Samudāya

map to a
decentralised habitat

Design & General Assembly

Modelled around a family of 4

INDEX

Projects

Ahmedabad, India
June, 2023

Prototype walls to increase familiarity with the new material amongst all stakeholders.

Ahmedabad, India
November, 2023

Prototype shelter structure to be built to test the weathering as a whole, after testing individual blocks under the code of BIS (Bureau of Indian Standards

Ahmedabad, India
January, 2024

Prototype House (6 x 8 m) built with services in place to showcase to the local authority.
Built in collaboration of architecture university.

About Us

Samudaya is a model system that empowers communities in developing countries like India to build their houses on-site, with the design and plan that suites them best, using the sustainable and innovative mycelium composite blocks.

We are creating infrastructure to help local communities and busineses build their homes using locally sourced materials combined with the set of tools provided by us. The future of habitat has to be decentralised, only then it reaches the bigger mass and solves the housing crises throught the countries. This is a step towards alternative construction methods, that paints a picture of an optimistic tomorrow.

Our Values

It is not just about building homes, it is about building local economic capicity, by solving the challenge of housing. Samudaya is an attempt to establish more honest relationship with the surrounding evironment, and leveraging nature's radical creations to provide to communities without skill or captial bias. We want to remove the impartial divide in access to a stable, performative shelter. We intend to keep the dialogue open to solve this crises on basic rights.

Technology

Saumdaya combines the modern and the vernacular knowledge, which allows for the creation of visionary solutions and opens new categories of products and materials. The processes are rooted in mycelium, the root formation of mushrooms, making the system environmentally responsible.

The design of the mycelium composite employs a variety of nutrient-rich, low-value fibres, essentially agro-waste, to transform them through fungal fermentation. Paired with auxetics, strucures that contract instead of expanding under stress, the composite material has increased compression and tensile strength making it longer lasting with widener commercial use cases.

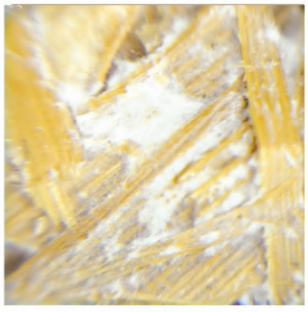
Circular Economy

The practices and processes are steadily founded in circular economy principles. The system design valorises the agriculture waste into high performance products. We offer a way to build functional, beautiful and meaningful products with a durable and sustainable life cycle. By empowering local communities to learn and employ the laid out system, we decentralised the housing system to march towards self relaincy and a resillient future.

About Mycelium

Mushroom forming fungi are known for their ability to degrade lignocellulosic waste streams such as sawdust and straw. Like other fungi, they colonize their substrate by means of 2–10 µm-wide filamentous cells called hyphae, a three-dimensional network by growing at their tips and by branching subapically. This mycelium secretes enzymes that convert polymers in the substrate into break-down products that can be taken up to serve as nutrients. As a result, the organic material is being degraded in time, while being replaced by fungal biomass on and within substrate particles. At a certain moment, hyphae grow out of the substrate into the air creating a fluffy or compact layer covering the substrate. This compact layer is also known as fungal skin. It can be made into a block which when dried and hardened, is equivalent to foam board.

For straw, best results are shown with hemp, cotton, and sugarcane fibres. Most commonly avaible and a close second are wheat and rice straw. For mycelium, reishi makes the strongest composite, but oyster is more forgiving and faster to grow.



Mycelium hyphae binding with straw

Mycelium - veneer composite

For mycelium blocks / composites to work as an efficient building component, it needs to have a higher compression rate. To do so the substrate, any straw, can be chopped < 5mm long or compress the straw more tightly in the mould. Another way is to pair mycelium with high lignin and cellulose based organic materials like veneer or jute and additives like starch to form a denser, stronger block.

