RESEARCH AND LEARNING INSTITUTE ON LOCAL BUILDING MATERIAL

By

TRISHI AKTER
14308016

A thesis submitted to the Department of Architecture in partial fulfillment of the requirements for the degree of
Bachelor of Architecture.

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Declaration

It is hereby declared that

1. The thesis submitted is my own original work while completing degree at Brac University.
2. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
4. I have acknowledged all main sources of help.

Student's Full Name & Signature:

Trishi Akter
14308016

Approval

The thesis/project titled “Research and Learning Institute on Local Building Material ” submitted by

1. Trishi Akter (14308016)

of Summer, 2019 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Bachelor of Architecture on August 07, 2019.

Examining Committee:

_____

Fuad H. Mallick, PhD
Professor and Dean, School of Design
BRAC University

_____

Dr. Mohammad Habib Reza
Assistant Professor, Department of Architecture
BRAC university

_____

Abul Fazal Mahmudun Nobi
Senior Lecturer, Department of Architecture
BRAC university

_____

Zainab Faruqui Ali, PHD
Professor and Chairperson, Department of Architecture
BRAC university

Abstract

Vernacular architecture of Bangladesh is the identical, rich building culture that sums up all the stories of life of specific time. It is associated with very native, local, common craftsmanship of the people of the country. Recent time depicts vernacular as backward and underdeveloped being in the contemporary culture of industrialization.

Vernacular learning center is a project that not only encourages local building craft but aspire enhancement of the traditional and cultural building domain of Bangladesh through architecture. The project is associated the NGO “SAFE” based in Dinajpur who insight the strength of local materials and building techniques and works to improve the sector.

In this project trying to connect neighborhood so that village people are more concern about vernacular architecture. There is a community space designed which is open to all for different social activities

Keywords: Vernacular Architecture, craftsmanship, local building material, neighbourhood project.

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Chapter 1

INTRODUCTION

1.1 PROJECT RATIONALE

Architecture is a form of art and an architect can be the artist or the person who enhances the need of art in different social levels. This project is chosen on the basis of systematic structure required for rural artisans to develop their skills and spread their knowledge to support their poverty.

Architecture is more significant when one sees the practical use and its positive effects on people, specially people who really need it. That is the one and only reason behind choosing this project.

Because people living in rural areas are the ones who need knowledge about making their own house, they don't need a designer to build their house. They are people who make home with aspirations and dreams but those dreams get washed away because of lack of knowledge. Whereas they are capable of doing better with traditional materials and methods. So a center for promoting local resources and technology can work like a guidance to rural people to be aware of their own capacity and spread their knowledge to others. Basically, this project is derived from the realization of need to promote architecture in rural sectors, not as an architect but as a social activist to create a greater impact on the rural areas of the country.

1.2 PROJECT BRIEF

Project Name: A Research and Learning Centre for Local Building Technology

Function: Research Centre, Centre for learning and sharing knowledge on rural materials and techniques

Location: Sundarban village, Dinajpur.

Area: 9.6 acre

Client: SAFE Bangladesh (NGO)

1.3 PROJECT BACKGROUND

The poor rural people are the ones who need most knowledge about utilizing their local materials and resources in order to be able to make their own building decisions. Such decisions should be encouraged to enhance our local technology.

Technology is referred as the systematic application of knowledge put to some practical use.

So local technology is the technology used for an area by using traditional knowledge, methods and materials. Resources can be defined as something that can be used for support or help.

And natural resource is material source of wealth, such as timber, water, mineral deposit that occur in a natural state and has economic value.

The idea is to create a center which works on innovation, building technology and artisan development in a rural area. The project would increase community self-reliance by creating skilled local builders, craftsmen and at the same time, interaction between scientific and traditional knowledge would be enhanced.

Architecture plays a decisive role in the development of Bangladesh. The population of

Bangladesh was 147 million in 2006 (banglapedia, 2006). About 75 percent of all Bangladeshis live in villages, most of them in earth or bamboo houses. Although these traditional building materials are highly sustainable, people are seeking for materials such as bricks, concrete, and corrugated iron sheets that are supposedly more durable. ln terms of the consequences of energy consumption through the production of these materials, such a trend could have severe consequences on the global warming.

Simple strengthening improvements for earth and bamboo construction houses can cost just 5% of the total construction cost. (www.safebangladesh.wordpress.com) By knowing appropriate

technology, people can reduce the vulnerabilities caused by natural hazards. The knowledge requires not only the understanding of technology but also of people and places. So the intention of this project is to create architecture by integrating local tradition and local technology to make improved house building techniques and environmental initiatives.

SAFE is an NGO based in the Dinajpur region in the far north west of the country. lt has been officially been operating since 2009 with support from Housing and Hazards, (www.housingandhazards.org) an international group of building professionals working to promote affordable hazard resistant housing. SAFE have also implemented projects in partnership with UNDP, Australian High Commission and British Women Association (Dhaka).

SAFE's founder, Azit Roy, has been involved in low cost housing projects for over 14 years.

There are two elements which underpin SAFE's activities:

1. Using methods that are appropriate
2. Communicating these methods in a way which people understand and will remember. (safebangladesh)

Local people not only observe their surroundings but also experiment and develop appropriate technologies to fit their own environment. Appropriate building techniques are those which are affordable and use materials which are available and techniques which can easily be learnt.

1.4 OBJECTIVES

The goals of this project are -

To learn about local technologies which are appropriate for specific site conditions in rural areas. Realizing the potential of the indigenous materials, method and design for the growing needs of today and tomorrow.

To improve the local resources and utilize them in developing rural architecture. The concept of people managing the construction processes would be encouraged. To explore the possibilities to be more eco-friendly and create a sustainable society.

To understand the socio-cultural development related to architecture.

To establish a system for educating rural people about local materials and methods which can be developed locally.

To realize our scope of contribution to promote local technology in rural sectors.

1.5 PROGRAMME

The functional requirements are as follows:

Office space

i) Lobby

ii) 3 office rooms

iii) 1 meeting room

iv) 1 waiting room

v) 1 information centre

Lab

i) Material treatment plant for bamboo

ii) Research lab

iii) Computer lab

Library

i) Material Library

ii) General Library

Multipurpose hall

(indoor and outdoor)

Exhibition space

Classrooms for:

i) Wooden crafts

ii) Bamboo, cane crafts

iii) Earth construction

Residential zone

i) Dorm (male and female)

ii) Dining hall (common)

iii) Kitchen

iv) Toilet

Test

This are the initial introductory study of my project. I am explaining this to next chapters. I am explaining them in details. Through my learning these study are changing.

Chapter 2

LITERATURE REVIEW

"Folk building growing in response to actual needs, fitted into environment by people who knew no better than to fit them with native feeling". (Write)

Rural architecture has its distinct characteristics as regards planning, use of materials and locations. Like urban architecture, rural architecture is also subject to change, but in Bangladesh rural architecture has clung to tradition. It has not really changed at all until recently. For centuries, rural architecture has been using locally available materials. It is only from the late nineteenth century that rural architecture began to change both structurally and in the use of housing materials.

Indigenous architecture in rural Bangladesh was largely built without formally trained professionals. Buildings were built by local construction workers, typically consisting of mistris (carpenters, roof builders), rajmistris (masons) and kamlas (helpers), together with household or community members. Construction skills were learnt through experience. Inter-generational transmission and design decisions were communicated verbally. Despite not being the designed product of a professional architect, such buildings continued to accommodate and serve the needs of the great majority of the population. In that sense, and being such a significant part of the built environment, such buildings represented a fundamental form of architecture that had evolved according to context-specific characteristics and resources.

lt is estimated that worldwide close to 90% of all building is vernacular, meaning that it is for daily use for ordinary, local people and built by local craftsmen.

Usually such construction is being conditioned by its immediate environment and economic ability.

Use of 'Appropriate Technology" is very rare in such cases. ln architectural terms, appropriate technology comprises, two interdependent aspects: techniques and knowledge. "Techniques" include the use of materials, energy, climate control and construction techniques. "Knowledge" is the historical dimension, the theory of settlement development including land use and typologies, socio-cultural needs, contextual considerations and the creative use of space and form. Implied in the definition is unquestionably also the principle that appropriate technology should benefit economically disadvantaged people, which in Bangladesh constitutes most of its population.

With a population of over 150million, Bangladesh is one of the most densely populated countries in the world, with approximately 80% of the population living in rural areas. This is leading to a large housing shortage, coupled with increase vulnerability to hazards, there is a great need to build stronger, more resilient rural housing. As Bangladesh develops, so does its architecture. As Patterns and Changes of Vernacular Architecture in Bangladesh (2003) documents, 'In the time of globalization the architecture in rural areas is clanging simultaneously...it is assumed that with the changes of building materials, changes in the use pattern of spaces and the additions of new built forms with houses, the architecture in rural areas may lose some aspects of its sustainability.'

"You must start right from the beginning, letting your buildings grow from the daily lives of the people who live in them, shaping the houses to the measure of the peoples songs, weaving the patterns of a village as if on the village looms,

mindful of the trees and the crops that will grow there, respectful to the skyline and humble before the seasons. There must be neither faked tradition nor faked modernity, but an architecture that will be the visible and permanent expression of the character of the community. But this would mean nothing less than a whole new architecture." - (Fathy)

The Egyptian architect was intellectually stimulated by the art of the paranoiac period and was directly influenced by vernacular architecture. He studied the buildings of the old city of Cairo and Nubian in order to create a national architectural language based on the employment of traditional elements and building techniques. His projects are based on the use of a narrow vocabulary made of morphological and structural elements taken from tradition: parabolic arches, square spaces covered with domes, rectangular rooms or narrow spaces with vaults, courts, balconies wind towers. Fathy recognized that architecture is for human beings. He believed that architecture must be shaped by factors like the wind, sun, nature and the individuality and culture of the people involved. He rejected architecture that was not indigenous rooted in the location and the culture of the area, which in his mind found its truest expression in the vernacular architecture of a society.

Fathy devoted himself to housing the poor in developing nations and deserves study by anyone involved in rural improvement. Fathy worked to create an indigenous environment at a minimal cost, and in so doing to improve the economy and the standard of living in rural areas. Fathy utilized ancient design methods and materials. He integrated a knowledge of the rural Egyptian economic situation with a wide knowledge of ancient architectural and town design techniques. He trained local inhabitants to make their own materials and

build their own buildings. Climatic conditions, public health considerations, and ancient craft skills also affected his design decisions. Based on the structural massing of ancient buildings, Fathy incorporated dense brick walls and traditional courtyard forms to provide passive cooling.

"The one man missing in the building venture was the architect. The owner dealt directly with the men who did the work, and he could see What he was getting. For their part, the craftsmen were free to vary their designs within the limits of tradition and subject to the owner's approval. If an architect had come between owner and craftsmen, he would have produced plans that neither could understand, an unable to escape from his drawing boards, would have remained quite ignorant that the variations of detail possible in a design make all the difference between a good house and a bad one." (Fathy)

Hassan Fathy demonstrated that it is possible to build for the poor and teaching people to build for themselves. According to him, "We need a system that allows the traditional way of cooperation to work in our society. We must subject technology and science to the economy of the poor and penniless. We must add the aesthetic factor because the cheaper we build the more beauty we should add to respect man."

The necessity of practicing rural architecture has been discovered by the great architects who devoted their knowledge to improve the condition of people who need it most. "l would rather see a million houses that cost only 500 rupees each, and are only

200 sq. ft. mud and thatch, than one more high rise building, even it were necessary. Unless I had done something for the 20 million homeless, I wouldn't be happy doing a high-rise building."- (Baker)

2.1 MATERIALS

Architecture does not involve with people only, it has a very strong relation with nature also, specially while choosing materials. "The construction of a house can be seen as process of negotiation between the builder/owner and the environment. The take from the earth what is needed to build, directly, or indirectly through a processing method.

Mud is directly used for construction whereas cement is processed from limestone. Unfortunately the environment has little say in the negotiation. Man takes or often plunders what is he needs from the environment.

The environment may retaliate by upsetting the balance of nature i.e. global warming etc. "The issue of sustainability is very much related to how direct this negotiation process is." (K.H.Kabir, 2005)"Living below the line: Sustainability and the houses of the ultra poor") (F.H.Mallik, 2005)

Each building has a relation with the nature, so one must be well aware to make a structure with local materials. Some of the materials are discussed below:

2.2 Earth

Unfired earth is the most common building material in the world: nearby 1/3 and maybe even half of the world's population lives in buildings made of unfired earth. The remaining2l3 of the population - maybe 50% - live in the other constructive typologies: in steel and in reinforced concrete houses.

(Maria Rosaria Gargiulo and lmmacolata Bergamasco," The Use of Earth in the

Architecture of Hassan Fathy and Fabrizio Carola: Typological and Building innovations,

Building Technology and Static Behavior.")

For many year earth architecture has held a minor role. lt was often linked to poor housing and self-building phenomena and as such it wasn't considered worth being studied in depth. The search for materials at a low environmental impact due to the energetic crisis of the 1970s caused the re-approach of the world of architecture to unfired earth. Since then several research study centers have been created regarding this material.

A Study on the Traditional Housing Technology of Bangladesh (2007) reveals the mud made housing technology is not only significant from ecological and economical perspective but also from social, cultural, and environmental context of human existence. There is also a huge number of resources supporting the importance of earth construction as a sustainable ecological building material.

There are many ways to use earth. Buildings can be made of raw unbaked earth alone in massive cob walls or in individual mud blocks (also called adobe). Plain earth or earth with a little lime or cement or bitumen can be used in rammed earth walls or compressed earth blocks (CEBs). Or earth can be poured into sandbags and stacked for earth bag walls, in what has been called the cheapest building method on earth.

Earth buildings last well when maintained. Outside walls of raw earth that get rained on should be replastered every few years unless they have special coatings.

Siloxane is a new water repellant that allows unsterilized earth walls to 'breathe' and dry out. lt is absorbed into earth or lime plaster, so that it does not wear off quickly.

