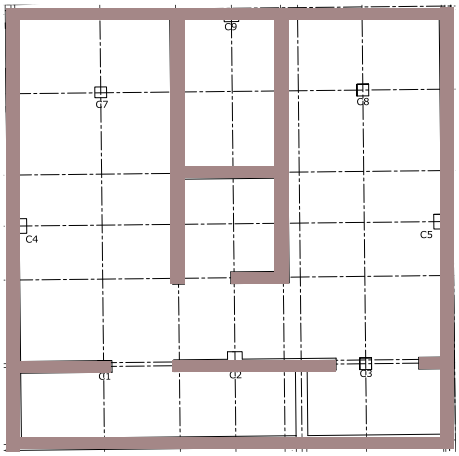


EVACUATION PLAN

QUANTIFICATION OF RESILIENCE

DURING DISASTER	QUANTITY	NOTES
Number of people (occupancy density)	**300**	Purpose Of Designing Ashray Is To Create Wood Crafting Center For Local Newari Community & Tourists, Simultaneously Assist Them Economically In The Times Of Post-disaster.
Water consumption (per person)		As site is located in Kathmandu valley of Nepal, suffers from water supply problem. For increasing water generation on-site We are using Vayujal's AWG.
Dry food storage (non-perishable)	**0.09kg**	To Cater The Packaged Food Items Which Can Be Store For Long Period Of Time And To Have Provision Amidst Disaster.
Rammed earth wall fire resistant rating	**4 hours**	After Perceiving Thrat Rammed-Earth Walls Have Good- Endurance In Times Of Fire As It Does Not Contains Any Flammable Components.
Life span of rammed earth	**1000+ years**	- Intention Of Using Rammed Earth Walls Is To Reduce The Operating Expenses. As It Has Very Low Maintenance - It doesn't need maintenance till-15-20yeras.
Evacuation time	**30 mins**	Guiding Peoples By Providing Signage At Intervals, To Prevent Stampede.
Energy consumption		Curtailing Energy Consumption By Providing Good Daylight Arrangements By Proposing Efficient Sized Windows.

STRUCTURAL RESILIENCE (CENTRE LINE PLAN)



Grid connection plan

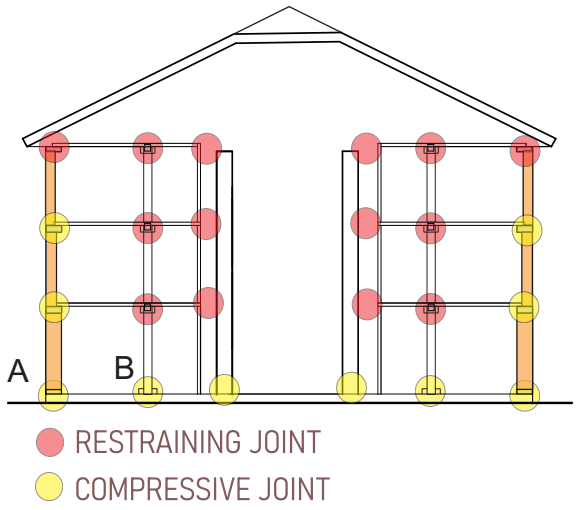
- Grid connection with central core (to maintain centrality while designing.

- Traditional wooden Columns with brackets which can be removed when needed.

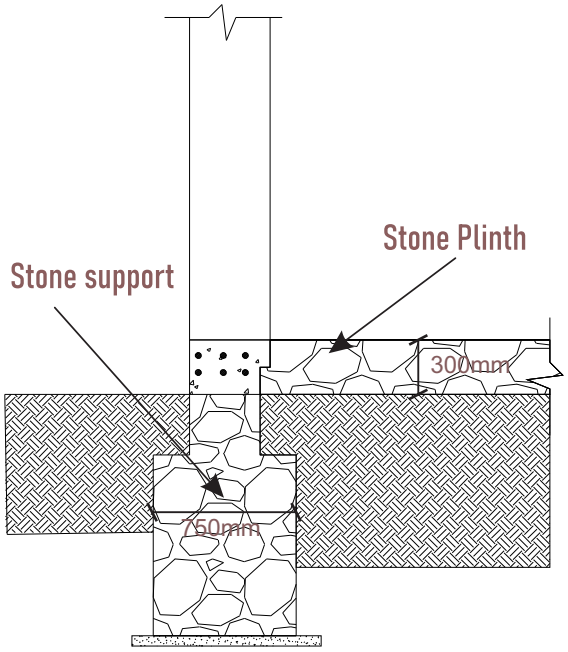
- Grid connection to come up with maximum space utility and controlled volumes to shelter 700 people during disaster.

-Structural resilience achieved with symmetry and compact planning.

JOINT DESIGN



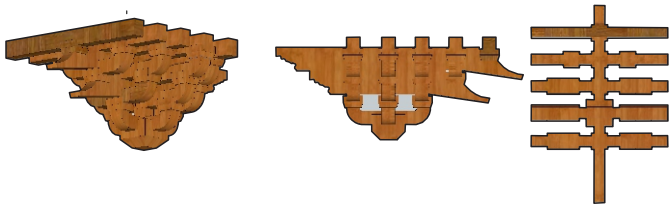
FOUNDATION DETAIL



Stone foundation has the thickness of 750mm.
Ring Beam Is provided upon the foundation is order to support the slab.
300mm of Stone plinth is raised.

RESTRAINING JOINTS

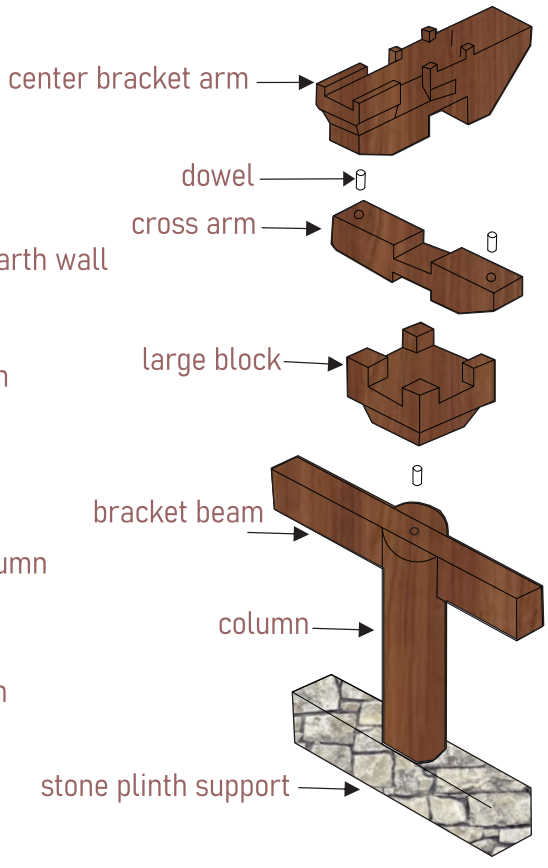
Restraining joints are the joints which allow some movement due to which they act as shock absorbers. They are provided where the earthquake shocks strike first for time period of 0.7-1 seconds.



A structure element of interlocking wooden brackets

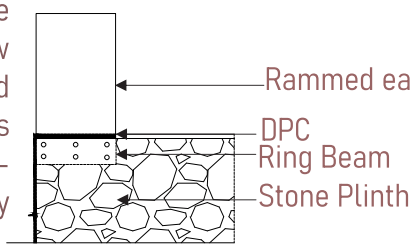
COLOUMN DETAIL:

Wooden Column is divided in many parts, which when assembled are used to transfer load of the upper wooden flooring and support it.



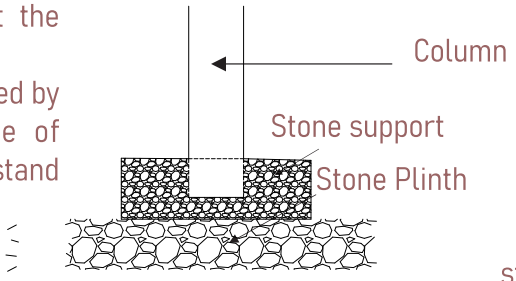
COMPRESSIVE JOINT

Compression joints are rigid type of joints which do not allow movement. They are provided where the earthquake shocks strike first for time period of 0.2-0.5 seconds. They provide rigidity and stability to the structure.



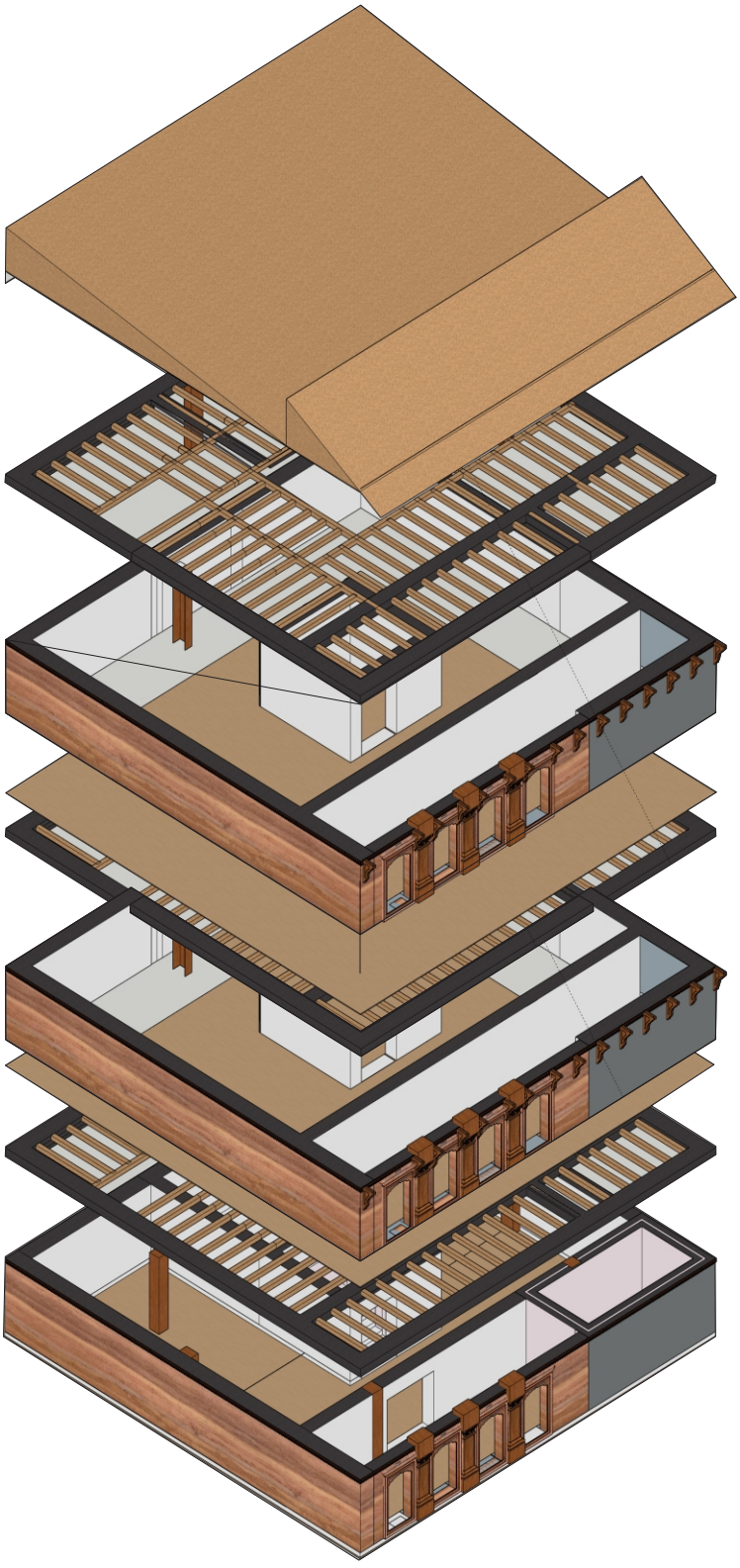
Details at A

Wooden Column are in order to transfer load, and support the slab of the upper floors.
These Columns are supported by the stone support at the of columns, which helps is stand and transfer the load.

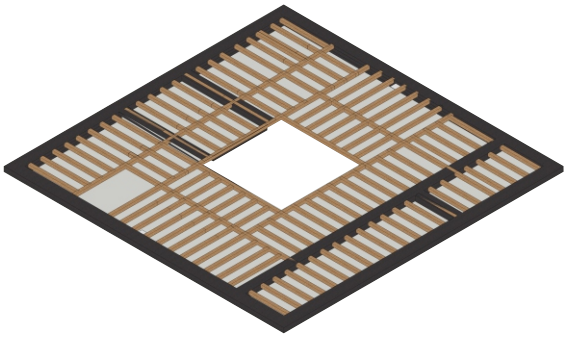


Details at B

EXPLODED VIEW OF THE STRUCTURE



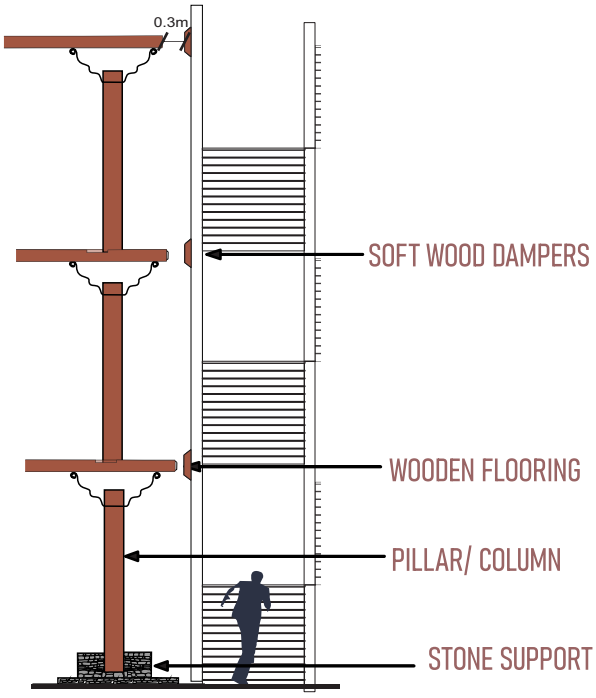
LOAD TRANSFER IN THE STRUCTURE:
The load of the structure is transferred from roofing to the wallplate, which transfers the load to the Rammed Earth walls which are supported by Pillars and Piers. Then that load is transferred to foundation.
The girders of the Structure radiate perpendicular to the shimbhashira (Core) of the structure, which Create space for dissipating the load by movement.
In order to brace the collision of the core to the flooring, soft wood dampers are provided which are helpful during earthquake lateral movements.



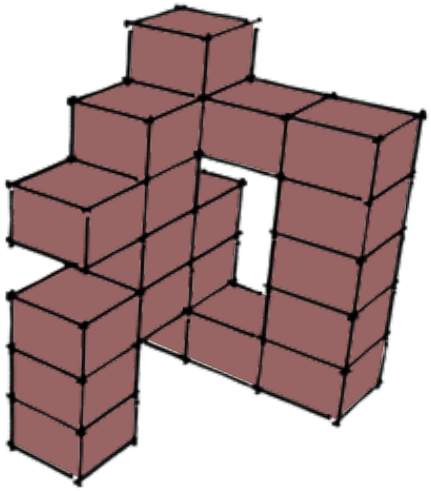
FLOORING DETAIL

SOFT WOOD DAMPERS:

Damper are provided in order to absorb the shocks during earthquake and keep the structure stabilised.