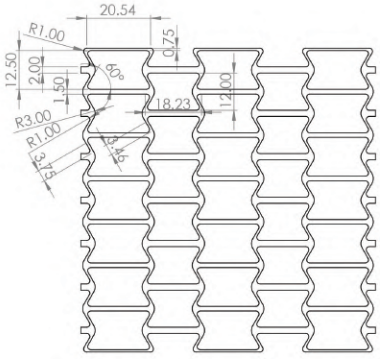
Once fully grown in 3 to 4 weeks, the material can b dried in an oven if it is a scaled down model or let it out to sun-dry for atleast 3 to 4 days if it is a large scale model.

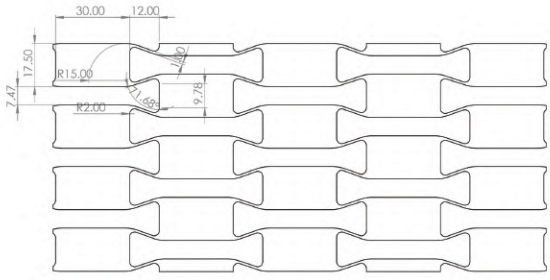
Mycelium bonded blocks, service block

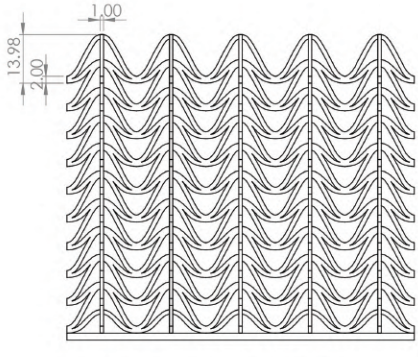
Understanding Auxetics

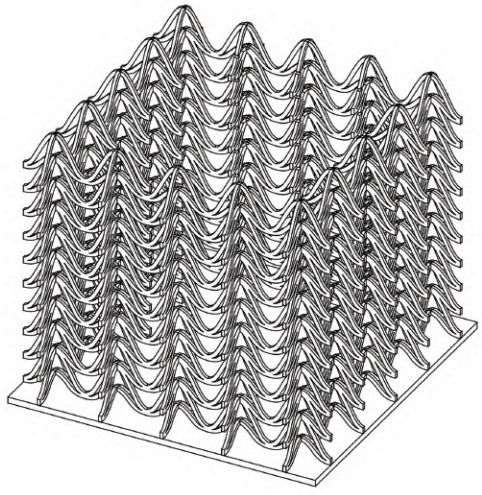
Auxetics are structures or materials that have a negative Poisson's ratio. When stretched, they become thicker perpendicular to the applied force. This occurs due to their particular internal structure and the way this deforms when the sample is uniaxially loaded.

These structures can be made into various 3 dimensional functional parts in the form of cubes, cylinders or planar, depending on the application. Their unique property of being light and still being highly shock absorbent.





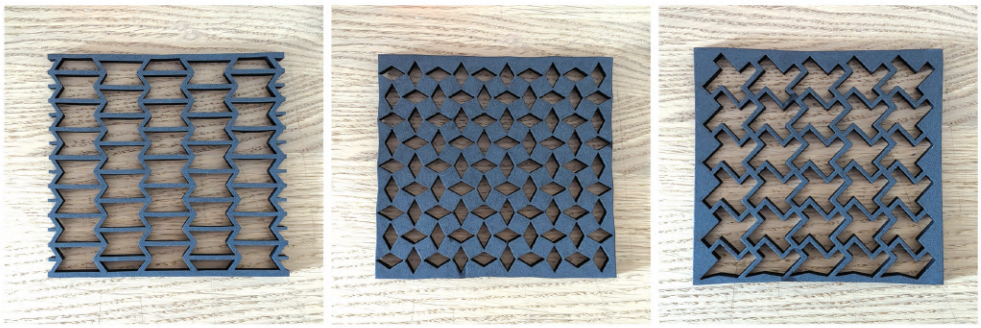




and many more...

Understanding Auxetics

The planar auxetics, once layerd over mycelium block, can negate the expansion of mycelium under compression, increasing the load bearing capacity and also making giving the structure a protective outer covering.



The particular auxetic design made out of polypropylene infused with jute can act as a mould that could be bonded with mycelium making a stable mycelium composite.

