AFFORDABLE AND SUSTAINABLE HOMES
(PRE-FABRICATED CONSTRUCTION)

A PROJECT REPORT

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE AWARD OF THE DEGREE OF

MASTER OF DESIGN

Submitted by

M.ROBEN SINGH (2K21/MDPD/08)

Under the supervision of

Prof.Partha Pritam Das

Asst. Prof. Department of Design

DEPARTMENT OF DESIGN

DELHI TECHNOLOGICAL UNIVERSITY

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APRIL,2023

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CANDIDATE'S DECLARATION

I, **Roben Singh**, Roll No. **2K21/MDPD/08** student of **M. Des. Product Design**, hereby declare that the project Dissertation titled "**Affordable and Sustainable Homes for People of North-East India**" which is submitted by me to the Department of Design, Delhi Technological University, Delhi in partial fulfillment of the requirement for the award of the degree of Master of Design, is original and not copied from any source without proper citation. This work has not previously formed the basis for the award of any Degree, Diploma Associateship, Fellowship or 'recognition. other similar title or recognition.

Place : Delhi
Dated : 26 April,2023

M.Roben Singh

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CERTIFICATE

I hereby certify that the Project Dissertation titled "**Affordable and Sustainable Homes for People of North-East-India**" which is submitted by **Roben Singh**, Roll No's – **2K21/MDPD/08**, Department of Design, Delhi Technological University, Delhi in partial fulfilment of the requirement for the award of the degree of **Master of Design** , is a record of the project work carried out by the students under my supervision. To the best of my knowledge this work has not been submitted in part or full for any Degree or Diploma to this University or elsewhere.

SUPERVISOR: PROF.

Prof.Partha Pritam Das

Asst. Prof. Department of Design

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(Formerly Delhi College of Engineering)
Bawana Road, Delhi-110042

ACKNOWLEDGEMENT

I am grateful to Mr. Prakash, Mr. Robindro, Prof. Ranganath M. Singari, and Prof. Partha Pratim Das for their guidance and mentorship during the project. They helped me understand the importance of the project and its industrial relevance. They were always available to answer my questions and help me overcome any challenges. I hope that my contributions and design inputs will enhance the productivity and usability of the products.

Place : Delhi
Dated : 26 April,2023

M.Roben Singh

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

This is to certify that M Roben Singh of Delhi Technological University pursuing Master of Design Final Year has been enrolled in six months Internship[Program under Design and Research team in Our company i.e., Qubits and Bigtech Group, starting date 12 Jan 2023 to date.

This letter is furnished on M Roben Singh's request for college project submission.

Your Sincerely,

Bigtech Group

Prakashanant
Director

ABSTRACT

North-East India is a hilly region with an economically backward economy. The people of this region face many challenges in accessing affordable housing. They need the intervention of experts and the government to develop affordable, modular, and portable homes made with sustainable materials. These homes would be especially beneficial in the event of natural or man-made disasters.

The design of these homes should be based on the following principles:

- Affordability: The homes should be affordable for the people of North-East India. This can be achieved by using sustainable materials and by using modular construction methods.
- Durability: The homes should be durable and able to withstand the harsh weather conditions of North-East India.
- Portability: The homes should be portable so that they can be easily moved in the event of a natural disaster.
- Sustainability: The homes should be made with sustainable materials and should be designed to minimize the environmental impact.

By following these principles, it is possible to design and develop affordable, modular, and portable homes that would be beneficial for the people of North-East India.

- The homes could be made from bamboo, which is a sustainable material that is abundant in North-East India.
- The homes could be designed to be energy-efficient, using solar power and rainwater harvesting.
- The homes could be built in a way that minimizes the impact on the environment, such as by using native plants and trees in the landscaping.

By taking these factors into account, it is possible to design and construct affordable and sustainable homes that will meet the needs of the people of North-East India.

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List of Symbols and Abbreviations

1. RCFB - Reenforced Cement Fiber Board
2. Block - AAC Blocks
3. AAC- Autoclave Aerated Concrete
4. Plan– Architectural/Engineering Plan
5. BDC - Business Development Centre
6. UI – User Interface
7. CJM – Customer Journey Mapping
8. UEM – User Experience Mapping
9. UX – User Experience
10. Fig. – Figure
11. RCC- Re-enforced Cement Concrete
12. MS - Mild Steel

Chapter-1

INTRODUCTION

1.1 Bigtech Group

Bigtech Group is an engineering and construction company headquartered in Gurugram and Delhi. The company is venturing into pre-fabricated steel and RCC buildings in India. Some of its subsidiaries provide consultancy services for design, engineering, and project management.
Bigtech Group is committed to providing affordable and sustainable homes in North-East India. The company believes that these homes will improve the health and well-being of the people of North-East India. Bigtech Group is working with government agencies and private organizations to implement modern technology and expertise to achieve this goal.

Some of the benefits of affordable and sustainable homes:

- Improved health: Homes that are energy-efficient and have good ventilation can help to improve the health of residents.
- Reduced pollution: Sustainable homes can help to reduce pollution by using less energy and materials.
- Increased productivity: Homes that are comfortable and safe can help residents to be more productive.
- Improved social cohesion: Homes that are affordable and accessible can help to improve social cohesion by bringing people together.

Bigtech Group is confident that affordable and sustainable homes can make a positive difference in the lives of people in North-East India. The company is committed to working with government agencies and private organizations to make this vision a reality.

1.2 Project Briefing

Designing a portable and affordable Farm-Houses, small cabins, Homes for the people of North-East, India. The Unit or the system will have durable, easily repairable components, sustainable design.

The people of North-East India face many challenges in accessing affordable housing. They need the intervention of experts and the government to develop affordable, modular, and portable homes made with sustainable materials. These homes would be especially beneficial in the event of natural or man-made disasters. North-East India is a hilly region with an economically backward economy, and developing such a housing system would help the people of this region.

Some of the specific challenges that the people of North-East India face in accessing affordable housing:

- The region is prone to natural disasters, such as floods, earthquakes, and landslides. These disasters can destroy homes and make it difficult for people to rebuild.
- The region has a hilly terrain, which makes it difficult and expensive to build homes.
- The region has an economically backward economy, which means that people have less money to spend on housing.

Affordable, modular, and portable homes made with sustainable materials would address these challenges. These homes would be:

- More resistant to natural disasters.
- Less expensive to build.
- Easier to relocate in the event of a disaster.
- Made with sustainable materials that are better for the environment.

Developing such a housing system would help the people of North-East India to live in safer, more affordable, and more sustainable homes.

1.3 Research Methodologies

- primary and secondary research
- Case studies
- Surveys
- Analysis of Datas and informations provided by govt and local bodies.

1.4 Market Research

Existing policies and programs to promote affordable housing in North-East India have not been effective. As a result, local communities have formed self-help groups or private organizations to help each other build homes. However, traditional homes built with locally available materials and techniques are not durable and can be easily damaged by natural disasters.
Several agencies, NGOs, and experts are working on this problem. However, there are many challenges. Our priority is to learn from their experiences and develop more affordable solutions.

Some of the challenges that these organizations face:

- Lack of funding: The cost of building affordable homes is high, and many organizations do not have the resources to fund these projects.
- Lack of skilled labor: There is a shortage of skilled labor in the region, which makes it difficult to build homes quickly and efficiently.
- Difficult terrain: The region is mountainous and has a difficult terrain, which makes it difficult to access and build homes in remote areas.
- Natural disasters: The region is prone to natural disasters, such as floods, earthquakes, and landslides, which can damage or destroy homes.

Despite these challenges, there are several organizations that are working to address the issue of affordable housing in North-East India. These organizations are working to develop new technologies and construction methods that can make homes more affordable and durable. They are also working to raise awareness of the issue and to mobilize resources to support these efforts.

With continued effort, it is possible to address the issue of affordable housing in North-East India and to provide all people with a safe and secure place to live.

Chapter-2

COMPETITIVE RESEARCH

2.1 Research Findings

Affordable housing is defined as a housing unit that costs ₹45 lakh or less and has a carpet area of 60 sq meter or less. In 2021, the contribution of affordable housing to total housing sales declined to 43% from 48% in the previous year. The share of units above Rs 75 lakh increased to 31% from 25%.
The lower-income group (LIG) has an annual household income between ` 1 to 2 lakhs. The income ceilings are subject to revision by the Ministry of Housing and Urban Affairs (MoHUA) from time to time. The LIG scheme is for the period 2013-2022 and is applicable to all cities/urban agglomerations (UAs) under the Pradhan Mantri Awas Yojana (PMAY).
The increasing demand for housing in urban areas is putting pressure on the existing infrastructure. The lack of housing options for the LIG section, coupled with limited income and minimal access to home finance for low-income borrowers, leads to cramped and poor living conditions.

Some of the challenges faced by the LIG section in accessing affordable housing:

- High cost of housing: The cost of housing in urban areas is high, making it difficult for LIG households to afford a home.
- Limited income: LIG households have limited income, which makes it difficult for them to save for a down payment or afford monthly mortgage payments.
- Minimal access to home finance: LIG households have minimal access to home finance, which makes it difficult for them to obtain a loan to purchase a home.

The government has taken some steps to address the challenges faced by the LIG section in accessing affordable housing. These steps include:

- The Pradhan Mantri Awas Yojana (PMAY): The PMAY is a government scheme that provides financial assistance to LIG households to purchase a home.
- The Credit Linked Subsidy Scheme (CLSS): The CLSS is a government scheme that provides an interest subsidy to LIG households to purchase a home.
- The Pradhan Mantri Kaushal Vikas Yojana (PMKVY): The PMKVY is a government scheme that provides training to LIG households in construction-related skills. This training can help LIG households to find jobs in the construction sector and earn a higher income.

Despite these efforts, there is still a need for more affordable housing options for the LIG section. The government needs to take further steps to address this issue and ensure that all LIG households have access to a safe and secure place to live.

Fig 2.1.1 Govt School in Gurugram, Constructed using Pre-Fabricated system.

2.2 Competitive Analysis

	STRENGTHS	WEAKNESSES	OPPORTUNITIES	THREATS
DLF	Strong brand name, financial resources, and experience in the real estate sector	High prices, limited focus on affordable housing	Government support for affordable housing, increasing demand for housing in urban areas	Competition from other real estate developers, rising costs of construction
HIRANANDANI GROUP	Strong brand name, financial resources, and experience in the real estate sector	Limited focus on affordable housing	Government support for affordable housing, increasing demand for housing in urban areas	Competition from other real estate developers, rising costs of construction
GODREJ PROPERTIES	Strong brand name, financial resources, and experience in the real estate sector	Limited focus on affordable housing	Government support for affordable housing, increasing demand for housing in urban areas	Competition from other real estate developers, rising costs of construction
LODHA GROUP	Strong brand name, financial resources, and experience in the real estate sector	Limited focus on affordable housing	Government support for affordable housing, increasing demand for housing in urban areas	Competition from other real estate developers, rising costs of construction
OBEROI REALTY	Strong brand name, financial resources, and experience in the real estate sector	Limited focus on affordable housing	Government support for affordable housing, increasing demand for housing in urban areas	Competition from other real estate developers, rising costs of construction

Fig 2.1.1 Competitive Analysis of Companies working in Affordable Housing

As you can see, the major strengths of these companies are their strong brand names, financial resources, and experience in the real estate sector. However, their major weaknesses are their high prices and limited focus on affordable housing.

The major opportunities for these companies are the government's support for affordable housing and the increasing demand for housing in urban areas. However, the major threats to these companies are competition from other real estate developers and rising costs of construction.

Overall, these companies are well-positioned to capitalize on the growing demand for affordable housing in India. However, they will need to focus on developing more affordable housing options and reducing their costs in order to remain competitive.

Some additional factors that could affect the competitive landscape for affordable housing in India:

- The availability of land: The availability of land at affordable prices is a major constraint for the development of affordable housing. The government needs to take steps to make land more available for affordable housing development.
- The cost of construction: The cost of construction is a major factor in the price of affordable housing. The government needs to take steps to reduce the cost of construction, such as providing subsidies for materials and labor.
- The availability of finance: The availability of finance is a major constraint for the purchase of affordable housing. The government needs to take steps to make finance more available for affordable housing, such as providing interest subsidies and guarantees.