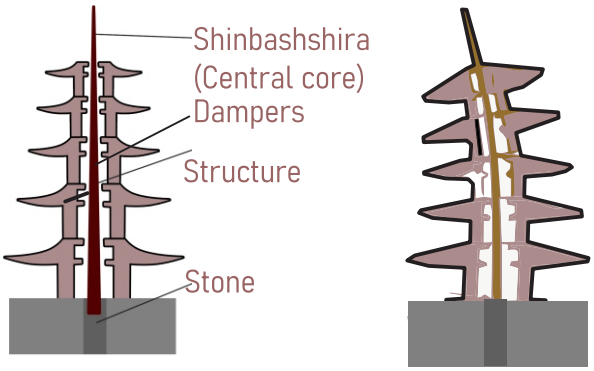


FORM DEVELOPMENT - CUBOIDAL FORM



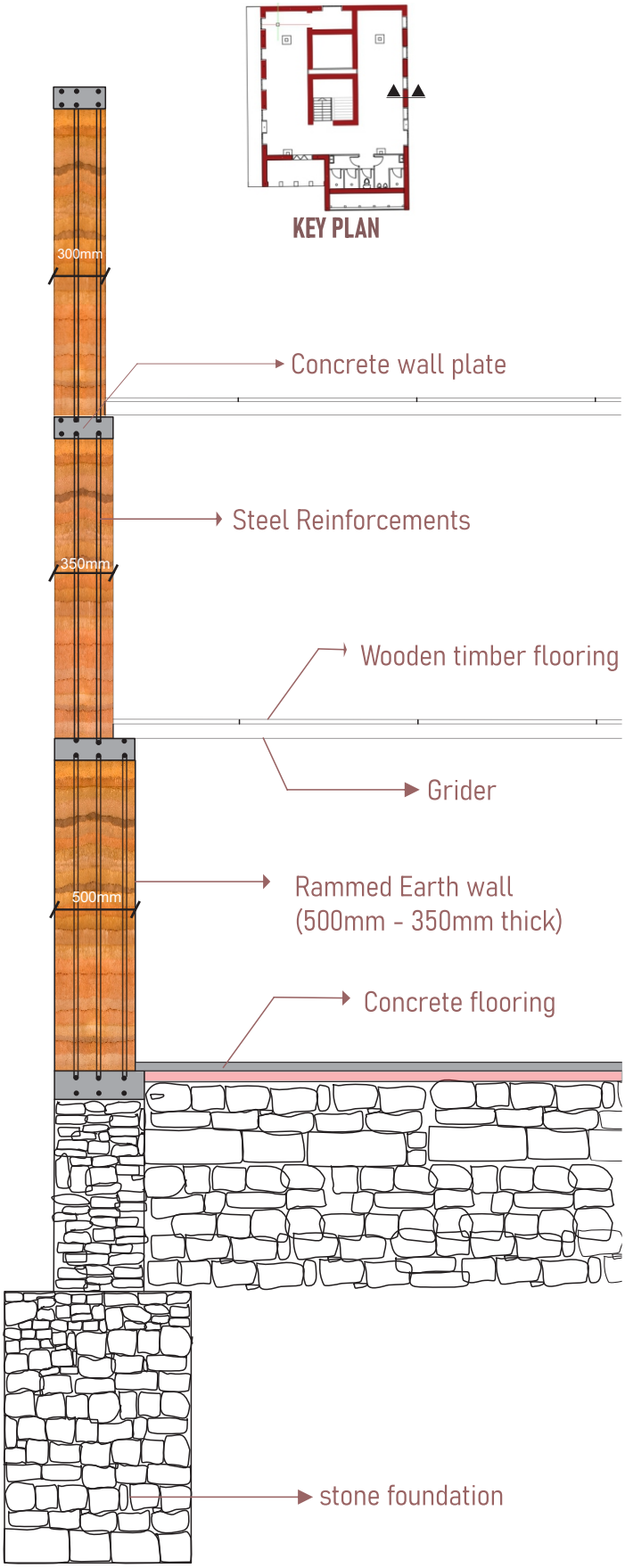
Cuboidal form is inculcated as the form of the structure because it provides betters structural stability during earth.
It also helps to make the plan inside the structure more optimum and Compact.
A unit based architecture is formed, which mean this structure can be a prototype unit for a building typology in earthquake prone

CONCEPT OF SHINBASHSHIRA (CENTRAL CORE)

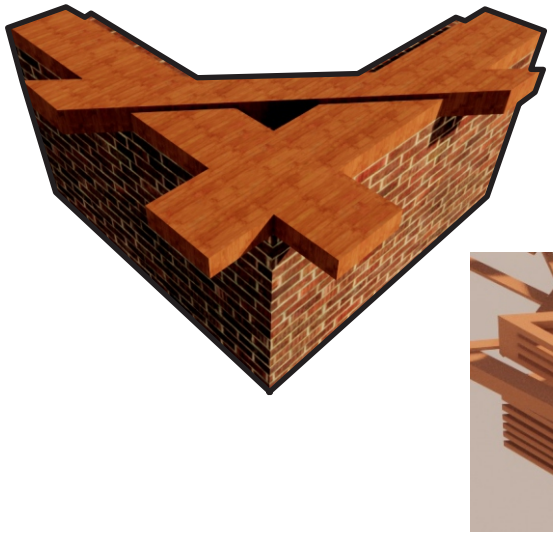


Shinbashshira is an age old concept used in japanese pagoda, it refers to Center long pillar, at the core of the pagoda. It provides support and rigidity the structure during the time of a earthquake, it deals with lateral movements due to shockwaves of earthquake which keeps structure stable, in order to do that dampers are provided between flooring slab and the central core. It helps the outer structure to gain its position back after the shockwaves of earthquake.

STRIP SECTION OF THE STRUCTURE

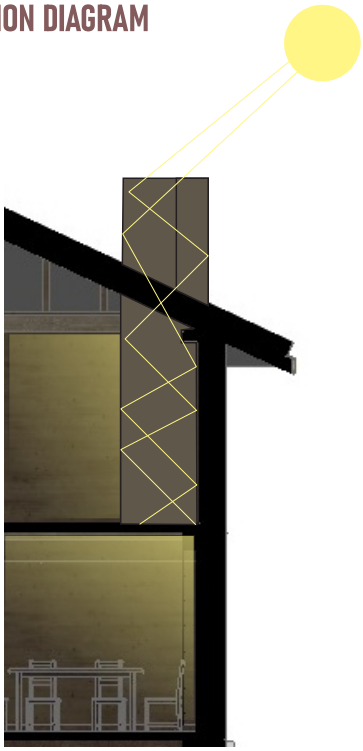


COLAR JOINERY



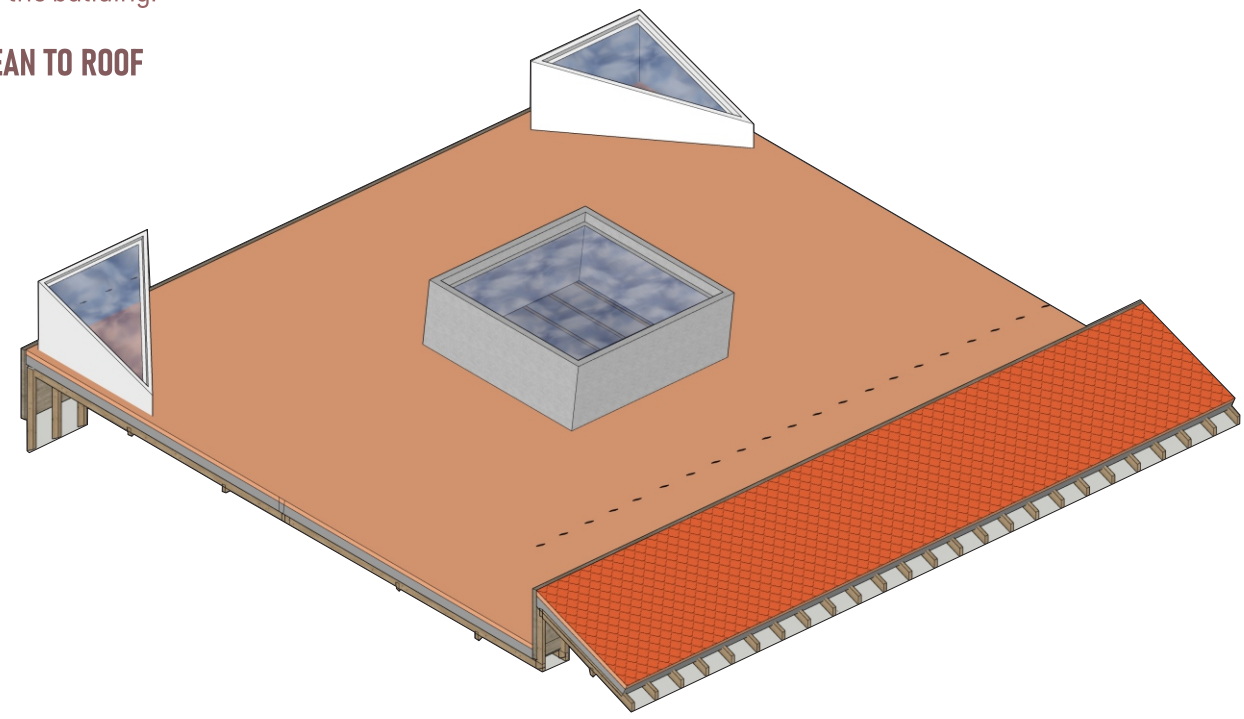
Cholar joinery is used to strengthen the structural integrity of the buliding and we have created a light shaft by stacking this joinery at the corners of the buliding.

LIGHT SHAFT REFLECTION DIAGRAM



LIGHT SHAFT provides sunlight and luminance to lower levels of the structures of the buildings.

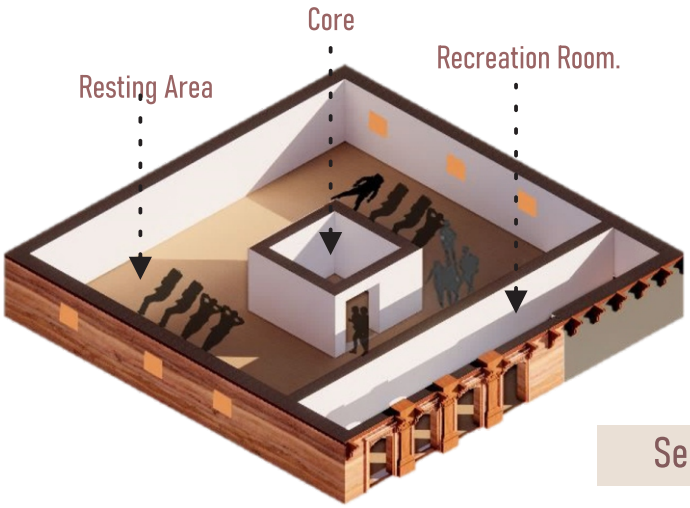
LEAN TO ROOF

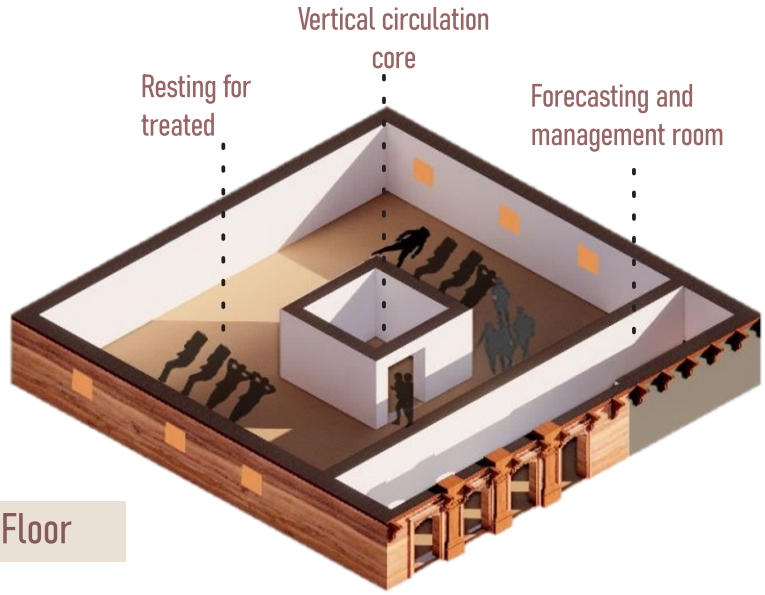


- Dummy roof is provided in order to blend with cultural typology of the building in Nepal. The front side of the roof which faces the south is cladded with manglore tiles.
- Rest of the roof is inclined at a angle, at which maximum amount of solar radiation is incident on the roof, which helps in generation of solar energy.
- solar panels are provided on the rest of roof.