Raw earth buildings need to be protected from rain and flooding to work well in humid climates. A good roof and a dry base of stone or cement stucco on gravel bags, or concrete are very important. Unsterilized earth construction must be raised 50 cm or more above the ground ln rainy areas. A good vapor barrier must be placed between all un-stabilized earth and concrete surfaces. Many people don't realize that raw earth buildings are healthier than concrete in high humidity. They never absorb enough water to let mold grow on them like concrete does. The most dampness they absorb from the air (5- 7% by weight) is not enough to let insects or mold grow (which need between 14 and 2O%).47 Very humid air is near its dew point. Every time that damp air warms up just a little more than a building, moisture in it condenses on the slightly cooler surface. Heavy concrete walls in very humid areas become frequently damp from condensation, causing algae or mold growth.

Hassan Fathy tested equally sized buildings in Cairo in 1964. On a March day the temperature varied between 12 and28 C. A building of 50 cm thick mud block with a vaulted mud block roof only stayed a comfortable 21 to 23 C inside. A similar building of 10 cm thick precast concrete walls and roof became 9 C hotter inside than out. Overall it was within the human comfort temperature range for only 5 hours out of 24. Because the mud block held more heat, it warmed up slowly in the morning, and cooled off slowly at night. lt also insulated much better than the concrete, and may have reflected more sunlight. (depending on surface finish)

2.3 Compressed earth blocks (CEBS)

It uses earth with about 5-10% clay. They are usually 2.5 times thicker than fired bricks, but they insulate better and moderate humidity better than fired bricks. These smaller blocks require more time for construction. Because CEBs are less expensive than fired brick, and can be produced by individuals with simple equipment, these blocks are improving living conditions in many countries. ln humid regions they must be either stabilized or protected by a substantial roof overhang. CEBs produced with bitumen or cement cost more than raw blocks. The quality of individual production should be pretested before use in exposed areas, because poorly stabilized CEBs can be damaged by absorbing too much moisture. Stabilized CEBs can be coated with cement plaster.

2.4 EARTHBAG

Earth bags are a simpler way to build with earth, using the strength of woven fabric bags while the earth dries. Because it is tamped, it has some of the properties of rammed earth without the need for heavy forms. Earth bag is finished with a plaster layer of earth materials and/ or cement or lime.

Earth bag building works well with a greater range of soils than most other earth techniques, between 5% and 30% clay. Earth bags can also be built of sand, gravel, or soil without clay, if they use some bamboo, wood, or steel reinforcement, or have a plaster of cement stucco, techniques which are better in

dry regions. lt can be reinforced enough to perform well even in high seismic risk regions.

Figure 1: Earth bag

(http://www.naturalbuildingblog.com/jiri-earthbag-project-report/)

2.5 MUD BLOCK

Unbaked mud block (or adobe) is usually built by masons, but is twice as thick as CEB walls. Lt is inexpensive because it does not require fuel or sophisticated equipment. Because of mud block's historic usage, basic rules of strength for unreinforced construction are well accepted for regions not subject to earthquake

hazard. In regions with medium or high risk of earthquakes, some sort of reinforcement may be necessary.

Mud block can be used there as infill between concrete posts. Historic structures of mud block have been built up to 8 stories. lt is strongest if built of short wall segments that include piers or comers. Windows should be spaced at least 1m from comers, and 1m apart unless a pier is located between windows. Corbelled window openings can be built without lintels.

Mud block requires water resistant mud plaster on exterior walls that must be renewed every few years. Like all raw earth construction, mud block should not be covered with concrete stucco. The concrete retains too much moisture and will decay the mud block. This material is a good choice for interior walls and furnishings, especially in buildings where reduced humidity is needed to preserve materials, like museums, libraries, and computer centers. Mud block walls are easier to clean and still retain much of their humidity-modifying properties if finished with a lime-plaster or tiled surface, or coated with a natural oil finish.

Figure 2: Mud block

(https://www.picbon.com/tag/mudblock)

2.6 RAMMED EARTH / COB

Solid earth can be rammed or built as cob. These are both difficult to build in wet climates because they dry slowly. Rammed earth walls need large forms to hold the earth in, are waterproof, and strong enough to build in multiple stories. Cob walls are traditional in many parts of Africa. They are built of hand sized loafs of mud, without forms. Since they must be thick to be strong they may receive more condensation than CEBs.

2.7 Bamboo

"The bamboo is literally the stuff of life. He builds his house of bamboo; he fertilizes his fields with its ashes; of its stem he makes vessels in which to carry

water; with two bits of bamboo he can produce fire; its young and succulent shoots provide a dainty dinner dish; and he weaves his sleeping mat of fine slips thereof. The instrument with which his women weave their cotton are of bamboo. He makes drinking cups of it, and his head at night rests on a bamboo pillow; his forts are built of it; he catches fish, makes baskets and stools, and thatches his house with the help of the bamboo. He smokes from a pipe of bamboo; and from bamboo ashes he obtains potash. Finally, his funeral pyre is lighted with bamboo." (Lewin, 1869) ln order to improve the durability and performance, bamboo are treated with or without the use of chemicals. Treatment is intended to:

. Extend durability and lengthen useful life.

. Capture and delay degradation.

. Preserve dimensional stability and retain strength.

. lmpart properties like fire resistance, luster, etc.

. lmprove aesthetic qualities

Selection of the treatment method depends on many factors:

. State of bamboo - green or dry

. Form - round bamboo, splits or bamboo products.

. End applications - in ground contact, exposed to atmosphere,

. undercover, structural/non-structural.

. Scale - quantity to be treated and time available.

. Potential causes of decay - biotic (fungus/insects) and a biotic

2.7.1 Traditional bamboo treatment:

It is cheaper compared to chemical preservative methods, but less effective. lt can be done easily in rural areas without special equipment. Therefore such bamboo treatment is needed to be promoted where such practice is declining.

1. Soaking in Water (Pynot') - Most Common Practice

- The culms should be placed in water for around two weeks.
- Then they are to be dried for a week (in the shade).
- By leaching, this process eliminates the nutrients (starch) sought after by bamboo borers.
- Does not retard termite infestation.

2. Clump Curing

- Cut bamboo should be stacked vertically for a few weeks after felling, with branches and leaves intact.
- Such bamboo continues to live off its reserves and hence reduces starch content and thereby insect attack.
- Does not hold back termite infestation.

3. Seasoning

- This should be done by drying bamboo in the open, under cover, with as much air movement as possible.
- lt can take a couple of months.

2.7.2 Chemical Preservative Treatment Methods:

Intermodal injection Method

Treatment method applicable for green or dry culms used for making members exposed to occasional wetting, such as bamboo posts.

i) 6 mm hole should be drilled in each intermodal of a whole bamboo culms and 20-50 ml creosote (tar oil/molten bitumen) combined with kerosene/ sump oil/ Mobil/ diesel should be injected with a large syringe.

ii) Paraffin wax (or putty, if available) should be used to plug the holes.

iii) The culms should be rolled 2-3 times a day for 7-10 days to distribute the preservative and complete the treatment.

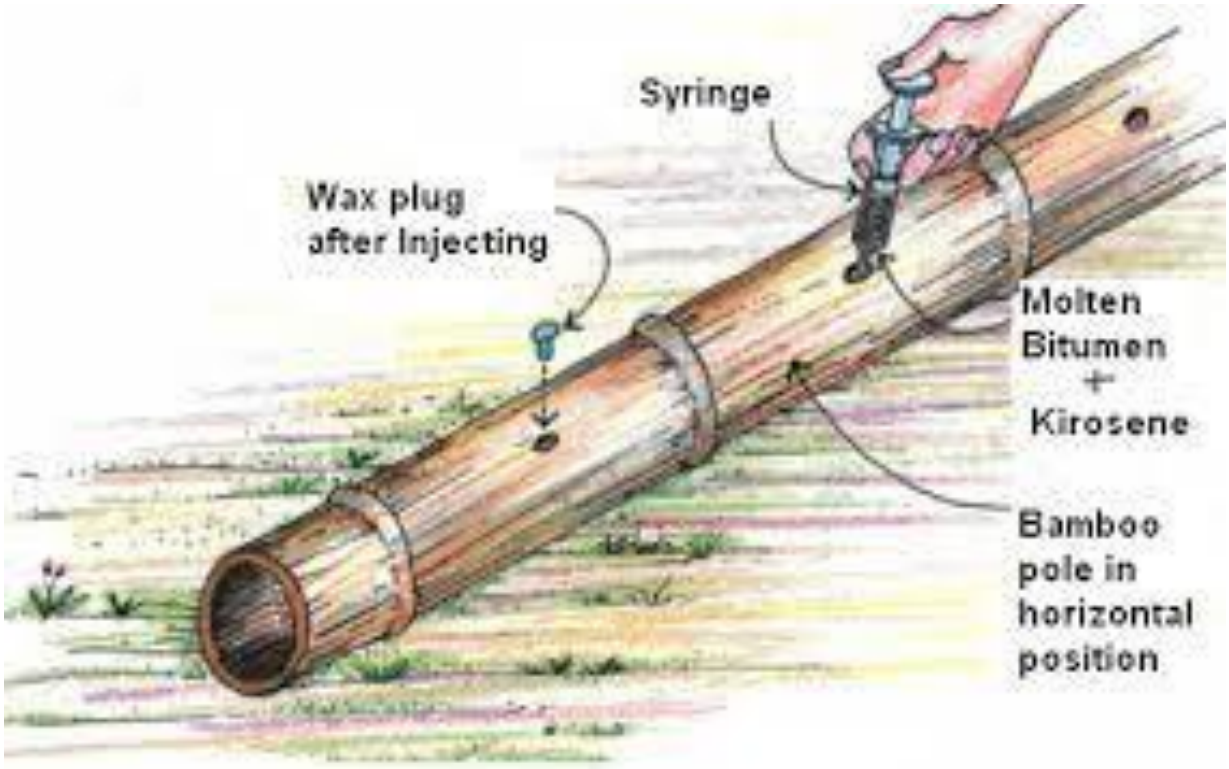


Figure 3: Detail of internation injection method

(http://www.disastermgmt.bih.nic.in/Compendium/Bihar_Bamboo_Hut_guideline.pdf)

ln SAFE, bamboo is treated with a solution of boric acid, borax and water. This solution penetrates the bamboo easily, reducing the level of sap in the bamboo and making it less likely to damage by insects. A vertical soak diffusion technique is used. Bamboo is used in various purposes like building material, scaffolding, shuttering, ladders for various construction works, rural bridges and tools. (safebangladesh)

Improvised field testing was candied out to ascertain a reasonable strength value for bolted bamboo connections used in the cross-bracing of informal housing. A single connection strength of 3.9kN was determined (which includes a 0.60 safety

factor for variations in materials and construction) provided that the following requirements are met:

. The end distance between the bolt and the end of the cross-bracing member must not be less than 2" (51mm)

. The minimum wall thickness of bamboo to be used as a cross-bracing member is to be 3/4" (19mm).

. The minimum outer diameter of bamboo to be used as a cross-bracing member is to be2.5" (63mm)

(Stephens, 2012)" Improvised field testing of bolted bamboo connections for use in bracing of informal housing."

Figure 4: Bamboo treatment

(safebangladesh)

This is a diagram in which it shows how safe treated bamboo are long term strong.

Here, for an affordable price, the people of the Sundarbon Union can purchase:

- Treated Bamboo
- Bondachula
- Mud Blocks
- and coming soon – Sand-Cement Tiles

All materials sold are aimed to allow low income households to make their houses stronger and make them last longer.

These are the overall study and examples of mud block, earth bag, rammed earth bamboo treatment and so on. Through these study I came to know how this works are going on. From these learning I like to design my project very carefully.

Chapter 3

SITE ANALYSIS

The site of my project is the existing site for SAFE (NGO) head office. My site is placed in Sundarban village, Dinajpur. The river Atrai forms the

eastern boundary of the village. The village sits on both sides of the main highway, midway between Dinajpur and Saidpur.

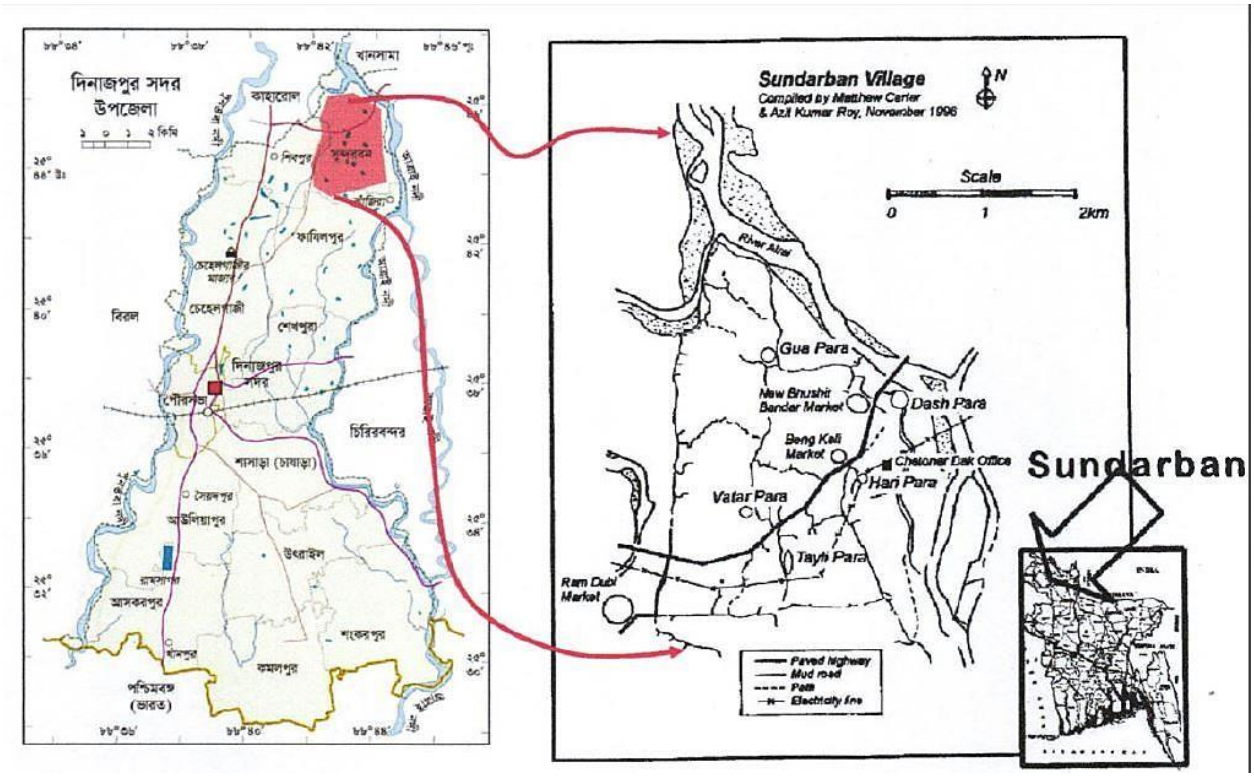


Figure 5: Site location

(google image)

Latitude : 25.7590443

Longitude : 88.7282038

3.1 MAPPING

Through my site visit, I have studied my site's road with, important features, connection to other important district, nearby paras, paddy fields eta.