By addressing these factors, the government can help to create a more favorable environment for the development and purchase of affordable housing in India.

2.3 Typical Construction Processes

CONSTRUCTION STAGES

Essential steps of home-building you need to know

VIEW STAGES

HOUSE PLANS

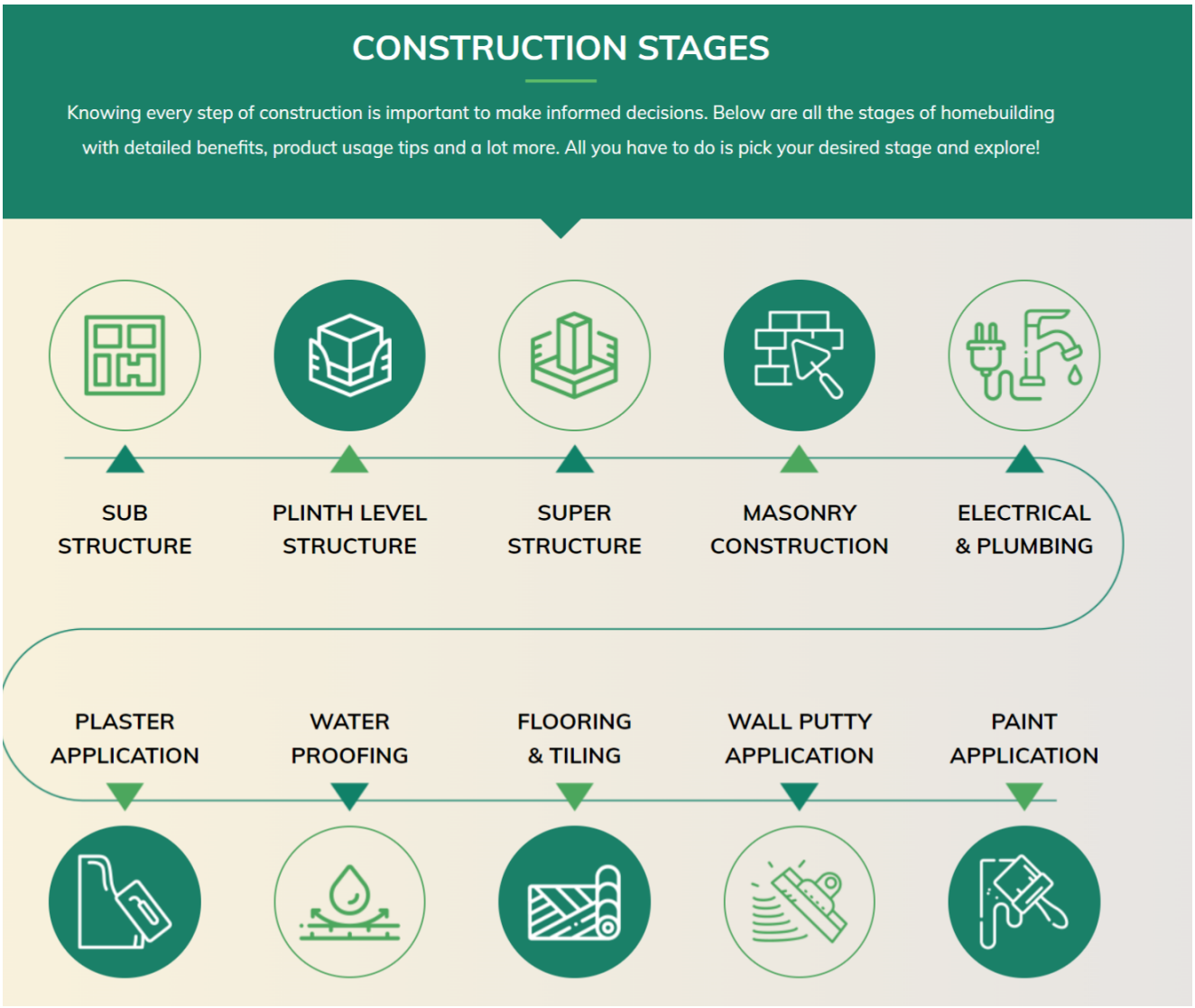
Floor plans to inspire you while building your own abode

EXPLORE

CALCULATORS

How 'NOT' to exceed the budget while building your home

VIEW MORE



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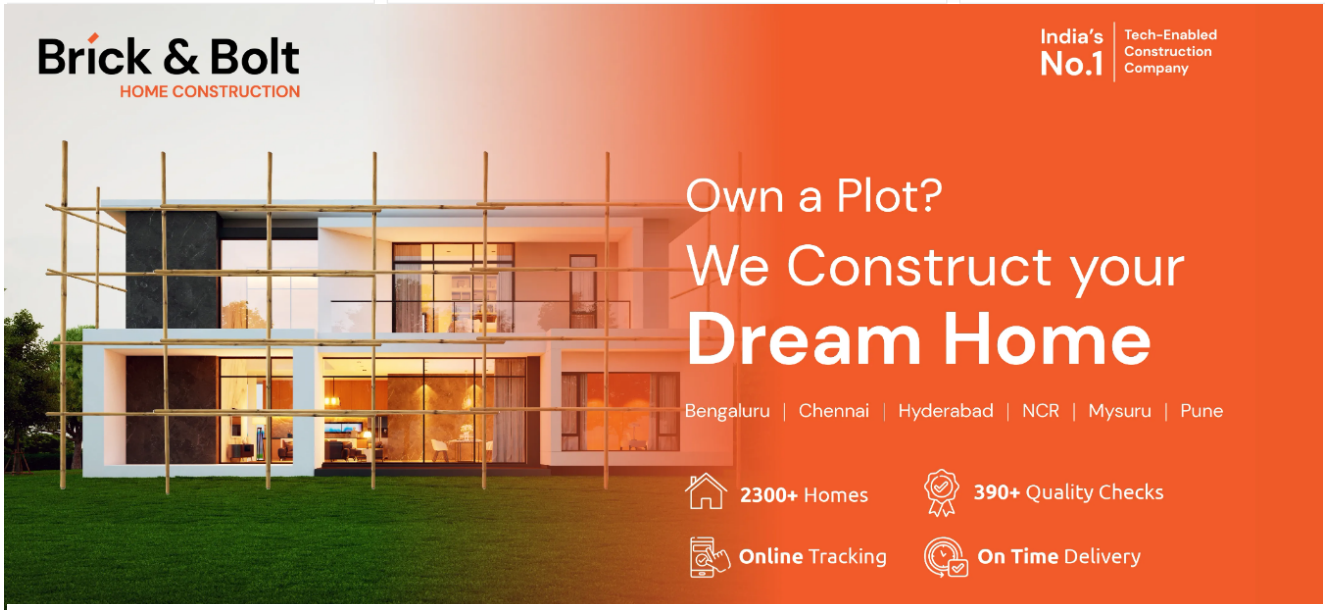

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Structure +	Structure +	Structure +
Kitchen +	Kitchen +	Kitchen +
Bathroom +	Bathroom +	Bathroom +
Doors & Windows +	Doors & Windows +	Doors & Windows +
Painting +	Painting +	Painting +
Flooring +	Flooring +	Flooring +
Electrical +	Electrical +	Electrical +
Miscellaneous +	Miscellaneous +	Miscellaneous +
Get in touch with us!	Get in touch with us!	Get in touch with us!
Talk To Our Expert →	Talk To Our Expert →	Talk To Our Expert →

Chapter-3

3.1 Design Programme :

The design and construction of affordable and sustainable homes for the people of North-East India is a complex and challenging task. The region is prone to earthquakes, cyclones, and other natural disasters, and the homes must be able to withstand these events. In addition, the homes must be affordable for the people of the region, who often live in poverty.

One approach to this challenge is to use modular construction. Modular homes are built in a factory and then transported to the site where they will be assembled. This method of construction is faster and more efficient than traditional construction methods, and it can help to reduce costs.

Another important consideration is the use of sustainable materials. Sustainable materials are those that are environmentally friendly and can be recycled or reused. The use of sustainable materials can help to reduce the environmental impact of the homes and can also save money in the long run.
By using modular construction and sustainable materials, it is possible to design and construct affordable and sustainable homes for the people of North-East India. These homes will be able to withstand natural disasters, and they will be a valuable asset to the region.

- The homes could be designed to take advantage of the region's natural resources, such as solar power and rainwater harvesting.
- The homes could be built in a way that minimizes the impact on the environment, such as by using native plants and trees in the landscaping.
- The homes could be designed to be easily maintained and repaired, so that they can last for many years.

By taking these factors into account, it is possible to design and construct affordable and sustainable homes that will meet the needs of the people of North-East India.

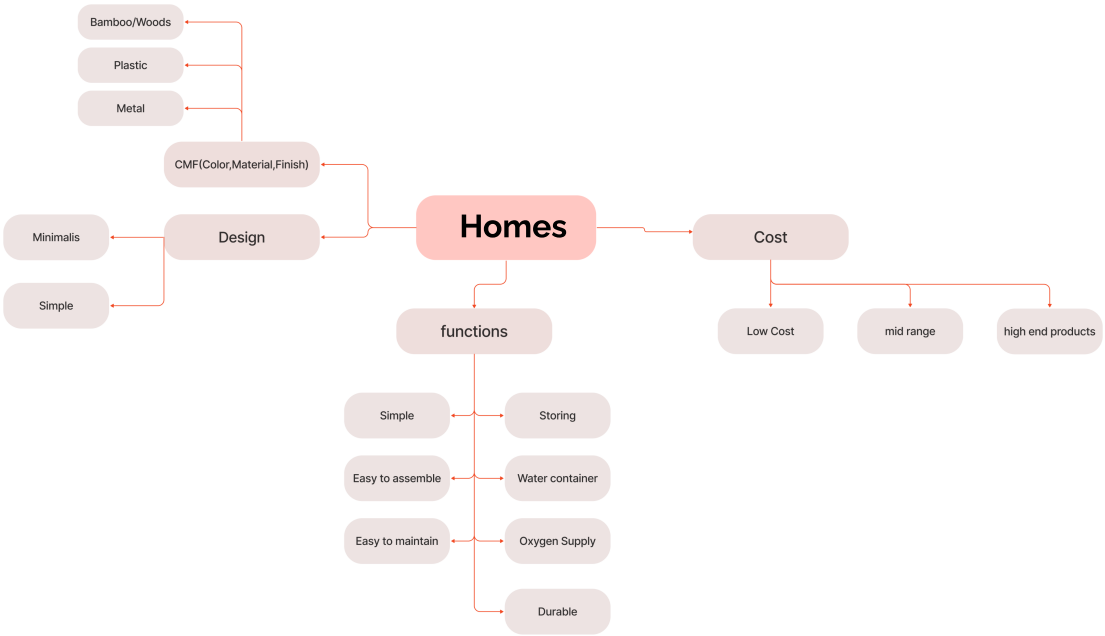


Fig 3.1.1 Mind Mapping and Design ideation

3.2 SOME OF THE TRADITIONAL HOUSES IN NORTH-EAST-INDIA

Fig 3.2.1 Images of some of the traditional Homes of North-East-India

The traditional homes of North-east India are built using locally available materials and techniques. The most common materials used are bamboo, wood, and mud. The houses are typically built on stilts to protect them from flooding. The roofs are made of thatch or bamboo. The walls are made of mud or bamboo matting. The floors are made of earth or bamboo. The houses are typically small and simple, but they are well-suited to the climate and environment of North-east India.

