

# PROFESSIONAL TRAINING REPORT

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

By

**YAZHINI .S (39890020)**



SCHOOL OF BUILDING AND ENVIRONMENT  
DEPARTMENT OF ARCHITECTURE

**SATHYABAMA**  
INSTITUTE OF SCIENCE AND TECHNOLOGY  
(DEEMED TO BE UNIVERSITY)  
Accredited with Grade "A" by NAAC  
JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

DEC 2020



# SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY  
(DEEMED TO BE UNIVERSITY)

(Est U/s(3) of UGC Act,1956) Accredited with Grade "A" by NAAC (A Christian Minority Institution)

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

**PHONE: 2450 1443/9941912481 INTERNET: [www.sathyabama.ac.in](http://www.sathyabama.ac.in)**

**E-mail: [archhod@sathyabama.ac.in](mailto:archhod@sathyabama.ac.in)**



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

**PROFESSIONAL TRAINING PORTFOLIO (S89 INT)**

**DEC 2020**

Name of the Student : S. YAZHINI

Semester : III

Reg No. : 39890020

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.YAZHINI (39890020)** who had undergone training in **SACRED GROOVES, AUROVILLE** 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

**Internal Examiner**

**External Examiner**



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**E-mail: [archhod@sathyabama.ac.in](mailto:archhod@sathyabama.ac.in)**



## DECLARATION

I **S.YAZHINI** hereby declare that the Professional Training Report **from 11-12-2020 to 22-12-2020** done by me under the guidance of **Ar. MANU GOPALAN** is submitted in partial fulfillment of the requirements for the completion of practical training session.

DATE : 28-01-2021

PLACE : CHENNAI

SIGNATURE OF CANDIDATE

## 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 Gopalan Chief Architect of Sacred Grooves, Auroville** 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.



Date: 11-12-2020  
Place: Auroville.

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

#### CONFIRMATION LETTER

This letter is to certify that Ms. **Yazhini S** of 4<sup>th</sup> Semester M.Arch -Sustainable Architecture at **Sathyabama Institute of Science and Technology, Chennai** has been confirmed as an **Architectural Intern** in our Organization based on her academic and professional achievements for 1 month practical training starting from **11<sup>th</sup> December 2020** onwards.

Yours's sincerely,

  
**Amal Ali**  
Architect

  
**Manu Gopalan**  
Chief Architect  
CA/2000/26025

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AUROVILLE- 605101

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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. **Yazhini S** of 4<sup>th</sup> Semester **M.Arch – Sustainable Architecture** at **Sathyabama Institute of Science and Technology, Chennai** has joined our office as a trainee, in the forenoon on **11<sup>th</sup> December 2020** as a part of internship programme under the university Curriculum.

Yours's sincerely,

  
**Amal Ali**  
Architect

*Come build with us!*

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Phone: 044 - 2450 3150 / 3151 / 3152 / 3154 / 3155 Fax: 044 - 2450 2344  
www.sathyabama.ac.in

### DEPARTMENT OF ARCHITECTURE

#### M. Arch (Building management)

#### Continuous Assessment Report for Professional training

(Continuous progress report of the trainee architect/Project Manager for the period of 30 working days in the office to be submitted to HOD by the Trainee attending the training session)

1. Name of the office / organization : SACRED GROVES - Ecological housing project
2. Address & Contact Number : Near center guest house, Auroville - 605101  
ph : 04132623696
3. Name of the student : S.YAZHINI
4. Duration : From 11-12-2020 To 18-12-2020
5. Total No. of days : 6
6. Evaluation of Performance criteria shall be on

\* Note: Kindly grade the student as per his/her overall performance in the office during the assessment month; which will be converted to the allotted marks by the department.

| Description of works                               | Excellent | Good | Fair | Poor | NA |
|----------------------------------------------------|-----------|------|------|------|----|
| Understanding of office culture and methodology    | ✓         |      |      |      |    |
| Active Participation in the Project activities     | ✓         |      |      |      |    |
| Documentation and tracking of project              | ✓         |      |      |      |    |
| Presentation Skills developed                      | ✓         |      |      |      |    |
| Understanding of construction details & techniques |           | ✓    |      |      |    |
| Participation and contribution in project meetings | ✓         |      |      |      |    |
| Understanding of codes and standards               | ✓         |      |      |      |    |
| Schedule preparation & tracking activities         |           | ✓    |      |      |    |
| Preparation / Management of drawings               |           | ✓    |      |      |    |
| Learning / Application of software in Projects     | ✓         |      |      |      |    |
| Preparation of concept for projects                | ✓         |      |      |      |    |
| Site Management / Discussion with clients          | ✓         |      |      |      |    |
| Overall Grading*                                   | A         |      |      |      |    |

(A - 8.0, B - 7.0, C - 6.0, D - 5.5, E - 5.0, F - <5)

Good work

7. Any other Remarks : \_\_\_\_\_

8. Signature of the  
Head of the Office /  
Organization (With Seal)

*Amal*  
SACRED GROVES



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2. Address & Contact Number : Near center guest house, Auroville - 605101  
ph : 04132623696
3. Name of the student : S.YAZHINI
4. Duration : From 21-12-2020 To 02-01-2021
5. Total No. of days : 10
6. Evaluation of Performance criteria shall be on

\* Note: Kindly grade the student as per his/her overall performance in the office during the assessment month; which will be converted to the allotted marks by the department.

| Description of works                               | Excellent | Good | Fair | Poor | NA |
|----------------------------------------------------|-----------|------|------|------|----|
| Understanding of office culture and methodology    | ✓         |      |      |      |    |
| Active Participation in the Project activities     | ✓         |      |      |      |    |
| Documentation and tracking of project              | ✓         |      |      |      |    |
| Presentation Skills developed                      | ✓         |      |      |      |    |
| Understanding of construction details & techniques |           | ✓    |      |      |    |
| Participation and contribution in project meetings | ✓         |      |      |      |    |
| Understanding of codes and standards               | ✓         |      |      |      |    |
| Schedule preparation & tracking activities         |           | ✓    |      |      |    |
| Preparation / Management of drawings               |           | ✓    |      |      |    |
| Learning / Application of software in Projects     | ✓         |      |      |      |    |
| Preparation of concept for projects                | ✓         |      |      |      |    |
| Site Management / Discussion with clients          | ✓         |      |      |      |    |
| Overall Grading*                                   | A         |      |      |      |    |

(A - 8.0, B - 7.0, C - 6.0, D - 5.5, E - 5.0, F - <5)

Good work

7. Any other Remarks : \_\_\_\_\_

8. Signature of the  
Head of the Office /  
Organization (With Seal)

*Amal*  
SACRED GROVES



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1. Name of the office / organization : SACRED GROVES - Ecological housing project