Jute - Veneer Auxetic Lattice Mould

Prototype Structure built in India

The structure was built by the stake-holders it was intended for. The result was invaluable feedback and insights about the scope of mycelium housing.

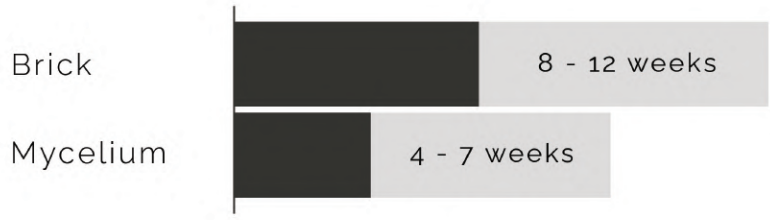
Built over a period of 4 weeks.

The mockup of assembly

The exhibit is to observe and gather data about how people interact and respond to the structure. The extensive data on everything involved will be shared on the open-source website.

Typical Build Cost

Project Build Time



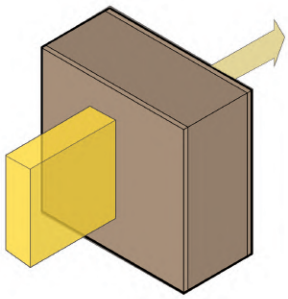
* this is an average calculation. The cost and time will vary as per the design and location of the house.

Fire Retardancy

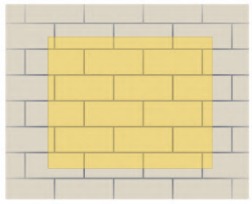
Samudaya mycelium composite are naturally fire retardant. Even without any treatment, mycelium has the natural tendency to burn slow and form char. Their fire reaction could be further improved to class B-s2-d0, with further coating, so it can be used in public spaces.

Thermal

The lower the thermal conductivity, the cooler the house will be in heat, and warmer in cold.



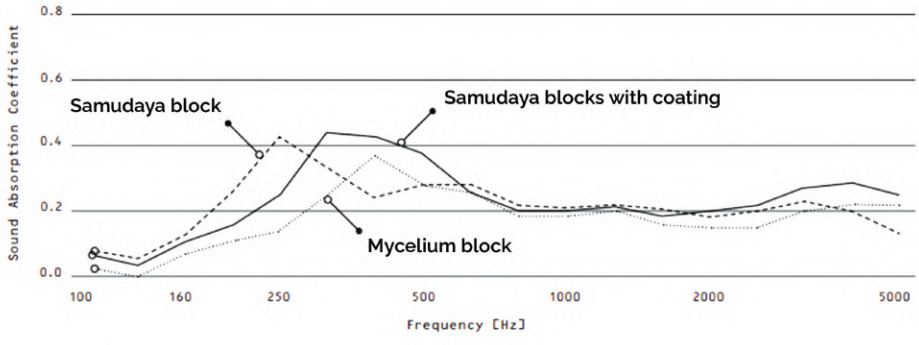
Mycelium
0.03 W/m^2K



Brick
0.18 W/m^2K

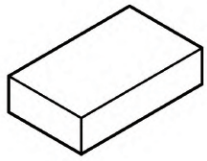
Acoustics

Mycelium's acoustic properties allows you to have the luxury of an interior void of traffic, construction or any neighbourhood noice.



Types of project best suited for

Works well for (**single storeys only** at this stage)



Detached Houses
Independent structures

Row Houses
Two blocks shared wall to increase acoustic insulation and fire insulation

Temporary Workspaces
Offices, Studios, Exhibitions, Retail

Garden Studio / Shed
Sheds, Micro offices, Gyms, Workshops, Gazebos

Rooftop Development
The stucture needs to be securely anchored down

Internal Walls
Need to make allowances for the wonkiness of the existing walls, floors

Extensions
Needs clever levelling of floors and ceiling

Cafe / Retail
Need to make sure the floors support additional loads

Locations best suited for

Climate
Only suited for dry & tropical climates.
In temperate, continental & polar climates, mycelium growth is drastically slower and thus not a practical construction method.