Figure 6: Land use

Source: Author

3.2 SITE IMAGE

Figure 7:Site image

Source: Author

3.3 HISTORICAL BACKGROUND

Although Dinajpur does not suffer from the severe storms that affect the coastal region of the country, localized flooding does often occur and strong winds in

September and October regularly cause damage to houses. Dinajpur also lies in the highest earthquake risk zone in Bangladesh. Dinajpur's economy depends largely on agriculture, the area being famous for its rice. Approximately 40% of its population are landless laborers. lt also has a large Hindu population, over 2O% according to the 2001 census.

The client, SAFE provides services in the rural area of Sundarban in Dinajpur, focusing on a relatively small geographical area consisting of around 500 households in total. lt has a recent history of successful workshops and other programs.

1. **lncome generating activities:** SAFE pursue the development of private construction work whose profits will subsidize its activities.

2. **Tree planting:** The trees provide future protection from wind and will prevent soil erosion and SAFE includes small workshops to demonstrate this. The team use selected indigenous speckles of trees and work with communities to select the type of tree and carry out the planting - often using trees that will later bear fruit or have medicinal uses. Since 2008 SAFE has successfully planted approximately 1000 trees in partnership with the local government Depending on funds we will aim to plant 700 trees in summer 2011.

3. Partnership with learning organizations: SAFE has partnerships with BRAC University, Housing and Hazards, Exeter University (UK) and RedR-UK to offer opportunities for students and professionals to participate in workshops and construction of demonstration houses.

4. **Building for Safety workshops:** There are 2 day long workshops with up to 20 people from the local community and local builders encouraging both men and women to participate. The workshops include practical sessions e.g. mud wall building, but also sessions on softer subjects such as house maintenance and the longer term financial benefits of certain techniques. The aim is to hold one workshop during the construction of each demonstration house.

5. **Construction of demonstration houses:** Together with the household and local builders, design and plan of the construction and selection of appropriate techniques is done. There are options that suit the house-owner's wants and needs, and are in line with what the owner would have originally paid, costing between 10-20% extra. SAFE subsidizes approximately 50% of the cost of the house.

6. **Provide material support and advice to householders using our techniques:** SAFE provide follow up visits to communities to reinforce the messages from workshops and encourage their use in future building works. Subject to funding will subsidize the additional costs of construction work using BfS techniques for low income households (households that own less than ½ acre of land).

7. Construction of community centre: SAFE aims to construct a local community centre in partnership with the local community. The community has participated in the planning of the project, which will be managed by community committee and will donate land and labor for the construction. The centre will be used as a pre-school for 25 pupils, and to hold events - weddings, funerals, public meetings.

The design will promote sustainable materials and construction techniques in line with our existing approach.

3.4 SWOT ANALYSIS

My site has both positive and negative sides, but much more opportunities are allowed to proposed to build the centre in the Sundarban village near Bengkali Bazar.

Strength:

- Visible and easily accessible from main road.
- Existing head office for SAFE makes it easy to relate.
- The raised land is surrounded by free lands which can be used to extend in future.

Weakness:

- The hot-dry climate of the area can make it difficult for the people from other areas to cope up with.
- There can be no vehicular access directly to the site as the adjacent road is narrow (10 ft).

Opportunity:

- Highlight local materials like bamboo, earth which are available in the surrounding.
- The surrounding landscape can be incorporated and used to enhance the beauty of the project.
- Set an example for proper sustainable architecture and system in this area would create a great social impact.

Threat:

- Local environment can be harmed with excess use of local materials and natural resources.
- The price of local materials may drive up because of emerging demand.

3.5 LOCAL ARCHITECTURAL CHARACTER

Traditional Houses represent the heritage of a country and also reflects traditional forms and values, fundamental to the culture of the people of that country. lt possesses distinct characteristics as regards planning, use of materials and location.

As rural Bangladesh housing typologies vary from region to region depending on available materials, the choice of the construction approach is dependent on the owners particular circumstances and preference. lt is completely reasonable that two adjacent houses can be made of completely different materials. The choice of materials available is largely cost driven.

Kutcha materials such as earth and bamboo construction being the most affordable, semi-pucca or pucca brick and timber are more expensive, although these materials hold more cultural prestige and deemed as much more durable.

Available materials used in Dinajpur: bamboo, Cl(Corrugated lron) sheet, Thatch, Clay

tiles.

The only buildings seen nearby are the farmers' houses, which have mud walls and straw thatched roofs. The building materials are available within the villages. Bamboo is used extensively - as structural members (fastened with jute ropes/string), or flattened for wall paneling, or simply woven together to act as screens.

3.6 CLIMATIC CONDITION

Dinajpur district experiences extremes of weather. There are three main seasons in Dinajpur. They are summer, monsoon and winter season. Summers are extremely hot and humid. Winters season experiences cold weather conditions.

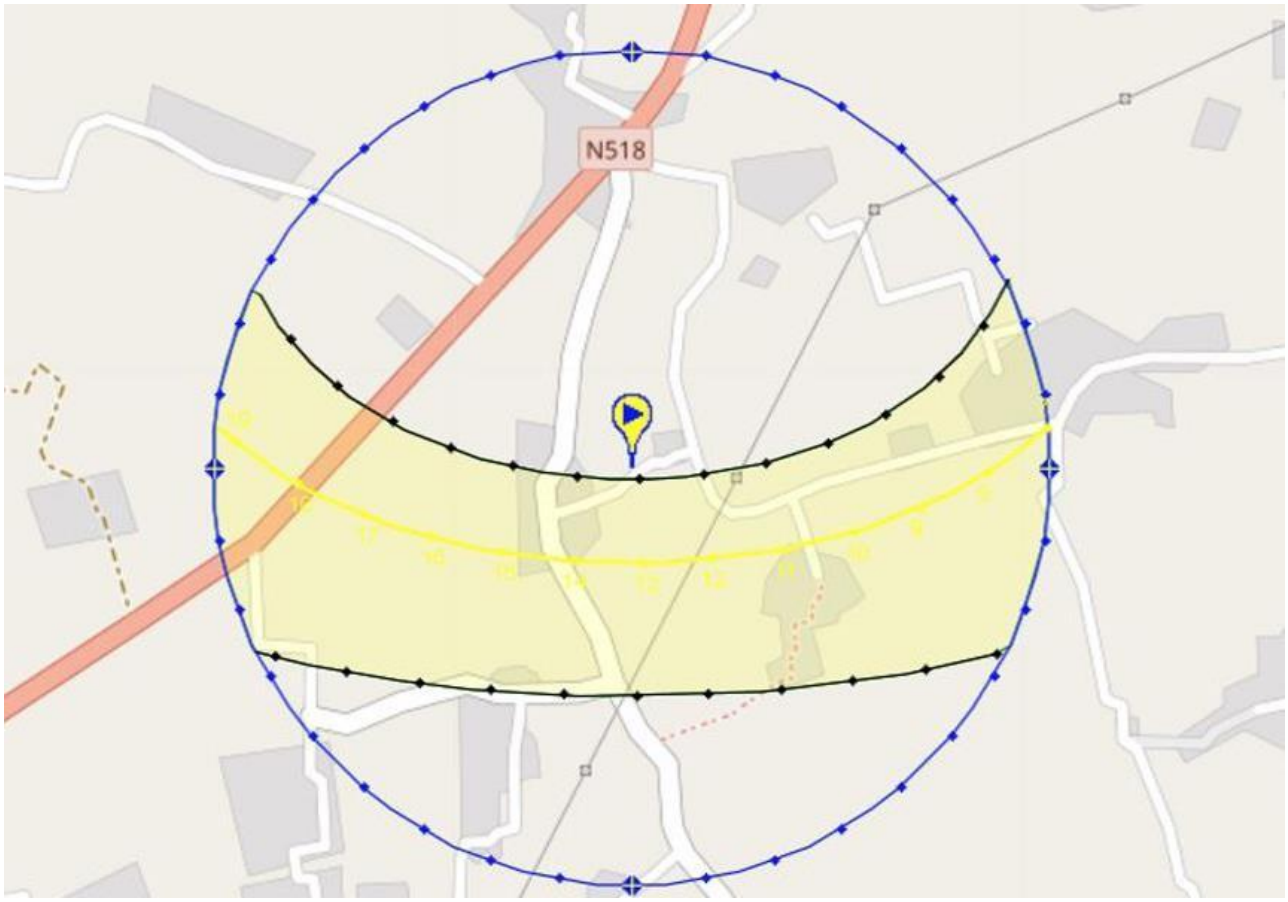


Figure 8:Sun path diagram

(http://andrewmarsh.com/apps/staging/sunpath3d.html)

Summer season is typically from early March to Late May. Summer experience high humidity. Temperatures in summer vary from a minimum of 32'C to a maximum of 40.C.

Humidity may rise up to 80 % in May. May is the hottest month of the year.

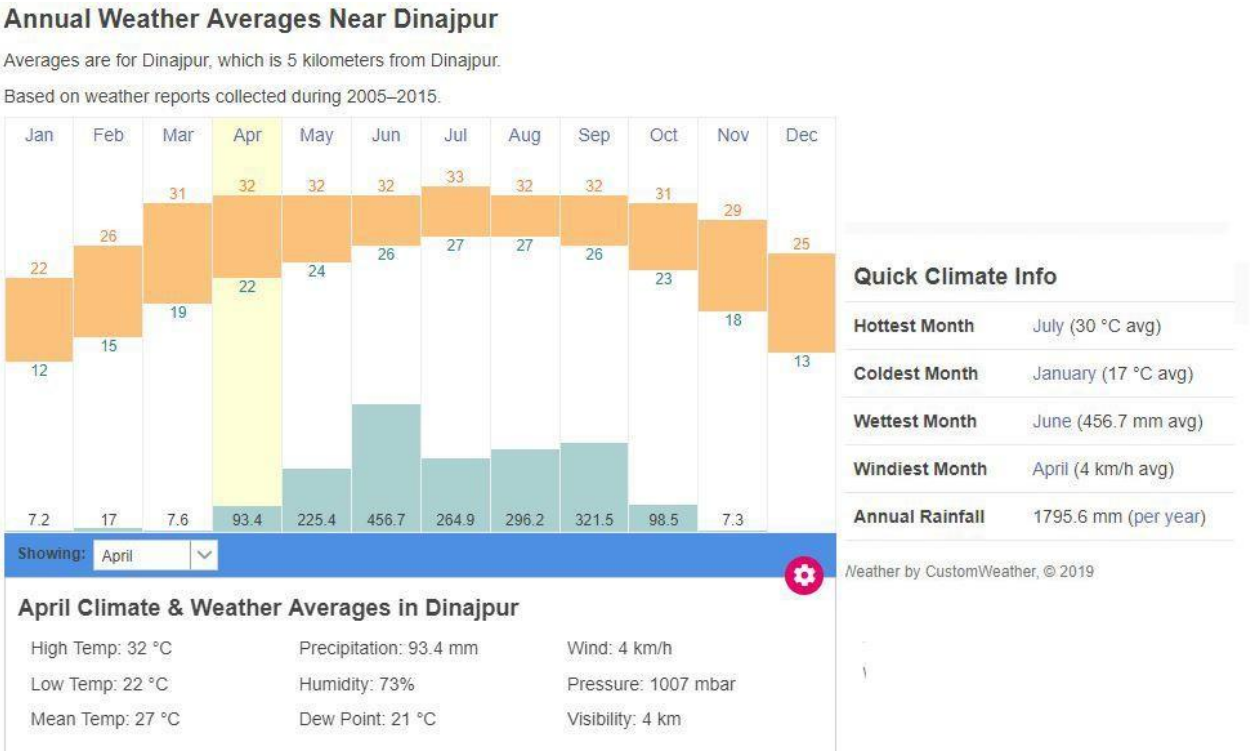


Figure 9:AVG temperature

(https://www.worldweatheronline.com/dinajpur-weather-averages/bd.aspx)

Monsoon season is from June to September. August receives the most amount of rainfall and humidity is also high during this period. Temperatures fall towards the end of the monsoon season.

Winter season starts in late November and goes on till February. The winters are extremely cold and temperatures can fall rapidly in January. December and January are usually the coldest month of the year. Temperatures range from a minimum of 10'C and rise up to a maximum of 20’C.