2. Address & Contact Number : Near center guest house, Auroville - 605101  
ph : 04132623696

3. Name of the student : S. YAZHINI

4. Duration : From 04-01-2021 To 13-01-2021

5. Total No. of days : 9

6. Evaluation of Performance criteria shall be on

\* Note: Kindly grade the student as per his/her overall performance in the office during the assessment month; which will be converted to the allotted marks by the department.

| Description of works                               | Excellent | Good | Fair | Poor | NA |
|----------------------------------------------------|-----------|------|------|------|----|
| Understanding of office culture and methodology    | ✓         |      |      |      |    |
| Active Participation in the Project activities     | ✓         |      |      |      |    |
| Documentation and tracking of project              | ✓         |      |      |      |    |
| Presentation Skills developed                      | ✓         |      |      |      |    |
| Understanding of construction details & techniques | ✓         |      |      |      |    |
| Participation and contribution in project meetings | ✓         |      |      |      |    |
| Understanding of codes and standards               | ✓         |      |      |      |    |
| Schedule preparation & tracking activities         |           | ✓    |      |      |    |
| Preparation / Management of drawings               |           | ✓    |      |      |    |
| Learning / Application of software in Projects     | ✓         |      |      |      |    |
| Preparation of concept for projects                | ✓         |      |      |      |    |
| Site Management / Discussion with clients          | ✓         |      |      |      |    |
| Overall Grading*                                   | A         |      |      |      |    |

(A - 8.0, B - 7.0, C - 6.0, D - 5.5, E - 5.0, F - <5)

7. Any other Remarks : Good work

8. Signature of the  
Head of the Office /  
Organization (With Seal)

*Amal*  
SACRED GROVES



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1. Name of the office / organization : SACRED GROVES - Ecological housing project

2. Address & Contact Number : Near center guest house, Auroville - 605101  
ph : 04132623696

3. Name of the student : S. YAZHINI

4. Duration : From 18-01-2021 To 22-01-2021

5. Total No. of days : 5

6. Evaluation of Performance criteria shall be on

\* Note: Kindly grade the student as per his/her overall performance in the office during the assessment month; which will be converted to the allotted marks by the department.

| Description of works                               | Excellent | Good | Fair | Poor | NA |
|----------------------------------------------------|-----------|------|------|------|----|
| Understanding of office culture and methodology    | ✓         |      |      |      |    |
| Active Participation in the Project activities     | ✓         |      |      |      |    |
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| Preparation / Management of drawings               |           | ✓    |      |      |    |
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| Preparation of concept for projects                | ✓         |      |      |      |    |
| Site Management / Discussion with clients          | ✓         |      |      |      |    |
| Overall Grading*                                   | A         |      |      |      |    |

(A - 8.0, B - 7.0, C - 6.0, D - 5.5, E - 5.0, F - <5)

7. Any other Remarks : Good work

8. Signature of the  
Head of the Office /  
Organization (With Seal)

*Amal*  
SACRED GROVES



## WORK DIARY

| DATE       | PROJECT NAME           | WORK DONE                                                        | DATE       | PROJECT NAME           | WORK DONE                                                     |
|------------|------------------------|------------------------------------------------------------------|------------|------------------------|---------------------------------------------------------------|
| 11-12-2020 |                        | Sacred Grooves Site Tour and Orientation                         | 04-01-2021 | Prototype House        | Flooring Design                                               |
| 14-12-2020 |                        | Earth Crete Column Casting Workshop                              | 05-01-2021 | Bubble Area Renovation | Bamboo roof design execution.                                 |
| 15-12-2020 |                        | Earth Crete Column Casting Workshop                              | 06-01-2021 |                        | Oxide Flooring, Wax Flooring Workshop                         |
| 16-12-2020 | Bubble Area Renovation | Beam Casting and Framework                                       | 07-01-2021 |                        | Sacred Grooves Site Tour to Tahir House                       |
| 17-12-2020 | Bubble Area Renovation | Beam Casting and Framework                                       | 08-01-2021 |                        | Introduction to Araish Plaster a Workshop                     |
| 18-12-2020 | Bubble Area Renovation | Beam Casting and Framework                                       | 09-01-2021 |                        | Introduction to Araish Plaster a Workshop                     |
| 21-12-2020 | Bubble Area Renovation | Existing Structure Dismantle                                     | 11-01-2021 |                        | Introduction to Araish Plaster a Workshop, Case Study on PTDC |
| 22-12-2020 | Bubble Area Renovation | Site Measurements and Design Execution                           | 12-01-2021 | Bubble Area Renovation | Tile Cleaning, Roofing Structural Details                     |
| 23-12-2020 | Bubble Area Renovation | Site Measurements and Design Execution                           | 13-01-2021 | Bubble Area Renovation | Tile Cleaning, Roofing Purlins and Rafters                    |
| 24-12-2020 |                        | Adobe Bricks and Foundation Digging                              | 16-01-2021 | Bubble Area Renovation | Tile Cleaning, Roofing Weathering Treatment                   |
| 26-12-2020 |                        | Column Foundation, Adobe Bricks, Case Study of Town hall         | 17-01-2021 | Bubble Area Renovation | Tile Placement                                                |
| 28-12-2020 | Bubble Area Renovation | Roofing Design, Existing Structure Dismantle                     | 18-01-2021 | Bubble Area Renovation | Tile Placement                                                |
| 29-12-2020 | Bubble Area Renovation | Bamboo Harvesting                                                | 19-01-2021 | Prototype House        | Flooring Design Execution                                     |
| 30-12-2020 | Bubble Area Renovation | Bamboo Harvesting                                                | 20-01-2021 | Prototype House        | Flooring Design Execution                                     |
| 31-12-2020 | Bubble Area Renovation | Bamboo roof design execution, Case Study Joseba House site visit | 21-01-2021 |                        | Lime Chakki Workshop                                          |
| 02-01-2021 | Prototype House        | Flooring Design                                                  | 22-01-2021 |                        | Lime Chakki Workshop                                          |

Chief Architect Signature:

Office seal:



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. **Yazhini S** of 4<sup>th</sup> 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 **30 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



  
**Manu Gopalan**  
Chief Architect  
CA/2000/26025

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# INTERNSHIP PORTFOLIO

YAZHINI SELVAMANI

39890020

# Sacred Groves

There is an acute shortage of affordable housing in Auroville which deters many good people from joining the community. The SacredGroves project was conceived to alleviate this problem with the construction of 108 new homes; for newcomers, Aurovilians and long-term volunteers, in a manner consistent with The Mother's vision for Auroville.

SacredGroves is basically concerned about the innovative usage of ecological materials in construction. The project is designed to be a model of ecological community living using ecologically sensitive construction methods.