Weather
Mycelium housing is not suited for sites with extreme windloads and harsh rainfalls.

Materials
Suited for urban and rural areas with close proximity to agro farms, where wheat, rice or sugarcane straw and also sawdust will be readily & cheaply available.

Economy
Especially useful in regions where there is a shortage of skilled construction workers or where construction overheads are very high. In these areas, local workers can be employed, or built by self.

Topography & Flooding
The independant foundation column will counter the earthquake well. Also, the lightness of the structure will ensure minimal injury & fatality because of the structure. It is not suitable for underground or flood prones areas.

Site constraints
extremely useful for small, constrained sites or sites with difficult access

Before you start

This document is a standard tool kit with tried and tested information about building your house. All the steps and equipments mentioned are recommended to be used in building your first house.

You may improvise and improve on the designs and construction given you run appropriate tests, comply with all relevant regulations, and upload the results and pictures on the website for expert inspection. You and your team are responsible for building your project in a safe way. If you have any questions, refer to the service section at the end of the document.

Read the full *Mycelium-Housing Terms
(will be uploaded soon)

What is Included

Wall Lattice mould rolls (7) x 35
Ceiling Lattice Mould rolls (7) x 15
Scaffolding C support x 120
Scaffolding clamp tighteners x 90
P.P. Bag for pastuerization - 25

What to rent

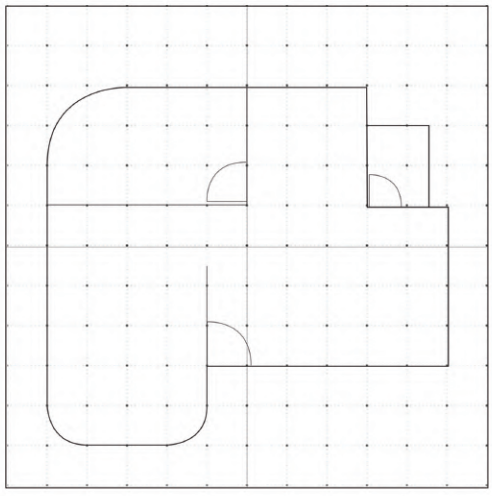
Ground leveling and testing equipments - Work gloves for handling
Genie lift for positioning floor and roof blocks (ie. SLA15) - equivalent scaffolding
Wood trimmer/multi-tool
Step ladders
Dust-masks
Pliers
Fire extinguisher
First aid kit

What to Source

Wheat / Rice / Cotton / Hemp / Sugarcane Straw
Oyster Mushroom Spawn
Metal pipe/ Bamboo 2.5 m in length

Space Grid

Mycelium mould blocks create internal spaces that follow a grid of 500mm x 500mm in plan. Main walls will then add a 200mm perimeter around this. Vertically, wall heights increase in increments of 500mm.