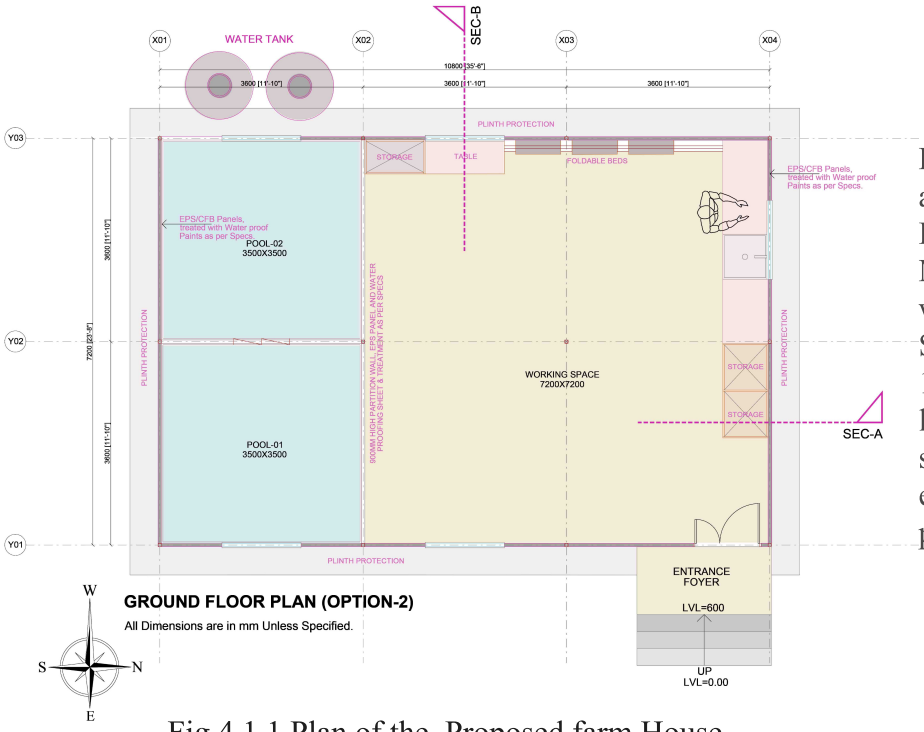
Some of the specific features of traditional homes in North-east India:

- Stilts: The houses are typically built on stilts to protect them from flooding. This is especially important in the plains of Assam, which are prone to flooding.
- Thatch roofs: The roofs are typically made of thatch, which is a natural material that is both water-resistant and fire-resistant.
- Mud walls: The walls are typically made of mud, which is a natural material that is both cool in the summer and warm in the winter.
- Earth floors: The floors are typically made of earth, which is a natural material that is both cool and comfortable.

The traditional homes of North-east India are a reflection of the culture and traditions of the people who live there. They are also a testament to the ingenuity and creativity of the people who built them.

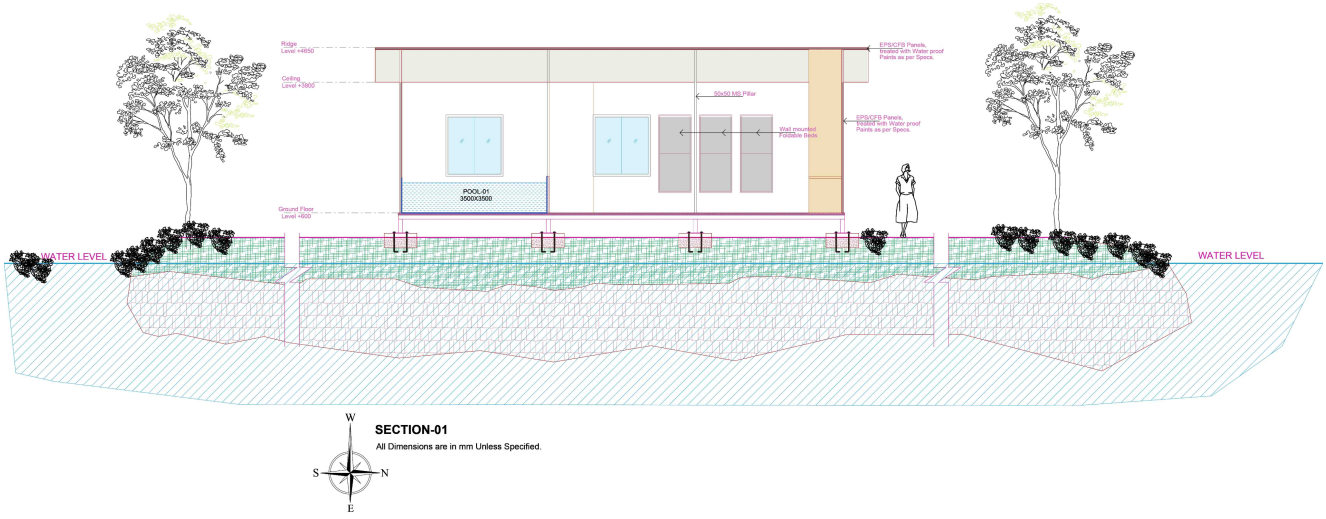
Chapter-4

4.1 Design Prototyping :

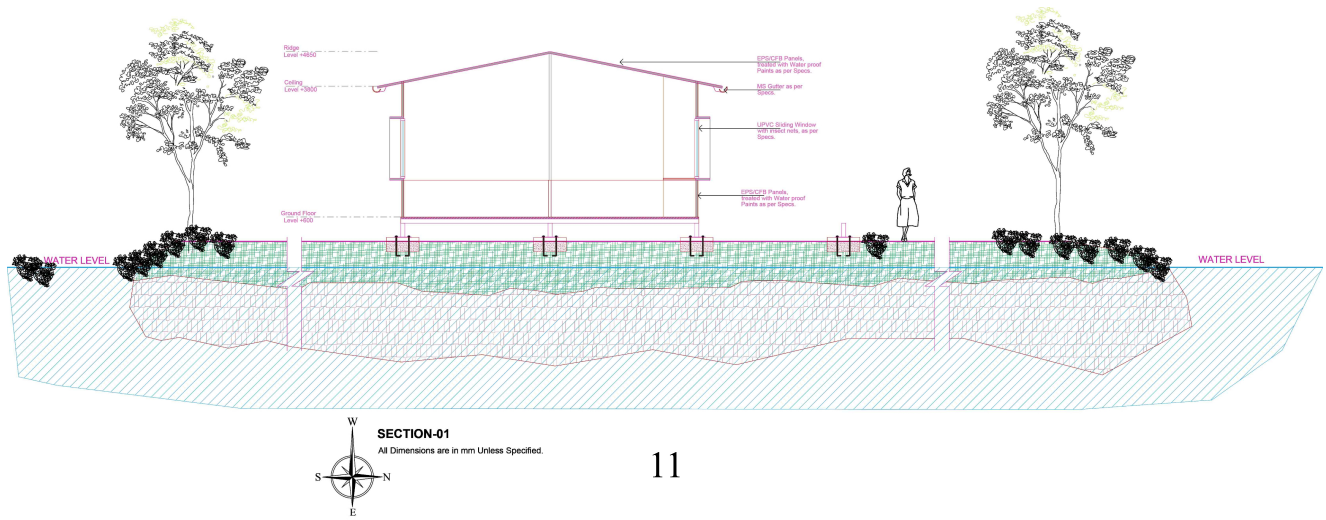


Keeping a margin/profit of about 1.2 Lacs for the Engineering and PMC (Management) per farm house we have started taking orders. So far we have proposal for 14 such projects at different locations of Manipur. We have started transportation and execution of some of the projects.

Fig 4.1.1 Plan of the Proposed farm House.



SECTION-01
All Dimensions are in mm Unless Specified.



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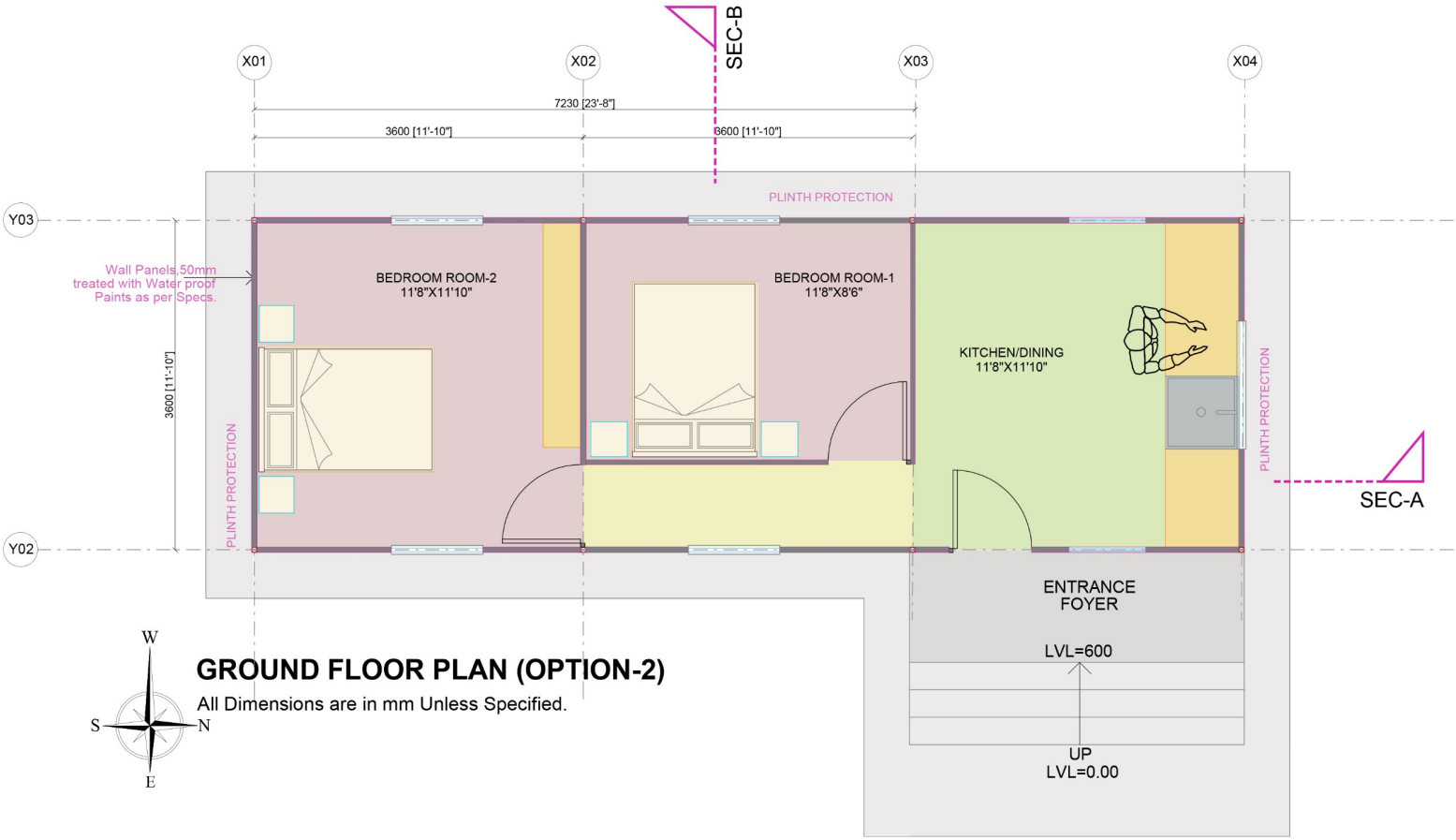

GROUND FLOOR PLAN (OPTION-2)