## ECOLOGICAL CONSTRUCTION

The SacredGroves project offers an alternative model of construction by using some the following elements:

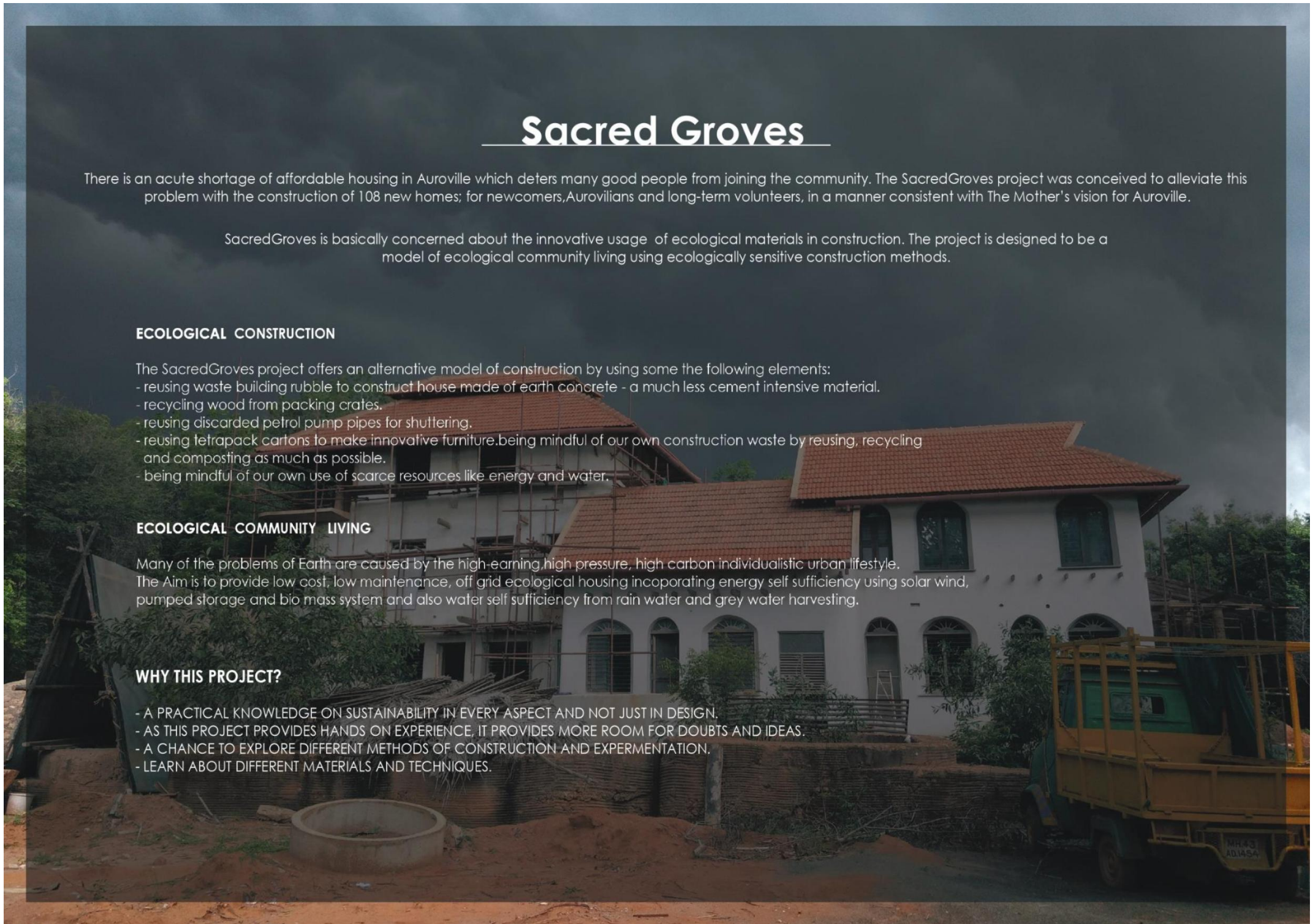
- reusing waste building rubble to construct house made of earth concrete - a much less cement intensive material.
- recycling wood from packing crates.
- reusing discarded petrol pump pipes for shuttering.
- reusing tetrapack cartons to make innovative furniture. being mindful of our own construction waste by reusing, recycling and composting as much as possible.
- being mindful of our own use of scarce resources like energy and water.

## ECOLOGICAL COMMUNITY LIVING

Many of the problems of Earth are caused by the high-earning, high pressure, high carbon individualistic urban lifestyle. The Aim is to provide low cost, low maintenance, off grid ecological housing incorporating energy self sufficiency using solar wind, pumped storage and bio mass system and also water self sufficiency from rain water and grey water harvesting.

## WHY THIS PROJECT?

- A PRACTICAL KNOWLEDGE ON SUSTAINABILITY IN EVERY ASPECT AND NOT JUST IN DESIGN.
- AS THIS PROJECT PROVIDES HANDS ON EXPERIENCE, IT PROVIDES MORE ROOM FOR DOUBTS AND IDEAS.
- A CHANCE TO EXPLORE DIFFERENT METHODS OF CONSTRUCTION AND EXPERIMENTATION.
- LEARN ABOUT DIFFERENT MATERIALS AND TECHNIQUES.



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# CONTENT



## EarthHauz Architecture & Design

EarthHauz Architecture & Design was established by Manu Gopalan in 2004. It is located at the International House (ex USA Pavilion) in Auroville. Its current focus is to develop Affordable Intermediate Technology in construction using 100% natural & recycled materials, participatory design and self-help construction. EarthHauz has been committed to the conception and construction of built environment that is ecological, site-specific, climatically responsive and respectful of traditions.

### Ar. Manu Gopalan

Manu believes in "learning by doing" method that he uses for his teaching and work. His view of the role of architects is different from the traditional western one, and is well grounded in holistic life. His aim is to make use of existing resources, improve them, add the "modern knowledge", and mainly to reduce adverse impact on the environment, not only in the locale of the buildings, but in India at large.

He wants to promote the Alternative Building Materials that can be used in the construction apart from the conventional materials. So, any harmful materials are either replaced by others, or are used in minimal expedience only (eg. cement, steel, glass, petrol derivatives, etc).

A pillar of his method is the issue of affordability, and the larger goal of alleviating housing shortage in India (and worldwide), and in Tamil Nadu (and the vicinity of Auroville, in particular). If possible, Manu Gopalan will seek waste materials to be used, in the same ways that local inhabitants of low means are doing, when they build an abode from scratch. One of his examples is coming from the urban slums of Mumbai, where entire streets are waste made huts, that residents scrap from the landfills.

He started with International House in Auroville. He is currently working on the Sacred Groves Project and Sustainable Livelihood Institute in Auroville itself.



# What is lime:

Lime is obtained from Limestone, a naturally occurring mineral which consists principally of calcium carbonate.

The lime can either be non-hydraulic lime or hydraulic lime.

Both are used in construction though Hydraulic lime is more expensive and more pure.