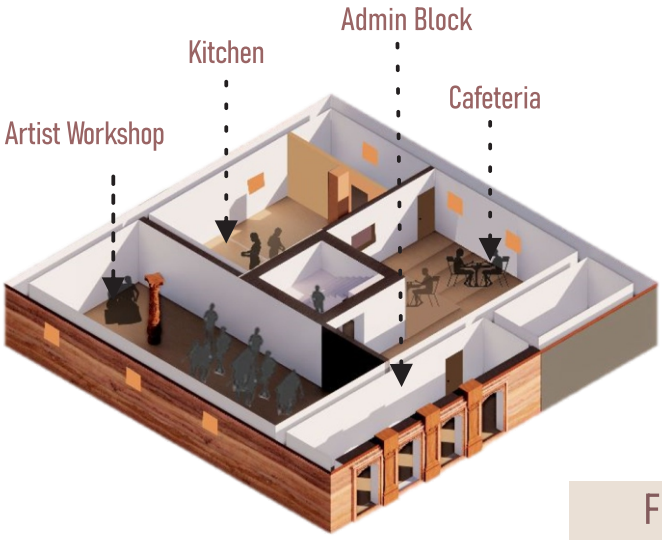
NORMAL DAYS

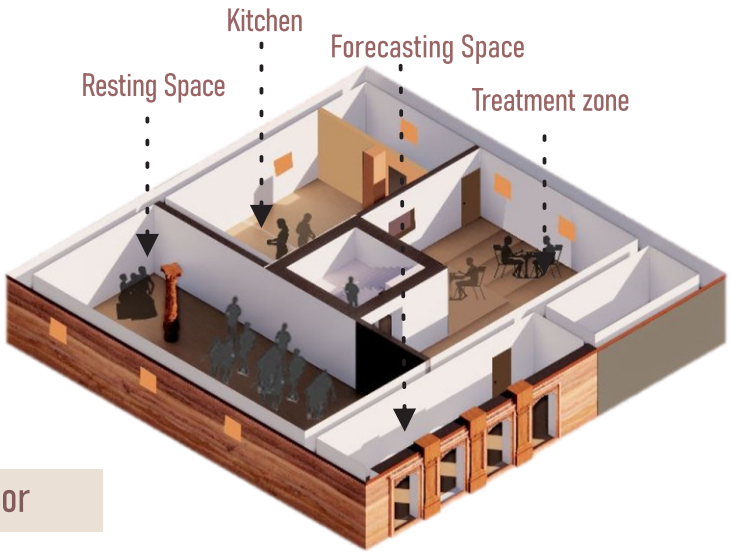
DURING DISASTER



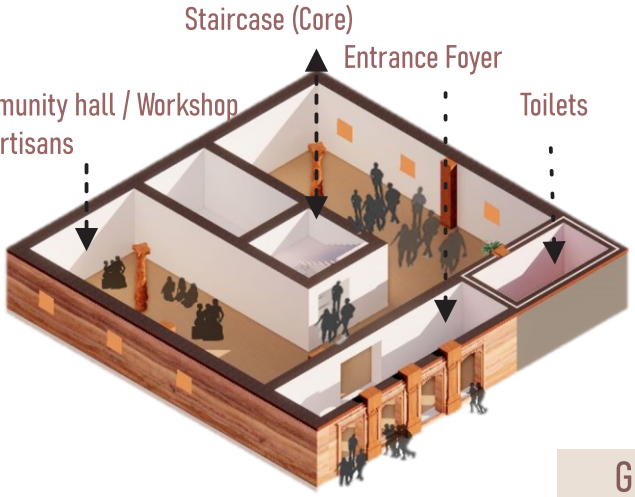


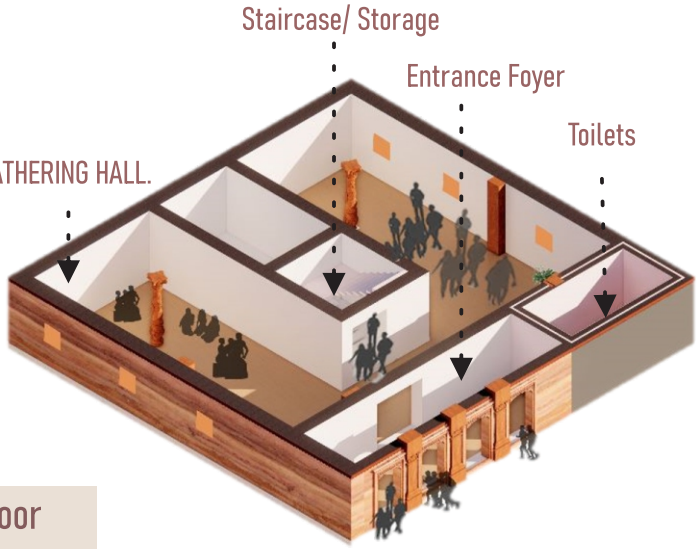
Second Floor





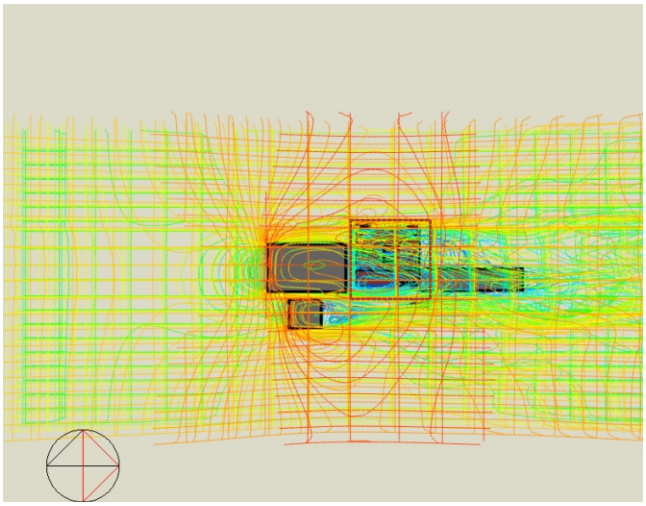
First Floor

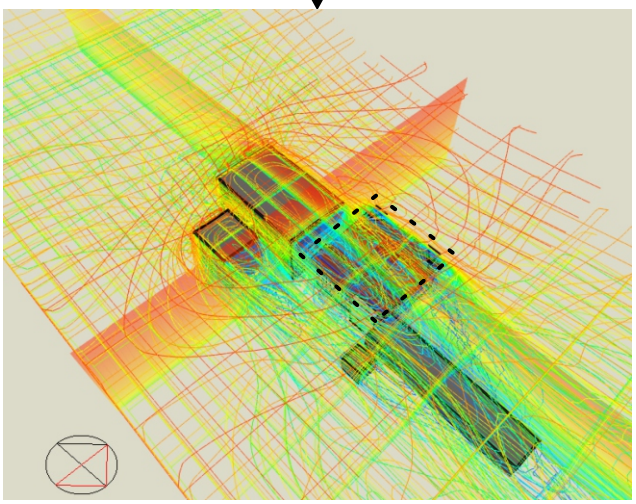




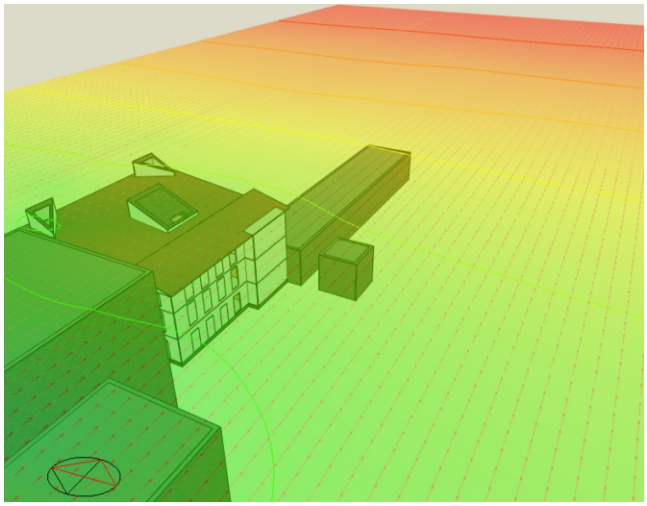
Ground Floor

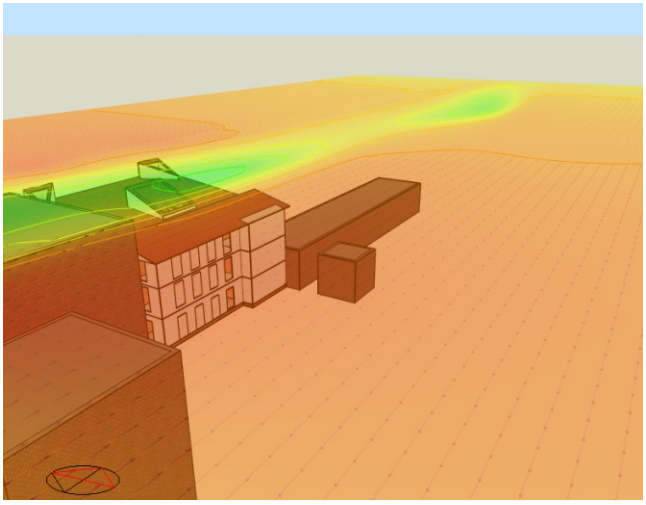
EXTERNAL CFD ANALYSIS :

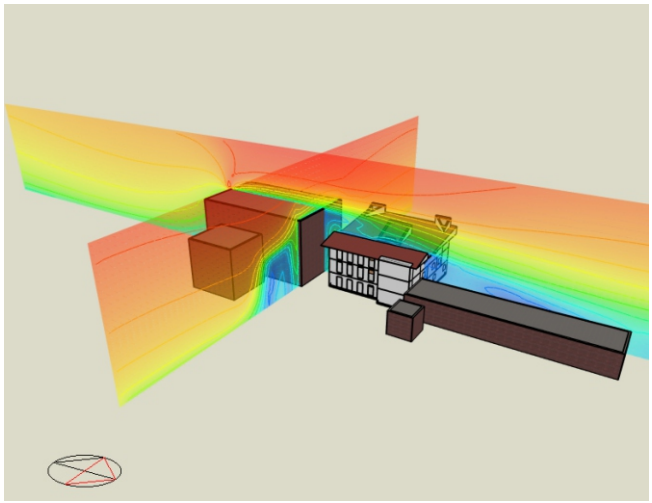


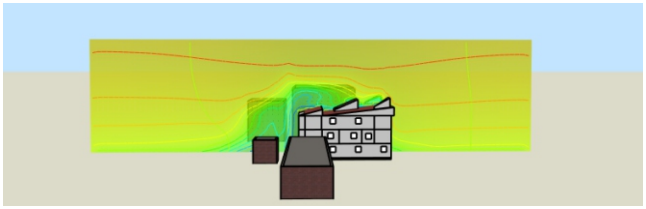


Wind is profusely coming from west, which helps to analyse negative and positive pressure with respective to site context.

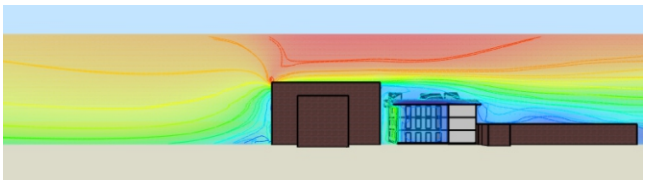








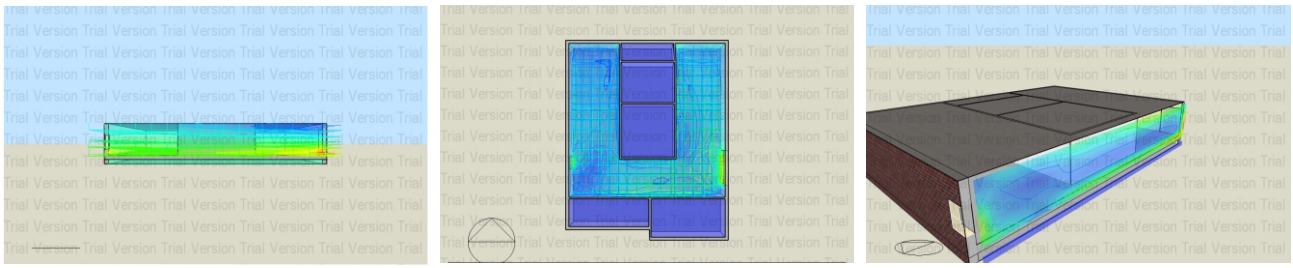
After scrutinizing the wind flow with regard to context through Plans & Elevations, We have come to the conclusion about where the windows should be placed avoiding air pockets to form inside the structure.



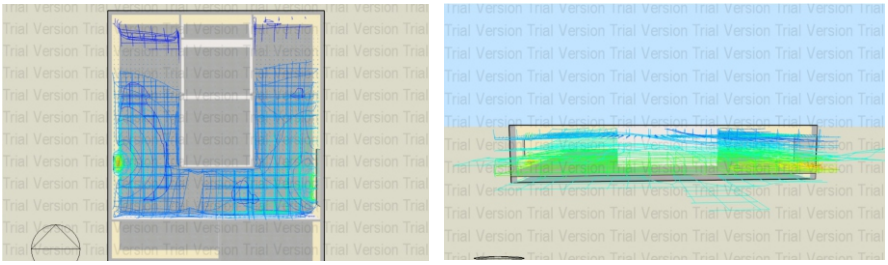
INTERNAL CFD ANALYSIS :

Step 1: Identifying cross vent by giving two openings.

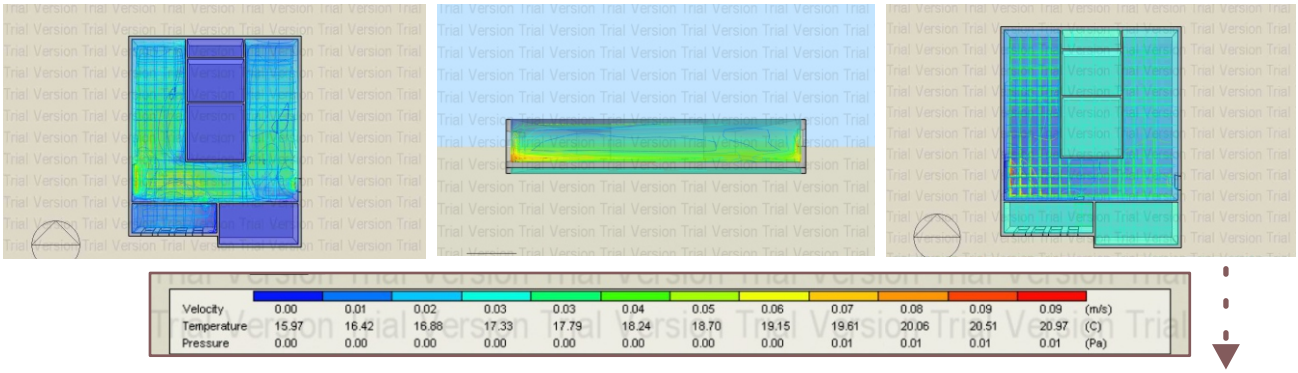
Ground Floor



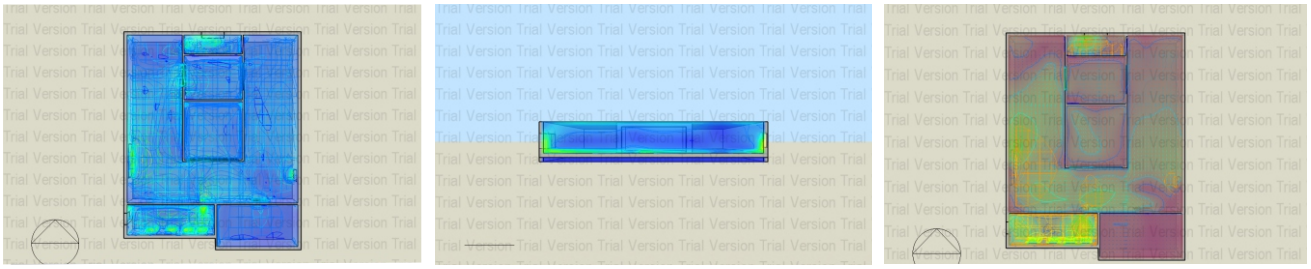
Step 2 : Increasing the size of right side window.



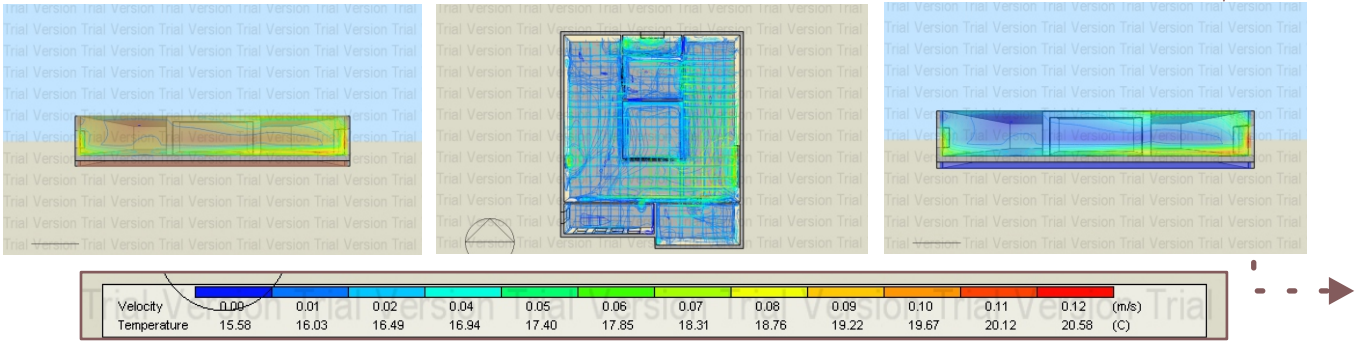
Step 3 : Openings in Entrance foyer and Small window on west and Large window on east with Door in Partition Wall for encouraging cross ventilation.



Step 4 : large window on west side & smaller window on east side.

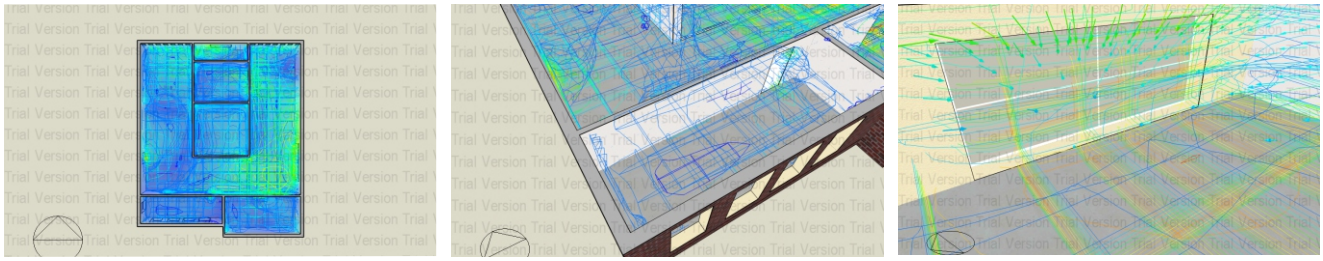


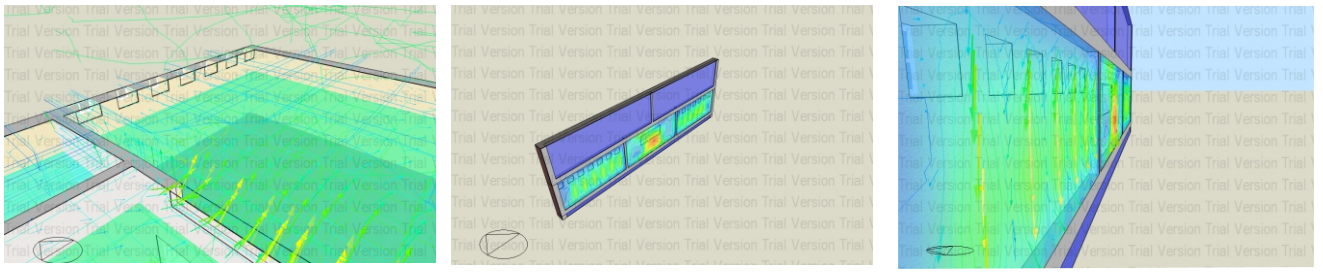
Step 5 : Reversing 4th step, Smaller window on west & Larger on east side.