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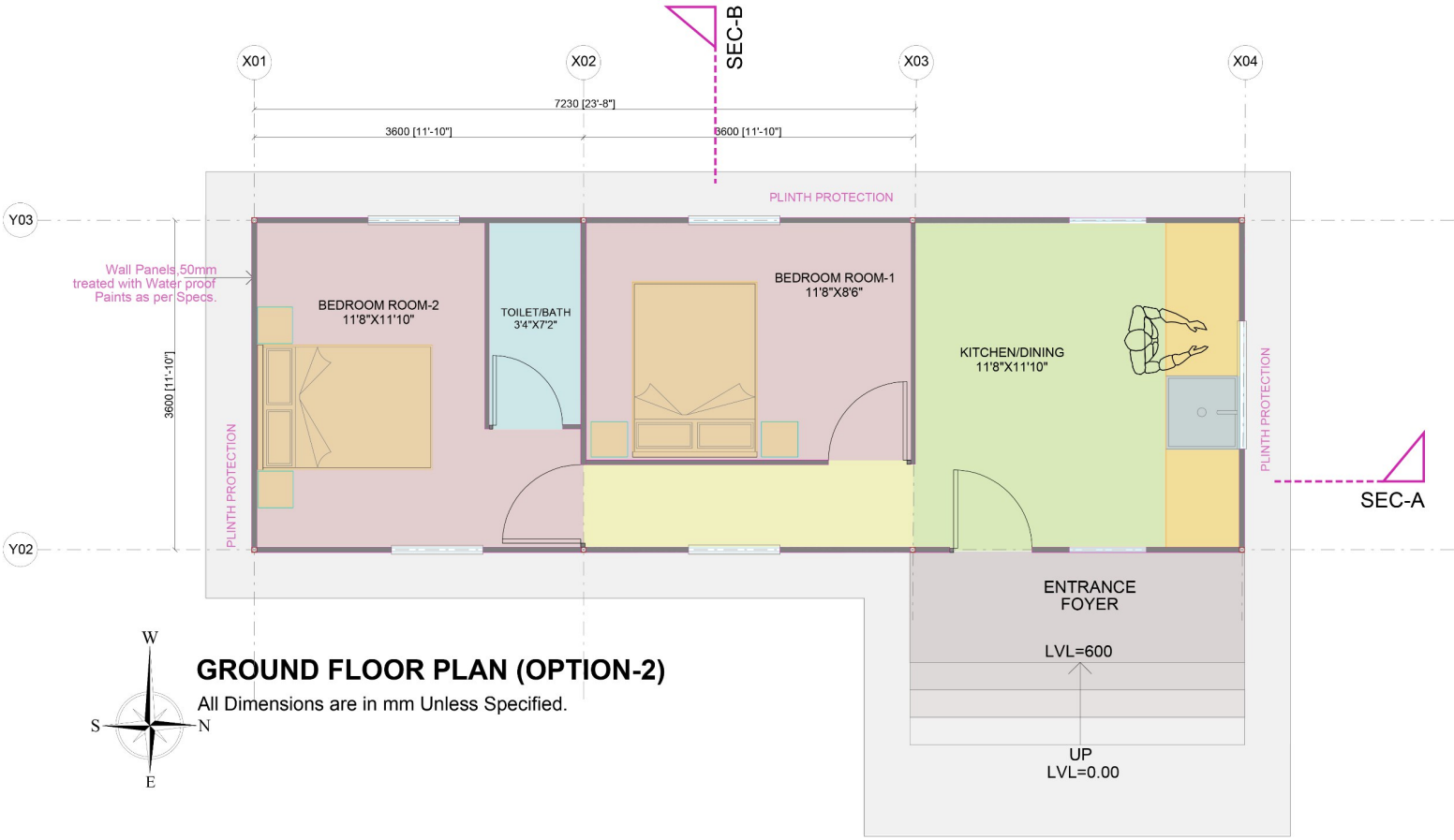

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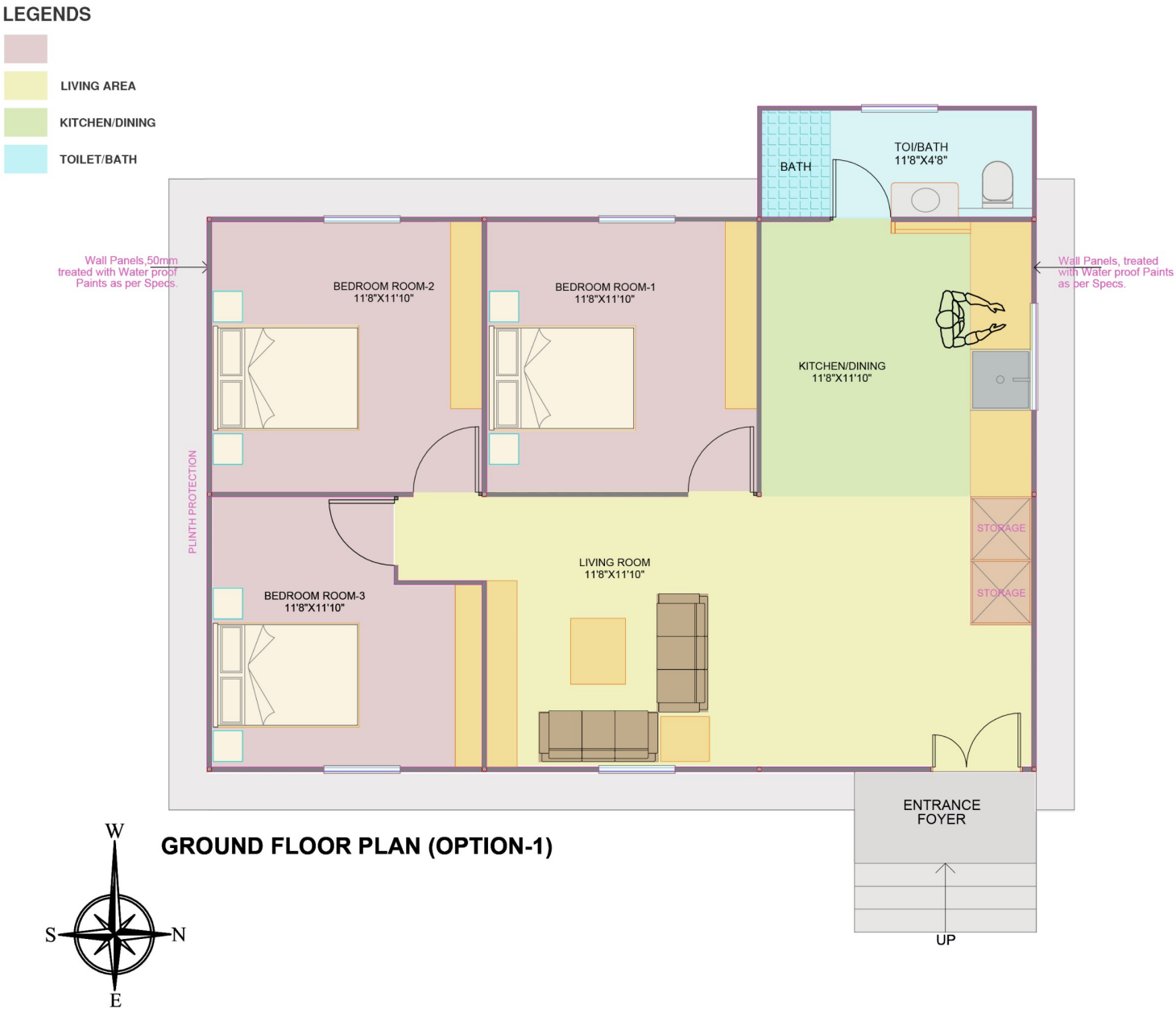

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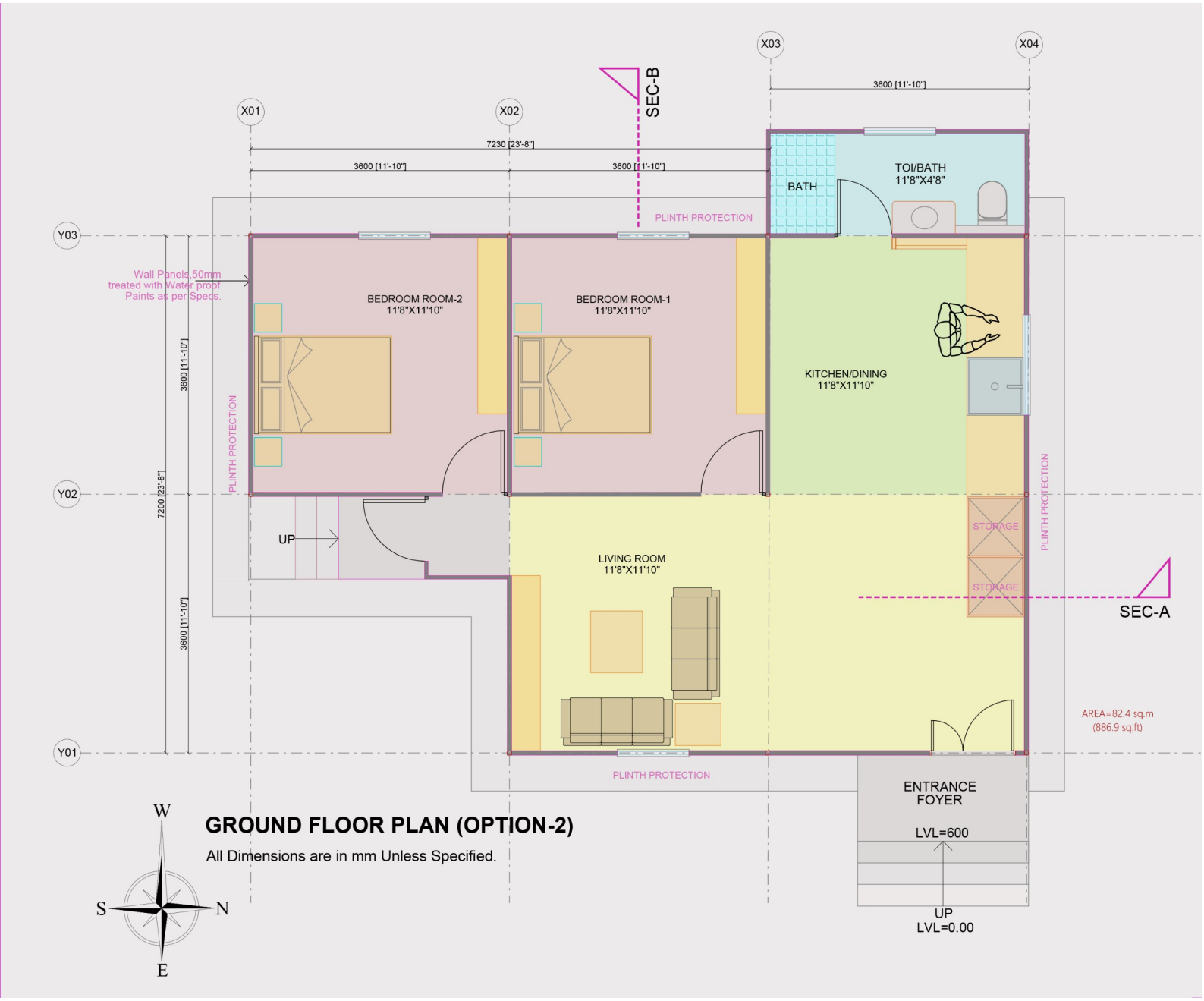

GROUND FLOOR PLAN (OPTION-2)