## HYDRAULIC LIME :

This is used for lime mortar, as it has more impurities. This is cheaper and ideal for exterior lime plastering. It costs around Rs.0.3/Kg

## NON - HYDRAULIC LIME :

It is used in making motifs and in interior plastering. This lime is obtained from seashells and gives a very smooth finish. It costs around Rs.30/Kg

Introduction

# Why lime

Lime has been used for thousands of years as a fabulous binder in mortars, plasters and paints.

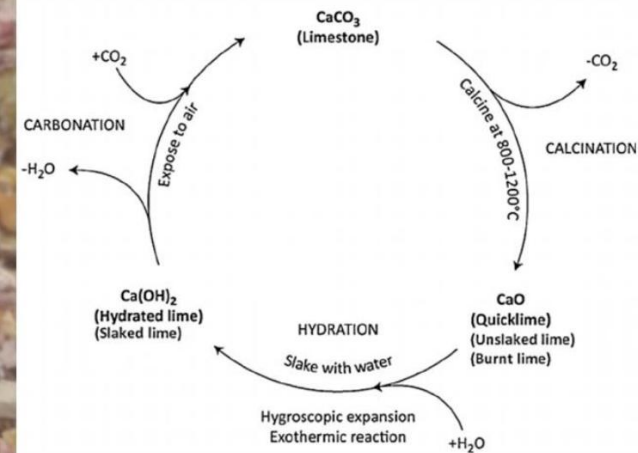
Lime is a breathable material, meaning it allows airborne moisture to travel freely through i.e., it does not trap moisture inside a wall system.

Mortar - Lime : Quarry dust - 1:3

Plastering - Lime : Quarry dust - 1:1.6



## Lime Cycle



- If limestone is heated strongly, it breaks down to form calcium oxide and carbon dioxide.
- Calcium oxide reacts with water to form calcium hydroxide, also called slaked lime
- Powdered lime then absorbs  $\text{CO}_2$  from the atmosphere and converts back to limestone or calcium carbonate.
- Thus lime absorbs back the  $\text{CO}_2$  it released during production.



Kankar is extensively used for producing hydraulic lime, while shell lime is mostly used in plasters and washes



Lime

## Lime mortar:

At Sacred Groves, usage of lime has been the back-bone of our initiative towards eco-housing. Lime mortar production is done on-site, an alternative to Cement mortar.

Lime chakki is an ancient method of producing lime plaster in-situ.

It is a circular ring about 5m in diameter.

The chakki stone moves around the circle, pulled by two bullocks, grinding the lime and quarry dust mix in the process.

Lime plaster is a type of plaster composed of sand, water, and lime, usually non-hydraulic lime (slaked lime, high calcium lime or air lime).

Ancient lime plaster often contained horse reinforcement and pozzolona additives to reduce the working time. This also shortens the curing time of lime plaster.

## METHODOLOGY

-Quarry dust and lime are mixed in a tarp in the ratio of 5:3

This is called a batch.

This batch is the raw material for the lime plaster.

Two mixtures are prepared. First, mix of lime and quarry dust and second, a fermentation of kadakai and jaggery at the ratio of 18 : 20, which is kept for fermentation for 1 week.

-3-4 batches of the lime and quarry dust mix is poured in the circular pit of lime chakki

-Then the fermentation of kadakai and jaggery is poured over it with little water for a perfect grind.

-Then the circular stone which is attached to a rod at the centre of the circular pit is driven by bullocks or a tractor.

-The bullocks have to drive the chakki along the pit for at least 200 rounds.

-The mix should be fine and perfectly grinded, so the mix has to be stirred with a shovel.

-Once the mix is ready, it cannot be used immediately. It has to be stored in fermentation for 2 weeks.

-After 2 weeks it can be used as a mortar or for plastering.

-The mortar prepared can be either unsieved (masonry and base coats) or sieved (interior plasters, final coats)



Lime

# Lime wash:

From olden times non-Hydraulic lime is used for lime plaster and lime wash.

The earliest recorded use of lime is in the pyramids and was widely popularised by Roman architecture

Lime provides breatheability to the walls and hardens over time, making it one of the few materials that do not degrade over time

The lime washes can be easily reapplied and are very economical

The self-healing property of lime is another major plus to using lime

Lime also keeps away insects and provides a healthier atmosphere in the building by absorbing the CO<sub>2</sub> to harden.



A mixture of shell lime, palm jaggery and cow urine is prepared

The cow urine is added to provide a smooth finish  
The jaggery is a good binding agent and keeps the layer of lime from rubbing off

## METHODOLOGY:

### Preparation of mix :-

#### Slaking :

The ratio of the mix to be prepared is 4 : 1 : 1 (shell lime : palm jaggery : cow urine)  
Non-hydraulic quick lime will be slaked along with palm jaggery and cow urine.  
The mixture is taken in a barrel and mixed until it is blended well,  
After mixing it starts to boil and by stirring it cools down gradually.  
It is kept closed in an air tight barrel for 15 days, and this process is called as Slaking Process.

#### Sieving :

After the mixture is done with the slaking process, it is well sieved to get the fine product for lime wash.

#### Application :

The wall is prepared by brushing it, cleaning the surface for the base coat and it is treated with water  
After sometime the base coat is applied.

The base coat is started by applying strokes of infinity such that the pores in the wall are covered.  
The application requires minimum of 3-4 coats to achieve an uniform white coat.  
By increasing the layers of coats the pores and small cracks can be covered.

#### Application of colours :-

It is not necessary that the lime wall must be left white, desired colour can also be done in lime wash.  
The colour pigments can be added after the slaking process.  
Natural pigments such as indigo and turmeric can be added too  
The colour coat is applied after the uniform white base coat is done.



Lime

# Plastering:

## LIME PLASTERING:

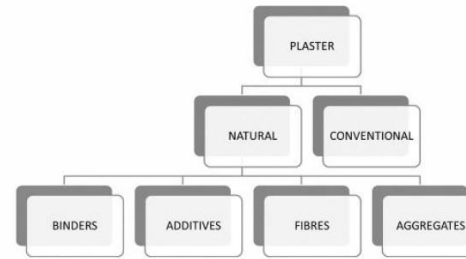
Lime is used on external walls to protect them from heavy rains.

The lime for lime plastering has to be pounded with sand particles together.

This is because the sand particles give strength to the lime.

In this case, the lime is pounded with quarry dust.

The fermented solution of kadukai and jaggery helps in decreasing the setting time of lime and also binds the lime and quarry dust very well.

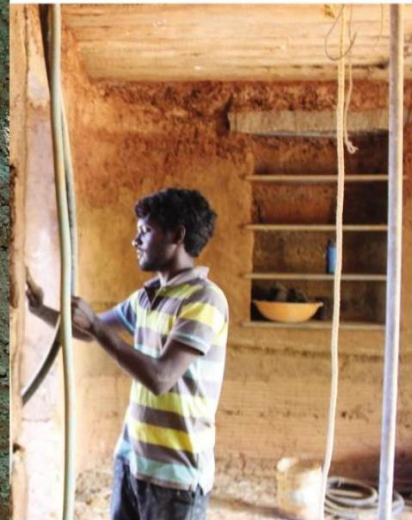


## Application of Plaster:

**First Coat-** First coat is the scratch coat which is spread on the wall from top to bottom just like painting on the wall.