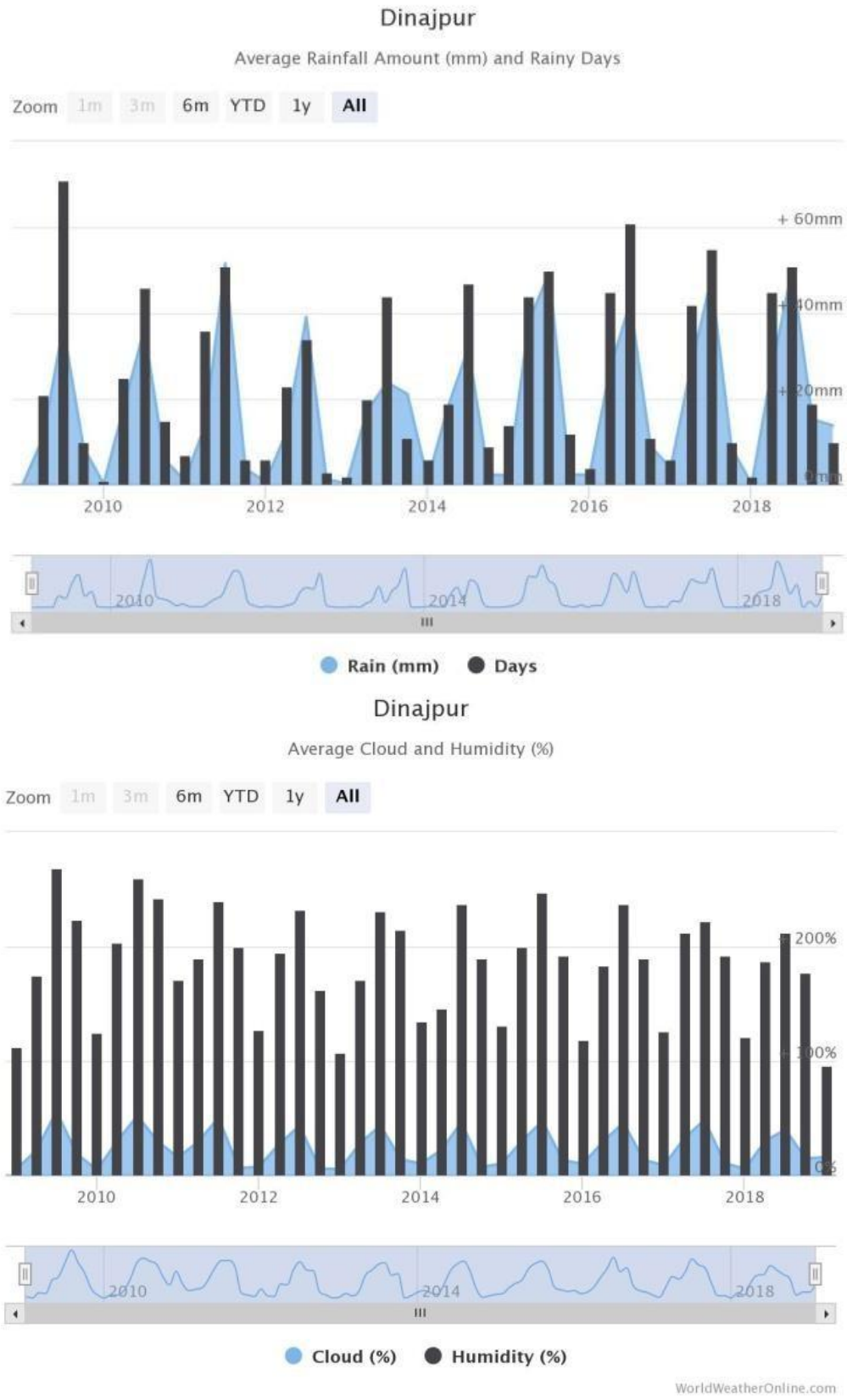


Figure 10:Rainfall and Humidity

(https://www.worldweatheronline.com/dinajpur-weather-averages/bd.aspx)

The challenge is to make a structure with natural ventilation and lighting considering this situation. Ultimately, the centre itself will be a shining example for sustainable architecture.

Weather study is very important for my site. Since my project is a research centre, so temperature is very important for me and at the same time humidity, rainfall are also important. So that I can left bamboo for several times for its treatment, mixture of earth for soaking water and so on.

This is the overall site study. My site is very nice and I like it a lot. This is a very perfect place for research and learning centre. Its weather is also very suitable.

CHAPTER 4:

CASE STUDY

I have studied few case studies so that I can gather much knowledge about my topic and can incorporate on my design. I have studied one local example and few international case studies.

4.1 LOCAL EXAMPLES

METI- Handmade School in Rudrapur.

There is a bright example of utilizing local materials in a school in Rudrapur in Dinajpur.

The project was conceptualized and designed by Architect Anna Heringer.

Figure 11:Meti school

(Side facade)

The local NGO Dipshikha has basically taken this great endeavor with the intention is to give the rural population perspectives and to help people learn about power of local materials. Part of this is a special school concept that instills in the children selfconfidence and independence with the aim of strengthening their sense of identity.

Local traditional building materials have been combined with learned construction knowledge to produce a building that is not only sustainable but also a much-needed facility for the village children. With the encouragement of the client the architect took up the challenge of using local materials to explore a new building dynamics in the design of a mud-wall construction. The project provides the classrooms which were required by the client as well as additional spaces for children to interact and be creative, which were not asked for. The classrooms at

the ground floor are enclosed by a mud wall, with apertures and doonivays strategically positioned to allow light and wind penetration. The classrooms on the first floor have walls of slatted bamboo that allow diffused light into the space as well as natural ventilation.

Figure 12:Ground floor plan

(Ground Floor Plan)

Traditional mud walls are formed with very wet loam. Here, an adapted technique called 'Wellerbau' was used. The wet loam is mixed with straw and applied to the wall in layers, each around 50-70 centimeters high. After drying for a couple of days the sides of the walls are trimmed with a sharp spade to obtain a regular flat surface. After a second drying period, a further layer can be added on top. The earth in this region is well suited to such construction and the stability of the mixture was improved by adding rice, straw and jute (cows and water buffalos did the work of treading in the mixture). A further vital technical improvement on traditional house construction was the introduction of a damp-proof course and a brick foundation. The ceiling as well as the first floor is constructed mainly from bamboo, which is

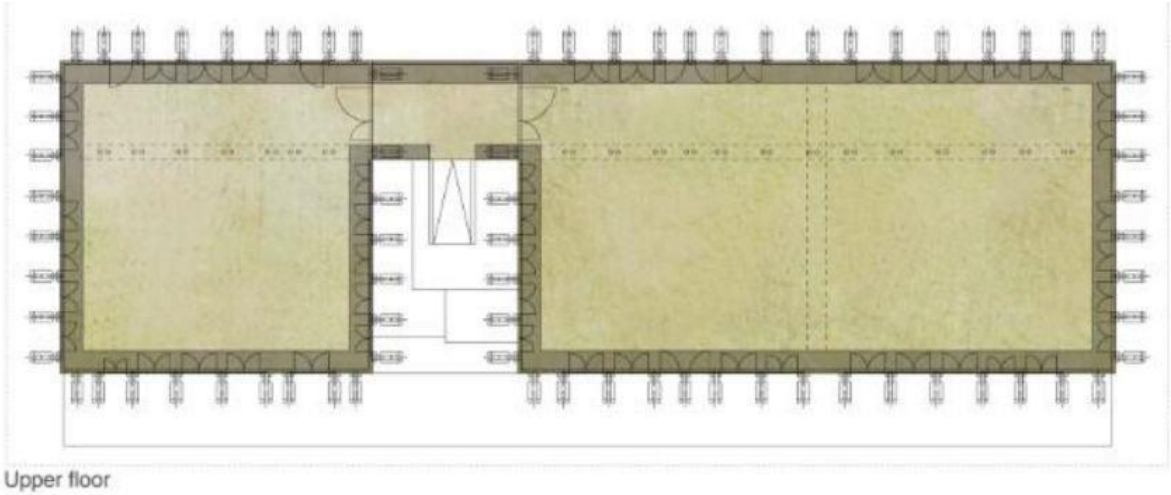


Figure 13: Upper Floor Plan

(Upper Floor Plan)

widely used by the locals for scaffolding, bridges and other structural components. ln many instances, bamboo is better than other comparable materials such as wood or steel. It is light in weight and exhibits a high elasticity and tensile resistance, which makes it appropriate for seismic zones. Bamboo is fast growing, comparatively low in cost, contributes to the aeration of other building elements, and is easy to handle and maintain. From an ecological point of view, it is also totally recyclable. Three layers of bamboo sticks, bamboo boards and an earth filling make up the surface of the floor. The upper walls and roof are a frame construction using four layers of joined bamboo sticks and vertical and diagonal bamboo poles. Steel pins are fixed with nylon lashing (a variation on the traditional jute ropes) from the junction of the sticks. The walls are covered with slats of bamboo that allow diffused light as well as natural ventilation.

Figure 14:Interior Space

(Interior Space)

"This joyous and elegant two-story primary school in rural Bangladesh has emerged from a deep understanding of local materials and a heart-felt connection to the local community. Its innovation lies in the adaptation of traditional methods and materials of construction to create light-filled celebratory spaces as well as informal spaces for children. Earthbound materials such as loam and straw are combined with tighter elements tike bamboo sticks and nylon lashing to shape a built form that addresses sustainability in construction in an exemplary manner. The design solution may not be replicable in other parts of the Islamic world, as local conditions vary, but the approach - which allows new design solutions to emerge from an in-depth knowledge of the local context and ways of building - clearly provides a fresh and hopeful model for sustainable building globally. The final result of this heroic volunteer effort is a building that creates beautiful, meaningful and humane collective spaces for, so enriching the lives of the children it serves." learning (Jury of The Aga Khan Award for Architecture

1Oth Circle) (www.anna-heringer.com)

This is one of my most favorite project. I am really interested on vernacular architecture. From this project I came to know about proper use of earth, space and so on. There are also

use of different color for school children. There are also different bamboo for facade treatment and these bamboo are treated bamboo. These are the example of my research centre.

4.2 INTERNATIONAL EXAMPLES

4.2.1 Hunnarshala Foundation, India

We can see shining example of such craftsmen based local research center in our neighborhood countries like, India. It is named Hunnarshala Foundation, situated in Kutch, Gujrat.

Figure 15:Vernacular Projects

(http://www.hunnarshala.org/)

Hunnarshala Foundation (HSF) was formed in response to the earthquake in Kutch in 2001. This organization facilitates self sustaining housing for the poor, favor artisans' involvement in mainstreaming buildings and promotes local eco-friendly and costeffective materials and technologies like earth, bamboo and sewerage recycling. HSF has worked in disaster rehabilitation in India, lran, Indonesia and Afghanistan. The HSF approach particularly focuses on empowering communities and their artisans by mainstreaming their sustainable knowledge systems, positioning artisans to be in charge of the technical success

of the programs and ensuring a decentralized community driven process. They provide technical guidelines and training to engineers and artisans as well as inputs for policy making for the government. The HSF approaches in their work is to see:

- how people are empowered to shape their own habitats;
- how habitat solutions can become more environment friendly, sustainable and disaster safe and
- how local artisanal knowledge and skills can deliver high quality products. ((www.hunnar.org))

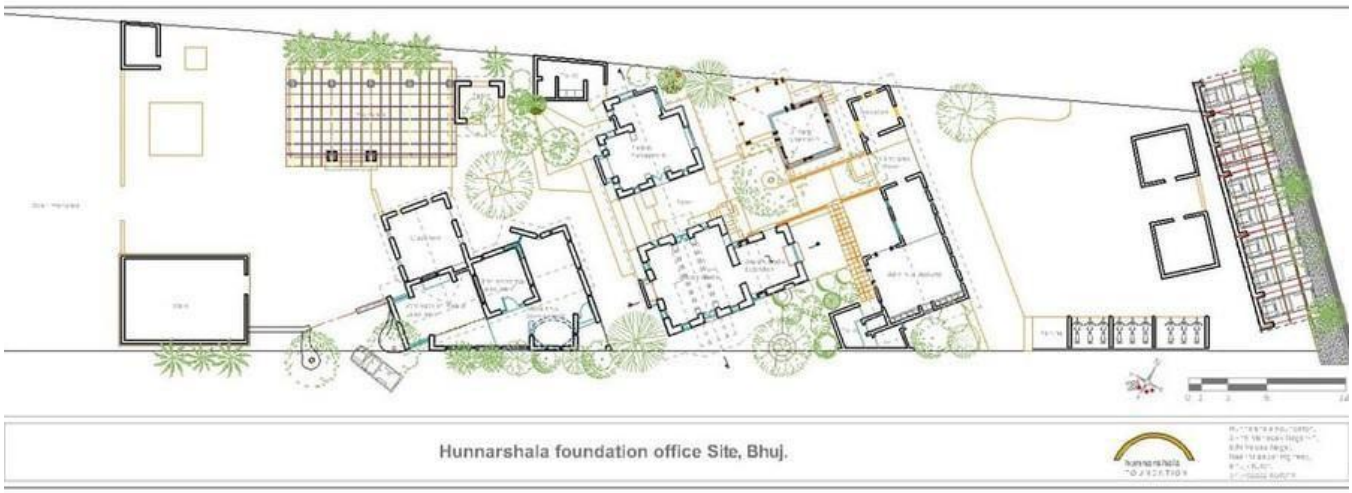


Figure 16:Hunnarshala foundation office Site, Bhuj

((www.hunnar.org))

Main activities:

Green technologies:

Hunnarshala uses a design vocabulary based on traditional features like courtyards, verandahs, and other features for passive solar cooling to respond to

climatic needs. The materials and technologies promoted and used by the foundation includes lime, earth, thatch, country tiles along with roof water harvesting, and decentralized waste water recycling. HSF works with stabilized and non-stabilized mud blocks, rammed earth, waffle & daub and adobe. HSF is making efforts to use these green approaches and technologies at large scale such as mass housing and city level. Hunnarshala collaborates with its sister organizations to get inputs particularly on water, renewable energy, bio-diversity, etc.