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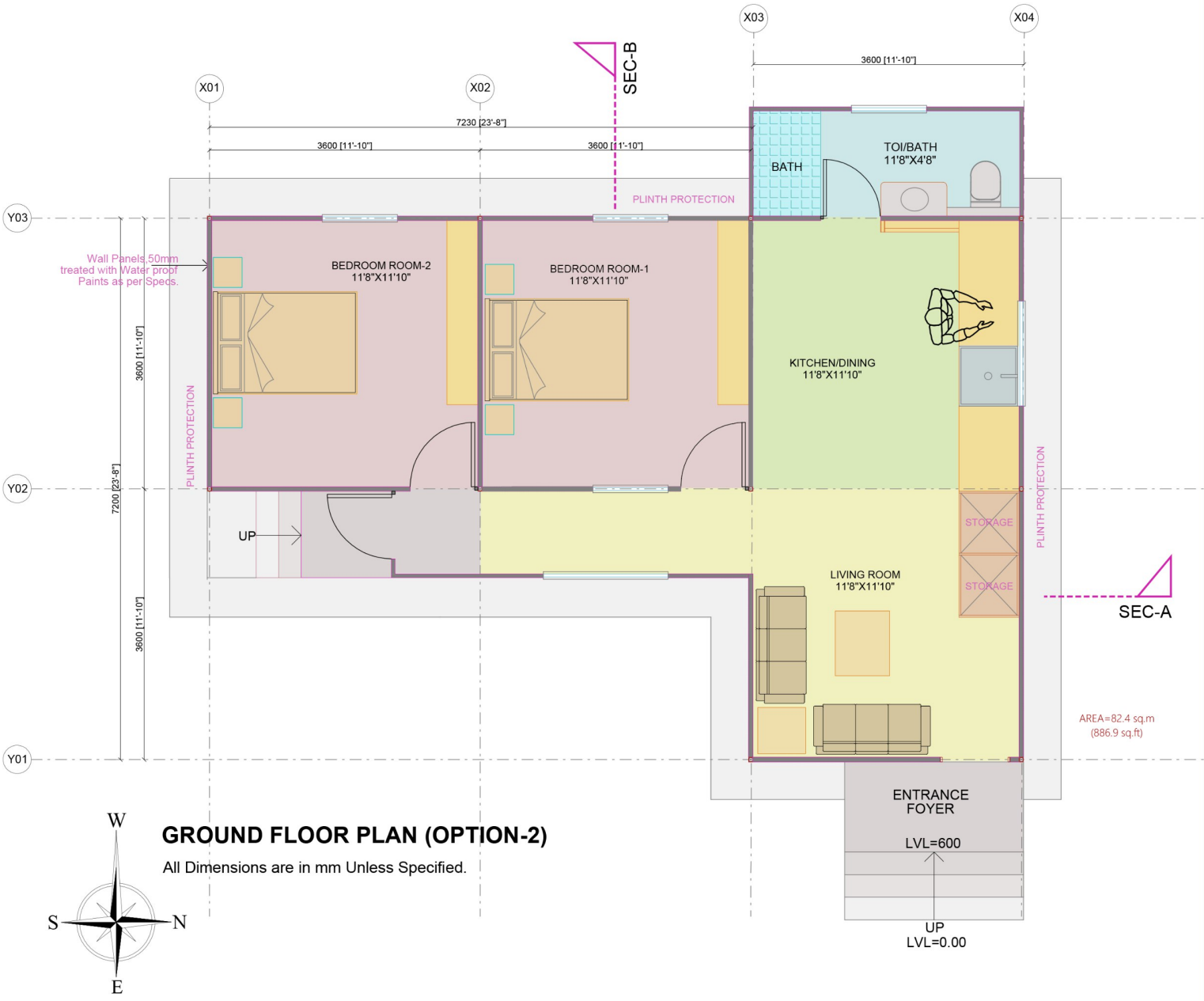

GROUND FLOOR PLAN (OPTION-2)

All Dimensions are in mm Unless Specified.

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Mild Steel Box Section - Regtangular and Square

Rectangular Hollow Section				Square Hollow Section	
Size	Thickness	Size	Thickness	Size	Thickness
mm	mm	mm	mm	mm	mm
50 X 25	2.0	120 X 40	3.0	20 x 20	2.0
50 X 25	2.5	120 X 40	3.6	20 x 20	2.5
50 X 25	3.0	120 X 40	4.0	25 x 25	2.0
50 X 30	2.5	120 X 40	5.0	25 x 25	2.5
50 X 30	3.0	120 X 40	6.0	25 x 25	3.0
50 X 30	3.2	120 X 40	6.3	30 x 30	2.5
50 X 30	4.0	120 X 60	3.0	30 x 30	3.0
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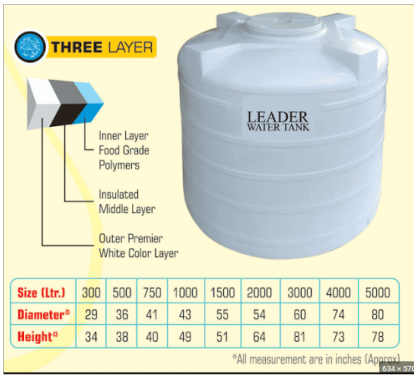
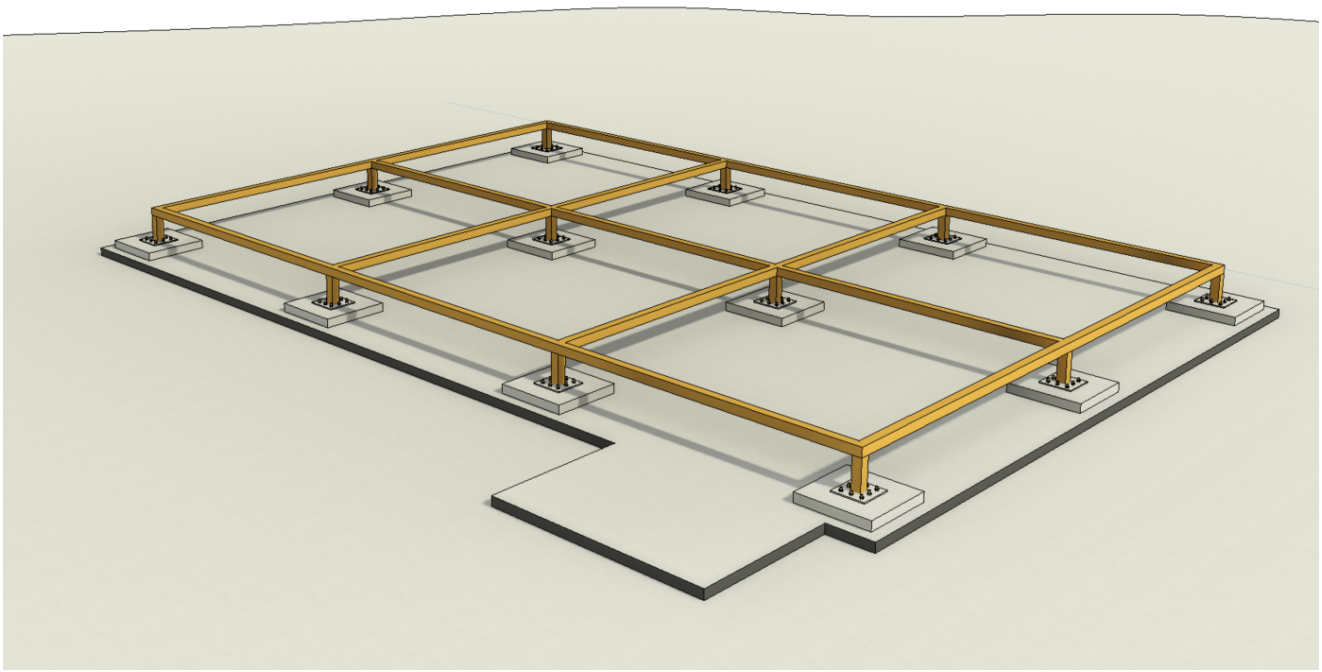


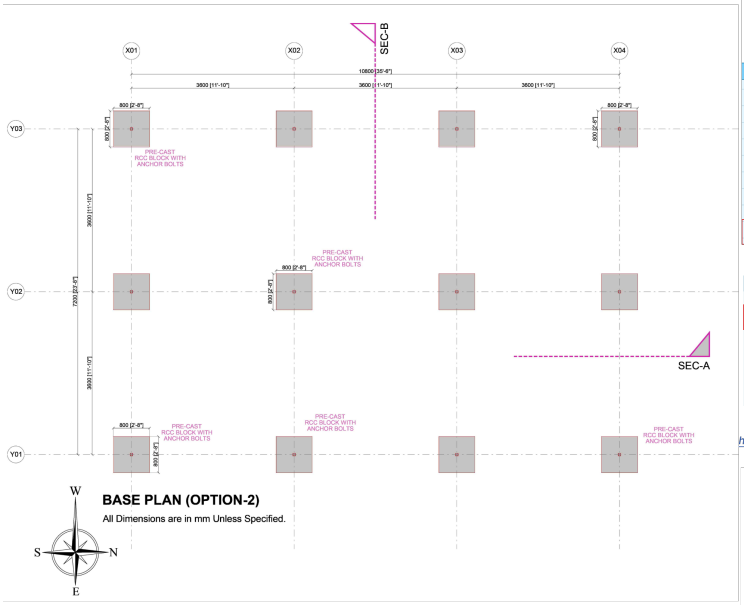
Size (Ltr.)	300	500	750	1000	1500	2000	3000	4000	5000
Diameter*	29	36	41	43	55	54	60	74	80
Height*	34	38	40	49	51	64	81	73	78

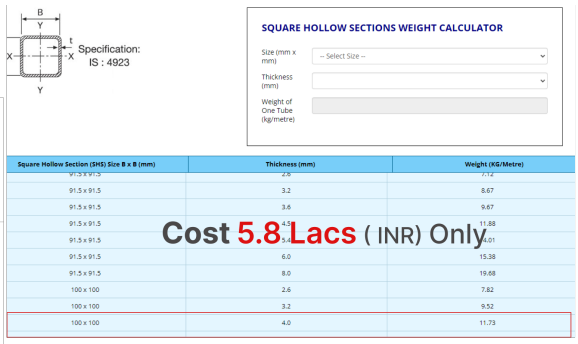
*All measurement are in inches (Approx.)

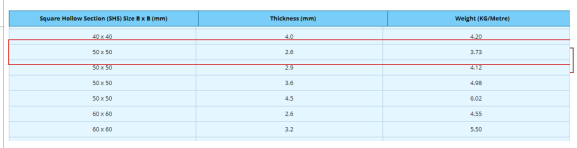


Foundation and PCC precast blocks with Foundation bolts will be placed/installed, 100x100 ms box sections will be installed.

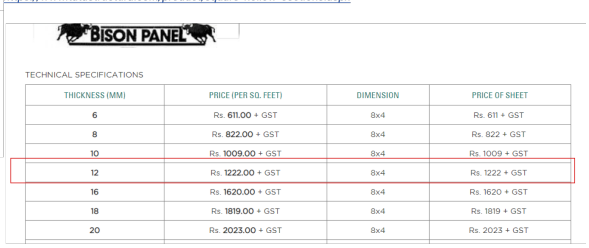
4.2 Planning and Estimations :







https://www.tatastructura.com/product/square-hollow-sections.aspx

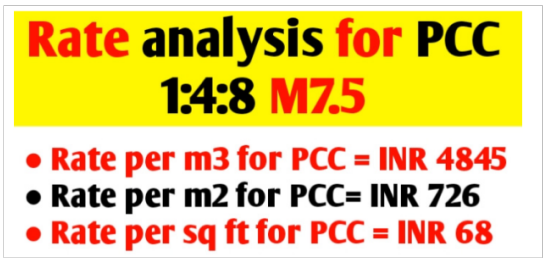


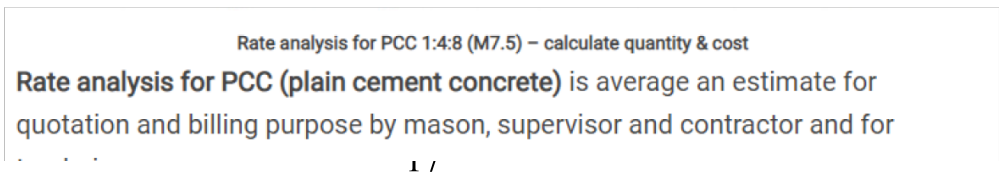
https://delhisales.in/product/detail/block-board-bison-bison-panel/3442

TECHNICAL SPECIFICATIONS

THICKNESS (MM)	PRICE (PER SQ. FEET)	DIMENSION	PRICE OF SHEET
6	Rs. 611.00 + GST	8x4	Rs. 611 + GST
8	Rs. 822.00 + GST	8x4	Rs. 822 + GST
10	Rs. 1009.00 + GST	8x4	Rs. 1009 + GST
12	Rs. 1222.00 + GST	8x4	Rs. 1222 + GST
16	Rs. 1620.00 + GST	8x4	Rs. 1620 + GST
18	Rs. 1819.00 + GST	8x4	Rs. 1819 + GST
20	Rs. 2023.00 + GST	8x4	Rs. 2023 + GST

https://delhisales.in/product/detail/block-board-bison-bison-panel/3442





4.3 BOQ and Estimate :

PROPOSED FARM HOME							
Sl.No	**Descriptions**	**Quantity**	**Units**	**No**	**Rate**	**Total (INR)**	**Remark**
1	**Preparation of site** , cleaning, cutting shrubs and levelling for the PCC Blocks and footings	82	sqmt	1	80	6560	
2	Supply and installation of PCC footing including 15mm Dia foundation bolt 500mm, casting and curing of PCC, framing etc.	14	No	14	1400	19600	
3	Supply and installation of 100X100 4mm thk, MS box sections	695	kg		75	52125.00	
4	Supply and installation of 50X150 2.6 mm thk, MS box sections, installed 800 C/C spacing for flooring of CFB	538	kg		75	40350.00	
5	CFB/ BISON Boards for Flooring, 12mm thick 8ft x 4ft,	28	No		1440	40320.00	
6	Supply and Installation of 50mm PCC for Tiling	84	sqmt		700	58800.00	
7	Supply and Installation of 450x450 tile flooring	84	sqmt		65	5460	
8	EPS Panel, 50 mm THK,	24	sqmt		700	16800	
9	UPVC Windows	5	No		8000	40000	
10	UPVC Door	1	No		14000	14000	
11							
12	Supply and installation of Pools	2	No		4000	8000	
13	**Labour Charge**	85			1500	127500	
14							
15			**TOTAL**			**429515**	
16							
17			**Cost per SQMT**			**5053.12**	
18							