**Second coat-** This is the levelling coat to maintain the uniform thickness of the plaster.

**Finishing coat-** This is the last coat generally applied to get the desired finish for the wall.



**INTERIOR PLASTERING:**  
Cob Plastering



Palingu Plastering



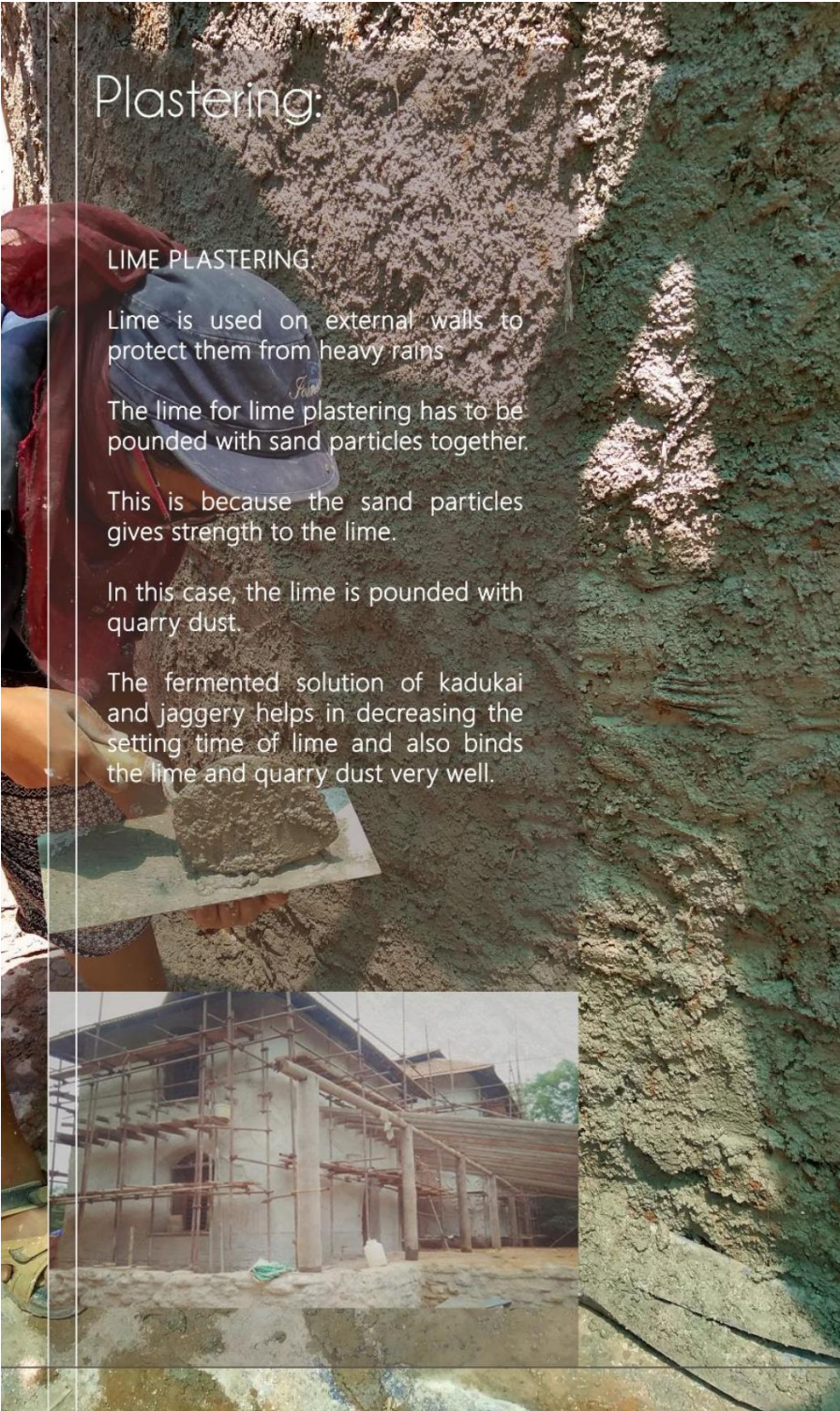
Cow dung Plastering



**EXTERIOR PLASTERING:**  
Lime Plastering



Lime Wash



## Palingu plaster:

Palingu plasters are water proof plasters mainly used on the walls of bathroom, toilets and bathtubs.

They are quite expensive plasters because they are labour intensive and time consuming.

But the finishes obtained are very beautiful and lasting.

## Lohi plaster

To prepare the lohi plaster same as palingu mix required binding agent

For fine aggregates and pigments surki powder is used to get natural colour.

Natural pigments and synthetic colours both work well as colouring pigments, though natural pigments can fade if exposed too much to the sun.

### Preparing the mixture:

To prepare the palingu mix, we require a binding agent, fine aggregates and pigments.

Here we used slaked shell lime as the basic binding agent and for fine aggregates: finely sieved quarry dust or marble powder was used.

A few drops of Coconut oil and Egg whites were added to the mixture. The egg-whites gives the smooth finish and also act as binding material

### Applying the plaster:

Wet the wall with kadukai jaggery water or plain water an hour before and once more before you just start applying the plaster.

Now apply the mix on the wall in two layers

The first layer has to be very thin and should be coarse and must fill up any cracks or pores on the wall

The second layer can be a maximum of 2 or 3mm thick

This layer must be applied when the first layer is semi-dry

The finish should be smooth and wetting the floater can help.

### Burnishing the Plaster:

When the surface is semi wet it can be polished by using a pebble.

The pebble is rubbed in a circular motion making sure the whole surface is burnished upto the same level.

This procedure can be followed if we are using a monochromatic plaster.

If you want to customize a wall then we have to add the colour to the mix and apply them next to each other and then continue the same procedure.

The finishes of the palingu plaster is upto the satisfaction of the client.

It can be smoothened till you get a matte finish or even a glossy finish.



# Soil:

Abundantly available and very eco-friendly, soil is one commodity that is easily available at any site.

It can be used for construction in different ways but the soil has to be tested before that.

Soil has major compositions of silt, clay and sand.

We can separate these for specific uses also

A simple soil test can be done in-situ to learn if the soil is predominantly clayey or sandy or silty.

## WHAT IS SOIL TEST?

Soil test is the way to examine the composition of our local earth by using the technique of shake test.

Every time the soil that is dug out is tested before starting the pre-mix by using shake test. This is done to evaluate the percentage of clay, silt and sand in it.