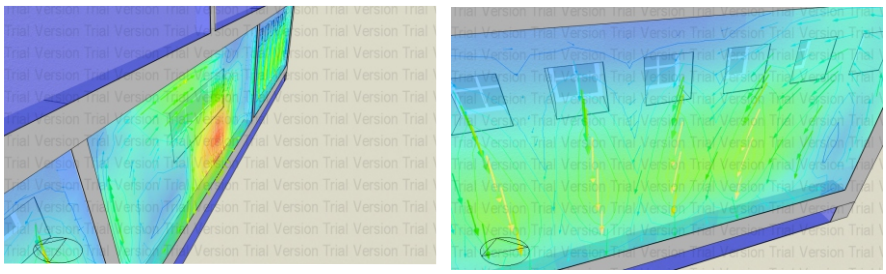


Step 6 : Adding Clerestory windows on north side

Ground Floor

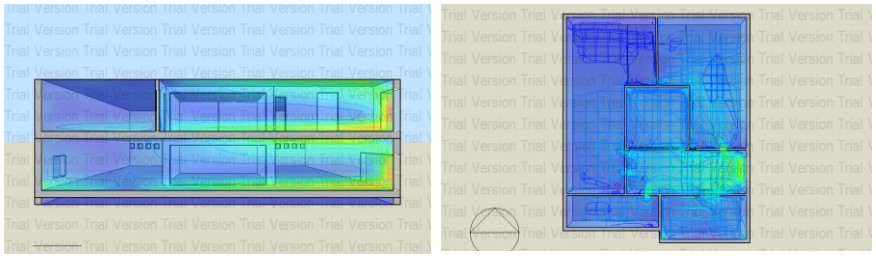




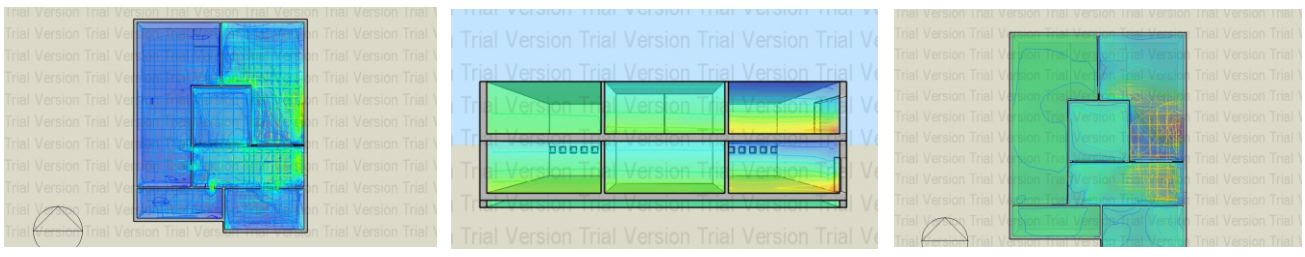


First Floor

Step 1 : Positioning of windows to analyse positive and negative pressure on + 0.3m level

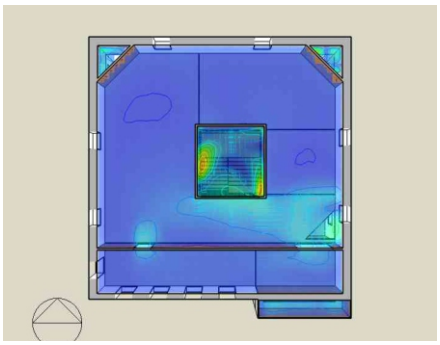


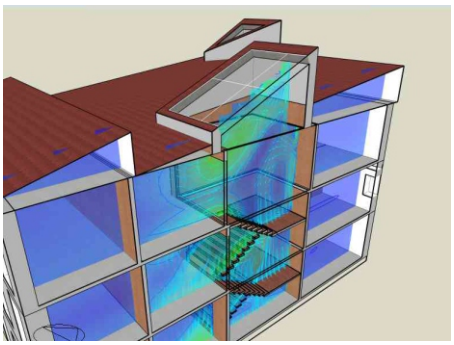
Step 2 : Changing the position of doors and adding larger window on east side of cafeteria

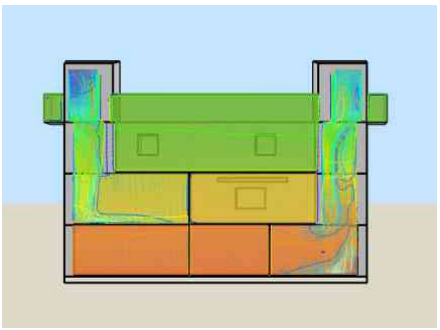


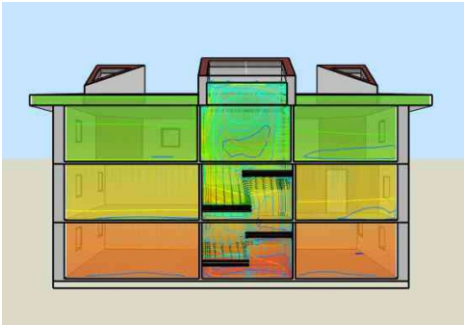
INTERNAL CFD ANALYSIS OF ASHRAY :

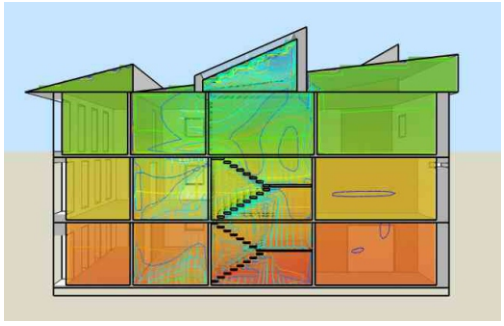
After analysing wind flow externally and internally till + 0.6m level from ground and identifying the apt position of windows by various permutations and combinations which would encourage prevailing breeze and proper cross ventilation, We Finalise the position of windows.

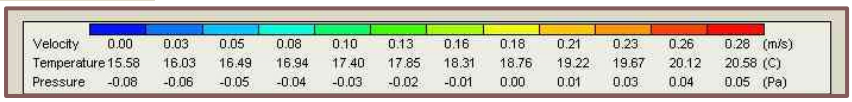










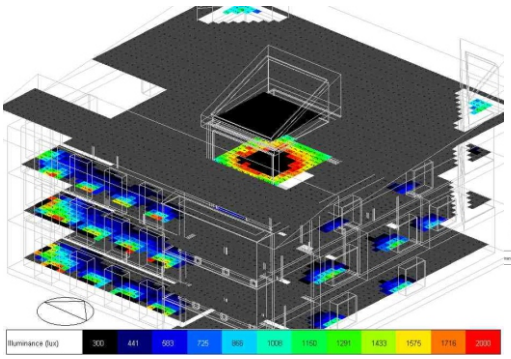


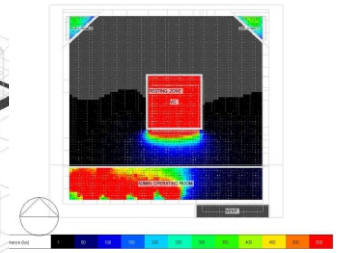
***According to Ashrae 55 adaptive thermal comfort standard for Natural ventilation space.**
The Thermal Comfort Hours during regular days and disaster by Maintaining Operative Temperature between 16°c to 25° :

On Regular days (10 hrs/day Schedule) : 457 hrs are comfortable out of 3560 hrs = 12.52% Hrs annually its comfortable.
During Disaster (24 hrs/day Schedule) : 6190 hrs are comfortable out of 8760 hrs = 70.66% Hrs annually its comfortable.

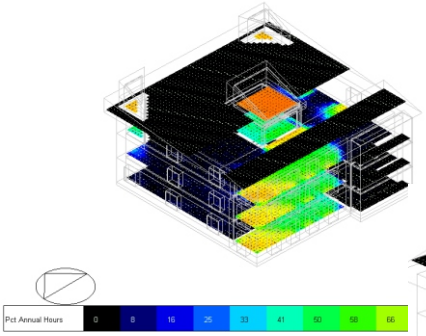
Daylight Analysis :

As our site is locating in a where close space where natural light is very less, nevertheless our approach was to get the light from south facade by providing larger & traditional type openings And by giving two light shafts.



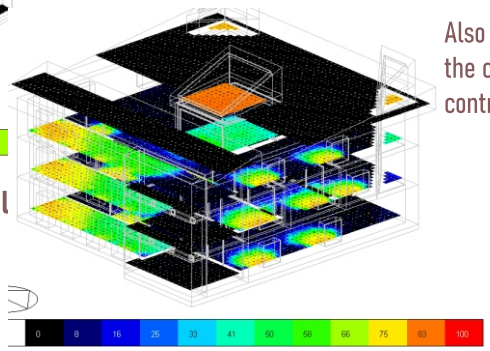


Point in time Simulation for illuminance



***sDA Leed standard Annual daylight Simulation**

Also we thought of inviting light through main central core, but at the central core we face the issue of glare, So Our provision is to control glare using horizontal wooden louvers at the top.



"In this way we tried to provide comfort through Natural ventilation and glare free daylight for healthy environment throughout the Aashray"

Intangible :

The quality of air in Nepal is decreasing day by day due to ever-increasing pollution. In order to obtain better air quality inside Ashray compared to the exterior, air pollen filtration is used on ventilation windows.The main hall in Ashray can be used for two purposes, organizing major events or creating a working space for artisans. This will help in maintaining the culture of the area and creating employment opportunities for these artisans. Prioritizing the work of these artisans will preserve and return this fading art to a higher place in the hierarchy.The Rato Machindranath Temple near Ashray has a large and regular footfall as a tourist attraction. The chowk in front of the temple will serve as a hub for carpenters next to it.

Tangible :

There are irrevocable benefits to the community that come along with this project. The local community has many chances to improve their way of life by helping with the construction of Ashray. By including the residents in Ashray's ornamentation process, we can give them work. Popular motifs and designs can be embellished on the building, primarily on the windows. As a result, we can crowdsource design concepts, and the neighbourhood can develop a feeling of ownership over the building by participating in the construction.The building's incorporation as a community venue for organising activities is one of Ashray's main purposes. These include carpentry projects and workshops that can bring in money for the community. These workshops also allow for the sale of their creations for profit.One of the major benefits of our structure is the ability to store water. In emergency situations, this surplus water will save lives, but in ordinary circumstances, it can be donated to the community or the government. Due to the fact that some residents of these areas lack access to clean, high-quality water, the community's requirements are also met.On the location, there is some rubble left over from the demolished building. We will use this debris, which will greatly lower the cost of construction materials. This will not only lower expenses but also stop material waste.

MULTI-FUNCTIONALITY OF SPACES.

view of Entrance Foyer

Arched In the Entrance foyer will help people to separate out their ways during emergency avoiding probability of stampedes. It also gives us opportunity to display the intricate craft of wood carving of Newari community which potrays a sense of community and selfness to the Newari community living there.

Site Plan

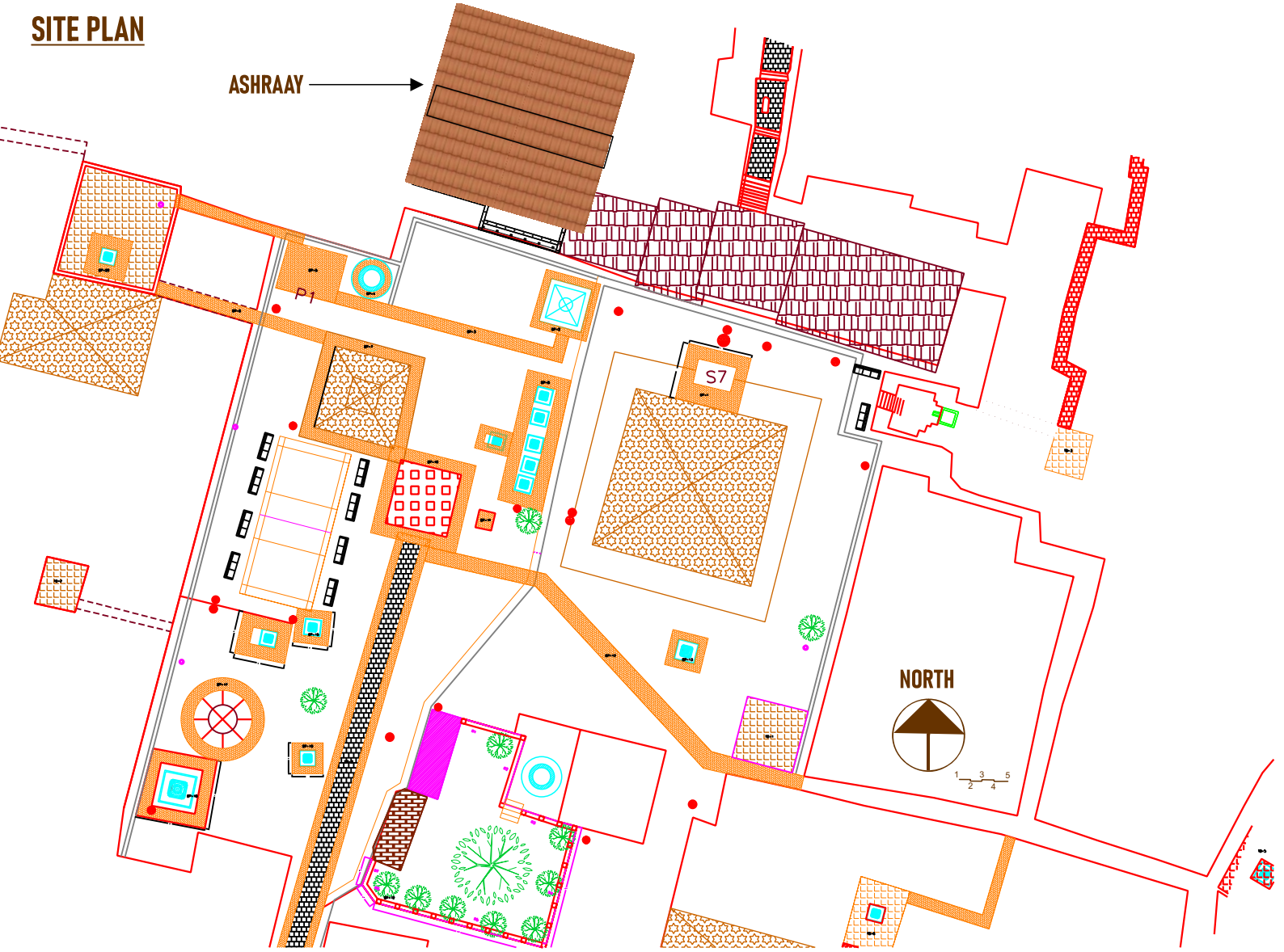
Around the year while there is no disaster **community hall** is used a **Carpenters hub** workspace where artist can work on their Art piece and second function is conducting Tradition Rituals at the times of Festivals. Community hall is divide into 2 spaces by Vertical circulation core and Storage area, both functions are carried out smoothly because of it.

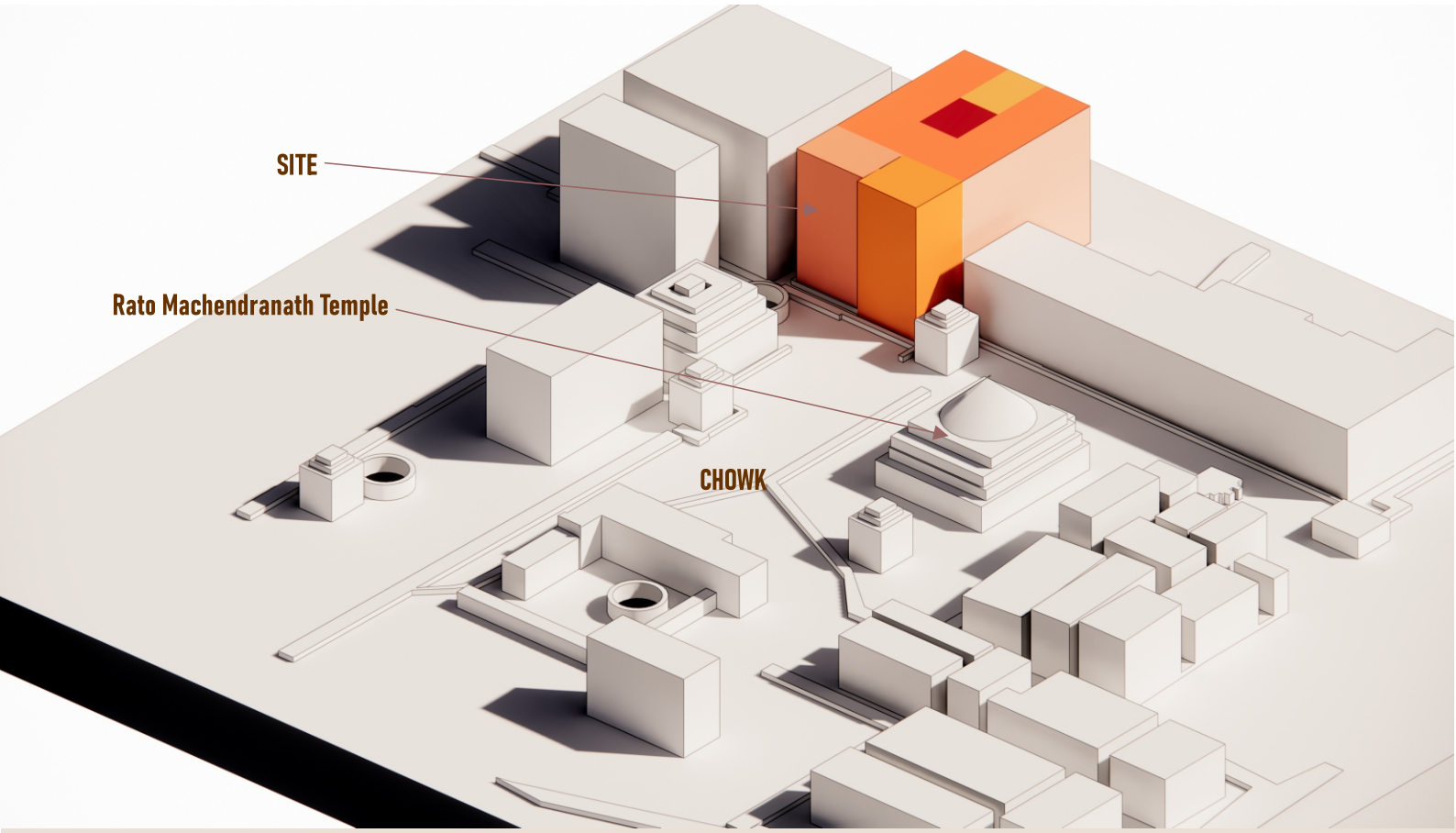
		FUNCTION WITHOUT DISASTER	FUNCTION DURING DISASTER
		PUBLIC SPACE	
1.	ENTRANCE FOYER	ENTRANCE HAVING VISUAL CONNECT WITH ART BEHIND	BRING A SENSE OF SAFETY AND PROTECTION
2.	COMMUNITY HALL	CULTURAL AND ECONOMICAL ACTIVITIES	COMMUNITY RESILIENCE
3.	STORAGE ROOM	STORAGE OF RAW MATERIAL AND MACHINES	STORAGE OF RAW MATERIAL AND MACHINES
		SEMI-PRIVATE	
4.	DISPLAY AREA	FINAL PRODUCT STORAGE AND DISPLAY	STORAGE OF EMERGENCY TOOL
5.	TOILET BLOCK	TOILET	TOILET
		PRIVATE	
6.	MEDICAL AREA	SLEEPING AND RESTING OF ARTISANS	TREATMENT OF INJURED