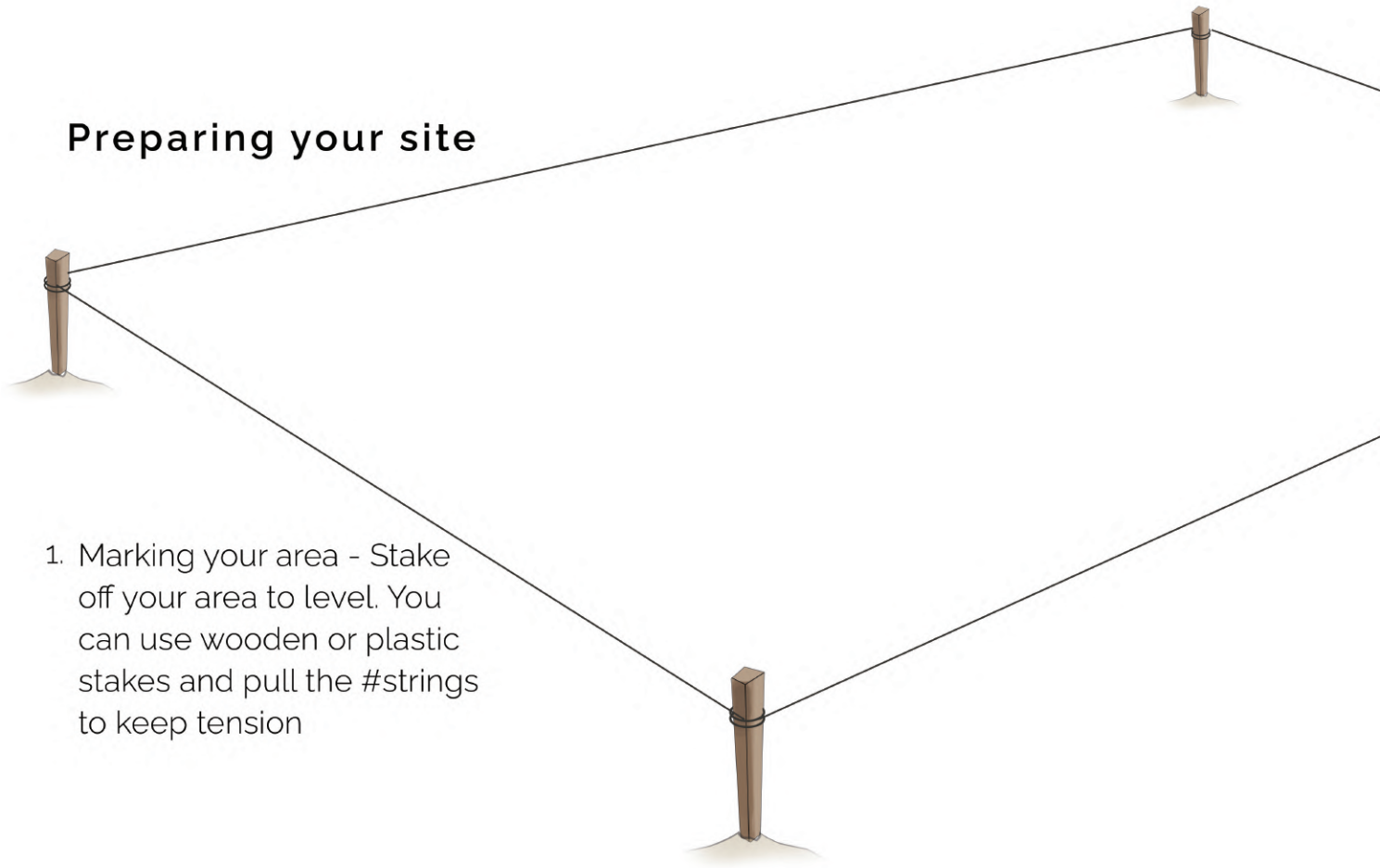


Of course, if you want to make a building with a specific dimension that doesn't quite fit this grid, you can do so by making one row of smaller custom blocks.