This gives us a rough idea whether the soil is suitable for making cob or not.



## MATERIALS REQUIRED:

To perform the soil test or shake test, we need

a clear glass jar with tight lids and straight sides, subsoil that we will use to make cob, a gallon of clear water, and a couple of ounces of salt or non-foaming liquid soap.

### CALCULATION OF PERCENTAGE!

Total height of jar = a  
 Clay % =  $\frac{x}{a} \times 100$   
 Silt % =  $\frac{y}{a} \times 100$   
 Sand % =  $\frac{z}{a} \times 100$   
 Clay % should be 14% - 20%  
 be 5/10

## PROCEDURE:

-Take the sample of the soil that you may want to use.

-Crush these sample and place them in the jar, between one third of the jar itself.

-Fill the jars nearly to the top with water and about a full teaspoon of salt or two drops of non-foaming liquid soap.

-The salt or soap will accelerate the clay settling out.

-Shake long and hard.

-At the end of shaking, suddenly stop moving the jar and leave it undisturbed.

## TIME TAKEN:

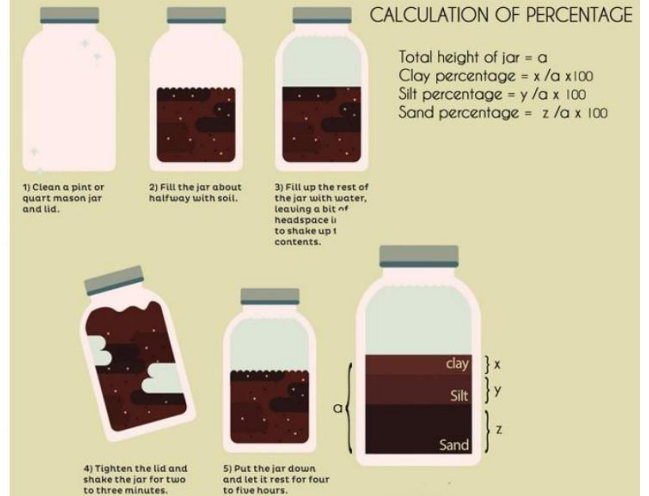
-Useful sand will fall in 3-5 seconds.

-Fine sand and silt will fall next, for up to 10-20 minutes.

-If the jar is left undisturbed, the clay will gradually settle down, leaving the clear water above it.

-It might take hours, days or even weeks, depending upon the type of clay.

## SHAKE TEST



Soil

## Adobe:

Adobe construction is a low-cost, readily available construction technique, usually used by local communities.

Adobe is mainly used in rural areas, where the houses are single storeyed with large wall thicknesses i.e., 250-800mm.

It has an excellent thermal and acoustic properties.

A traditional adobe house that exhibits good seismic behavior is the bhonga type.

In dry climates adobe structures are highly durable and are accounted for some of the oldest existing buildings in the world.

### Adobe Bricks:

These are bricks made of soil, molded to form bricks.

These bricks are strong and withstand shear force, in the hardest of climates.

This is a cheap affordable method of making walls.

## ADOBE BRICK MAKING & LAYING

Collect six barns of earth and put it on a tarp. Add water to it and mix the earth very well. After some time, add one barn of quarry dust to it and continue mixing the batch until we get the consistency to make a brick.

Put the mixed batch in the brick making muld of size 22x11.5x7 cm. Once the mould is filled with mix, clean the mould corners and take the mould out.

Once the brick is ready, allow it to dry for two days in a shaded place.

After two days, again dry it under direct sunlight for a day.

## RATIO FOR ADOBE BRICK MAKING

Ratio - 6:1 where, 6 part is earth and 1 part is quarry dust.

We can also customize the size of the brick. Care should be taken to avoid air gaps or voids which can reduce the strength of them.

## ADOBE BRICK LAYING

For brick laying, the mortar used is earth mixed with water.

The course used to lay bricks follows English bond. The surface is made wet before laying the mortar.

The level is checked for each brick with a spirit level and mortar is either added or removed from it to adjust the level.



# Cob construction:

Cob has been used in building shelters from ancient times.

Cob is a mixture of subsoil, sand (optional), fiber while adding water to bind them effectively.

Ideally 10%-20% of clay is required in the Cob mix, but if the clay content is more, sand (optional) is required to balance the ratio.

## BENEFITS OF COB:

Cob is a mixture of earth, straws and water all of which are natural materials.

If the straws are exposed to atmosphere they rot by releasing CO<sub>2</sub>. But if these straws are fossilized in the earth as cob then the cob becomes as a CO<sub>2</sub> bank.

This is one of the main advantages of using cob.

Cob does not require skilled labour. It is very economical and is characteristic of its locality.

## PROPORTION FOR COB:

Proportion is 5 : 1

5 parts of Earth

1 part of quarry dust.

## Making Cob:

### STEP 1:

Take a tarp, mix earth and quarry dust in the ratio mentioned above by adding sufficient water and pug it till the mixture is properly blended.

### STEP 2:

After achieving the desired consistency add straws onto evenly and then start pugging till the straws are well mixed.

### STEP 3:

Once the mixture is well pugged, next is to check the strength of the cob with few tests mentioned.

By adding sufficient water and pug it till the mixture is properly blended.

### STEP 4:

Once all the test is successful we can make chunks from the batch we made and the cob batch is ready for use.

## 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.

## 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 hearing the sound of grating of sharp sand grains.

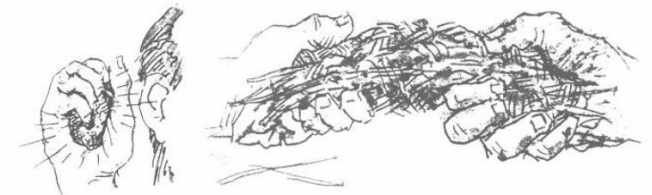
If there is excess of cracking, it means there is more sand.



## 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 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. This test is done as the final test of quality of cob.



Soil

# Wattle and Daub:

## Partition wall: using morning-glory stalks:

Wattle and daub is a simple and very effective wall construction technique.

It was often used in medieval Europe.

A wattle is a woven wooden skeleton and daub is a sticky mixture of sub soil (the layer of earth beneath the top soil) and fibers like rice straw and rice husk that is applied on the wattle.

It is a very effective earthquake resistant structure.

In our site, wattle is made of bamboo, palm reeds and reapers.

Daub is made of a mixture of mud and straw.

