

PROFESSIONAL TRAINING REPORT

Submitted in partial fulfillment of the requirements for the award of
Master of Architecture degree in Sustainable Architecture

by

S.MANJULA - 39890011



SCHOOL OF BUILDING AND ENVIRONMENT
DEPARTMENT OF ARCHITECTURE

SATHYABAMA
INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
Accredited with Grade "A" by NAAC
JEPPIAARNAGAR, RAJIV GANDHI SALAI, CHENNAI-600119

JUNE 2019

(Annexure I)



SATHYABAMA

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JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHEMMENCHERY, CHENNAI – 600119. TAMILNADU.

PHONE: 2450 1443/9941912481 INTERNET: www.sathyabama.ac.in

E-mail: archhod@sathyabama.ac.in



SCHOOL OF BUILDING AND ENVIRONMENT
DEPARTMENT OF ARCHITECTURE
M. Arch (Sustainable Architecture)

PROFESSIONAL TRAINING PORTFOLIO (S89 INT)
JAN 2021

Name of the Student :S.MANJULA

Semester :III

Reg No. : 39890011

Batch : 2019-2021



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SCHOOL OF BUILDING AND ENVIRONMENT

DEPARTMENT OF ARCHITECTURE

M. Arch (Sustainable Architecture)

BONAFIDE CERTIFICATE

This is to certify that the professional training (S89 INT) is the work of **S.MANJULA- 39890011** who had undergone training in **SACRED GROVES** and has been monitored by the continuous assessment during **Dec 2020 to Jan 2021**.

DR.DEVYANI GANGOPADHYAY

DEAN,

School of Building and

Environment

Department of Architecture

Submitted for Viva voce Examination held on ___30/01/2021___ Sheetal.A.

Internal Examiner

External Examiner



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DECLARATION

I **S.MANJULA - 39890011** hereby declare that the Professional Training Report **DEC 2020 – JAN 2021** done by me under the guidance of **Ar.MANU** is submitted in partial fulfillment of the requirements for the completion of practical training session.

DATE :11/12/2021

PLACE :AUROVILLE

CANDIDATE

SIGNATURE OF

ACKNOWLEDGEMENT

I am pleased to acknowledge my sincere thanks to Board of Management of **SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. I am grateful to them.

I convey my thanks to **Dr. Devyani Gangopadhyay**, Dean and Head of Department, School of building and Environment, Dept. of architecture for providing me necessary support and details at the right time during the progressive training session.

I would like to express my sincere and deep sense of gratitude to **Ar. MANU** for his valuable guidance, suggestions and constant encouragement paved way for the successful completion of my project work. My sincere thanks to **Ar. Sheetal Kalamkar**, Professional Training Coordinator for her motivation.

I wish to express my thanks to all Teaching and Non-teaching staff members of the Department of Architecture who were helpful in many ways for the completion of the project.

I would also like to thank Ar.d (Also thank Architect of the firm)_ **SACRED GROVES** _____ (**Architect's or PM'S name, Firm Name, Address**)

(Family and Others) _____



CONFIRMATION LETTER

Date: 29-01-2021
Place: Auroville.

To,
The Head of the Department,
Faculty of Architecture,
Sathyabama Institute of Science and Technology
Chennai, Tamilnadu

JOINING LETTER

This letter is to certify that Ms. **Manjula S** of 4th Semester **M.Arch – Sustainable Architecture** at **Sathyabama Institute of Science and Technology, Chennai** has joined our office as a trainee, in the forenoon on **11th December 2020** as a part of internship programme under the university Curriculum.

Yours's sincerely,


Amal Ali
Architect



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Consolidated Certificate (Experience)



Date: 29-01-2021
Place: Auroville.

To,
The Head of the Department,
Faculty of Architecture,
Sathyabama Institute of Science and Technology
Chennai, Tamilnadu

TRAINING CERTIFICATE

This letter is to certify that Ms. **Manjula S** of 4th Semester **M.Arch – Sustainable Architecture** at **Sathyabama Institute of Science and Technology, Chennai** has been working in our organization as an **Architectural Intern** for a period of **21 days** from **11-12-2020** to **23-01-2021**.

During her Internship tenure, she has worked on the Sacred Groves Ecological housing project and have been exposed to various earth building techniques.

Her contribution to the project has been good!