Community driven housing:

HSF helps people get together, develop their own relevant solutions and articulate their plan of actions. The people achieve this not as individuals but as a community. This is also a process of empowerment and results in habitats that nourish and enrich lives of its inhabitants. This process of housing through collective decision-making and efficient management results in speedier construction, and caters better to individual and community needs.

Strengthening artisans:

Amalgamating technology with cultural needs, local artisans have developed habitat design and technologies that are time-tested for safety and use environmental resources in a sustainable way.

However, new knowledge creation in scientific and design institutions has disregarded this traditional knowledge base. New knowledge systems have created specializations, where artisans have been relegated only to skilled labor and the prerogative of providing the design and artistic content is controlled by

new educated elite. This has resulted in lack of validation of traditional sciences and its inability to keep pace with fast changing needs of modern times.

My reflection from these projects are given below:

- validation of the science of local artisans' knowledge;
- redesigning products using their knowledge and skills for the contemporary needs;
- Documenting their knowledge base in its cultural and environmental context;
- Identifying the master artisans to link them to market through their projects.
- Through this process, Hunnarshala hopes that an indigenous vocabulary of architecture would emerge giving expression to local culture.

4.2.2 Suoi Re Village Community House, Vietnam

Located in Suoi Re, Luong Son, in the HoaBinh province, the community house was erected against a picturesque scene, leaning against mountains and facing an incredible valley. Contextually aware of its surroundings, as well as the architectural typology of the Kinh and Muong people of the area, the interior of the structure is strikingly modern by comparison.The idea of having a convection wind tunnel, the ellipsoid open space, the grass steps, slopes taper, exposure roof make all those connect with the front and the back, the interior and the exterior, the upstairs and the downstairs, creating a continuous chain of open space.

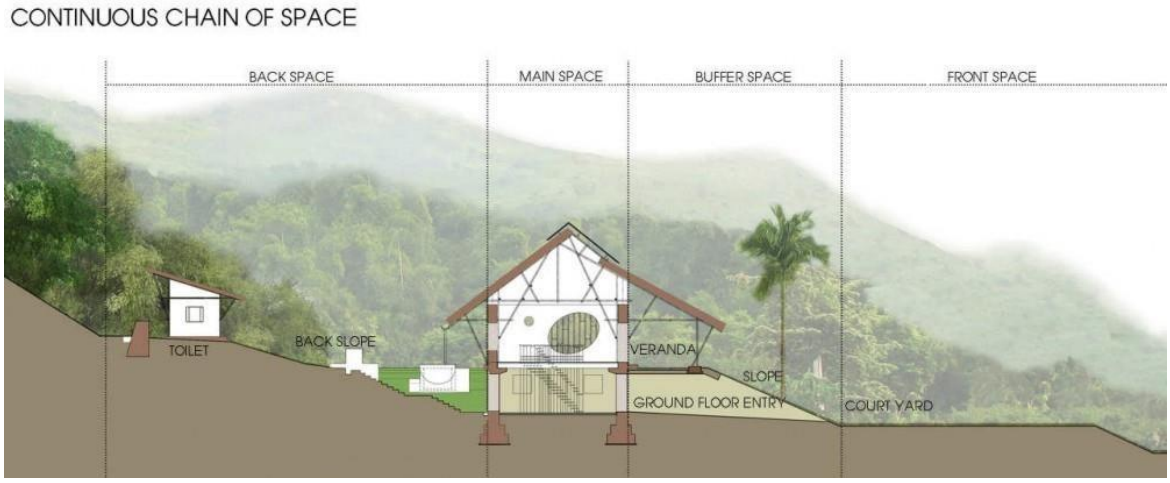


Figure 17:Zoning

(https://inhabitat.com/suoi-re-village-community-house-in-vietnam-features-rammedearth-and-bamboo/third/)

The overall space is organized in a chain, where the front space is an open courtyard, the main living space lies at the center and consists of connecting two floors. Upstairs one can find a teaching area, library and meeting areas. Overall, open space and programmatic flexibility were the focal points in determining the layout of the floor plan. Built simply and economically with local materials, the ground floor was constructed with smoother stone, while bamboo doors cover passageways, and a bamboo ceiling warms the space. A rammed-soil wall with heavy stones supports the structure, and the bamboo roof frame has been adorned with dense palm leaves, providing protection from above.

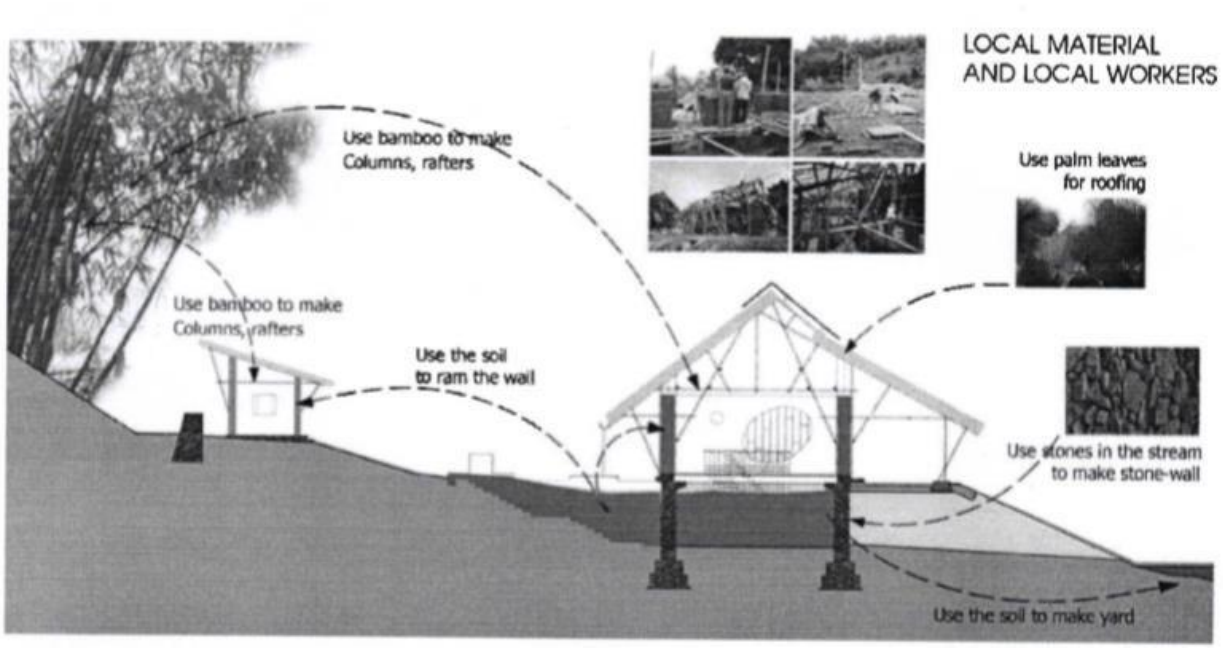


Figure 18:Use of local materials

(https://inhabitat.com/suoi-re-village-community-house-in-vietnam-features-rammedearth-and-bamboo/third/)

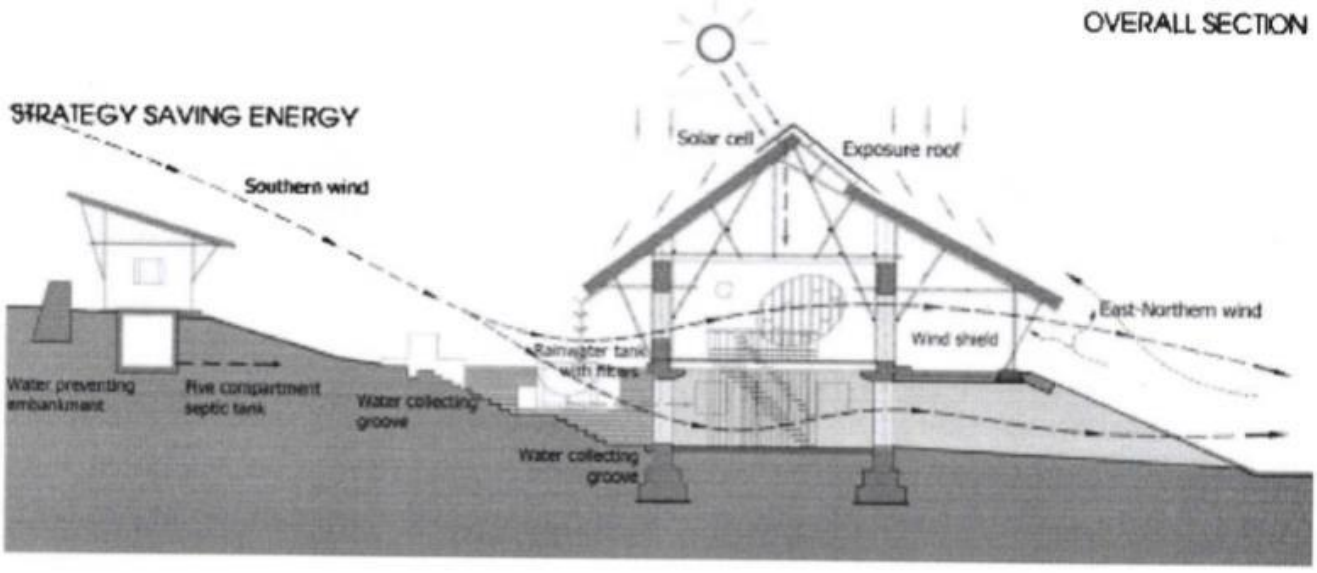


Figure 19:Saving energy

(https://inhabitat.com/suoi-re-village-community-house-in-vietnam-features-rammedearth-and-bamboo/third/)

My reflection from this project is every project is geography based. It is very good example for zoning, different materials and saving energy. Here, they use treated bamboo and also design is in a way that it can save energy very well. As our people are middle income people so it is very helpful for our country and save energy. I can incorporate this idea in my design.

4.2.3 SOME OTHER EXAMPLES

Figure 20:A project for re-inventing African mud hut

(https://www.indiegogo.com/projects/mud-house-reinventing-the-african-mud-house#/)

I have learnt many interesting use of mud through this case study. This case study inspire me more for my project and its research.

CHAPTER 5

PROGRAMME AND DEVELOPMENT

The requirement and program of the project is originated from the basic function of the institute and also the demand of the client. The program leads to the success of a design. Individual space requirements were determined calculating the minimum space requirements of the functions. Some functions were also added later for its necessity

that I felt.

Initially I have four programs to construction like bamboo construction, earth construction, wood workshop and metal workshop. I am thinking an open space for handicrafts. For classroom/studios, I have calculated per person's sft, no of users, rooms etc.

I also do detail study for lab. I will have two computer lab, one research lab and three material treatment. Computer lab is for sharing information through internet and updated the research. Material treatment lab is for experimenting different materials.

I have decided for two types of library- 1. General library and 2. Material library. I have 20,000 books in general library.

I also have common area. This area will be consist of multi-purpose hall, instructor's common room, meeting room, prayer space, medical and health unit cafe etc.

I have an administrative section as well. There are also research section and dormitory for participants and researchers.

The program, their brief description and their minimum space requirements are given below:

5.1: Number of participants and instructors for different subjects:

SUBJECT	SUBDIVISION	NUMBER OF PARTICIPANTS	NUMBER OF INSTRUCTORS	NUMBER OF ASSISTANTS
BAMBOO CONSTRUCTORS	i)BAMBOO TREATMENTS ii)BAMBOO CONNECTIONSBRACING iii)PRACTICAL STUDIO	30	2	1
EARTH CONSTRUCTION	i) INTRODUCTION TO VARIOUS TYPES OF EARTH CONSTRUCTION ii)PRACTICAL STUDIO	30	2	1
WOOD WORKSHOP	i)THEORY ii)PRACTICAL STUDTO	30	2	1
METAL WORKSHOP	i) THEORY ii)PRACTICAL STUDTO	30	2	1
TOTAL		120	8	4

5.2: AREA FOR CLASSROOM/STUDIO

SUBJECT	NO OF USERS	SPACE REQUIRED PER PERSON (SFT)		NO OF ROOMS		TOTAL AREA FOR PARTICIPANTS (SFT)		STORE ROOM AREA (SFT)	AREA REQUIRED (SFT)
		LECTURE ROOM	WORKING STUDIO	LECTURE ROOM	WORKING STUDIO	LECTURE ROOM	WORKING ROOM		
BAMBOO CONSTRUCTION	30	20	50	1	1	600	1500	150	2250
EARTH CONSTRUCTION	30	20	50	1	1	600	1500	100	2200

WOOD WORKSHOP	30	20	50	1	1	600	1500	150	2250
METAL WORKSHOP	30	20	50	1	1	600	1500	100	2200
								SUB TOTAL	8900
								CIRCULATION (30%)	2670
								TOTAL AREA (SFT)	11,570

5.3: AREA FOR LAB

SPACE	No OF USERS	SPACE REQUIRED PER PERSON (SFT)	SPACE REQUIRED PER ROOM (SFT)	NO OF ROOMS	AREA REQUIRED (SFT)
COMPUTER LAB	30	10		2	600
RESEARCH LAB	15	50		1	750
MATERIAL TREATMENT			2000	3	6000
PLANT					
				SUB TOTAL	7350
				CIRCULATION (30%)	2205
				TOTAL AREA (SFT)	9555

5.4: GENERAL LIBRARY

SPACE	NO OF USERS	SPACE REQUIRED PER ROOM (SFT)	NO OF ROOMS	AREA REQUIRED (SFT)
LOBBY AND RECEIPTION		150		200
CHECK AREA AND LOCKER				200
READING AREA	150		1	1500

BOOK STACK	20,000 BOOKS	0.1 SFT/BOOK		2000
LIBRARIAN'S ROOM	2	100	2	200
AUDIO-VISUAL SECTION			1	800
COPY SECTION			1	200
STORE			1	400
TOTAL FOR GENERAL LIBRARY				5500