## Procedure:

Morning glory stalks or beshram plant, is ideal to use as wattle, as they are very flexible and are very strong



Wooden reapers are placed vertically at about 1 ft from each other. The stalks are braided through this so that no major gaps are left



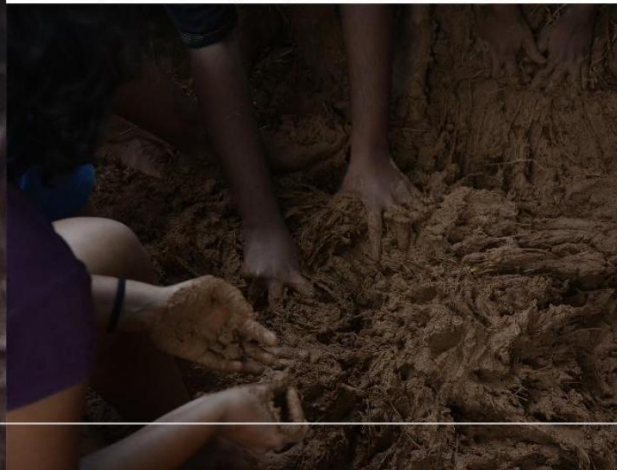
The weaving is done alternatively. Intermediate reapers can be placed if the spacing is wider.



A mixture of earth, quarry dust (4:3/4) and straw is made and the wattle is plastered completely with this daub.



Once the plaster is dried, it is checked for cracks and another layer of plaster is applied. Desired projections can be made.



## Wattle and Daub

# Wattle and Daub:

Dorm wall:  
using palm stalks:

It is light weight structure and looks elegant. We can build upto G+2 structure with wattle and daub.

Daub can be stabilized with lime to make it lighter and to get better water resistance.

You can make panels of wattle and daub that can be moveable and prefabricated or can be directly cast in situ

Construction method:

We constructed wattle and daub as exterior walls in the dorm.

Bamboo vertical supports were laid at 2ft interval dividing the span of 12ft into 6 divisions.

Reapers are attached to the main frame longitudinally and palm reeds are nailed to the reapers horizontally.

In the 2ft gaps palm reed were laid in a diagonal fashion with the help of reapers.

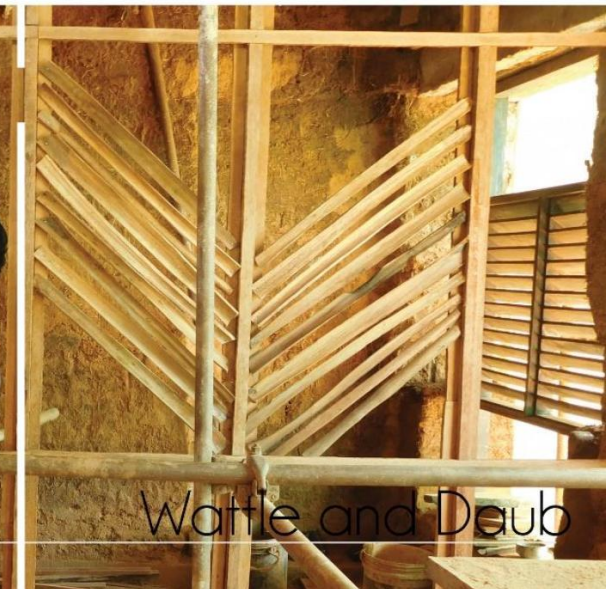
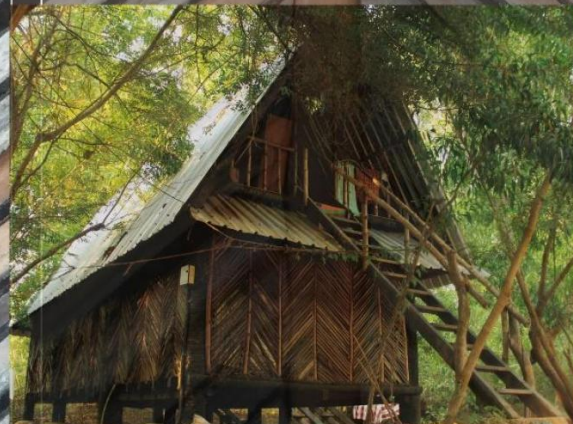
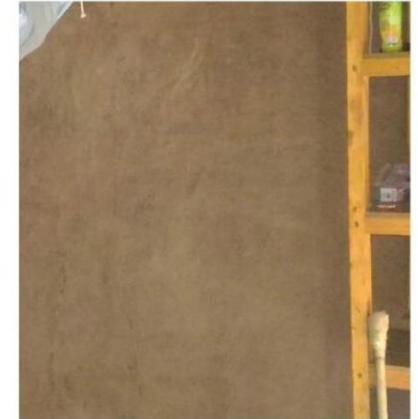
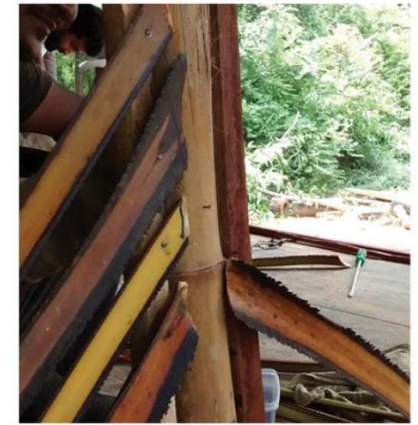
Wet mix of cob is prepared by adding sub soil, quarry waste and straws mixed with water.

The ratio of the wet mix is 4:3/4 of subsoil and quarry waste with straws and water.

The wet mix was then laid on the wattle from both the sides in such a manner that there were no air gaps left.

It was left to dry until it lost moisture completely

Since it is a simple interior partition wall and did not require any water proofing we applied a simple wet mix of sub soil as plaster.



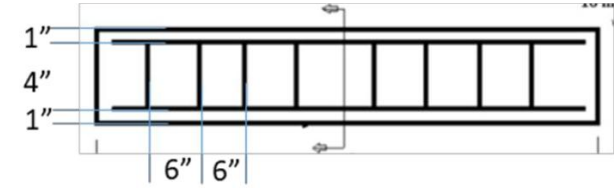
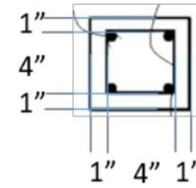
## Earth Crete Column

Earth Crete as its name suggests is concrete but made with natural material as its main component of as earth.

It has a wet mixture of earth, broken debris and cement is used for the sole purpose of binding all of these materials.