We wish her all the best for her future endeavors.

Yours's sincerely,


Amal Ali
Architect


Architecture & Design
At. Manu Gopalan
Principal Architect
CA/2000/26025


Manu Gopalan
Chief Architect
CA/2000/26025

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PROFESSIONAL TRAINING



SACRED GROVES

INTRODUCTION

- Sacred Groves is a community in Auroville, India. Their main objective is to bring down the barriers between the earth and the toxic building processes employed in modern times.
- They believe in an ecologically balanced and sustainable model of construction and have been researching on the endless possibilities in ecological development since their conception.
- Sacred Groves has a unique perspective to look at any problems faced by them during construction, they strive to achieve the perfect balance between the building and its ecological surroundings.
- The work at Sacred groves is majorly powered by volunteers and Architectural interns and some hired labour from the neighbouring villages.
- While creating jobs for the locals, they also help Architects and students of Architecture to understand the materials better and empower them to be able to bring their wonderful ideas to life.

PROJECTS DURING OUR TENURE

- Prototype Houses
- Experimental Structure of Washing Area
- Mud Flooring designs
- Types of Plastering
- Natural Building Materials
- Adobe bricks
- Cob wall
- Lime Chakki
- Bamboo Truss Detail

PROTOTYPE HOUSES

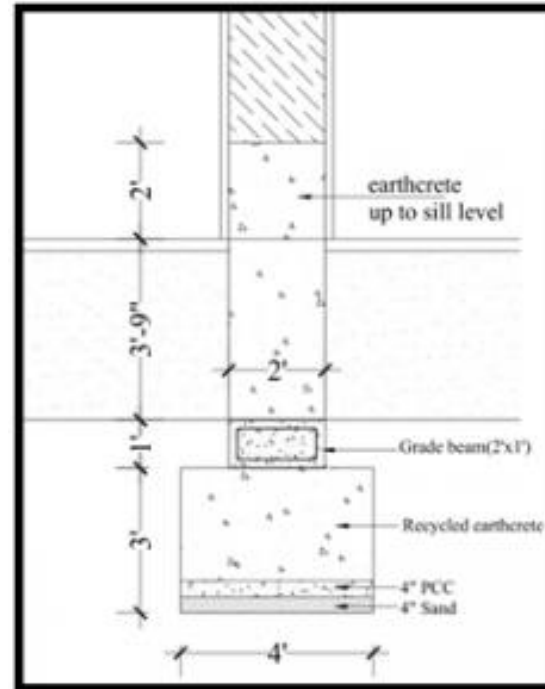


In a comparative study of the prototype scale structure built with contemporary materials to the one built with natural building technology, it shows that natural & up-cycled construction **saved up-to 59.5% of Carbon emissions.**

It consists of three houses G, G+1, G+2.

Every materials which were used in this particular house are recycled.

Walls, Floors are made up of Mud and Lime plaster.

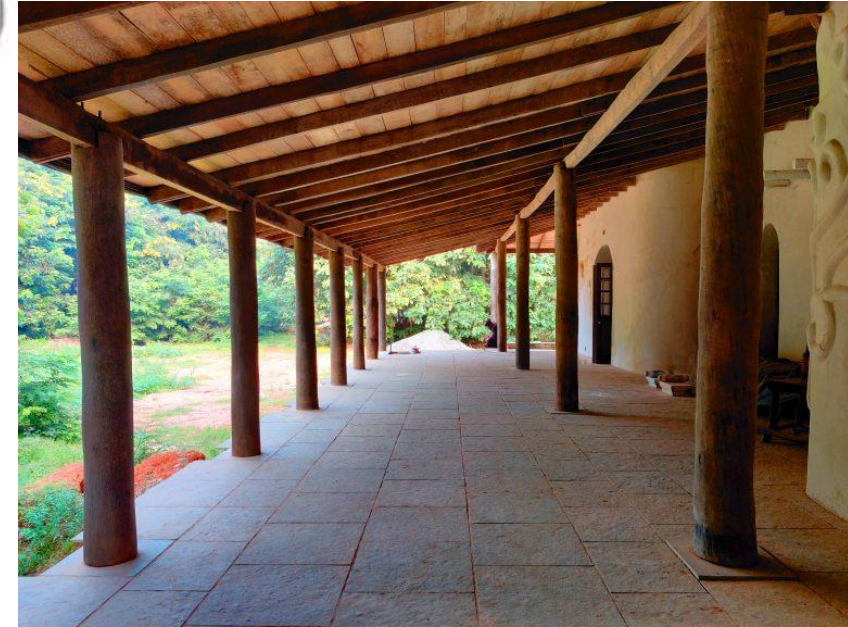
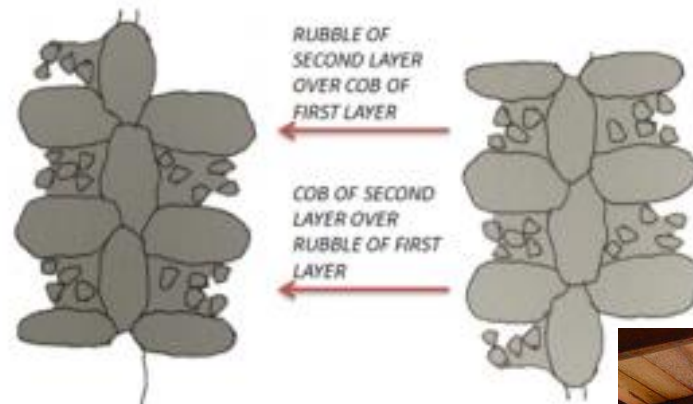