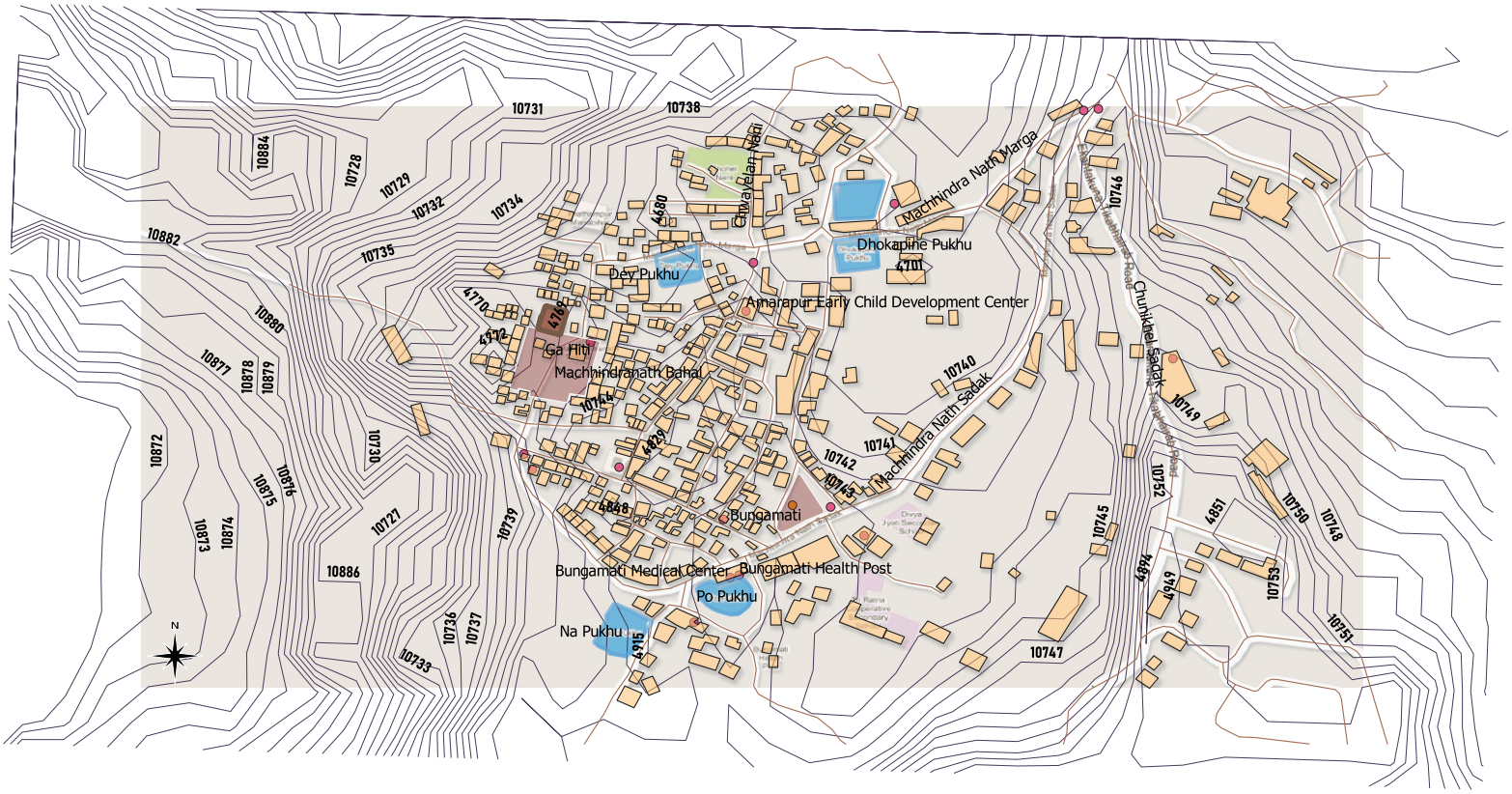
AREA PROGRAM

Programs	Area
Entrance Foyer	23.24
Toilet	20.6
Community Hall	132.9
Storage Area	14.9
Vertical Circulation	9.48
Workshop	56.12
Kitchen Area	42.8
Café	22.8
Corridor	18.52
Admin	34
Resting Area	141

SITE PLAN



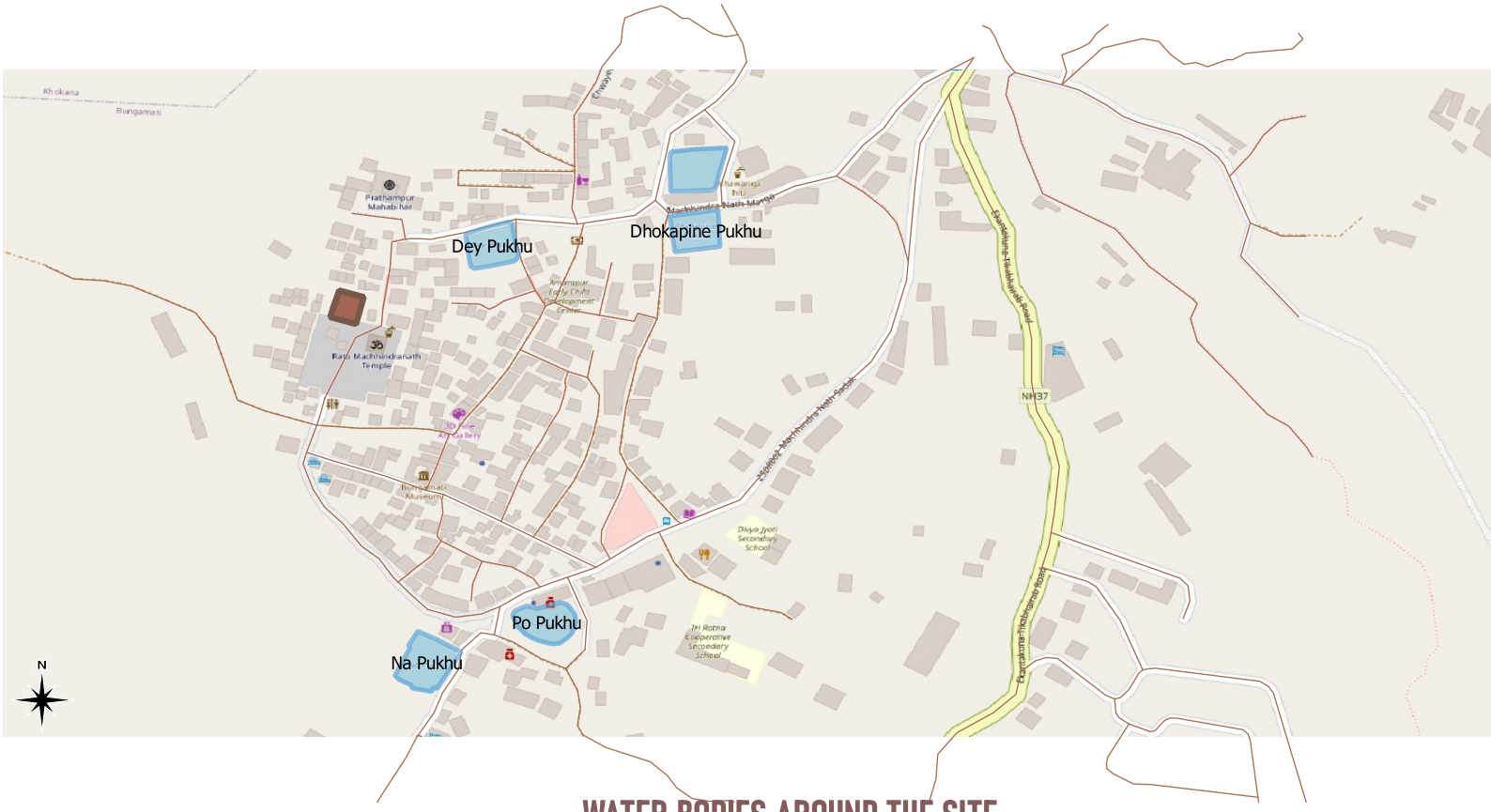




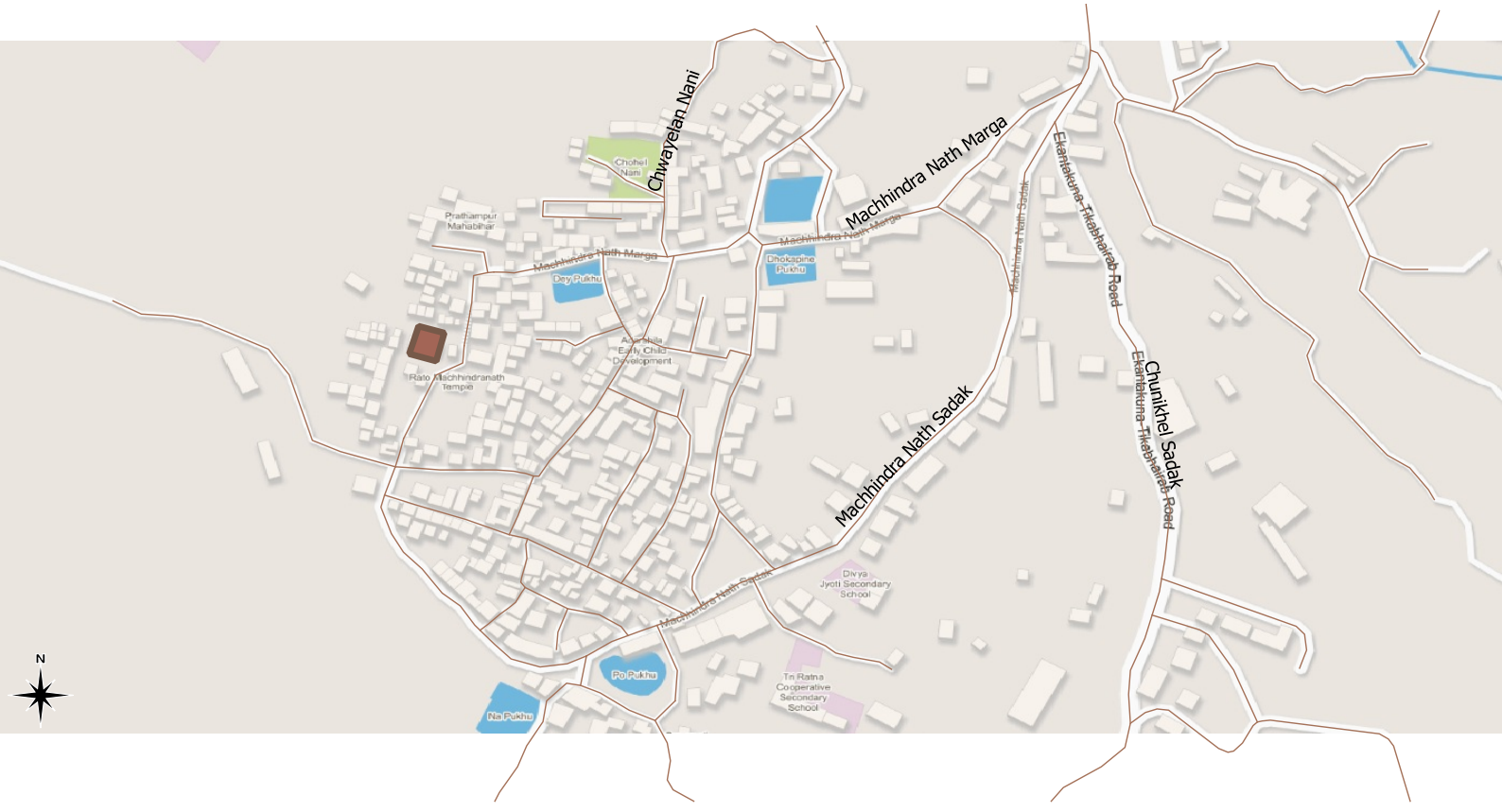
CONTOUR ANALYSIS

SITE IS LOCATED IN A VALLEY.