5.5:MATERIAL

LIBRARY

DISPLAY				1	500
STUDY AREA			400	4	1600
LIBRARIAN'S ROOM		1	100	1	100
STORE				1	400
TOTAL FOR GENERAL LIBRARY					2600
TOILET	OFFICE		80	1	80
	PARTICIPANTS		160	2	320
SUB TOTAL					8500
CIRCULATION (30%)					2550
TOTAL AREA (SFT)					11,050

5.6: COMMON AREA

SPACE		NO OF USERS	SPACE REQUIRED PER PERSON (SFT)	SPACE REQUIRED PER ROOM (SFT)	NO OF ROOMS	AREA REQUIRED (SFT)
EXIBITION	TEMPORARY					2500
	PERMANENT					7500
MULTI-PURPOSE HALL		200	10		1	2000

INSTRUCTOR'S COMMON ROOM	12	20		1	240
MEETING ROOM				1	500
INSTRUCTOR'S TOILET			160	2	320
PATICIPANT'S TOILET			320	2	640
PRAYER SPACE			500	2	1000
MEDICAL AND HEALTH UNIT				1	200
CAFE			250	1	250
				SUB TOTAL	15,150
				CIRCULATION (30%)	4,545
				TOTAL AREA (SFT)	19,695

5.6:AREA FOR ADMINISTRATIVE SECTION

SPACE	NO OF USERS	SPACE REQUIRED PER PERSON (SFT)	SPACE REQUIRED PER ROOM (SFT)	NO OF ROOMS	AREA REQUIRED (SFT)
RECEIPTION					100
WAITING ROOM	20	15			300
DIRECTOR'S ROOM	2		300	2	600
REGISTER'S ROOM	1				250
ACCOUNTS OFFICE	4	80			320
GENERAL OFFICE ROOM	6	80			480
CONFERENCE ROOM	15	20		1	300
TOILET			160	2	320
				SUB TOTAL	2670
				CIRCULATION (30%)	801
				TOTAL AREA (SFT)	3471

5.7: AREA FOR RESEARCH SECTION

SPACE	NO OF USERS	SPACE REQUIRED PER PERSON (SFT)	SPACE REQUIRED PER ROOM (SFT)	NO OF ROOMS	AREA REQUIRED (SFT)
RECEIPTION					100
INFORMATION CENTRE				1	300
GENERAL OFFICE ROOM	15	80			1200
CONFERENCE ROOM	15	20		1	300
TOILET			160	2	320
				SUB TOTAL	2220
				CIRCULATION (30%)	666
				TOTAL AREA (SFT)	2886

5.8: AREA FOR DORMITORY

SPACE		NO OF USERS	SPACE REQUIRED PER PERSON (SFT)	SPACE REQUIRED PER ROOM (SFT)	NO OF ROOMS	AREA REQUIRED (SFT)
PARTICIPANTS ROOM	MALE	80	100		40	8000
	FEMALE	40	100		20	4000
TOILET				320	2	640
INSTRUCTORS DORM	MALE	8	100			800
	FEMALE	4	100			400
TOILET				160	2	320
STAFF DORM	MALE	10	60			600
	FEMALE					

RESEARCHER DORM	15	120			1800
TOILET			100	2	200
KITCHEN				1	1000
DINING	120	10		2	1200
WASH					200
				SUB TOTAL	19160
				CIRCULATION (30%)	5748
				TOTAL AREA	24,908

5.9: GRAND TOTAL

AREA FOR	SQFT
CLASSROOM / STUDIO	11,570
LAB	9,555
LIBRARY	11,050
ADMINISTRATIVE SECTION	3,471
RESEARCH SECTION	2,886
DORMITORY	24,908
COMMON SPACE	19,695
TOTAL	83,060

Knowing the program is very essential at the initial stage of design. If the accurate space requirements are known and the programming is done accurately then the area calculation will help decide the size and position of the different functions. Program should be taken into account very seriously and use them to lead the design into an efficient one.

CHAPTER 6

DESIGN DEVELOPMENT

At this chapter I have explained my concept, design development phase, plans sections, elevation and many others.

6.1 Concept and Design Consideration

Since my design area is situated at a village, so neighbourhood connection is very important for my design. At the same time my project is for village people and for surrounded people, for this public accessiblity is very important for the project. There are three villages surrounded my site and had already a access pathway through my site. And these are my design considerations:

Figure 21: Exixting Pathway

SOURCE: AUTHOR

Considering existing pathway, surrounded villages and existing green, I decided zoning for my project.

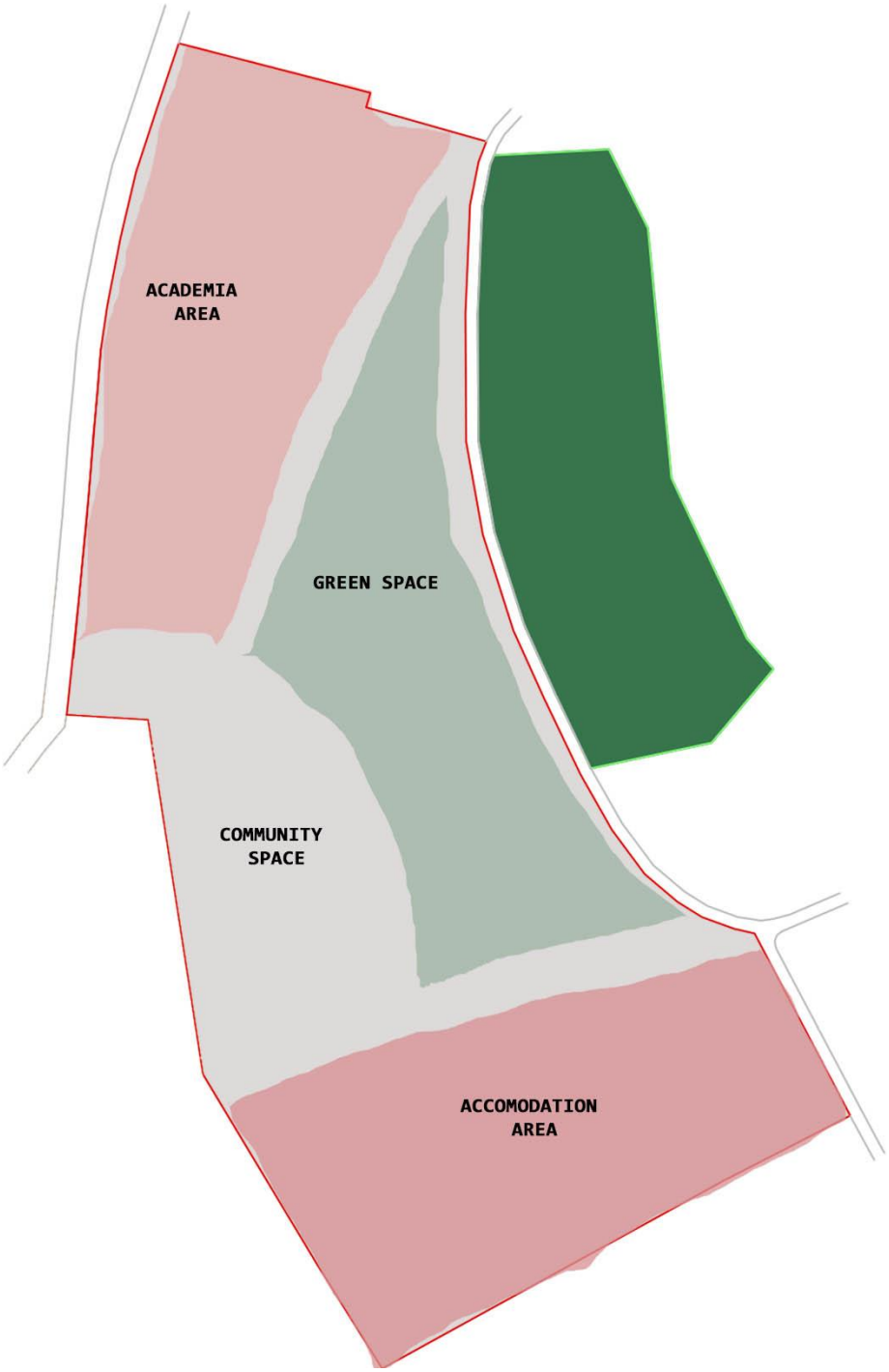


Figure 22: Zoning

SOURCE: AUTHOR

These are my design developments:

Figure 23: Design Development

SOURCE: AUTHOR

6.2 Structural System

I used some vernacular structure system for my project. I used filler slab for a vernavular appearance. In this project , bamboo treatment is very important and at the same time bamboo is very available here. So I used bamboo roof.