FOUNDATION

- Sand bed was provided before laying the PCC.
- Grade beam was executed.
- Corrugated tetrapack sheets were used as shuttering for the grade beam.
- Once the Earth-crete wall is built above the grade beam, a layer of DPC is placed.
- The DPC layer consists of a bitumen sheet with an inch of PCC above it.



COB WALL



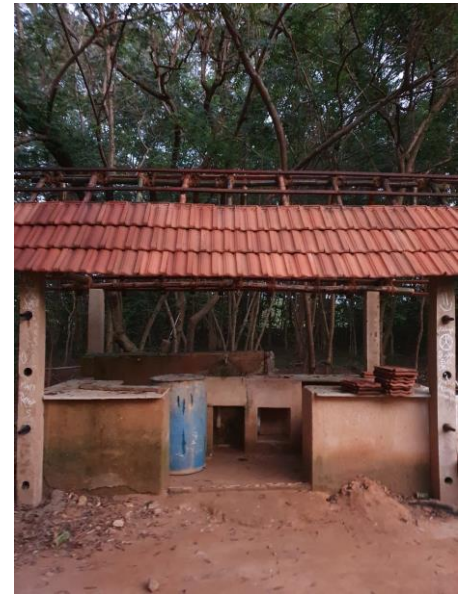
The veranda which acts as a buffer space is common for three houses. The Pillars are made up of Palm tree, The Rafters and reapers are made up of coconut plants and the roof is covered by Mangalore tiles.



With 7 collection tanks adding to 240,000 liters of catchment capacity & 3 supplementing filtration tanks – the houses are one step closer to being self sufficient!

RAIN WATER HARVESTING

EXPERIMENTAL STRUCTURE OF WASHING AREA



MUD FLOORING DESIGNS



TYPES OF PLASTER

ARAISH PLASTER:



Araish is an exclusive technique of producing an extremely smooth, glossy and crack-free surface.

The technique of lime araish has extensively been developed and flourished in Rajasthan and had been used for variety of surface, external and internal wall surfaces, decorative patterns, floor finishes, borders and painted frescos.

The process of preparing the lime mix and its application technique is very unique and different from the lime araish practiced in the other regions of India.

For 500 g of Lime powder,
Lime powder and Marble powder
1:1.

100g of Jaggery and 75 g of
Kadukkai in 1:5 water

This plaster is applied on natural
surface like Lime plastered Sand
stone in the ratio of 15:9 of sand
and lime respectively.

Apply 3mm thickness of Araish in
the surface and level it.



And using Talcum powder brush
the surface and subsequently,
smooth the surface using Pebble
for glossiness and smooth surface.

Also we could add Natural
pigmentation to receive your
desired colors.