4.4 Customization and Redesigns-Doors Windows :

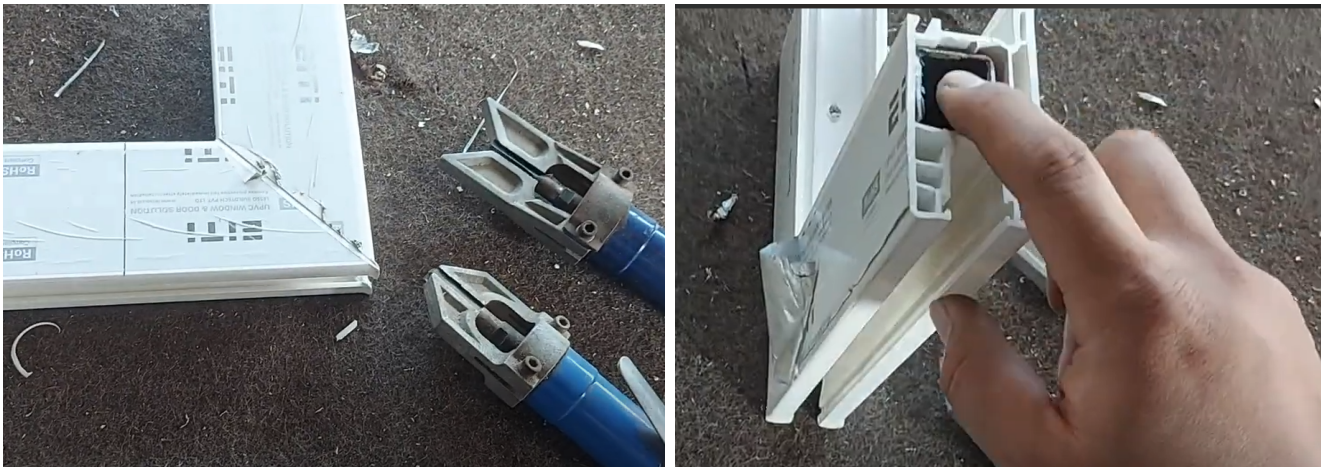
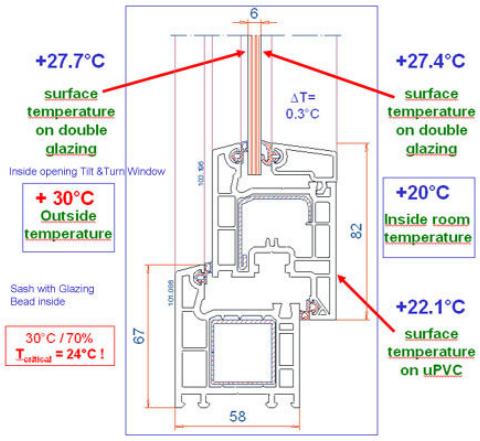


Fig 4.4.1 Images of Customized Doors/Windows frames.

We have customized and redesigned sections of doors and windows to meet the needs of our clients, reduce costs, and take into account the weather and climate. We have done this by using modular parts that can be easily assembled and disassembled. This allows us to create custom-made doors and windows that are both affordable and durable. We also take the weather and climate into account when designing our doors and windows. For example, we use materials that are resistant to extreme temperatures and weather conditions. We also make sure that our doors and windows are energy-efficient, so that our clients can save money on their energy bills.

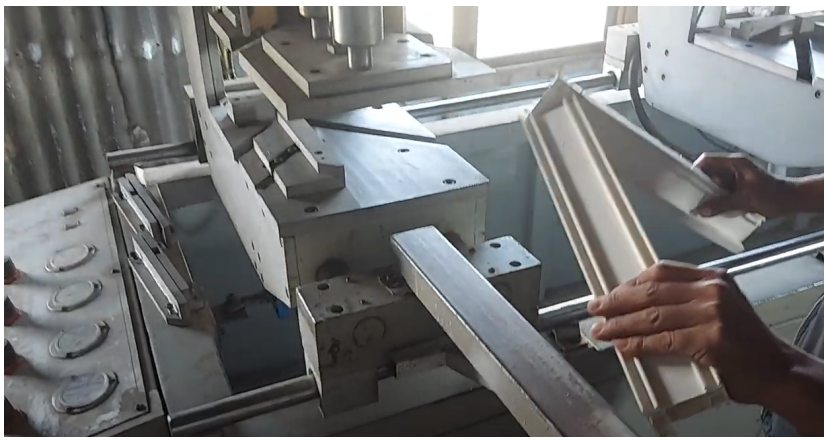


4.5 Customization and Redesigns-Bolts and Base plates, installation system:

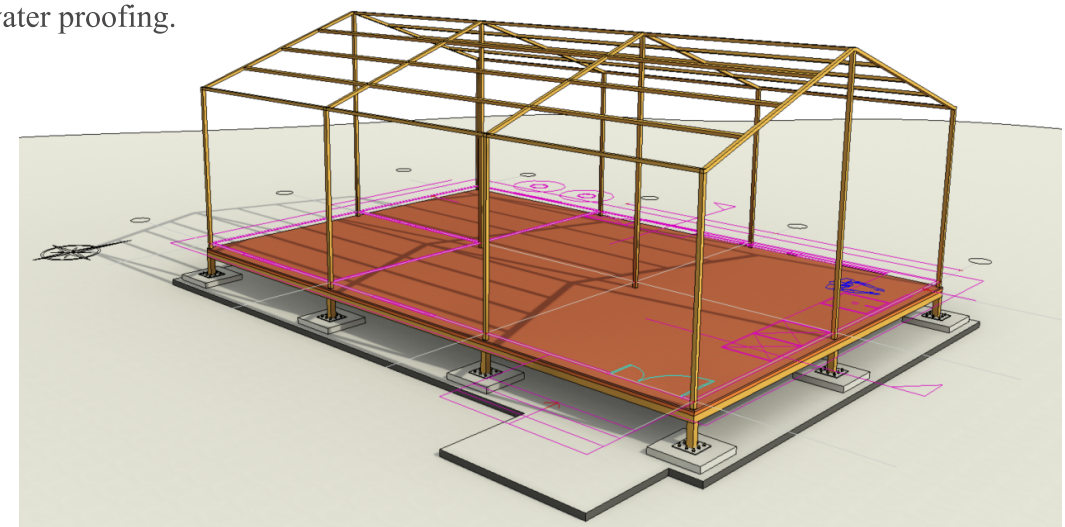
Fig 4.5.1 Images of Customized foundations and installation units

To reduce costs and increase effectiveness, we have redesigned and fabricated many building components in our factories. We have also taken into account the earthquake zone 5 rating of North-East India and tested our products to comply with ISI norms. Our new factories in Gurugram and Faridabad will be manufacturing many of the parts needed to provide affordable homes to the people of North-East India.

Some of our tools and products in Manipur for the proposed projects

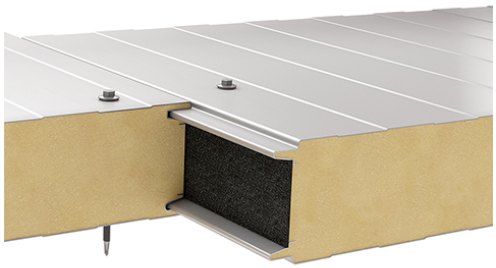


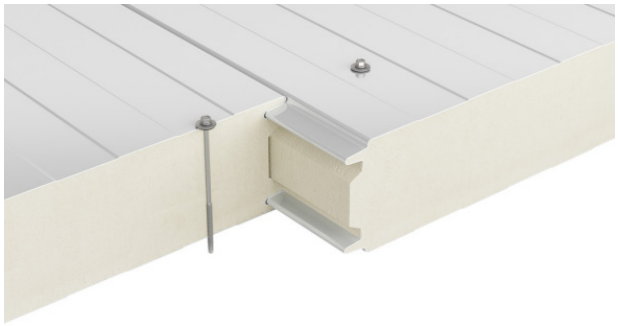
CFB(Cement Fibre Boards)/ BISON boards for flooring, 50mm PCC and tile floorings with water proofing.



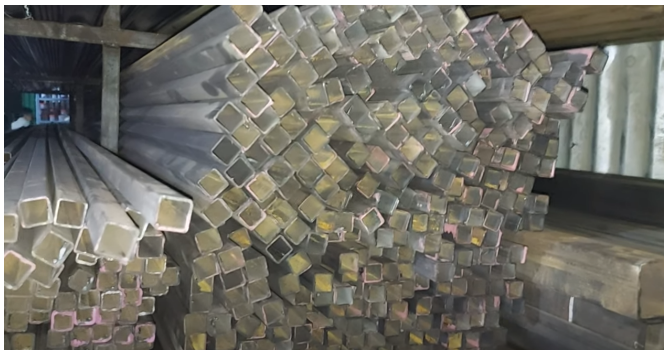
CONCEPTUAL VIEW STRUCTURAL FRAME

4.6 Customization and Redesigns-Wall Panels, Ceiling panels, Roof Panels:



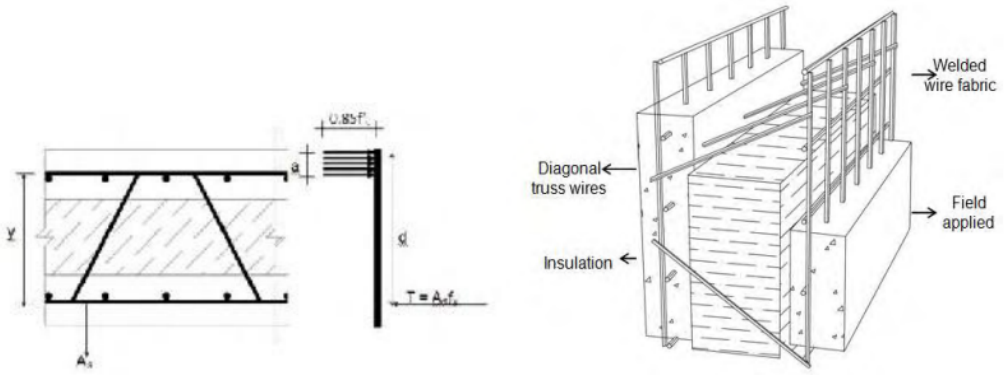


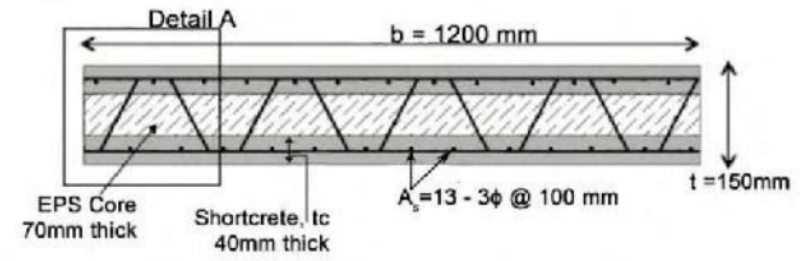
Specially Developed panels for north-east, India. To be able to take the loads of heavy rainfall, winds, snowfalls etc.