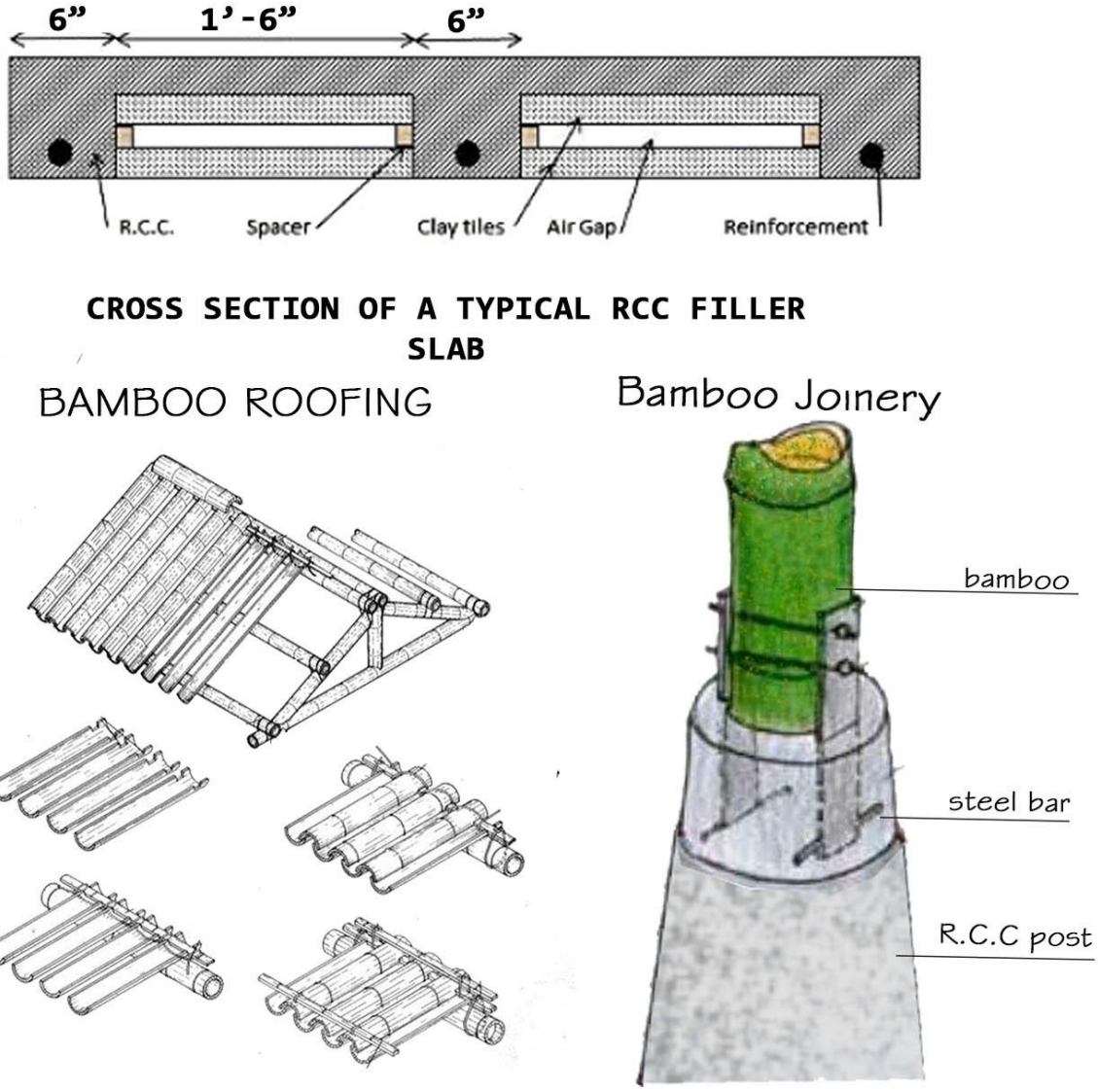


Figure 24: Structural system

SOURCE: AUTHOR

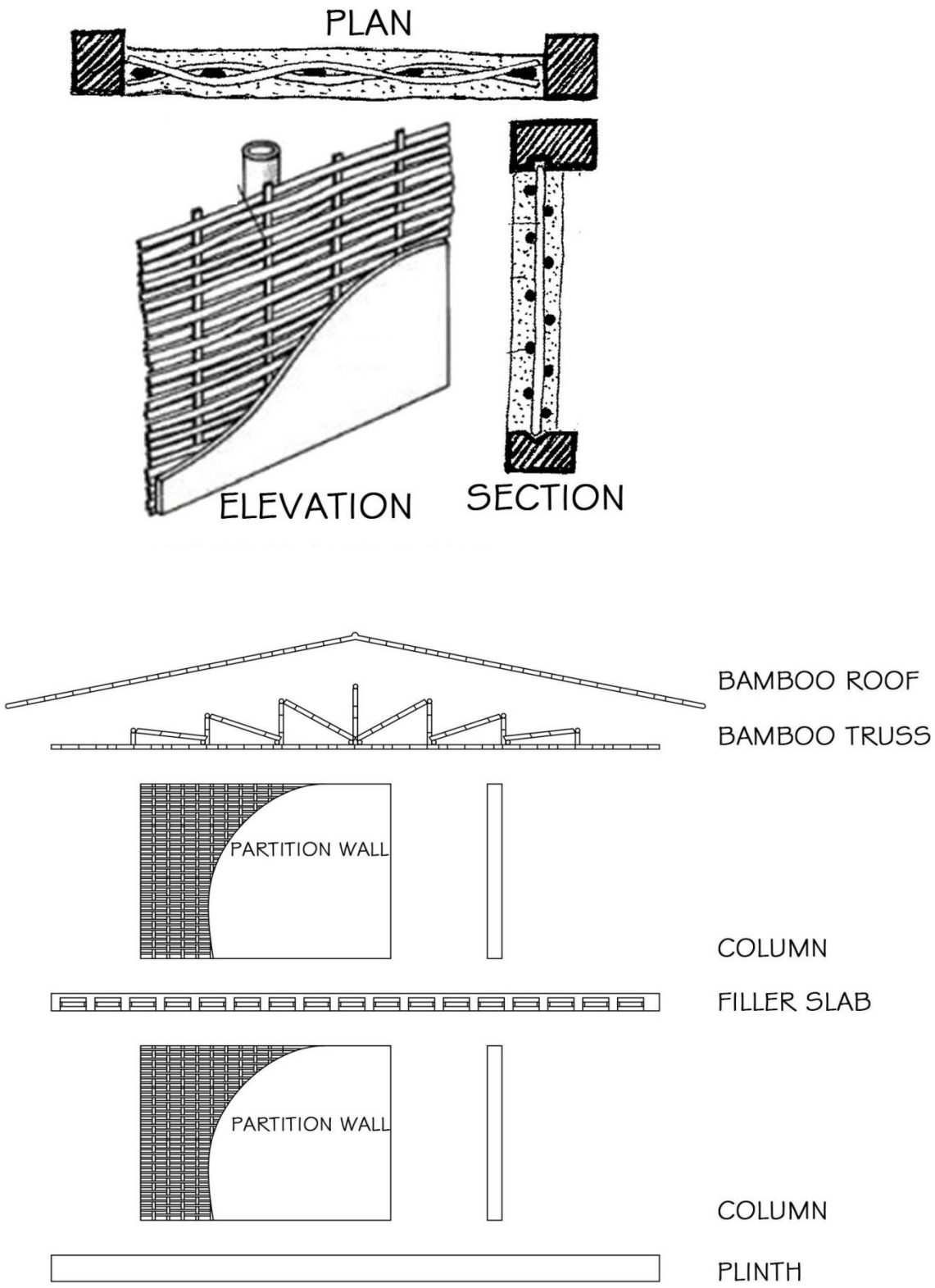


Figure 25: Structure

SOURCE: AUTHOR

6.3 Plans Sections Elevation

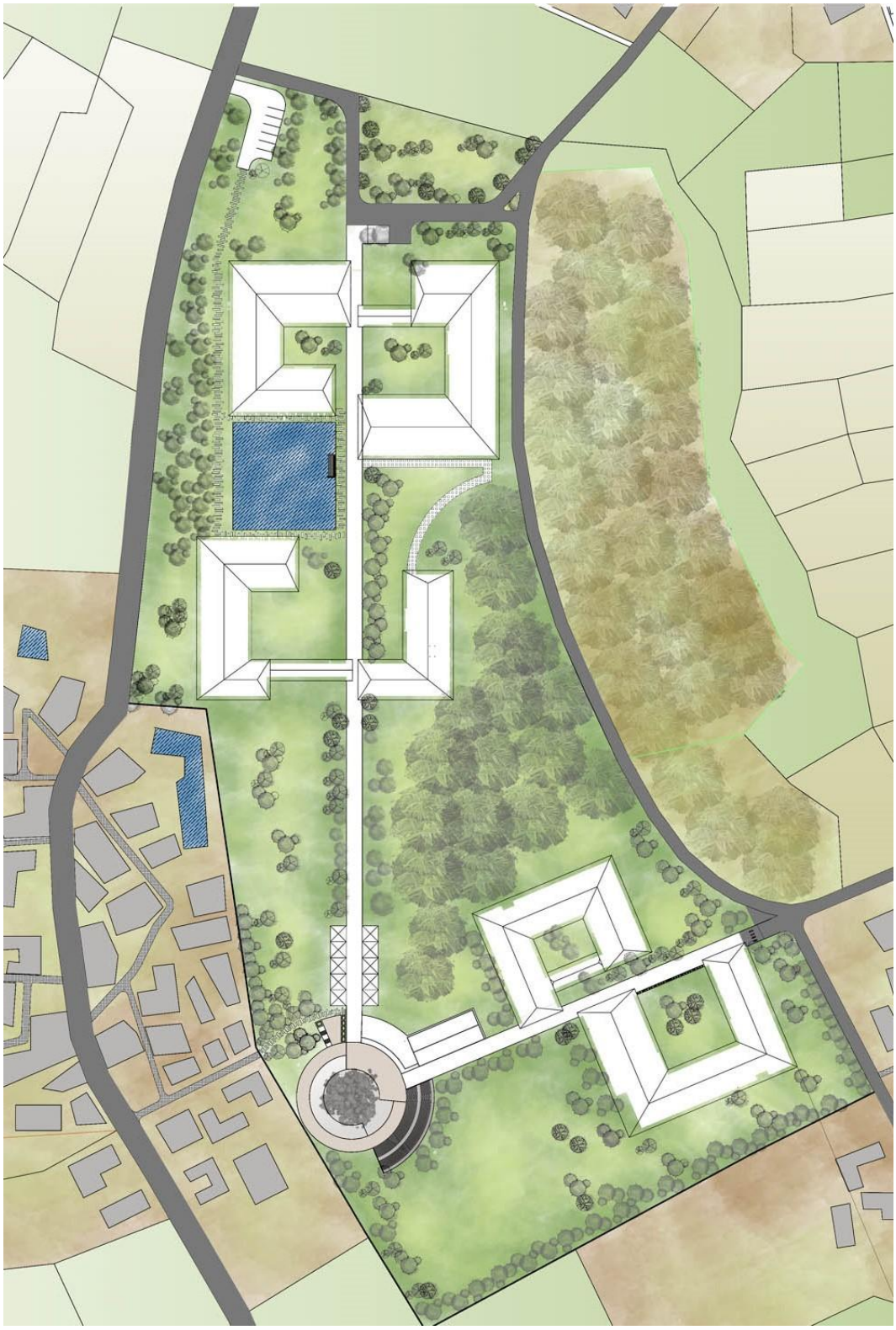


Figure 26: Roof Plan

SOURCE: AUTHOR

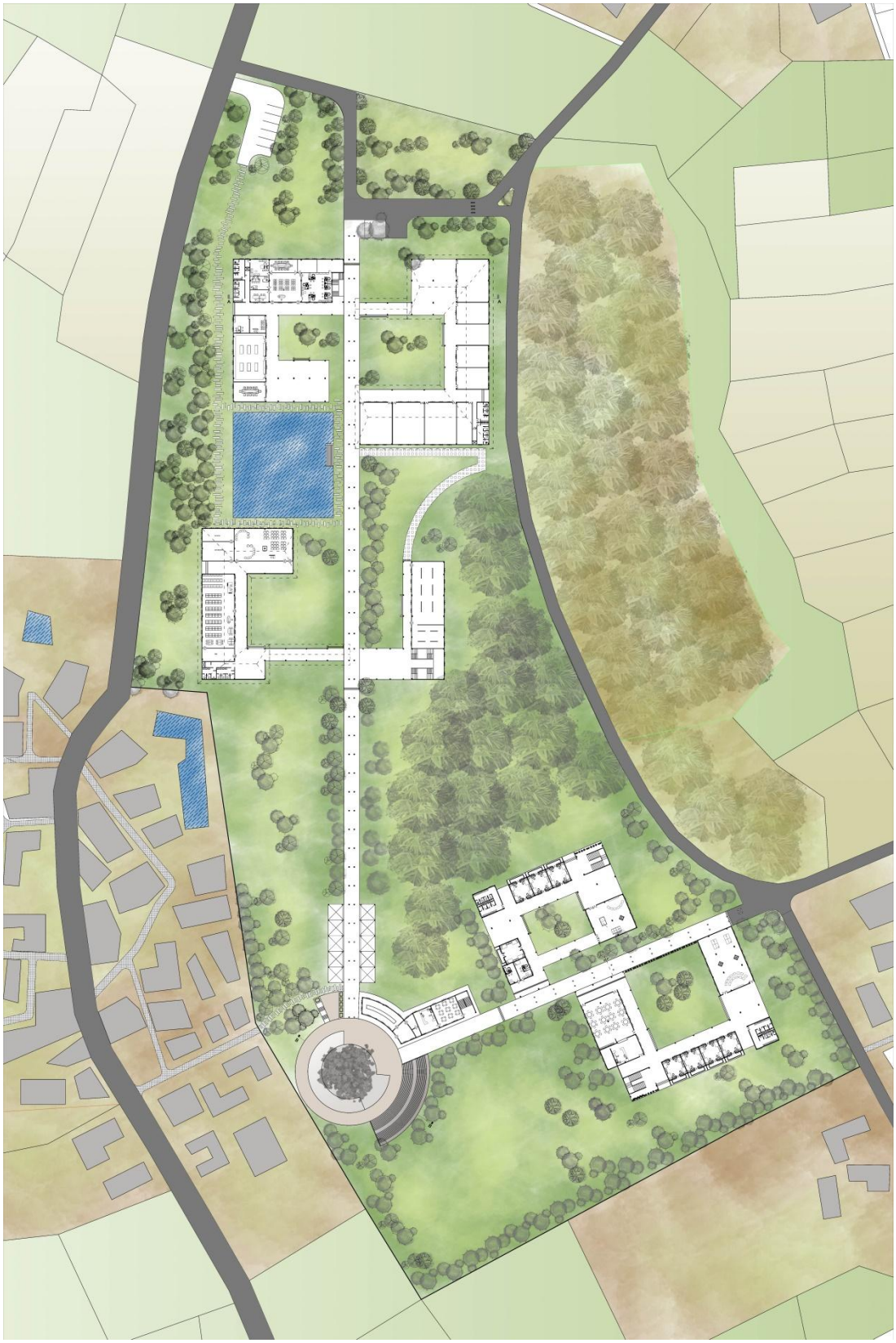


Figure 27: Master Plan

SOURCE: AUTHOR

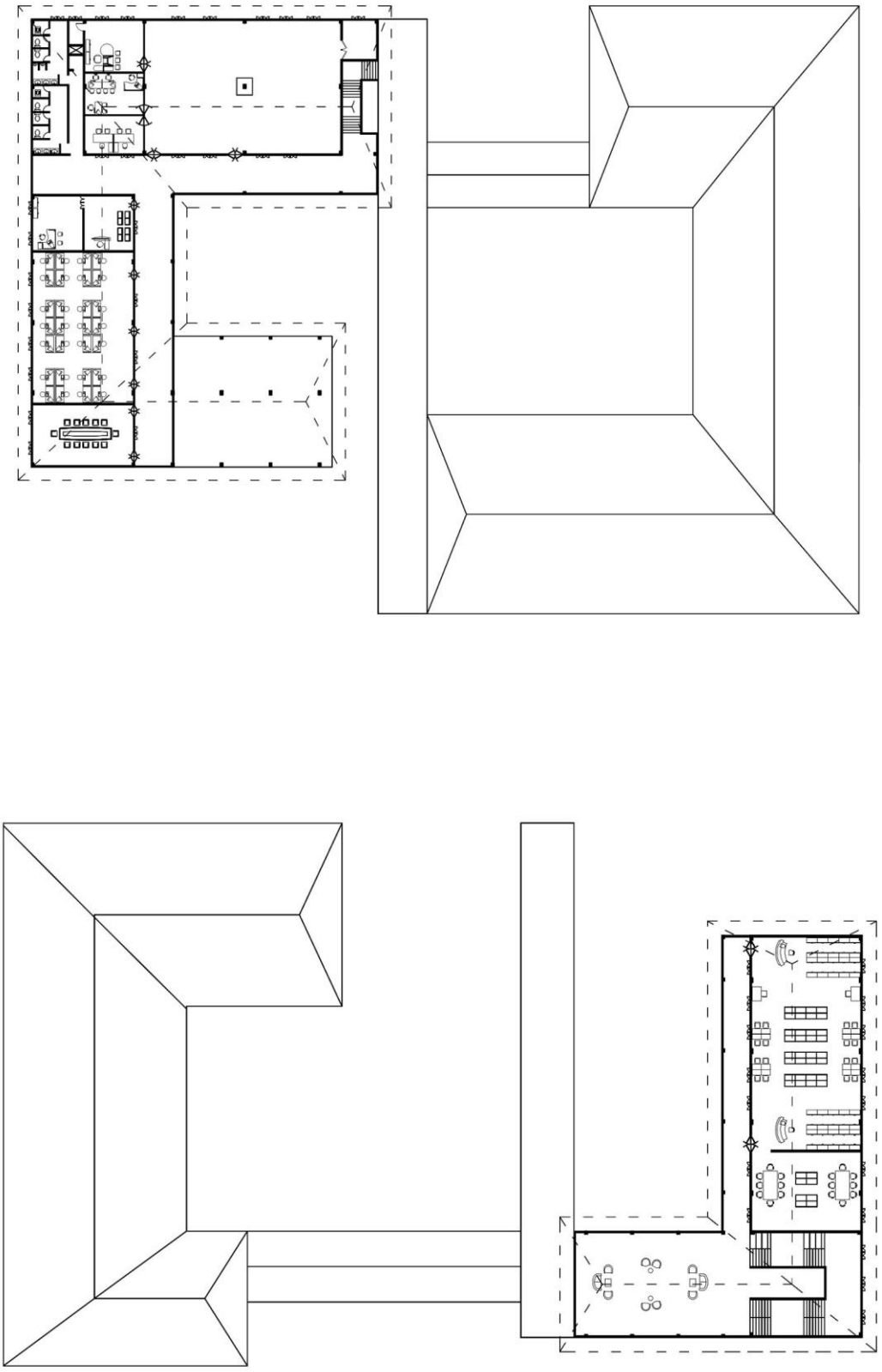


Figure 28: First floor plan (Academic)