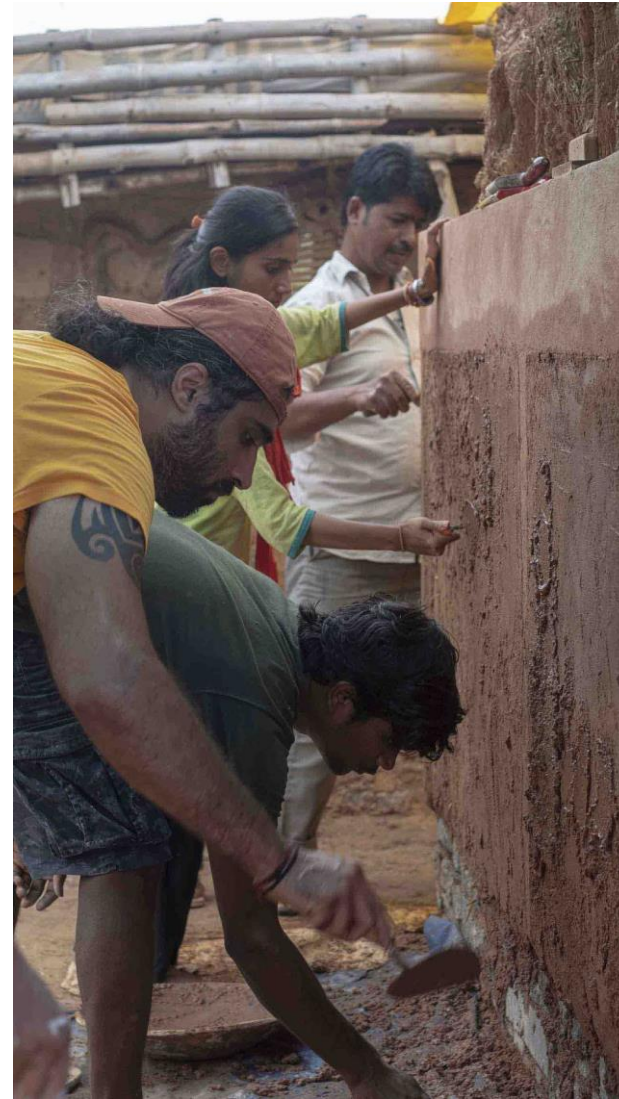


LOHI PLASTER:



The origin of the Lohi plaster is Jaipur.

The process of Lohi plaster is more or less similar to Araish plaster, the difference is instead of Marble powder, Surkhi is used for the mixture.



NATURAL BUILDING MATERIALS



LIME STONE



CACTUS



SURKHI



KADUKKAI



SHELLS



M SAND



COIR



COAL

EARTH CRETE



At Sacred Groves earth-crete is used in building different structural members of the prototype house:

1. Plinth wall: The plinth wall was made with a mix of (Cement:Earth:Aggregates from rubble): 1:9:18 with width of 2ft up to a height of 1.2 m from ground level to prevent water from getting in contact with the cob wall.
2. Toilet slab: Wherever it was possible steel reinforcements were replaced by bamboo to reduce the carbon footprint of the house. The ratio of earth-crete mix in the toilet slab is 1:3:4:: Cement: Soil: Gravel.

3. Ring beam: The ring beam was cast to support the cantilever balconies. The ratio of earth-crete mix in the ring beam is 1:3:4 : :Cement: Soil: Gravel. Wherever it was possible the steel reinforcements were replaced by bamboo.

4. Cantilevered balconies: The cantilever was cast to support the cantilever balconies. The ratio of earth-crete mix in the ring beam is 1:3:4: :Cement: Soil: Gravel. Wherever it was possible the steel re-inforcements were replaced by bamboo.





5. The compost pit chute: The width of the compost pit wall is 4". Marine ply wood shuttering was used with PVC as spacers. The ratio of earth-crete mix in the ring beam is 1:9:18: :Cement: Soil: Gravel.

6. As partition walls: The width of the partition wall is 4". Marine ply wood shuttering was used with PVC as spacers. The ratio of earth-crete mix in the ring beam is 1:9:18: :Cement: Soil: Gravel.

7. Rain water collection tanks: The width of tank wall is 2'. Waste petroleum pipes were used as shuttering. The ratio of earth-crete mix in the ring beam is 1:9:18: : Cement: Soil: Gravel



COB WALL

Cob has been used in building shelters from ancient times. It is one of the earliest and most sustainable building technique discovered.

Advent of cob at Sacred Groves happened when we couldn't afford skilled masons and materials for earth-crete any more because of shortage of funds.