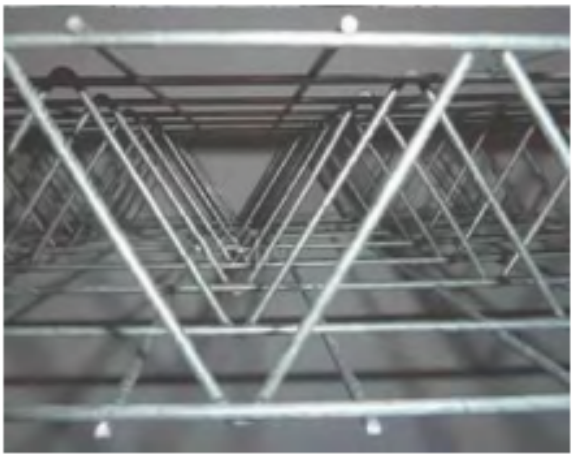
MS box sections acquired for the projects

DESIGN AND PROTOTYPING

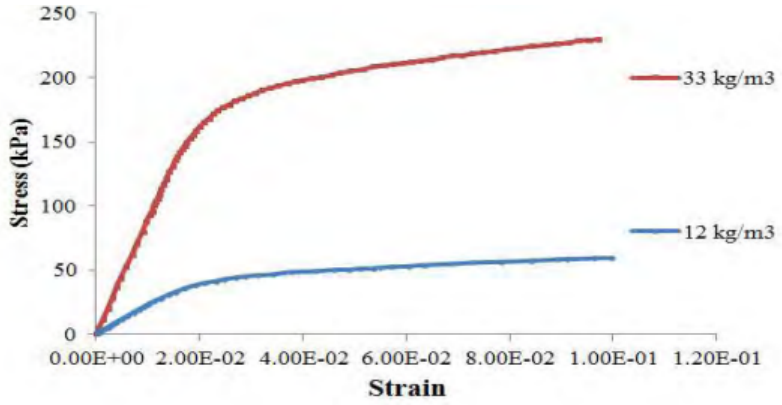




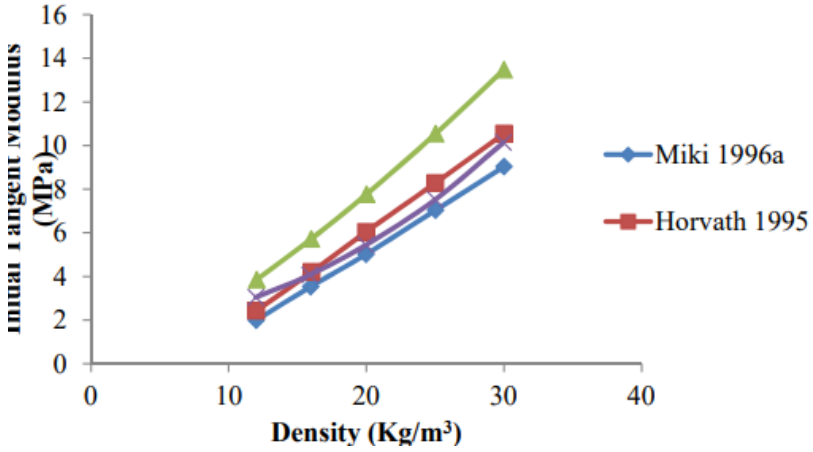
Individually welded internal strut wires or diagonals extend through the panel core between each surface. These galvanized strut wires are welded continuously in the required spacing so they form, with the welded wire fabric, into a triangulated truss system which greatly increases the panel strength.



The typical EPS panel is generally manufactured with dimensions of 1200 m width, 3000 mm length and over all thickness range of 80-230 mm. The panels are finished at the site using minimum 30 mm thick shotcreting of cement & coarse sand in the ratio of 1:4 applied under pressure. The shotcreting coat encases the EPS Core with centrally placed steel welded wire mesh.



shows the uniaxial compression stress-strain curve of EPS for two different densities. The two densities shown are considered the extreme values for most engineering applications done so far. Specimens are 0.05m cubes tested at a displacement rate of 0.005m/min. From the figure the stress-strain curve can be simply divided into two main straight lines connected with a curved portion. The slope of the straight-line portions increase with density. The stress at any strain level increases also with the density. The bead size has no important effect on the compressibility of cut specimens



The stress strain curve of EPS has an initial linear portion. The value of the slope of this initial portion is defined as the initial tangent modulus. It is known as Young's Modulus as well as the modulus of elasticity. EPS initial modulus is a function of the density as shown from Fig 2.2. For EPS, as shown from the same figure, there is no agreement from the researchers on a constant value for each density. For a 20kg/m3 density the initial modulus ranges between 5MPa and 7.75MPa, which means a 55% difference. The relation is linear for some researchers.

Density, kg/m³	After 7 Days	After 1 Year
15	3.0	5.0
20	2.3	4.0
25	2.2	3.8
30	2.0	3.5
35	1.9	3.3

Openings will be made on the EPS Panels pre-installation. UPVC Doors and windows will be installed in the openings

The water absorption of expanded polystyrene is low. Although water absorption decreases as density increases as shown in Table 2.3. Fusion is the most important factor influencing the moisture resistance of expanded polystyrene. Good fusion reduces the amount of water absorption. For 9–12 years of service, equilibrium values of 8-9 % volume have been found in EPS fills below the ground water table.

Bulk Density (kg/m³)	**Thermal conductivity mW/cm °C**	
	0°C	**10°C**
15	0.34	0.37
20	0.32	0.35
25	0.30	0.33
30	0.29	0.32
35	0.28	0.31

The thermal conductivity at 0°C and 10°C, respectively of the material shall not exceed the values given below according to IS:4671-1984, determined in accordance with the method prescribed in IS : 3346-1980.

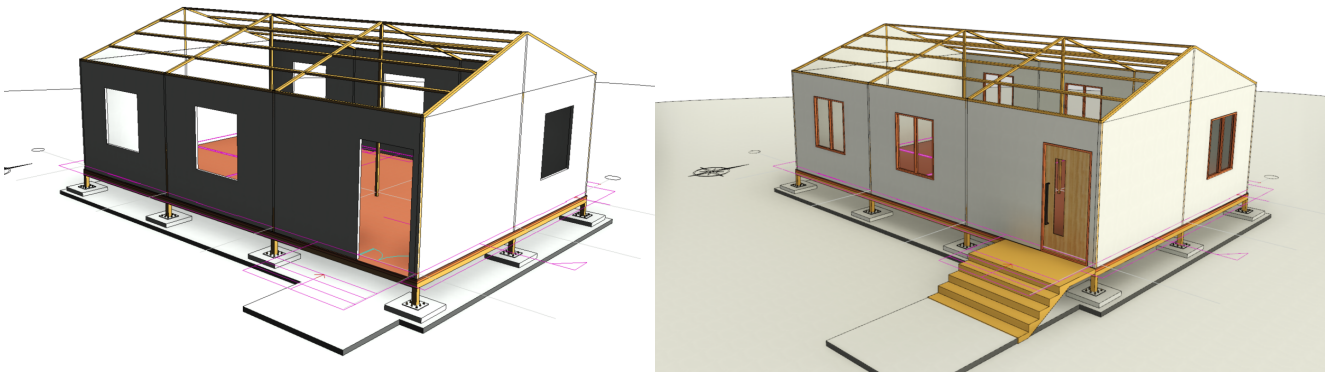
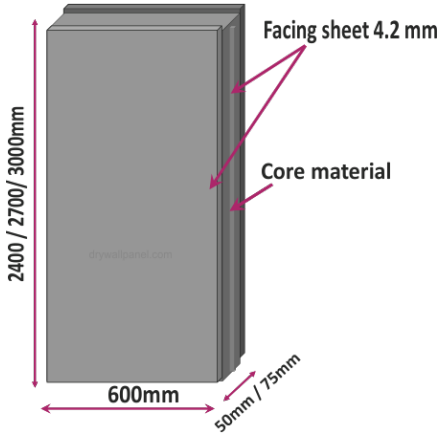
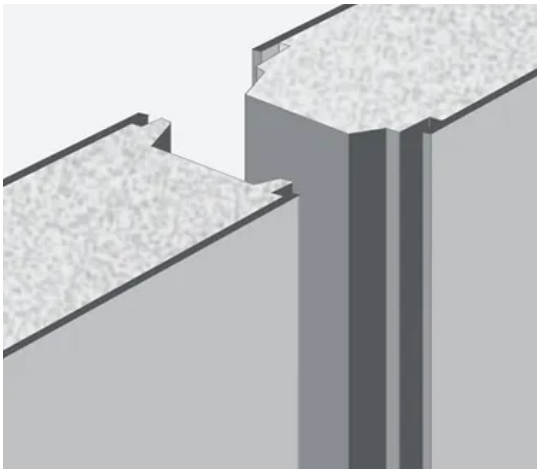


Fig 4.6.1 Images of installation process of Wall and other Structural Units.





The reinforced cement boards (RCBs) that are currently available in the Indian market do not directly address some of the issues like cracks at the joints, need for external cladding materials to increase durability, etc. Some of the RCBs are also very heavy, increasing dead loads to the structure. Additionally, the price of RCBs is as expensive as bricks/AAC walls, which is the traditional form of construction.
We are working on customizing these panels and collaborating with manufacturers to address the specific needs of the Indian market. We are also working on changing the chemical compositions or finishes of the RCBs to make them more durable for the weather conditions of North-East India.

- A study by the National Building Construction Corporation (NBCC) found that RCBs are more prone to cracking than traditional brick walls.
- A study by the Indian Institute of Technology (IIT) Bombay found that RCBs need to be clad with external materials to increase their durability.
- A study by the Central Building Research Institute (CBRI) found that RCBs are more expensive than traditional brick walls.

We believe that by customizing RCBs and changing their chemical compositions or finishes, we can make them a more viable option for construction in India. We are confident that our products will address the specific needs of the Indian market and provide a more durable and affordable alternative to traditional construction methods.