IMPORTANT LANDMARKS AROUND THE SITE

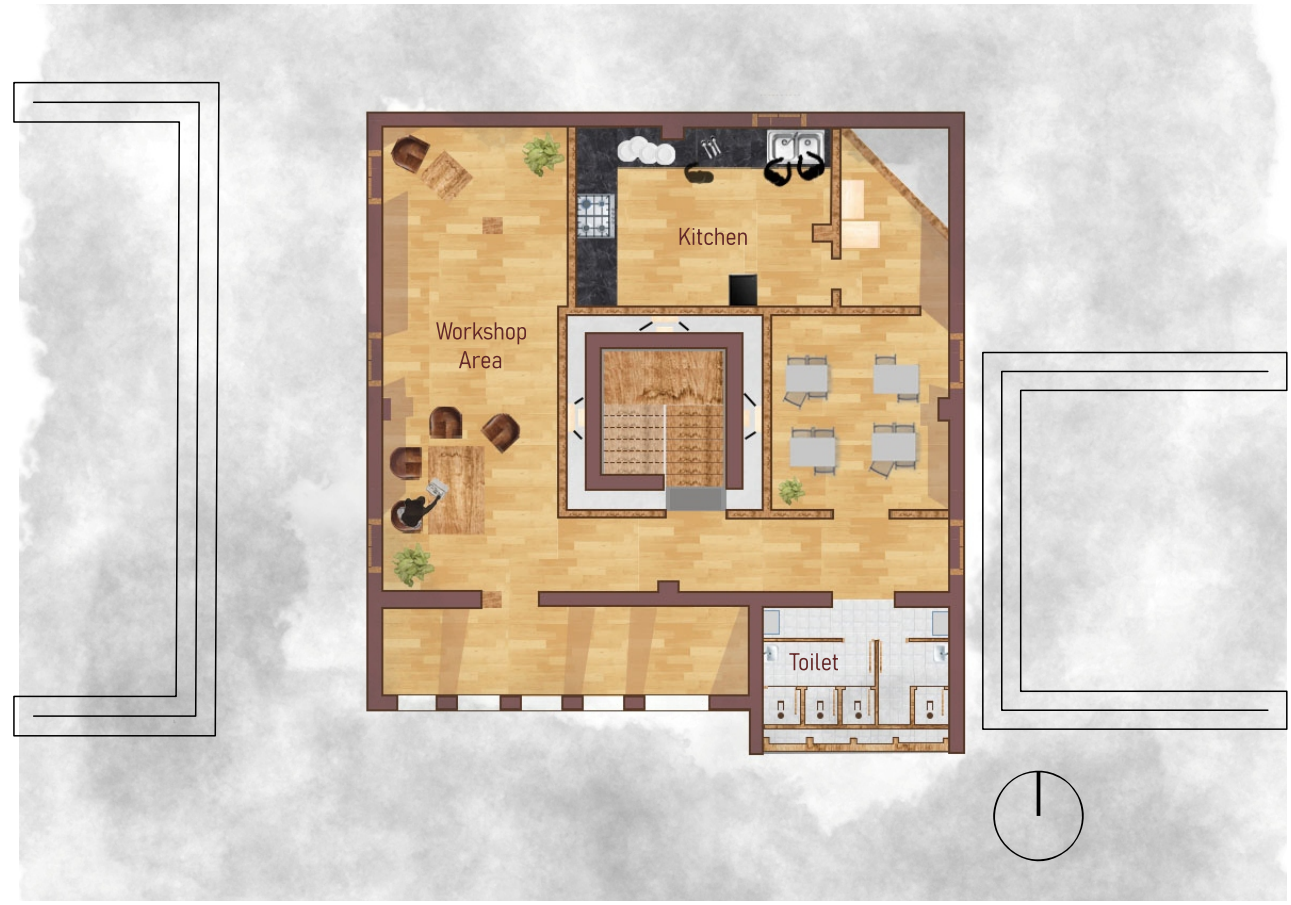


WATER BODIES AROUND THE SITE

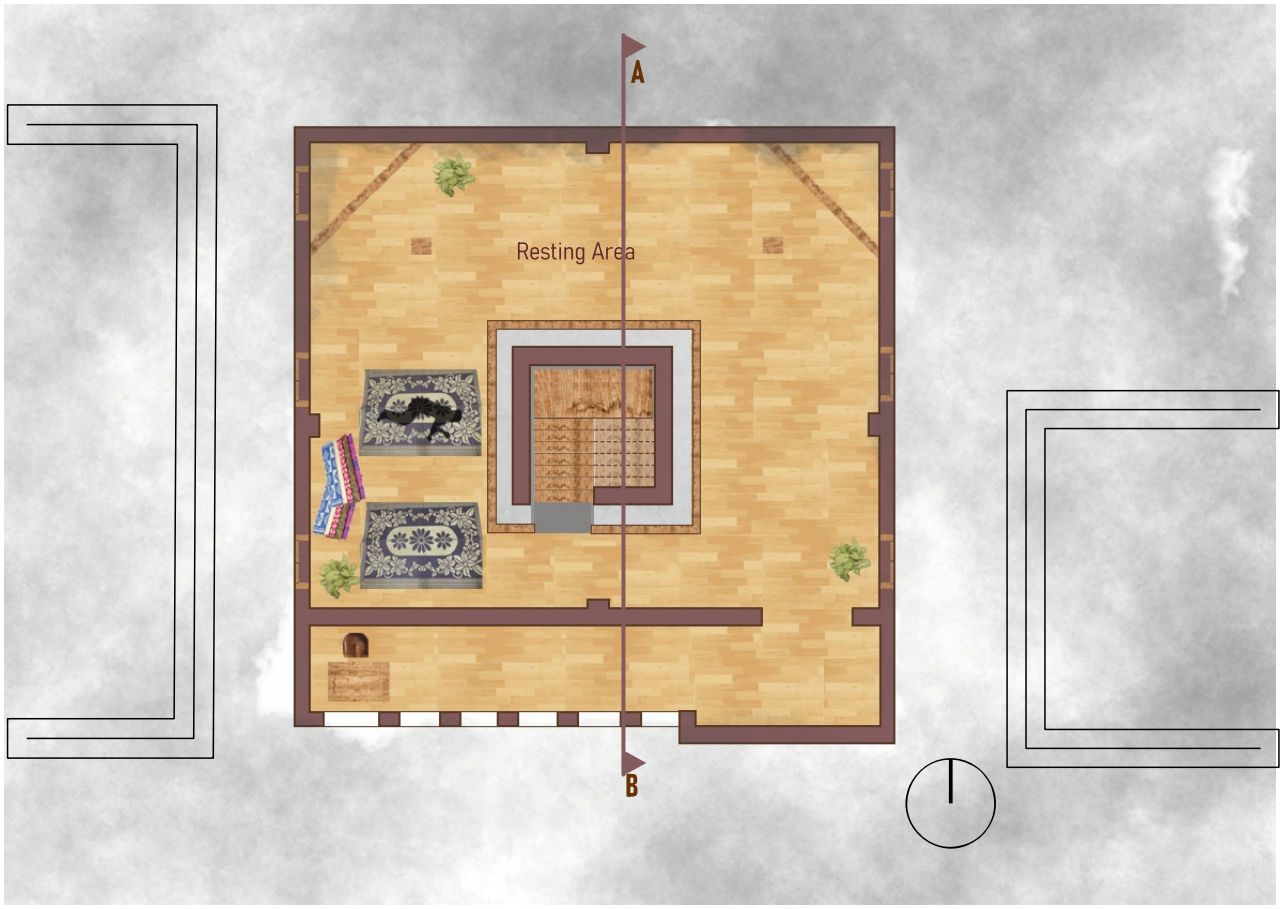


ROADWAYS AROUND THE SITE

Chhendi (Ground floor)



Mattan (First floor)

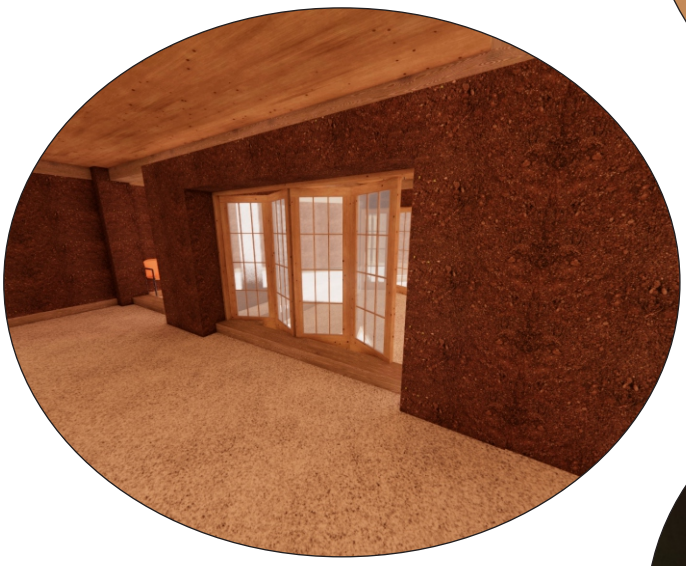


Chota (Second floor)

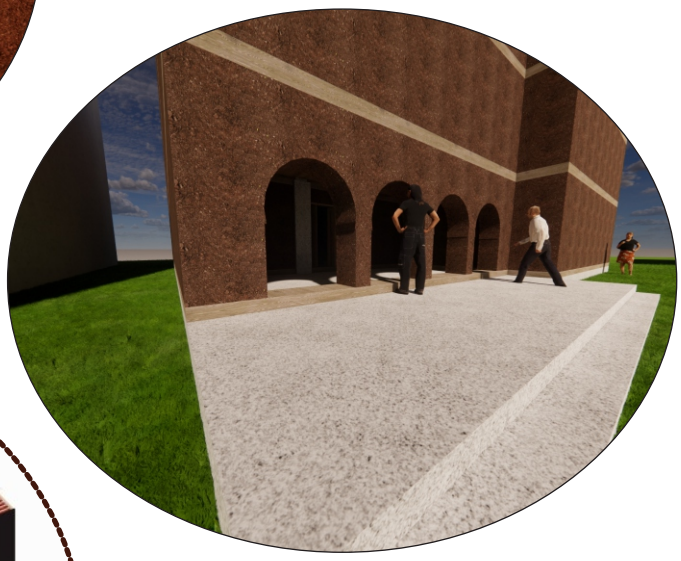
SECTION AB

VIEW OF ENTRANCE FOYER

VIEW OF COMMUNITY HALL



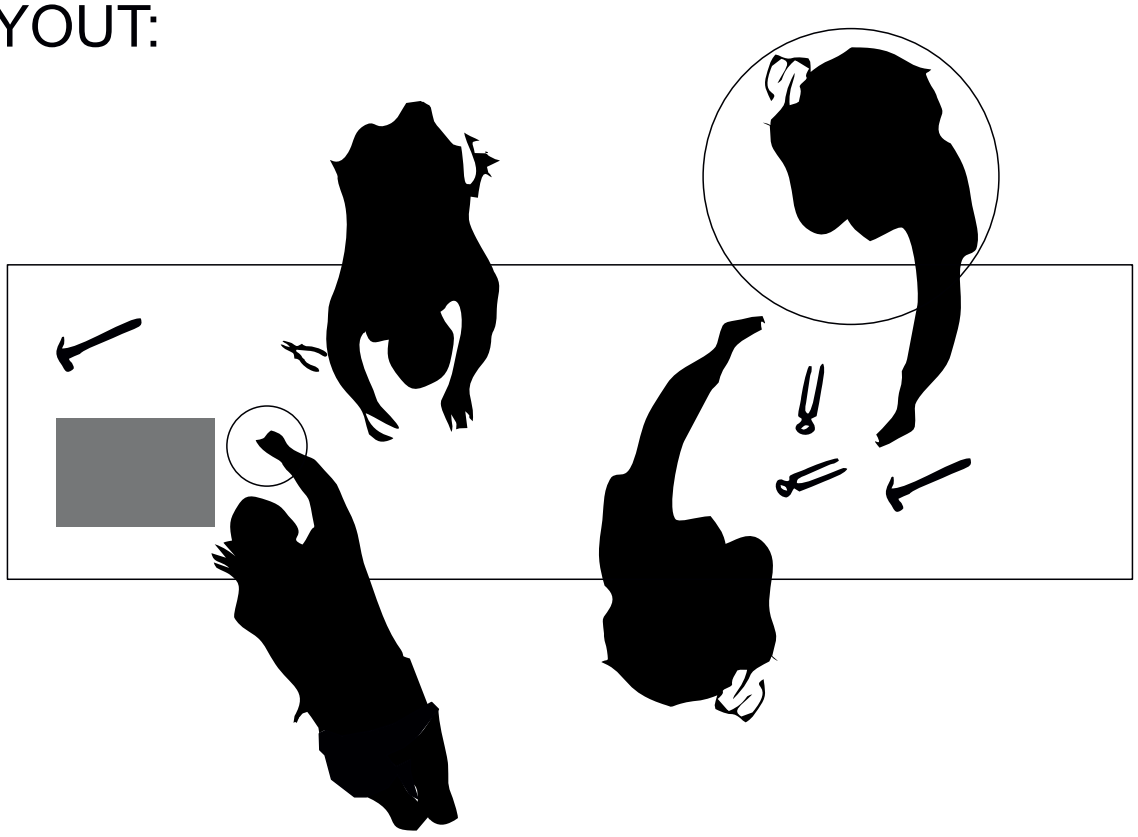
VIEW OF STORAGE

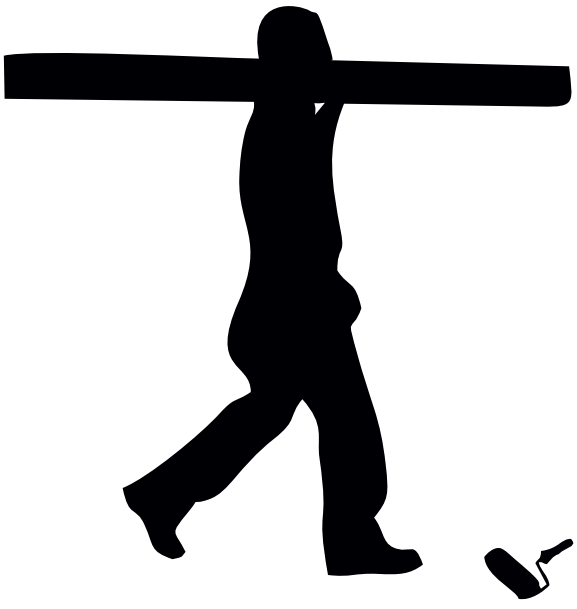


VIEW FROM SOUTH FACADE

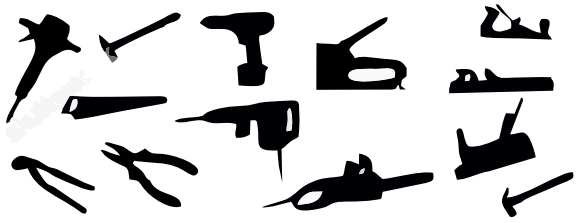
ISO SECTIONAL VIEW

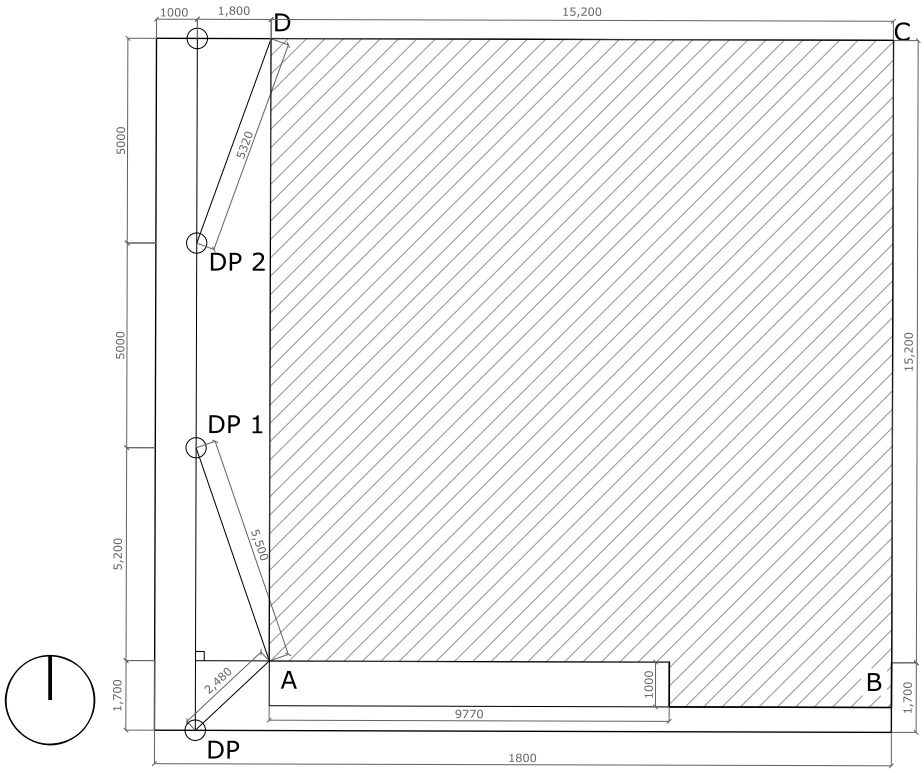
LAYOUT:



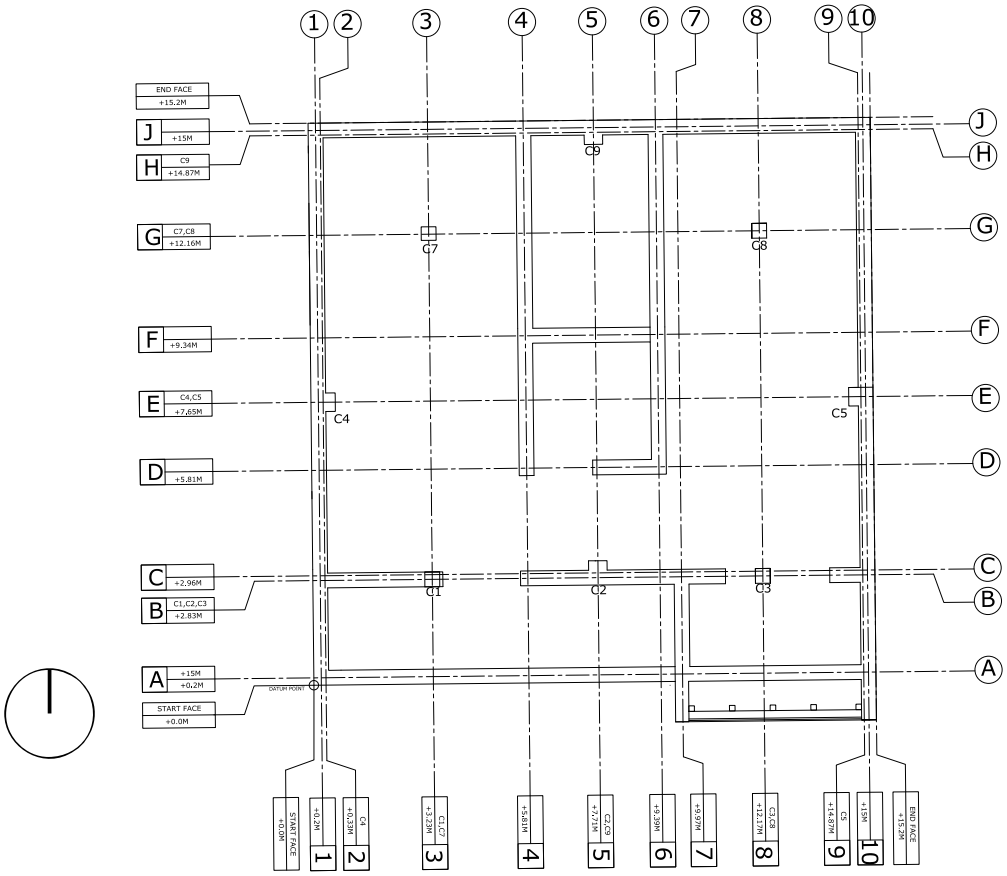


tools information

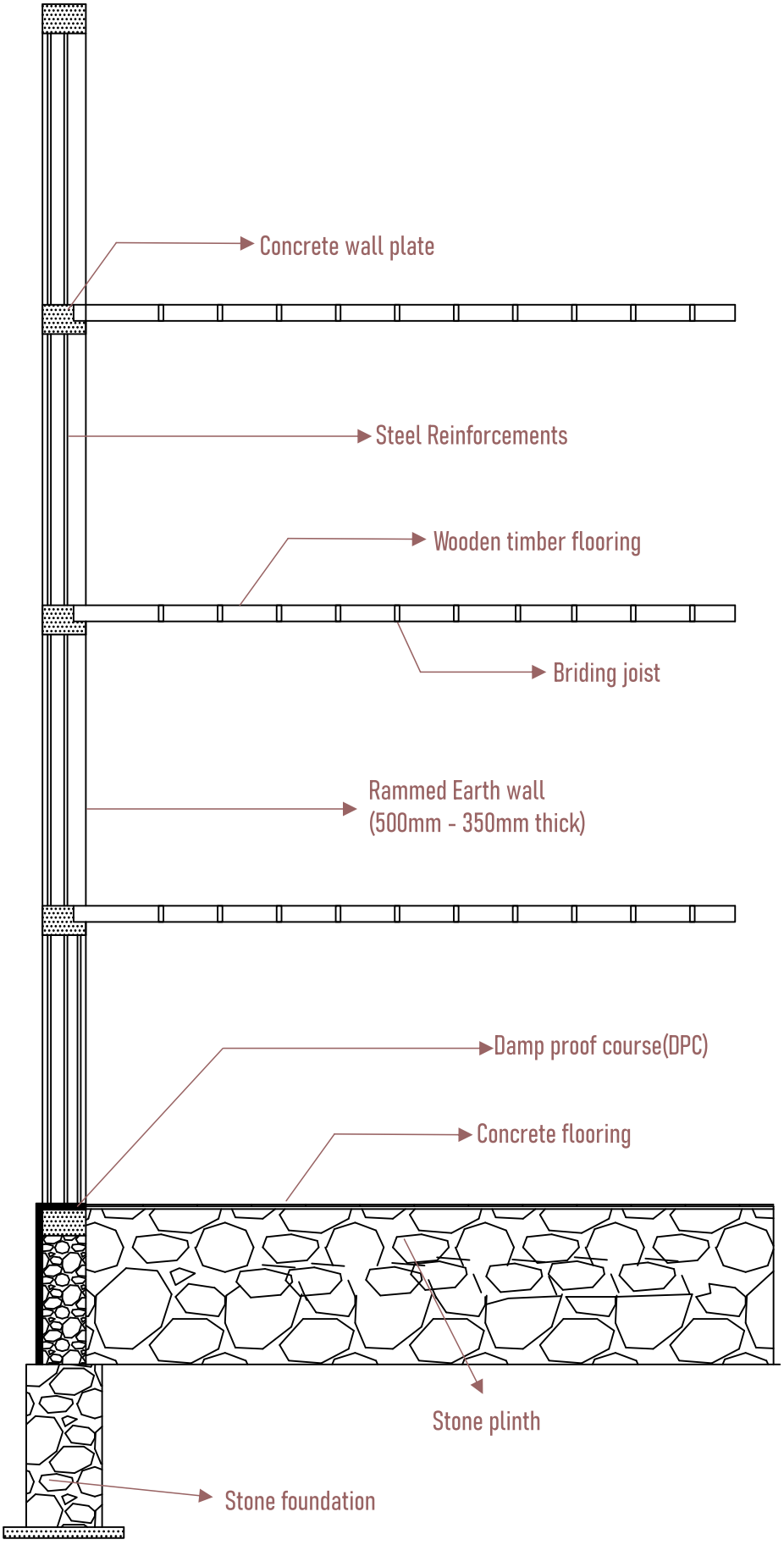




Setting Plan



Centerline Plan


Concrete wall plate
Steel Reinforcements
Wooden timber flooring
Briding joist
Rammed Earth wall
(500mm - 350mm thick)
Damp proof course(DPC)
Concrete flooring
Stone plinth
Stone foundation

ENERGY CONSUMPTION CASE 1

BASE DESIGN (ECBC COMPLIANT)											
Sr.No.	Spaces	Area (sq.m.)	LPD	Electrical Appliances	Number	Rating (Watt)	Rating (kW)	Usage Hours	Daily (kWh)	Usage Days	Consumption Annual
1	Entrance Foyer	22.83	5	INCANDESCENT	-	114.15	0.114	10	1.1415	306	52.78
			-	CCTV	1	15	0.015	24	0.36	365	131.4
2	Community Hall	130.01	8.2	INCANDESCENT	-	1066.08	1.066	3	3.198	306	6687.17
			-	Ceiling Fan	4	60	0.06	3	0.72	214	154.08
				CCTV	2	15	0.015	24	0.72	365	262.8
				Fire alarm	2	8	0.008	24	0.384	365	140.16
3	Workshop	91.71	8.6	INCANDESCENT	-	788.706	0.789	3	2.366	306	5175.72
			-	Table Saw	2	500	0.5	2	2	36	72
				CCTV	1	15	0.015	24	0.36	365	131.4
				6 A Socket Outlet	2	100	0.1	2	0.4	306	122.4
				Fire alarm	1	8	0.008	24	0.192	365	70.08
4	Storage Room	18.13	2.7	INCANDESCENT	-	48.951	0.049	2	0.098	306	72.37
5	Toilet	28.04	3.8	INCANDESCENT	-	106.552	0.107	10	1.066	306	771.96
			-	Exhaust Fan	8	50	0.05	24	9.6	365	3504
6	Kitchen	36.76	7.5	INCANDESCENT	-	275.7	0.2757	2	0.5514	306	88.96
			-	Mixer Grinder	2	600	0.6	0.5	0.6	306	183.6
				Fridge	1	500	0.5	24	12	306	3672
				Stove	2	1500	1.5	4	12	306	3672
				Exhaust Fan	1	50	0.05	2	0.1	306	30.6
				6 A Socket Outlet	3	100	0.1	4	1.2	306	367.2
				Fire alarm	1	8	0.008	24	0.192	365	70.08
				Water Heater	1	1125	1.125	1	1.125	306	344.25
7	Cafeteria	16.97	5.8	INCANDESCENT	-	98.426	0.098	2	0.197	306	146.68
				CCTV	1	15	0.015	24	0.36	365	131.4
				Fire alarm	1	8	0.008	24	0.192	365	70.08
8	Administration Room	35.84	7.7	INCANDESCENT	-	275.968	0.276	4	1.104	365	618.95
			-	6 A Socket Outlet	3	100	0.1	24	7.2	365	2628
				CCTV Monitor	2	300	0.3	24	14.4	365	5256
				CCTV	1	15	0.015	24	0.36	365	131.4
				Fire alarm	1	8	0.008	24	0.192	365	70.08
9	Resting	145.37	10.6	INCANDESCENT	-	1540.92	1.541	3	4.623	306	12464.13
			-	Ceiling Fan	4	60	0.06	3	0.72	214	154.08
				Fire alarm	2	8	0.008	24	0.384	365	140.16
10	Recreational	22.83	3.2	INCANDESCENT	-	73.056	0.073	2	0.146	306	44.71
11	Circulation	16.69	2.7	INCANDESCENT	-	45.063	0.045063	24	1.08151	365	652.02
13	Outside			INCANDESCENT	2	20	0.02	4	0.16	365	58.4
				Fire alarm	2	8	0.008	24	0.384	365	140.16
				CCTV	2	15	0.015	24	0.72	365	262.8
TOTAL CONSUMPTION PER YEAR (kWh/yr)											48746.06
TOTAL CONSUMPTION PER YEAR PER M2 (kWh/yr/m2)											68.57

ENERGY CONSUMPTION CASE 2

PROPOSED DESIGN (ENERGY EFFICIENT APPLIANCES)											
Sr.No.	Spaces	Area (sq.m.)	LPD	Electrical Appliances	Number	Rating (Watt)	Rating (kW)	Usage Hours	Daily (kWh)	Usage Days	Consumption Annual (kWh)
1	22.83	20.89	3.8	LED	-	79.382	0.07938	10	0.79382	306	160.83
			-	CCTV	1	8	0.008	24	0.192	365	70.08
2	130.01	132.91	6.5	LED	-	863.915	0.86392	3	2.59175	306	3127.09
			-	Table Fan	4	10	0.01	3	0.12	214	25.68
				CCTV	2	8	0.008	24	0.384	365	140.16
				Fire alarm	2	6	0.006	24	0.288	365	105.12
3	91.71	54.25	6.8	LED	-	368.9	0.3689	3	1.1067	306	2781.66
			-	Table Saw	2	0	0	2	0	36	0
				CCTV	1	8	0.008	24	0.192	365	70.08
				6 A Socket Outlet	2	100	0.1	2	0.4	306	122.4
				Fire alarm	1	6	0.006	24	0.144	365	52.56
4	18.13	14.95	2.1	LED	-	31.395	0.0314	2	0.06279	306	93.14
5	28.04	20.64	3.1	LED	-	63.984	0.06398	10	0.63984	365	960.88
			-	Exhaust Fan	4	50	0.05	24	4.8	365	1752
6	36.76	42	6	LED	-	252	0.252	2	0.504	306	1163.44
			-	Mixer Grinder	2	600	0.6	0.5	0.6	306	183.6
				Mini Fridge	1	100	0.1	24	2.4	306	734.4
				Stove	2	200	0.2	4	1.6	306	489.6
				Exhaust Fan	1	12	0.012	2	0.024	306	7.344
				6 A Socket Outlet	3	100	0.1	4	1.2	306	367.2
				Fire alarm	1	6	0.006	24	0.144	365	52.56
				Water Heater	1	200	0.2	1	0.2	306	61.2
7	16.97	22.46	4.6	LED	-	103.316	0.10332	2	0.20663	306	182.89
				CCTV	1	8	0.008	24	0.192	365	70.08
				Fire alarm	1	6	0.006	24	0.144	365	52.56
8	35.84	34.52	6.3	LED	-	217.476	0.21748	4	0.8699	365	403.98
			-	6 A Socket Outlet	3	100	0.1	24	7.2	365	2628
				CCTV Monitor	2	100	0.1	24	4.8	365	1752
				CCTV	1	8	0.008	24	0.192	365	70.08
				Fire alarm	1	6	0.006	24	0.144	365	52.56
9	145.37	144.68	8.4	LED	-	1215.31	1.21531	3	3.64594	306	2229.29
			-	Table Fan	4	10	0.01	3	0.12	214	25.68
				Fire alarm	1	6	0.006	24	0.144	365	52.56
10	22.83	20.89	2.8	LED	-	58.492	0.05849	2	0.11698	306	116.1
11	16.69	10	1.6	LED	-	16	0.016	24	0.384	365	97.9
13	Outside			LED	2	8	0.008	4	0.064	365	23.36
				Fire alarm	2	6	0.006	24	0.288	365	105.12
				CCTV	2	8	0.008	24	0.384	365	140.16
TOTAL CONSUMPTION PER YEAR (kWh/yr)											20523.344
TOTAL CONSUMPTION PER YEAR PER M2 (kWh/yr/m2)											28.87

ENERGY CONSUMPTION CASE 3

(NON-DISASTER) PROPOSED DESIGN (FINISHES)											
Sr.No.	Spaces	Area (sq.m.)	LPD	Electrical Appliances	Number	Rating (Watt)	Rating (kW)	Usage Hours	Daily (kWh)	Usage Days	Consumption Annual (kWh)
1	Entrance Foyer	22.83	3.8	LED	-	75.42	0.07542	10	0.7542	306	160.83
			-	CCTV	1	8	0.008	24	0.192	365	70.08
2	Community Hall	130.01	6.5	LED	-	820.72	0.82072	3	2.46216	306	2792.03
			-	Table Fan	4	10	0.01	3	0.12	214	25.68
				CCTV	2	8	0.008	24	0.384	365	140.16
				Fire alarm	2	6	0.006	24	0.288	365	105.12
3	Workshop	91.71	6.8	LED	-	350.46	0.35046	3	1.05138	306	2789.45
			-	Table Saw	2	0	0	2	0	36	0
				CCTV	1	8	0.008	24	0.192	365	70.08
				6 A Socket Outlet	2	100	0.1	2	0.4	306	122.4
				Fire alarm	1	6	0.006	24	0.144	365	52.56
4	Storage Room	18.13	2.1	LED	-	28.83	0.02883	2	0.05766	306	94.44
5	Toilet	28.04	3.1	LED	-	60.7848	0.06078	10	0.60785	365	975.49
			-	Exhaust Fan	4	12	0.012	24	1.152	365	420.48
6	Kitchen	36.76	6	LED	-	239.4	0.2394	2	0.4788	306	1170.08
			-	Mixer Grinder	2	600	0.6	0.5	0.6	306	183.6
				Mini Fridge	1	100	0.1	24	2.4	306	734.4
				Stove	2	200	0.2	4	1.6	306	489.6
				Exhaust Fan	1	12	0.012	2	0.024	306	7.344
				6 A Socket Outlet	3	100	0.1	4	1.2	306	367.2
				Fire alarm	1	6	0.006	24	0.144	365	52.56
				Water Heater	1	0	0	1	0	306	0
7	Cafeteria	16.97	4.6	LED	-	98.15	0.09815	2	0.1963	306	182.88
				CCTV	1	8	0.008	24	0.192	365	70.08
				Fire alarm	1	6	0.006	24	0.144	365	52.56
8	Administration Room	35.84	6.3	LED	-	206.6	0.2066	4	0.8264	365	416.27
			-	6 A Socket Outlet	3	100	0.1	24	7.2	365	2628
				CCTV Monitor	2	100	0.1	24	4.8	365	1752
				CCTV	1	8	0.008	24	0.192	365	70.08
				Fire alarm	1	6	0.006	24	0.144	365	52.56
9	Resting	145.37	8.4	LED	-	1154.55	1.15455	3	3.46365	306	2233.58
			-	Table Fan	4	10	0.01	3	0.12	214	25.68
				Fire alarm	1	6	0.006	24	0.144	365	52.56
10	Recreational	22.83	2.8	LED	-	55.58	0.05558	2	0.11116	306	170.35
11	Circulation	16.69	1.6	LED	-	13.6	0.0136	24	0.3264	365	66.22
13	Outside			LED	2	8	0.008	4	0.064	365	23.36
				Fire alarm	2	6	0.006	24	0.288	365	105.12
				CCTV	2	8	0.008	24	0.384	365	140.16
TOTAL CONSUMPTION PER YEAR (kWh/yr)											18865.04
TOTAL CONSUMPTION PER YEAR PER M2 (kWh/yr/m2)											26.54

ENERGY CONSUMPTION CASE 4

(DISASTER) PROPOSED DESIGN (FINISHES)											
Sr.No.	Spaces	Area (sq.m.)	LPD	Electrical Appliances	Number	Rating (Watt)	Rating (kW)	Usage Hours	Daily (kWh)	Usage Days	Consumption Annual (kWh)
1	Entrance Foyer	22.83	3.8	LED	-	75.42	0.07542	10	0.7542	306	1114.35
			-	CCTV	1	8	0.008	24	0.192	365	70.08
2	Community Hall	130.01	6.5	LED	-	820.72	0.82072	3	2.46216	306	14710.59
			-	Table Fan	4	10	0.01	3	0.12	214	0
				CCTV	2	8	0.008	24	0.384	365	140.16
				Fire alarm	2	6	0.006	24	0.288	365	105.12
3	Workshop	91.71	6.8	LED	-	350.46	0.35046	3	1.05138	306	6623.94
			-	Table Saw	2	0	0	2	0	36	0
				CCTV	1	8	0.008	24	0.192	365	70.08
				6 A Socket Outlet	2	100	0.1	2	0.4	306	0
				Fire alarm	1	6	0.006	24	0.144	365	52.56
4	Storage Room	18.13	2.1	LED	-	28.83	0.02883	2	0.05766	306	667.13
5	Toilet	28.04	3.1	LED	-	60.7848	0.06078	10	0.60785	365	1141.98
			-	Exhaust Fan	4	12	0.012	24	1.152	365	420.48
6	Kitchen	36.76	6	LED	-	239.4	0.2394	2	0.4788	306	4824.46
			-	Mixer Grinder	2	600	0.6	0.5	0.6	306	183.6
				Mini Fridge	1	100	0.1	24	2.4	306	0
				Stove	2	200	0.2	4	1.6	306	489.6
				Exhaust Fan	1	12	0.012	2	0.024	306	0
				6 A Socket Outlet	3	100	0.1	4	1.2	306	367.2
				Fire alarm	1	6	0.006	24	0.144	365	52.56
				Water Heater	1	0	0	1	0	306	0
7	Cafeteria	16.97	4.6	LED	-	98.15	0.09815	2	0.1963	306	1354.23
				CCTV	1	8	0.008	24	0.192	365	70.08
				Fire alarm	1	6	0.006	24	0.144	365	52.56
8	Administration Room	35.84	6.3	LED	-	206.6	0.2066	4	0.8264	365	3890.30
			-	6 A Socket Outlet	3	100	0.1	24	7.2	365	2628
				CCTV Monitor	2	100	0.1	24	4.8	365	1752
				CCTV	1	8	0.008	24	0.192	365	70.08
				Fire alarm	1	6	0.006	24	0.144	365	52.56
9	Resting	145.37	8.4	LED	-	1154.55	1.15455	3	3.46365	306	16023.07
			-	Table Fan	4	10	0.01	3	0.12	214	0
				Fire alarm	1	6	0.006	24	0.144	365	52.56
10	Recreational	22.83	2.8	LED	-	55.58	0.05558	2	0.11116	306	1796.07
11	Circulation	16.69	1.6	LED	-	13.6	0.0136	24	0.3264	365	467.77
12	Corridor	18.61	2.3	LED	-	40.66	0.04066	4	0.16264	365	59.3636
13	Outside			LED	2	8	0.008	4	0.064	365	23.36
				Fire alarm	2	6	0.006	24	0.288	365	105.12
				CCTV	2	8	0.008	24	0.384	365	140.16
TOTAL CONSUMPTION PER YEAR (kWh/yr)											59571.17
TOTAL CONSUMPTION PER YEAR PER M2 (kWh/yr/m2)											83.80