Cob was chosen over other materials because it did not require high skilled labor and any volunteer who joined the project could learn to do it with a very minimal training



1. Dry mix the subsoil: Lay the tarp. Put sub soil and sand (optional) in their respective proportions. Flip the tarp as many times as required to make a homogenous mix. Sand is added only when the soil has more clay than the required amount.

2. Add some water: Make the dry mix into a heap and create a crater in the middle.

It might be easier to mix, but it will not hold up as well when you start building and will slump sometimes.

A wet mix of cob can also crack more as it dries. However, if you do add too much water you can either leave the batch to dry out in the sun, add more straw to soak up some excess water.



3. Mix with your feet: Push the outside of the dry material towards the center of the crater with your feet. Once the crater is covered with dry mix you can start stomping.

Once it starts taking shape somewhat like a burrito the cob is almost done and it is ready to be mixed with straw.

4. Add the straw mix and complete: Flatten the mix. Take a handful of straw and spread it.

Stomp the mix again until all the straw gets covered. Keep repeating the process until all of the straw is thoroughly distributed and mixed into the cob.



COB WALL

- Cob spine holds the cob ribs with itself that's why merging of 2 bricks is necessary .We put construction rubble that is soaked in water in between every 2 ribs and alternatively in each layer.
- After putting cob ribs and spine we walk on them with spiked wooden shoes to merge all the bricks in a way that they are not individual bricks anymore but a single layer instead and then in the gap between every two ribs we put rubble.
- We can also wear wooden thimbles to do the job. The binding of straws happens majorly along the spine. At the ribs the cob and rubble alternate and the cob of the top layer merges with the rubble in the lower layer.
- We merge the layers so that there are no joints anywhere and the wall is one homogeneous monolithic structure. We have no joints in the corner of the wall also but instead we have curves connecting different planes of walls.
- □ We don't need straight forms or rectilinear molds, cob lends itself to organic shapes: curved walls, arches and vaults. Building with cob is a sensory and aesthetic



COB TEST

- Crunch test:

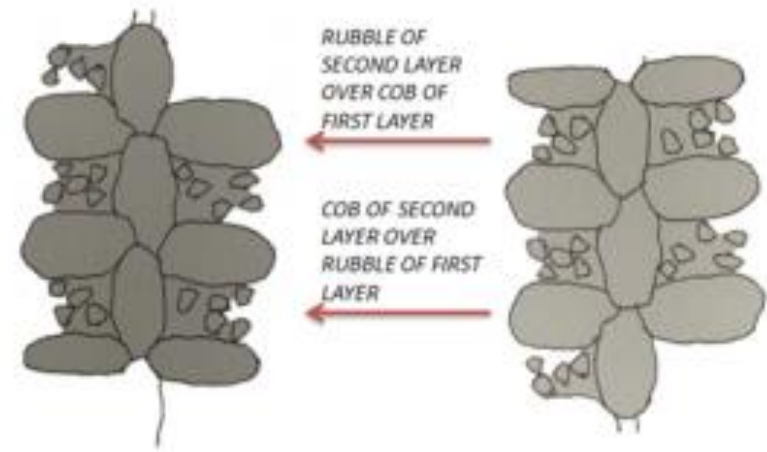
This is done by making a ball of sub soil (moistened with water but before adding straw) and pressing it in the palm and judging the amount of sand (optional) and soil by the appearance of cracks. If there is excess of cracking it means that the sample has more sand.

- Drop ball test:

It is done by rolling a ball of moistened sub soil (before adding straw) in hand and dropping it from an elevation of one meter. The lower portion of the ball will go flat on the surface but it should not lose the spherical shape of the upper half. If there are cracks in the edge of the lower flattened side it means that the soil has more sand (optional). If the upper dome shape deforms then it means that the soil has more clay.

- Cigar test:

Cigar test is done to check for the tensile strength of cob. It is done after cob mix is prepared. The cob mix with fiber is shaped in the form of a cigar. It should be held at the two ends with fists and should be pulled apart. If it can't be pulled apart into two pieces it means that the cob mix is made well.



ADOBE WALL

Procuring soil:

The sub soil 2ft underneath the ground was dug out at our own site. Any soil good for construction should have 15 – 25% of clay, 5 – 30% of silt and around 60% of sand and should be devoid of any organic matter.