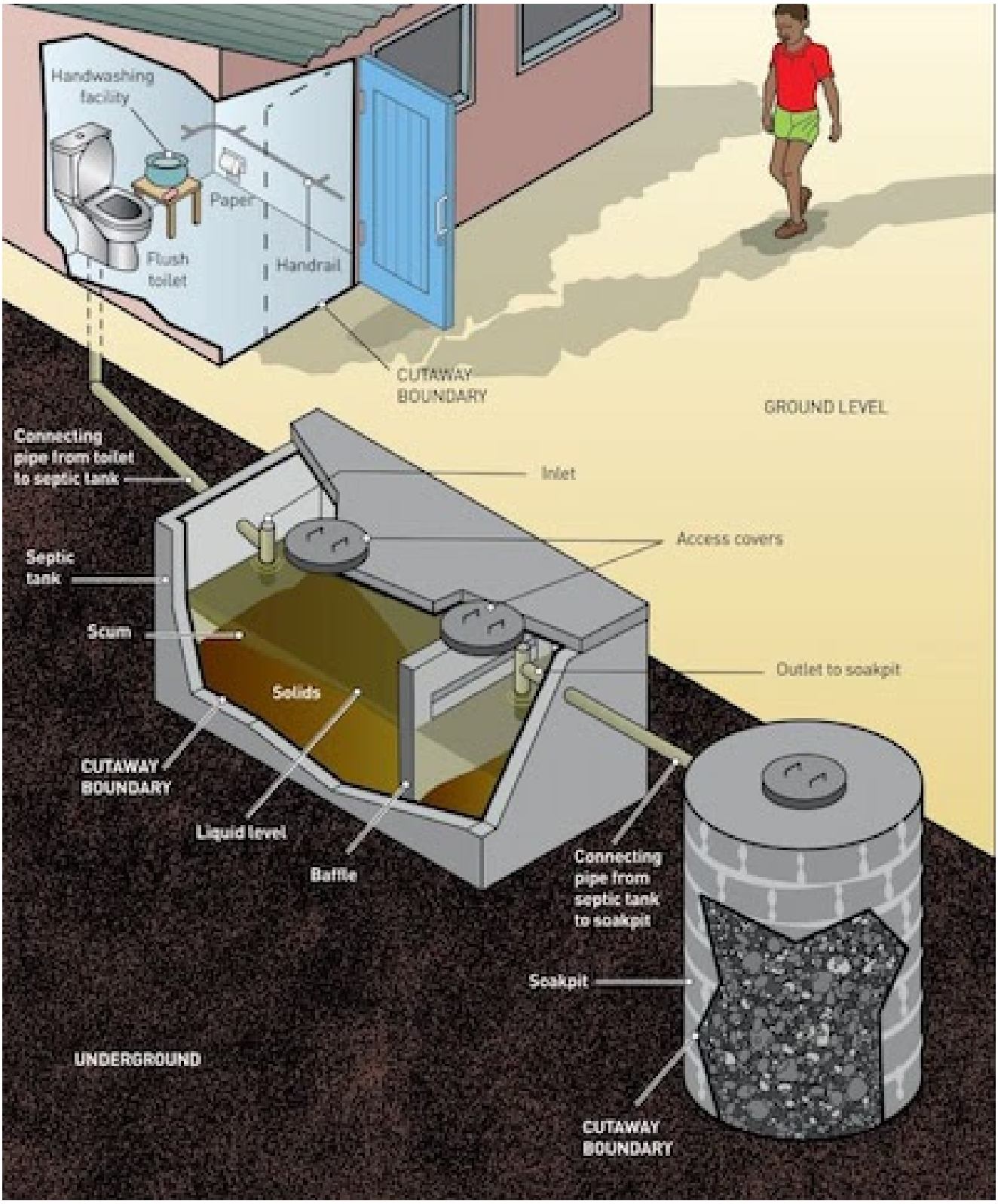
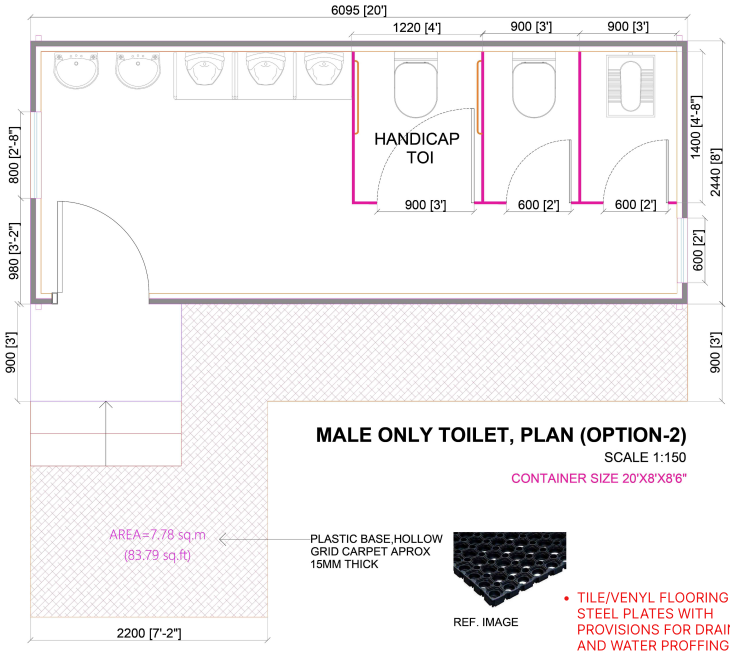


Fig 4.6.2 Schematic View of the Sewage System.

4.7 Modular Toilets and Sewage Systems

Our system is modular in nature, which means that it is made up of individual components that can be easily assembled and disassembled. This makes it ideal for use in modular toilets and sewage systems, as it allows for easy installation and maintenance.

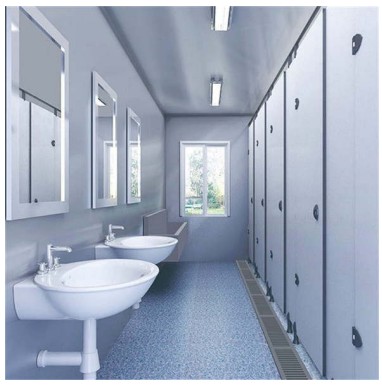


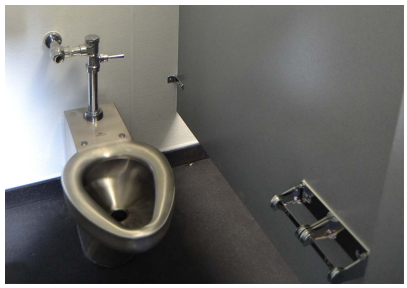
MALE ONLY TOILET, PLAN (OPTION-2)

SCALE 1:150

CONTAINER SIZE 20'X8'X8'6"

- TILE/VENYL FLOORING ON MS STEEL PLATES WITH PROVISIONS FOR DRAINAGES AND WATER PROFFING.
- WATER PROOF ENAMEL PAINTS ON THE WALL
- SS WASH BASINS /CERAMIC OR AS PER SELECTION.
- PROPER VENTILATIONS AND EXHAUST.
- WESTERN WCS AND MODULAR PARTION WALL AND DOORS.





	Option- 4Toilets : BOQ and COST SUMMARY OF MATERIAL REQUIREMENT					
S.NO.	Description	Unit	Qty	Unit cost	Amount(Rs.)	Remarks
1	2	3	4	5	6	
A	MS Portable container	each	1	185000	185000	
	S.Total				**185000**	
B	**Civil Works:**					
1	PCC For base to install Pota-Container	Cum	3	4850	13095	
2	Preparation of Sludge tank- Earth work ,PCC,PVC tank	LS	1	30000	30000	
3	Internal Partition: 8mm thick FCB inside the cabin including G.I frame	sqm	36	2200	79200	
4	Wc Internal Partition: 12mm thick Prelam board inside the cabin including G.I frame	sqm	12.6	2020	25452	
5	Other Elevations : Enamel paint on MS Sheet	sqm	78.82	180	14187.6	
6	Dado with Vitrified Tile in Internal Partition	sqm	14.4	1350	19440	
7	Wash basin mirror	Each	4	1500	6000	
8	Flooring with Vitrified Tile	sqm	19.8	1350	26730	
9	Option: Painting in Internal Partition	sqm	14.4	240	3456	Option
10	Ventilator :Aluminium frame with 6mm thick glass and hardware	Nos	6	1820	10920	
11	FRP doors	Nos	2	5500	11000	
12	Granite in entry Porch	sqm	6	3850	23100	
13	Painting : Local artist in Manipur culture	LS	1	15000	15000	option
	S.Total				**277580.6**	
C	**Electrical Works**					
1	Electrical LED lights including conduiting ,wiring-Internal + External	Each	6	950	5700	
2	Exhaust Fan in Ventilator-6" dia	Each	6	1750	10500	
3	Power socket	Each	2	1250	2500	
	S.Total				**18700**	
D	**Plumbing Works**					
1.0	Supplying & Fixing of Plumbing Fixtures required complete etc: Refer interior.specs sheet for below items:-(Chinaware And CP Fittings-KOHLER MAKE)					
1.01	W.C PRESQUILE WALL HUNG TOILET,W/SC SEAT (SKU code no.18133T-S-0)	Each	4	4650	18,600	
1.02	W.C (Flush Plate K-4177IN-2-CP)	Each	4	750	3,000	
1.03	In Wall Tank (HT-310 In wall tank,Side Inlet 3/6L,4178IN-2S-NA)	Each	4	1560	6,240	
1.04	Connector Accessories Pack (SKU Code No-1046327-S)	Each	8	450	3,600	
1.05	M12 Rack Bolts For WH Inatallation (SKU Code No.1213309-0)	Each	8	655	5,240	
1.06	Health Faucet w/sdspray,Metal hose with holder,12927IN-CP	Each	4	450	1,800	
	BASIN AREA				0	
1.07	Wash Basin (Milano Semi-Recessed, 18072K-1-WK)	Each	4	2250	9,000	
1.08	Angle Valve(Cuff Angle Valve G1/2,37317IN-4-CP)	Each	16	550	8,800	
1.09	Grab Bar (K-10542)	Each	1	1850	1,850	
1.10	Toilet Paper Holder (K-11584-CP)	Each	4	1560	6,240	
1.11	Soap Dispenser	Each	4	780	3,120	
1.12	Urinals: White vitrous china clay	Each	4	2760	11,040	
1.13	Flush tap with connectors for Urinals	Each	4	950	3,800	
1.14	OHT	Each	2	5000	10,000	
	S.Total				**92,330**	

S.NO.	Description	Unit	Qty	Unit cost	Amount(Rs.)	Remarks
1	2	3	4	5	6	
	TOTAL (B+C+D)				**3,88,611**	

Modular Toilets and Sewage Systems

The modular components of our system are made from durable materials that are resistant to corrosion and weathering. This makes them ideal for use in harsh environments, such as those found in North-East India.
Our system is also designed to be energy-efficient, which can help to reduce the cost of operating a modular toilet or sewage system.
Overall, our modular system is a cost-effective and reliable solution for the construction of modular toilets and sewage systems. It is made from durable materials, is easy to install and maintain, and is energy-efficient.

Some of the benefits of using a modular system for modular toilets and sewage systems:

- Ease of installation: Modular systems are easy to install, as they are made up of individual components that can be easily assembled. This can save time and money on installation costs.
- Ease of maintenance: Modular systems are easy to maintain, as the individual components can be easily accessed and repaired. This can save time and money on maintenance costs.
- Durability: Modular systems are made from durable materials that can withstand harsh environments. This can help to extend the lifespan of the system and reduce the need for repairs.
- Energy efficiency: Modular systems are designed to be energy-efficient, which can help to reduce the cost of operating the system.

If you are considering installing a modular toilet or sewage system, we encourage you to contact us for more information. We would be happy to discuss your specific needs and help you choose the best system for your application.

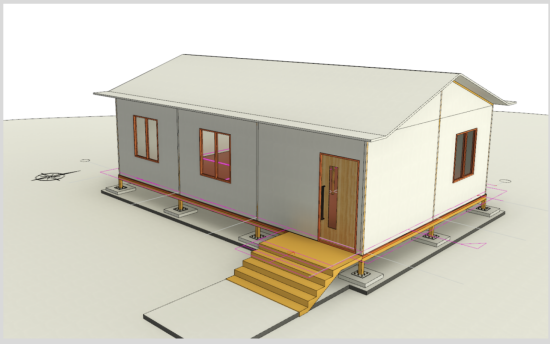
5. Results and Conclusions

The proposed project will use light-weight and modular building components sourced directly from factories and processing plants in Faridabad, Gurugram, and Gujarat. This will ensure that the quality, design, and cost of the project are kept under budget. The materials are designed and manufactured to withstand different climatic conditions and natural disasters, such as heavy rainfall, strong winds, and earthquakes.

The project will address many of the problems that cannot be addressed by traditional houses made of bamboo or GI sheets. The light-weight and modular components will make the houses easier to build and maintain. They will also be more resistant to natural disasters. The project will also use recycled materials, which will help to reduce the environmental impact of the construction.

The project is expected to create jobs and boost the economy of the region. It will also provide much-needed affordable housing for the people of North-East India.

COMPARISION BETWEEN EXISTING TRADITIONAL FARM HOUSE
AND OUR PROPOSED FARM HOUSE



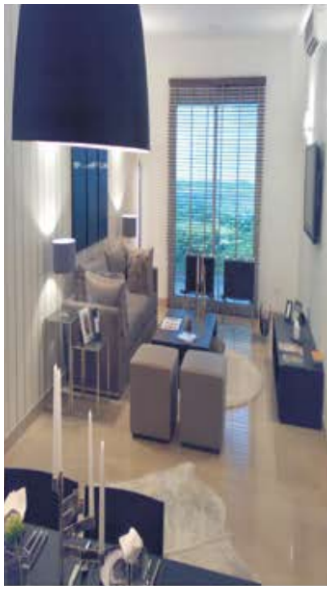
6. Scopes & Some of our Projects









Reference and Bibliography

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The Constructor_**https://atad.vn/steel-structure-introduction/**

SteelConstructionInfo_**https://steelconstruction.info/**
The Steel Construction Information SystemSt

AISC _**https://www.aisc.org/**