Unit

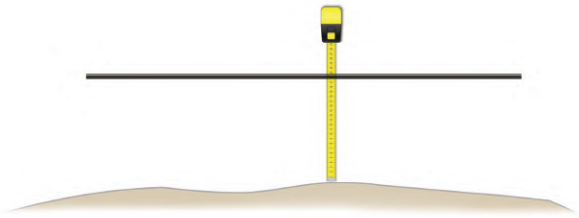
1 sqaure = 1 x 1 m

Preparing your site



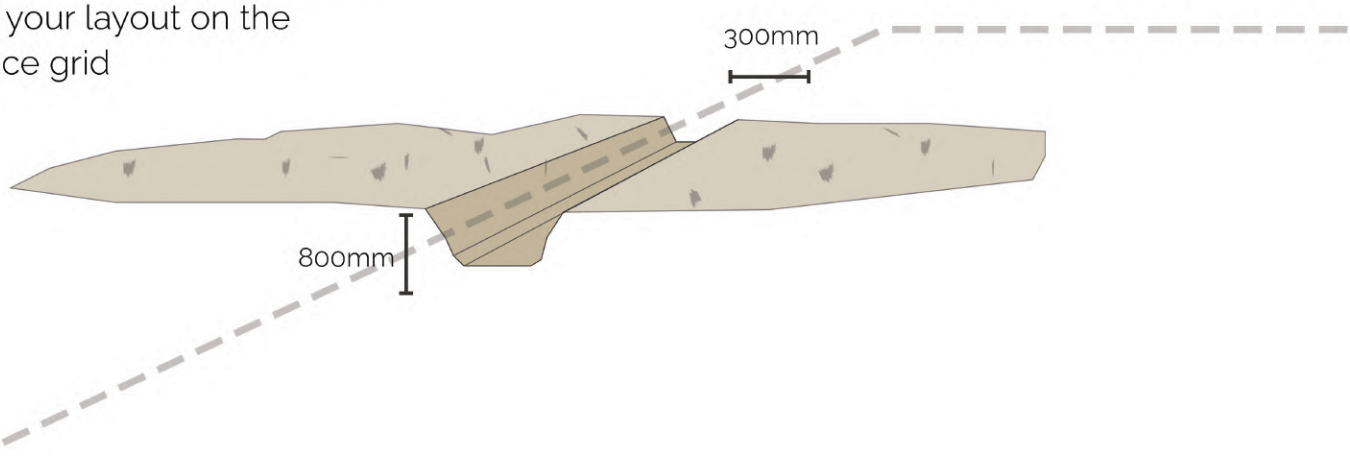
1. Marking your area - Stake off your area to level. You can use wooden or plastic stakes and pull the #strings to keep tension

2. Attach a string level to determine the high point



3. Adjust the strings using a tape measure until you can see how much height needs adjusting

4. Dig a shallow foundation as per your layout on the space grid



Sourcing and Treating materials

Perimeter of the area X Wall **L**ength X **W**idth
Small bale size average is 14"x18"x42".
Small bale weight is 50 lb

Volume
P x L x W = _____

Bales required
small size = _____

(Bales of Wheat, hemp, etc.)

Pasteurisation
Required pH level - above 12
Keep it over night, 12 to 24 hours
repeat for the entire lot