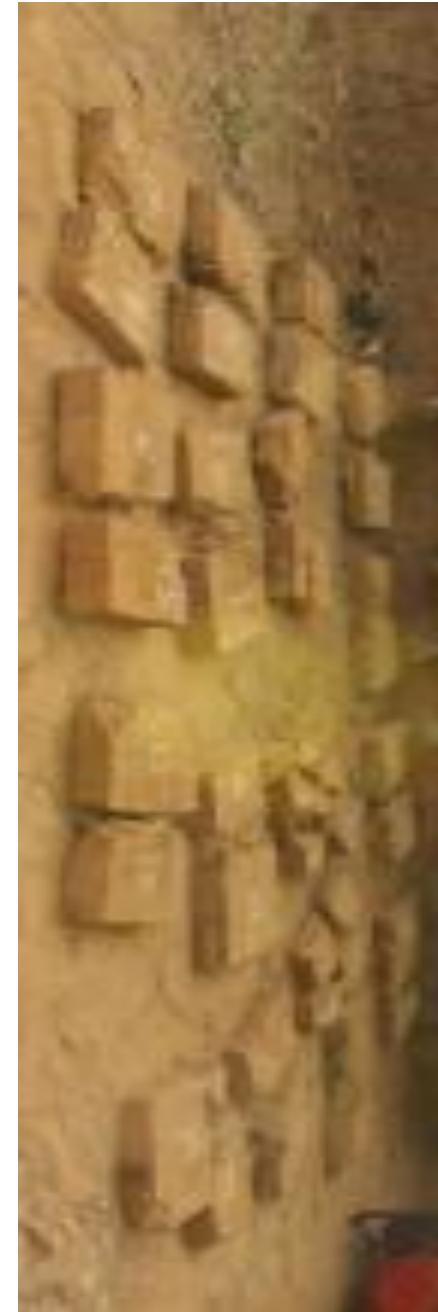
The required specifications:

The remaining portion of the building required a 30cm thick masonry wall at the second floor level. So bricks of size 45X30 were chosen to make a single brick thick masonry wall.

The materials, proportions and sizes:

Different mixes were prepared with permutations and combinations of earth with fiber materials viz. long rice straw, chopped rice straw, rice husk and two combinations of rice husk and chopped rice straw (one with the ratio of rice husk and chopped rice straw being 1:2 and the other being 2:1) in the ratio of 6: 1 respectively.

The mix was then filled in molds of 3 different thicknesses that are 5cm, 6cm and 7cm and was dried under the sun.