After Pouring the mixture it takes around 24 - 48 hours for curing

Bottles for reducing material usage



Form Work with Double legged Stirrup paced at 6" C/C

## MIXING RATIO



4 Stone Jelly



2 M Sand



2 Sand

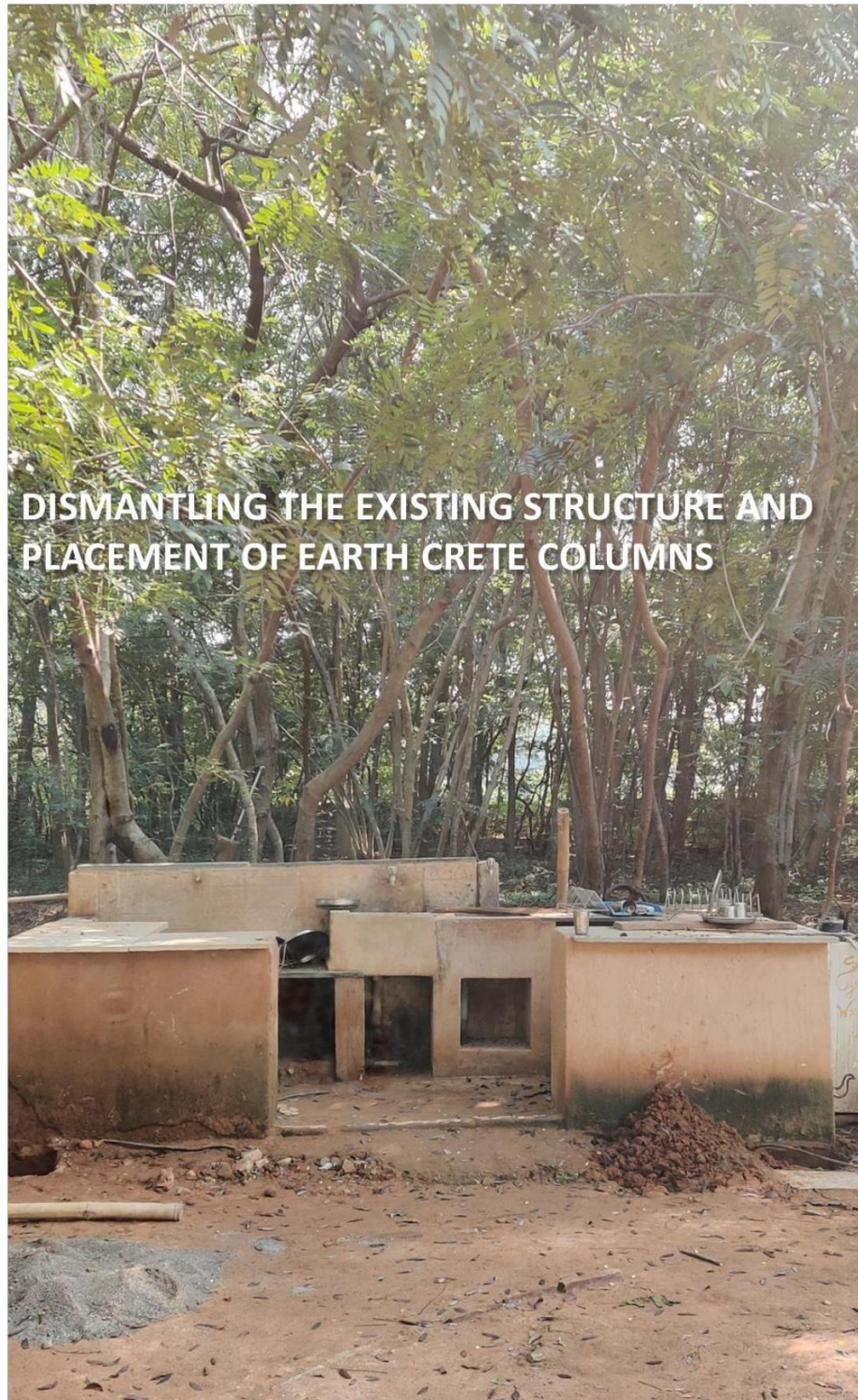


1 Cement



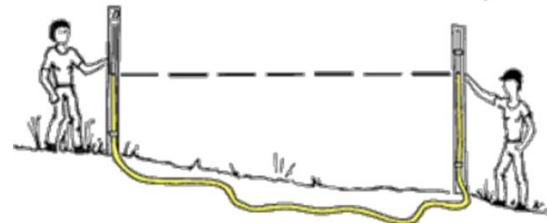
DESIGN – BUBBLE AREA

## DISMANTLING THE EXISTING STRUCTURE AND PLACEMENT OF EARTH CRETE COLUMNS



### Tubular Level for Checking the levels of all the 4 columns without any height difference.

Tube leveller is a technique used to determine the apparent inclination of an object or surface and for matching elevations of locations that are too far apart for a spirit level to span. The simplest water level is a section of clear tubing, partially filled with water. The ends are held vertical, and the rest of the tubing lies on the ground or floor. The water level at each end of the tube will be at the same elevation, whether the two ends are adjacent or far apart.



Pits of Depth 18" are dug and filled with construction waste stones and M-sand for foundation purposes, the new Earth Crete columns are placed inside the pits and water is poured for setting the sand



## BAMBOO HARVESTING FOR ROOF

### Bamboo Harvesting and Treating

Bamboo should be harvested when the wood is at its maximum strength, usually between 3 to 5 years old. It is best to harvest bamboo with the least amount of sap in it to minimize the sugars and starches that attract pests and fungal growth.

The best time is in the dry season, during the period of the new moon and in the early morning or evening.

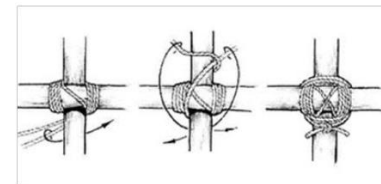
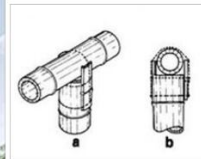
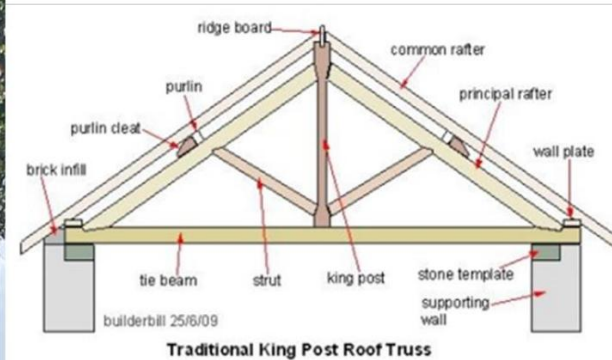
After the bamboo is cut as much of its sap is removed as possible. A traditional method is to lie the freshly cut bamboo in a flowing stream for several weeks to leach out the sap replacing it with water.

Another method is to stand the bamboo upright in drums of water for several days. The bamboo draws in the water and exudes the sap.

Yet another method is to inject water under pressure into the end of the culms to force the sap out. Untreated bamboo will, like any grass, not last long. For short term purposes such as scaffolding or buildings for temple ceremonies the bamboo is not treated and may only last 2 or 3 years. Good harvesting and treatment can extend the life up to as much as 20 or 30 years.

Treatment provides protection against the natural enemies of bamboo, termites, powder borer, fungus and wet rot.





Bamboo Lashing with coir rope  
Japanese Square Lashing technique



Bubble Area After Laying  
Terracotta Tiles



Bamboo Lashing



Use of Bamboo Nails for  
structural stability