WATER CONSUMPTION - PROPOSED CASE - NON-DISASTER SCENARIO

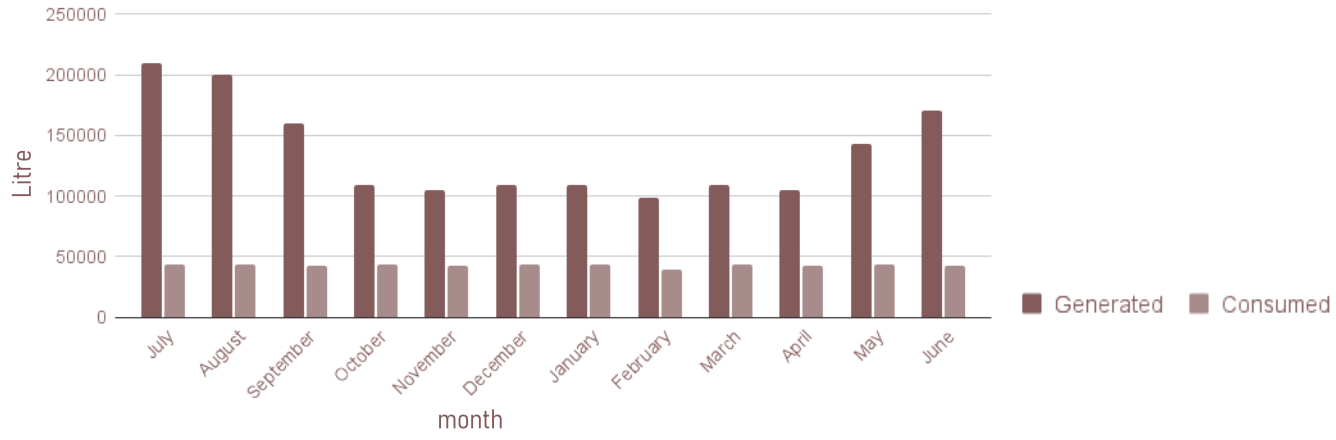
Per Capita daily consumption	Number of Occupants	Total Daily consumption	Grey Water Filter efficiency
7	200	1400	75%
Muncipality Water Supply (L/Day)			2,000

Water Consumption for 200 occupants during non-disaster scenario

End Use	Percent Use	Use in LPD	Greywater in LPD	Blackwater in LPD
			-	-
Cleaning house	2.9%	41	41	-
Washing Utensils	35.7%	500	500	-
Wash Basin	8.60%	120	72	-
Drinking	21%	294	-	-
Cooking	29%	406	-	-
Toilet	4%	60	-	60
Total		1421	613	60

Detailed water consumption table

Months	Days	Domestic Use (L)	Total consump-tion	Municipal water(L)	Rainwater (L)	Greywater (L)	Blackwater (L)	Total water stored
Jul	31	43KL	43KL	62,000	101340	18992	1,866	138932
Aug	31	43KL	43KL	62,000	91488	18992	1,866	268011
Sept	30	42KL	42KL	60,000	54893	18379	1,806	359283
Oct	31	43KL	43KL	62,000	12668	18992	1,866	409542
Nov	30	42KL	42KL	60,000	845	18379	1,806	446766
Dec	31	43KL	43KL	62,000	2252	18992	1,866	486610
Jan	30	43KL	43KL	62,000	2534	18992	1,866	526735
Feb	28	39KL	39KL	56,000	4223	17154	1,686	564912
Mar	31	43KL	43KL	62,000	8445	18992	1,866	610948
Apr	30	42KL	42KL	60,000	15483	18379	1,806	662810
May	31	43KL	43KL	62,000	33780	18992	1,866	734182
June	30	42KL	42KL	60,000	64745	18379	1,806	835306
Total	365	511KL	511KL	7,30,000	3,92,693	2,23,614	21,973	



WATER CONSUMPTION - PROPOSED CASE - DISASTER SCENARIO

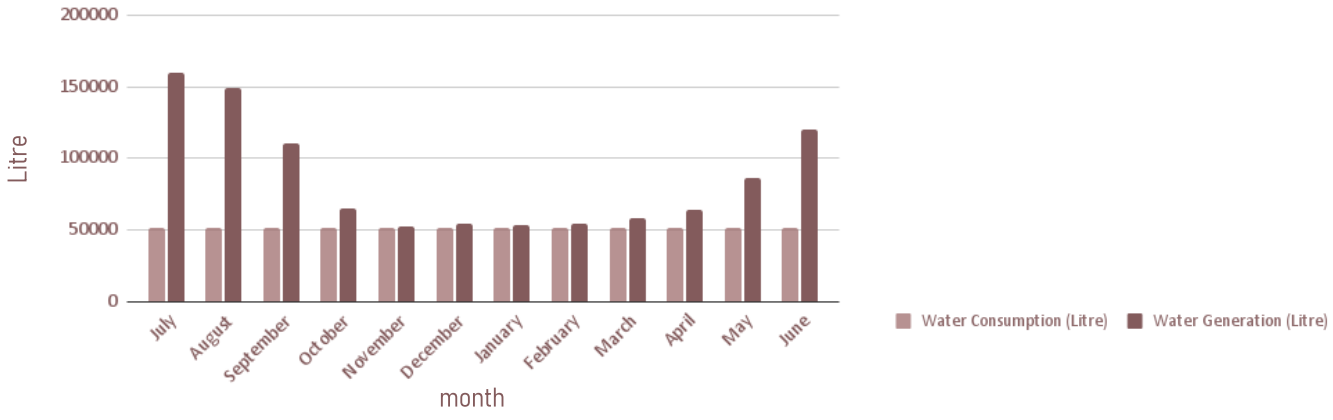
Per Capita daily consumption	Number of Occupants	Total Daily consumption	Grey Water Filter efficiency
57	300	17100	75%
Muncipality Water Supply (L/Day)			2,000

Water Consumption for 300 occupants during disaster scenario

End Use	Percent Use	Use in LPD	Greywater in LPD	Blackwater in LPD
Bathing	88%	14,997	14,997	
Cleaning house	0%	0	-	
Washing Utensils	4%	752	752	
Wash Basin	1%	188	94	
Drinking	3%	445		
Cooking	4%	599		
Toilet	1%	86		86
Total		17,066	15,843	86

Detailed water consumption table

Months	Days	Domestic Use (L)	Total consump-tion	Municipal water(L)	Rainwater (L)	Greywater (L)	Blackwater (L)	Total water stored
Jul	3	51,300	51,300	6,000	101340	47,529	257	103569
Aug	3	51,300	51,300	6,000	91488	47,529	257	197286
Sept	3	51,300	51,300	6,000	54893	47,529	257	254408
Oct	3	51,300	51,300	6,000	12668	47,529	257	269305
Nov	3	51,300	51,300	6,000	845	47,529	257	272379
Dec	3	51,300	51,300	6,000	2252	47,529	257	276861
Jan	3	51,300	51,300	6,000	2534	47,529	257	281624
Feb	3	51,300	51,300	6,000	4223	47,529	257	288076
Mar	3	51,300	51,300	6,000	8445	47,529	257	298750
Apr	3	51,300	51,300	6,000	15483	47,529	257	316462
May	3	51,300	51,300	6,000	33780	47,529	257	352471
June	3	51,300	51,300	6,000	64745	47,529	257	419446
Total	36	6,15,600	6,15,600	72,000	3,92,693	5,70,353	3,078	4,19,446



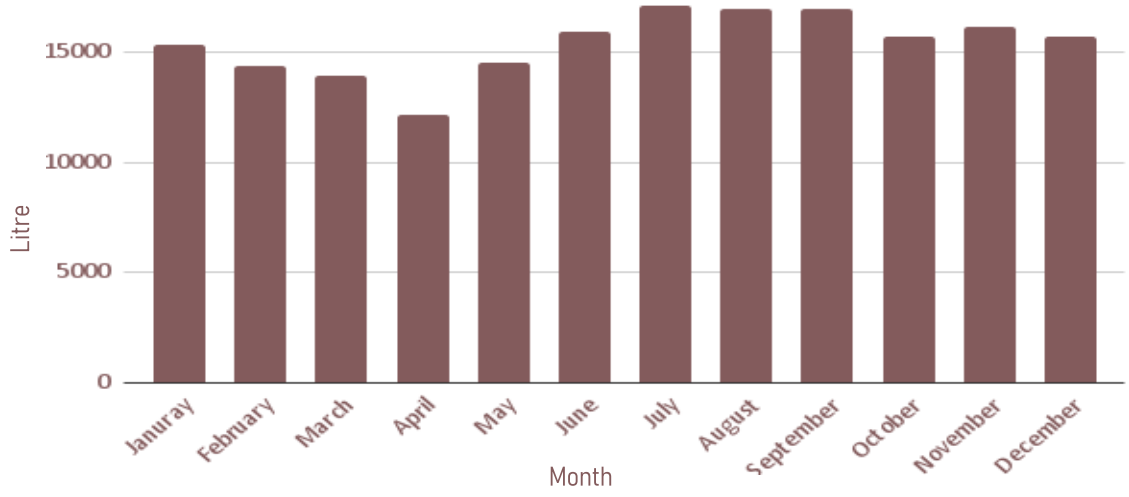
WATER GENERATION

AWG SPECIFICATION: we have provided 3 AWG systems.

VAYUJAL HOME - 40 LPD

Actual size (LxWxH) : 45 x 55 x 85 (cms)
Power Efficiency : 0.42 kWh / ltr (at 70% RH and 30 °C)
Built-in storage capacity: 16 ltrs. (SS 304)
Power supply & rating : 230 V, 1 Ph, 50 Hz & 0.7 kW
Air Purification : 10 Micron-Al mesh supported HDPE fabric
Water Purification:7 Stage filtration, including ozonizer, UV, membrane

Months	Relative Humidity (%)	Daily Generation(L)	Monthly Generation(KL)
July	86	552.8	17KL
August	85	546.4	16KL
September	85	546.4	16KL
October	79	507.8	15KL
November	81	520.7	16KL
December	79	507.8	15KL
Januray	77	495	15KL
February	72	462.8	14KL
April	70	450	13KL
March	61	392	12KL
May	73	469	145KL
June	80	514	15KL
Generation by 1 AWG			184KL
Generation by 3 AWG			184KL x 3 = 552KL



VIVEKANAND EDUCATION SOCIETY'S

College of Architecture

V.E.S. Since 1962

(Approved by Council of Architecture (COA), Recognised by Govt. of Maharashtra & Affiliated to University of Mumbai)

Reg. No. : VESCOA / 718/2022-23

Date : 22 / 02 / 2023

TO WHOMSOEVER IT MAY CONCERN

This is to certify that students mentioned below are bonafide students of our College, studying in Second & Third Year B.Arch. course for the Academic Year 2022-23. The B.Arch. course is Approved by Council of Architecture, recognized by Government of Maharashtra and Affiliated to University of Mumbai.

Roll No.	Students Name	Gender
AR20038	Takale Dhruv Mahesh	Male
AR20008	Ghaware Shravani Vishnu	Female
AR21057	Patel Himisha Vinod	Female
AR21015	Deogharkar Ritesh Prakash	Male
AR21074	Sinkar Siddhesh Vinod	Male

This Bonafide letter has been issued for the purpose of Solar Decathlon India Design Competition (2022-23).

Dr. Prof. Anand Achari
Principal
VESCOA

VES COLLEGE OF ARCHITECTURE CHEMBUR, MUMBAI-74

Hashu Advani Memorial Complex, Collector's Colony, R. C. Marg, Chembur, Mumbai - 400 074.
Tel.: 022-6291 3333 Email : principal.vescoa@ves.ac.in Website : www.ves.ac.in / architecture

Vivekanand Education Society's
Institute of Technology

(Affiliated to University of Mumbai, Approved by AICTE & Recognised by Govt. of Maharashtra)

Since 1962

Dr. (Mrs.) J. M. Nair
M. Tech., Ph.D. (IIT-B)
Principal

Ref. No.: VESIT/ DK/INST/2258/22-23

Date : 23/02/2023

TO WHOMSOEVER IT MAY CONCERN

This is to certify that Ms. **C S LAKSHMI SUNDARAM** is a bonafide student of Vivekanand Education Society's Institute of Technology studying in Third year of Bachelor of Engineering in Instrumentation Engineering branch with Roll No. D13-04 for the academic year 2022-23.

This letter is issued based on student request to participate for **SOLAR DECATHLON INDIA 2022-23**.

With Regards,

Dkhimani
HOD

VIVEKANAND EDUCATION SOCIETY'S INSTITUTE OF TECHNOLOGY
CHEMBUR, MUMBAI-400 074 INDIA

Hashu Advani Memorial Complex, Collector's Colony, Chembur, Mumbai - 400 074. INDIA.
Phone : +91 22 6153 2532 | Fax : +91 22 6153 2555 | Email : vesit@ves.ac.in / principal.vesit@ves.ac.in | Website : www.ves.ac.in/vesit

Vivekanand Education Society's
Institute of Technology

(Affiliated to University of Mumbai, Approved by AICTE & Recognised by Govt. of Maharashtra)

Dr. (Mrs.) J. M. Nair
M. Tech., Ph.D. (IIT-B)
Principal

Ref. No.: VESIT/DK/INST/2259/22-23 Date : 23/02/2023

TO WHOMSOEVER IT MAY CONCERN

This is to certify that Ms. **NAIR NIDHI VIVEK** is a bonafide student of Vivekanand Education Society's Institute of Technology studying in Final year of Bachelor of Engineering in Instrumentation Engineering branch with Roll No. D18-36 for the academic year 2022-23.

This letter is issued based on student request to participate for **SOLAR DECATHLON INDIA 2022-23**.

With Regards,

Dkshimane
HOD

VIVEKANAND EDUCATION SOCIETY'S INSTITUTE OF TECHNOLOGY
CHEMBUR, MUMBAI-400 074
INDIA

Hashu Advani Memorial Complex, Collector's Colony, Chembur, Mumbai - 400 074. INDIA.
Phone : +91 22 6153 2532 | Fax : +91 22 6153 2555 | Email : vesit@ves.ac.in / principal.vesit@ves.ac.in | Website : www.ves.ac.in/vesit

VayuJal Technologies Private Limited

Place: Chennai Date: 23 Feb 2022

To,

The Director,

Solar Decathlon India

Dear Sir,

This is to inform you that our organization, VayuJal Technologies Pvt. Ltd.), is collaborating with the participating team led by VIVEKANAND EDUCATION SOCIETY COLLEGE OF ARCHITECTURE, MUMBAI on a Community Resilience Shelter Building project for their Solar Decathlon India 2022-23 competition entry.

The nature of our collaboration will be to integrate Vayujal's AWGs with the proposed design of COMMUNITY RESILIENCE SHELTER in Nepal.

We would like a representative from our organization to attend the Design Challenge Finals event in April/May based on the progress and 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,

VAYUJAL TECHNOLOGIES PVT. LTD. CHENNAI 600 113

Ramesh Kumar Soni (CEO and Co-founder)

VayuJal Technologies Pvt. Ltd.

VayuJal Technologies Private Limited (an IIT Madras Incubated and ISO 9001-2015 Certified Company)
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CIN No. U74999TN2017PTC118695 | GSTIN: 33AAGCV1076L1Z5 | DIPP10995 | UDYAM-TN-02-0004746
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Vivekanand Education Society's
Institute of Technology

(Affiliated to University of Mumbai, Approved by AICTE & Recognised by Govt. of Maharashtra)

Since 1962

Dr. (Mrs.) J. M. Nair
M. Tech., Ph.D. (IIT-B)
Principal

Ref. No.: VESIT/DK/INST/2260/22-23

Date : 23/02/2023

TO WHOMSOEVER IT MAY CONCERN

This is to certify that Mr. **ISHAAN SHARMA** is a bonafide student of Vivekanand Education Society's Institute of Technology studying in Final year of Bachelor of Engineering in Instrumentation Engineering branch with Roll No. D18-52 for the academic year 2022-23.

This letter is issued based on student request to participate for **SOLAR DECATHLON INDIA 2022-23**.

With Regards,

Dkhimani
HOD

VIVEKANAND EDUCATION SOCIETY'S INSTITUTE OF TECHNOLOGY
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