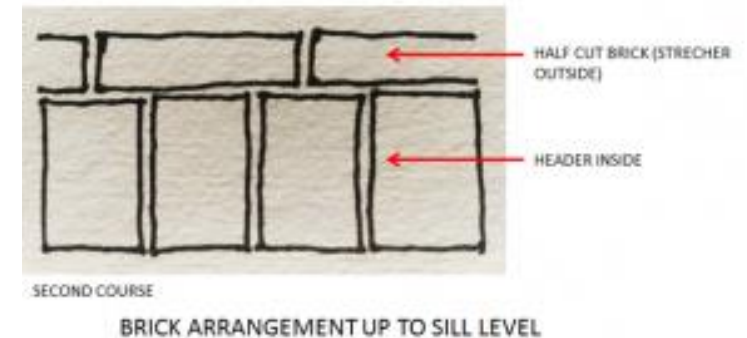
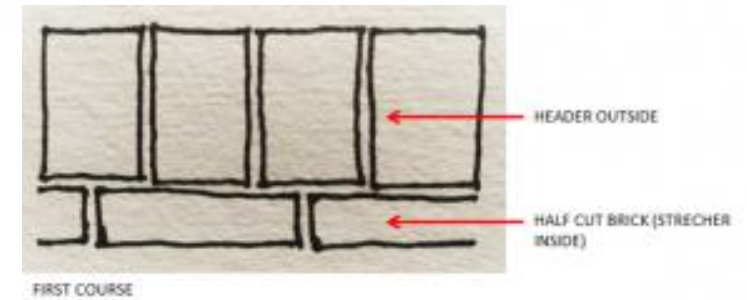
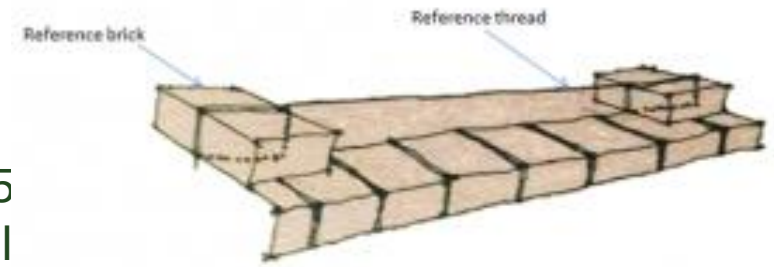
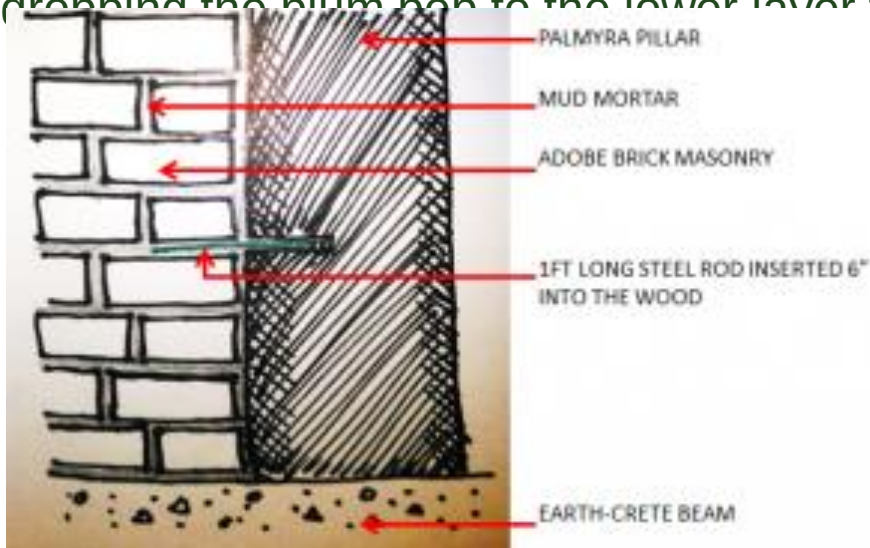
LAYING THE BRICKS

The earth crete beam is 45 cm thick and we had to build a 45 cm thick wall up to the Sill level and then a 30cm wall up until the roof.

We started with tying a reference thread for the first brick course. At the two ends of every adobe wall portions a reference brick was laid.

To get the alignment of the rest of the bricks straight we tied a thread from one reference brick to another. The rest of the bricks were laid following the alignment of reference thread.

After the first brick course is done the alignment was done by dropping the plum bob to the lower level for reference.



As leveling each and every course is not necessary and doing so also slows down the pace of construction the horizontal level was checked only at the top three courses using a spirit level.

Note:

- The thickness of mortar should be at least 1".
- The total error in vertical alignment should not exceed

LIME CHAKKI



Lime Chakki is an ancient method of producing lime plaster. The ring is 5m dia in which the stone moves in a circular path pulled by the bullocks. There are two types of lime. One is hydraulic lime(impure), used for mortar purpose and also exterior plastering and non – hydraulic lime (pure) which is used for smooth finishing.



Ingredients Used

- Lime
- Quarry Dust
- Kadukkai & Jaggery Water (Fermented)

Proportion for Kadukkai-Jaggery Mix

For every 700 litres of water 20kg of jaggery and 18kg of kadukkai powder. It should be stirred well and kept for fermentation for about 2 weeks.



LIME CHAKKI PROCESS

Two mixtures are prepared. First mix of **Lime & quarry dust** in the ratio 9:15, second **kadukkai & jaggery** in the ratio 18:20 which is allowed to ferment for 4 weeks. 3 to 4 batches of lime & quarry dust mix is poured into the CHAKKI. Then the fermented kadukkai & jaggery water is poured over it for perfect grinding.



The stone which is attached to the wooden log from the center is pulled by the tractor with a rope tied to its back. The tractor has to drive along the pit. Five to six people will stir the mix continuously with shovels and the rest of them enjoy the tractor ride on sitting on top of the tractor and vice versa.

BAMBOO TRUSS DETAIL