SOURCE: AUTHOR

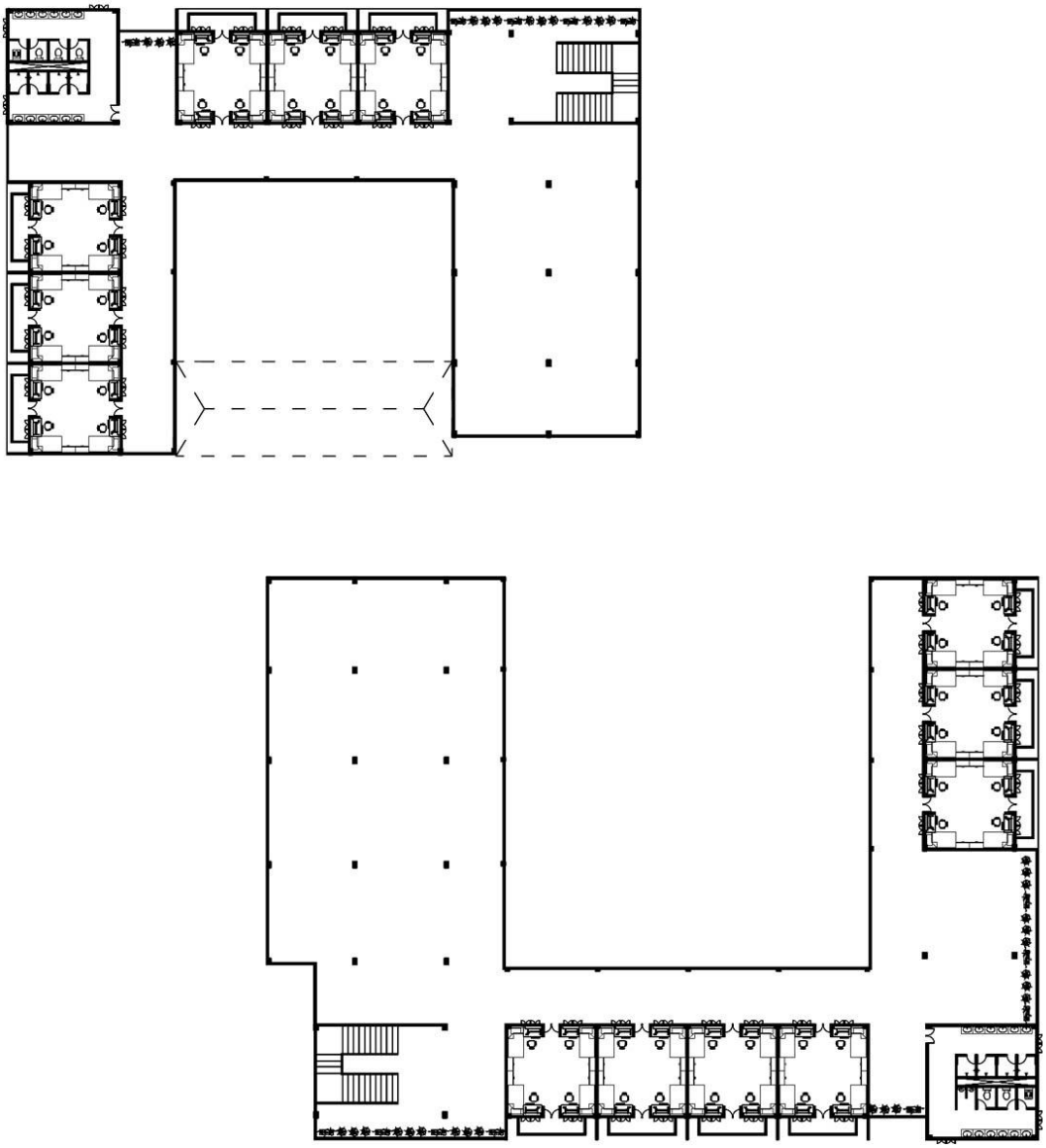


Figure 29: First floor plan (Dorm)

SOURCE: AUTHOR

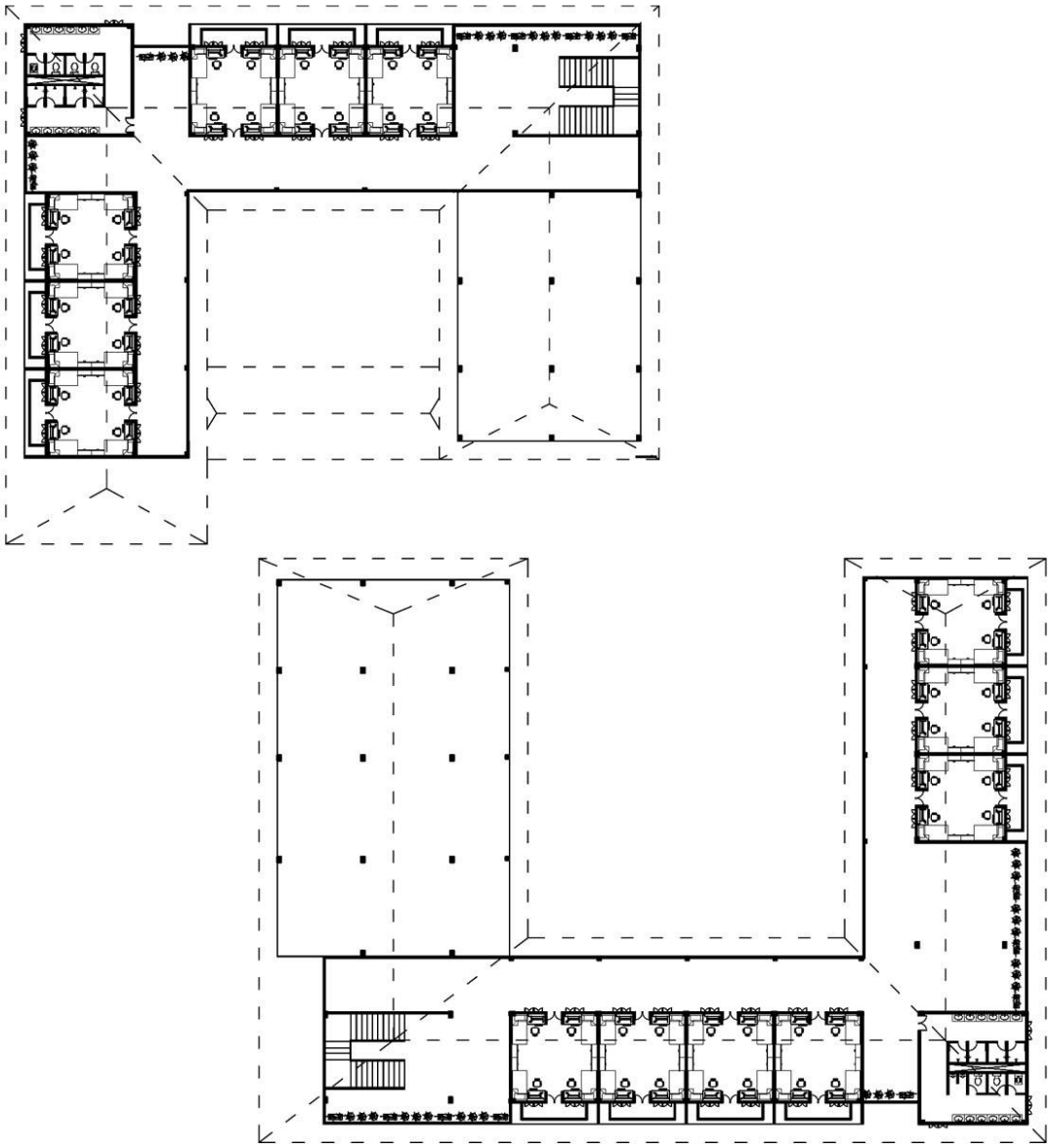


Figure 30: Second floor Plan (Dorm)

SOURCE: AUTHOR

Figure 31: Sections & Elevation

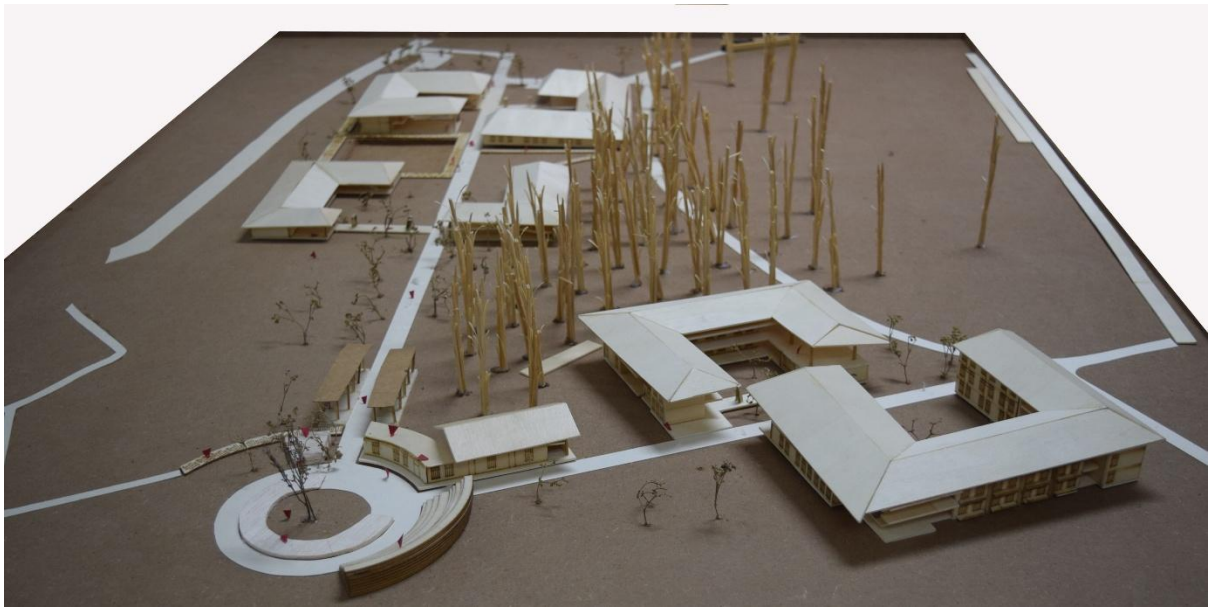
SOURCE: AUTHOR

6.4 3D views

Figure 32: 3D views

SOURCE: AUTHOR

6.5 Model Images



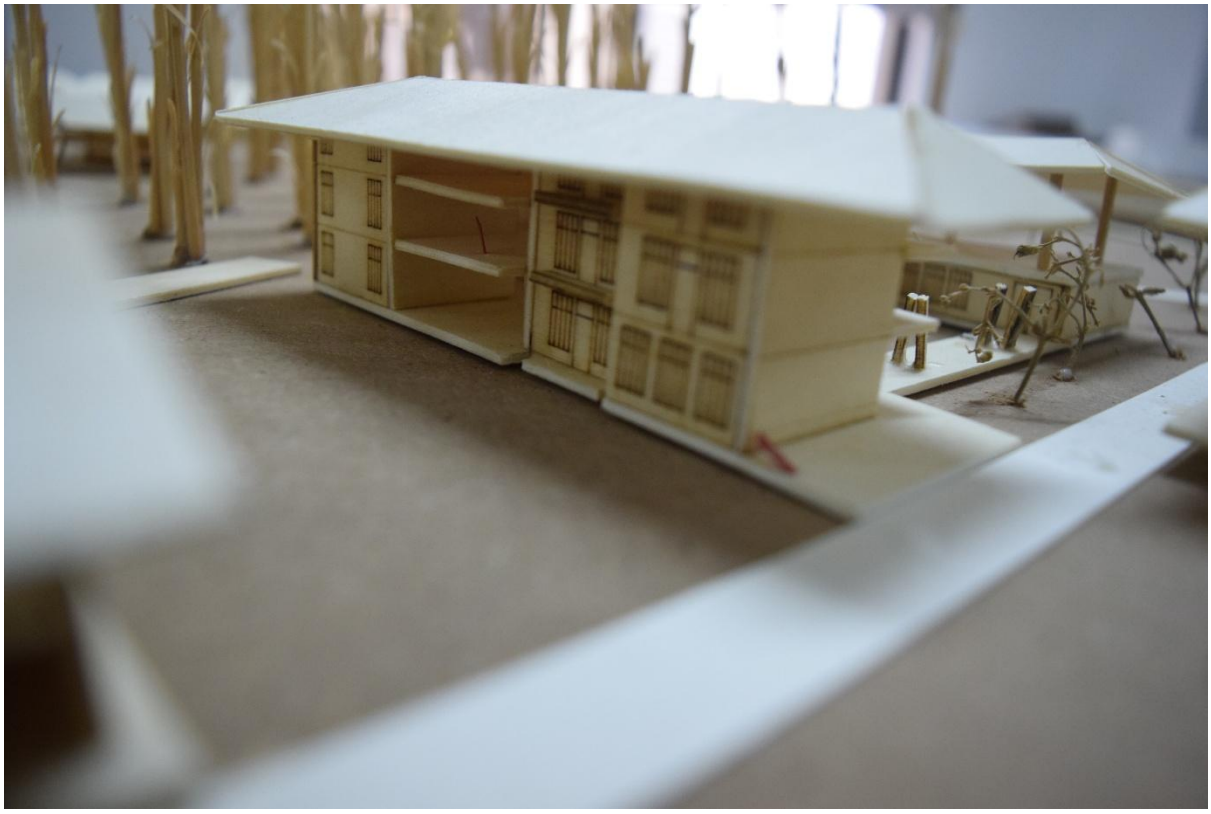


Figure 33: Model images

SOURCE: AUTHOR

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