5 kg

+

1 pp bag

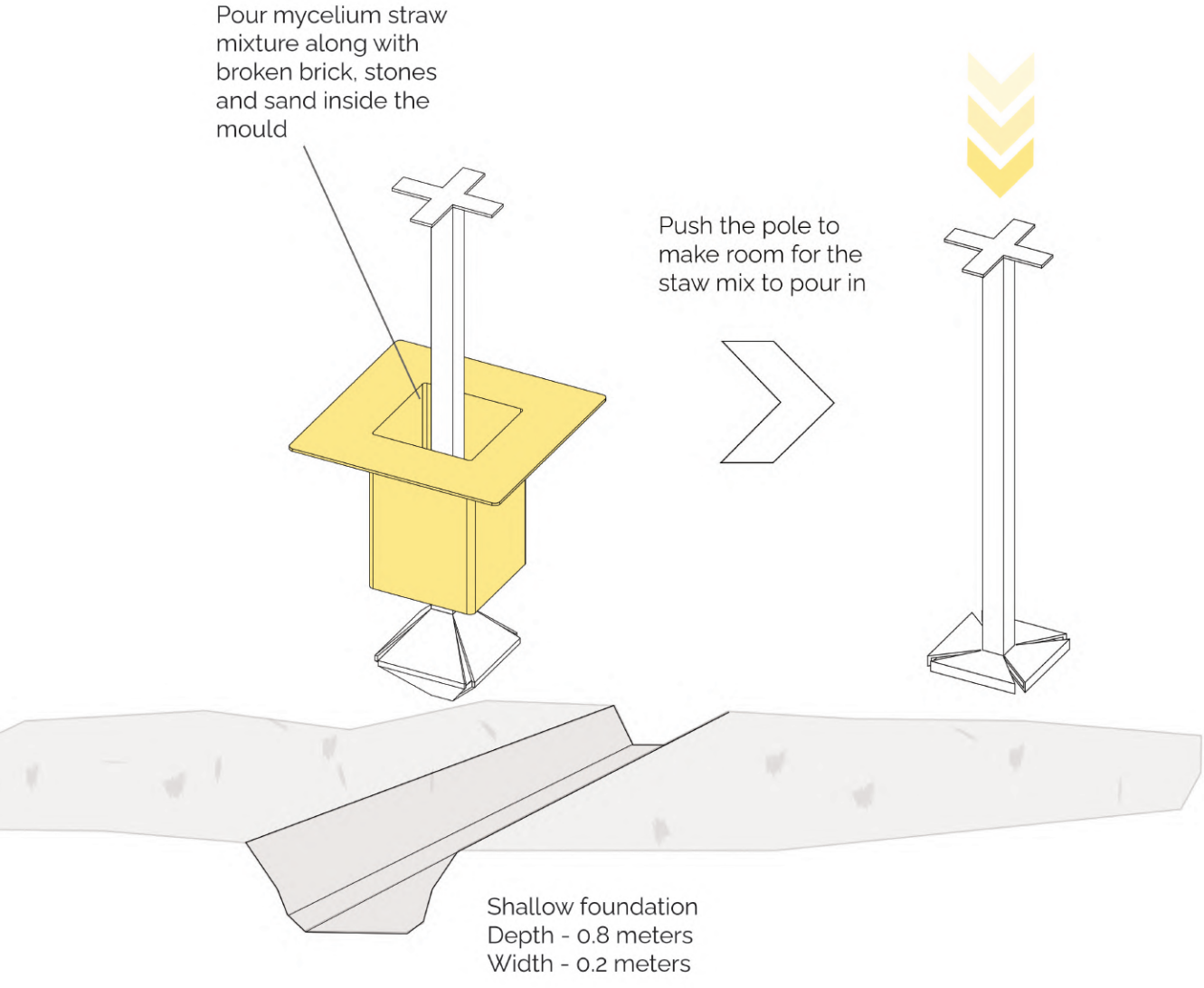
+

50 g hydrated lime

Drying
Spread the straw to take out
excess water for 12 to 24 hours

Foundation

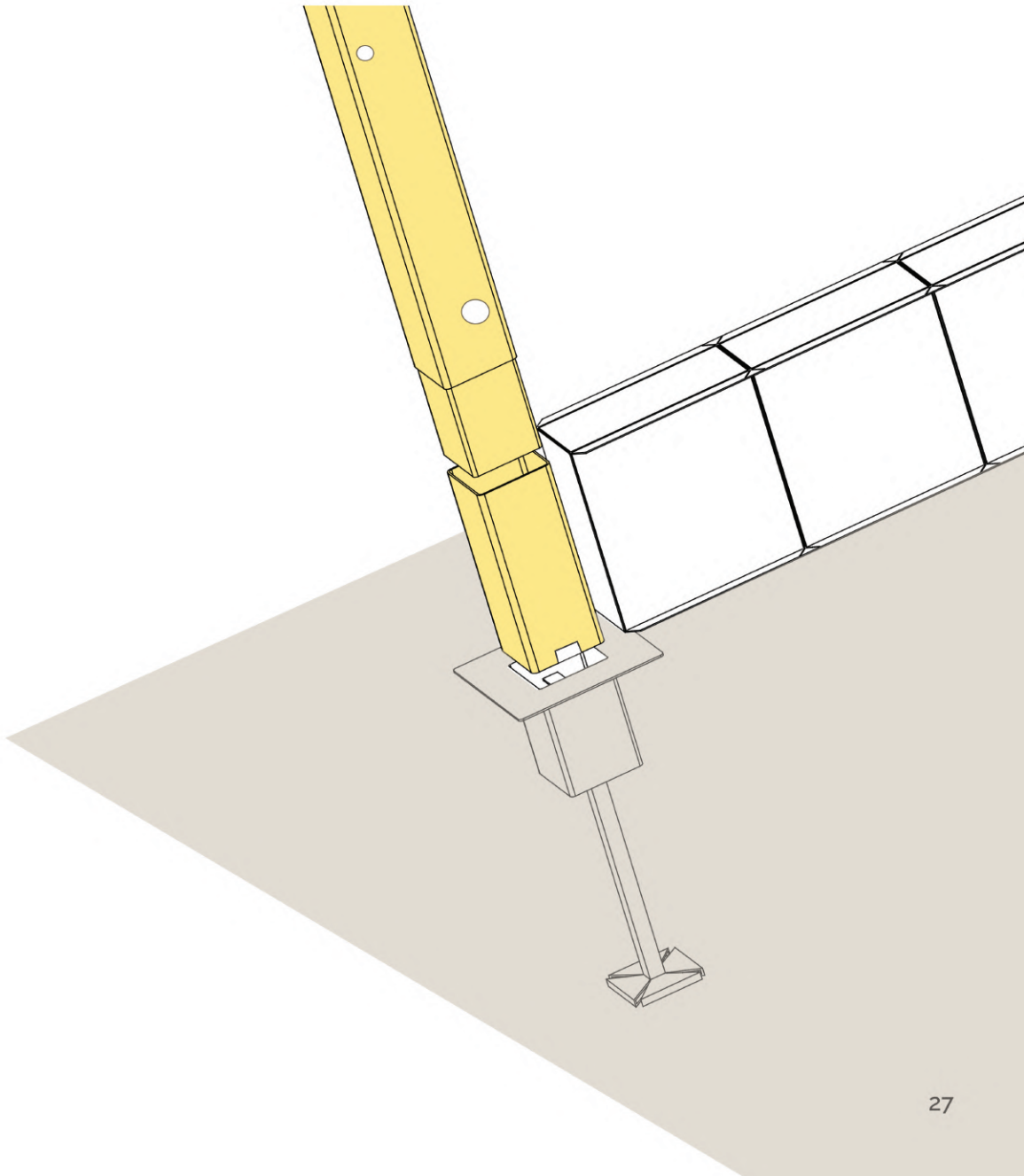
One of the big advantages of manufactured building components is that blocks can be delivered just-in-time. This enables a build team to have all the groundworks, foundations, and, in some cases, even the landscaping before any of the chassis parts arrive on site.



Corner Blocks and Services

The foundation block acts as the corner block. The column going on top of the foundation block houses all the services- electricals and plumbing, with the rest being burried underground.

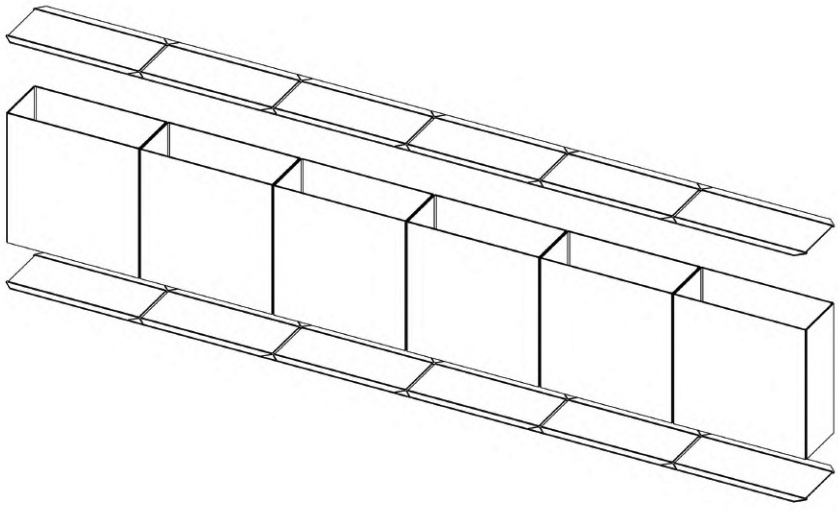
Fill the rest with inoculated mycelium to ensure minimal play. Holes can be punched to stretch the electrical or plumbing line in any direction.



Stacking the Blocks

Fill each lattice mould
Fill the pasteurised straw and mycelium spawn,
starting from 1 inch of straw with sprinkled spawn.
Keep layering it till the top. Manually compress the straw
and make sure to push it in the corners and edges.

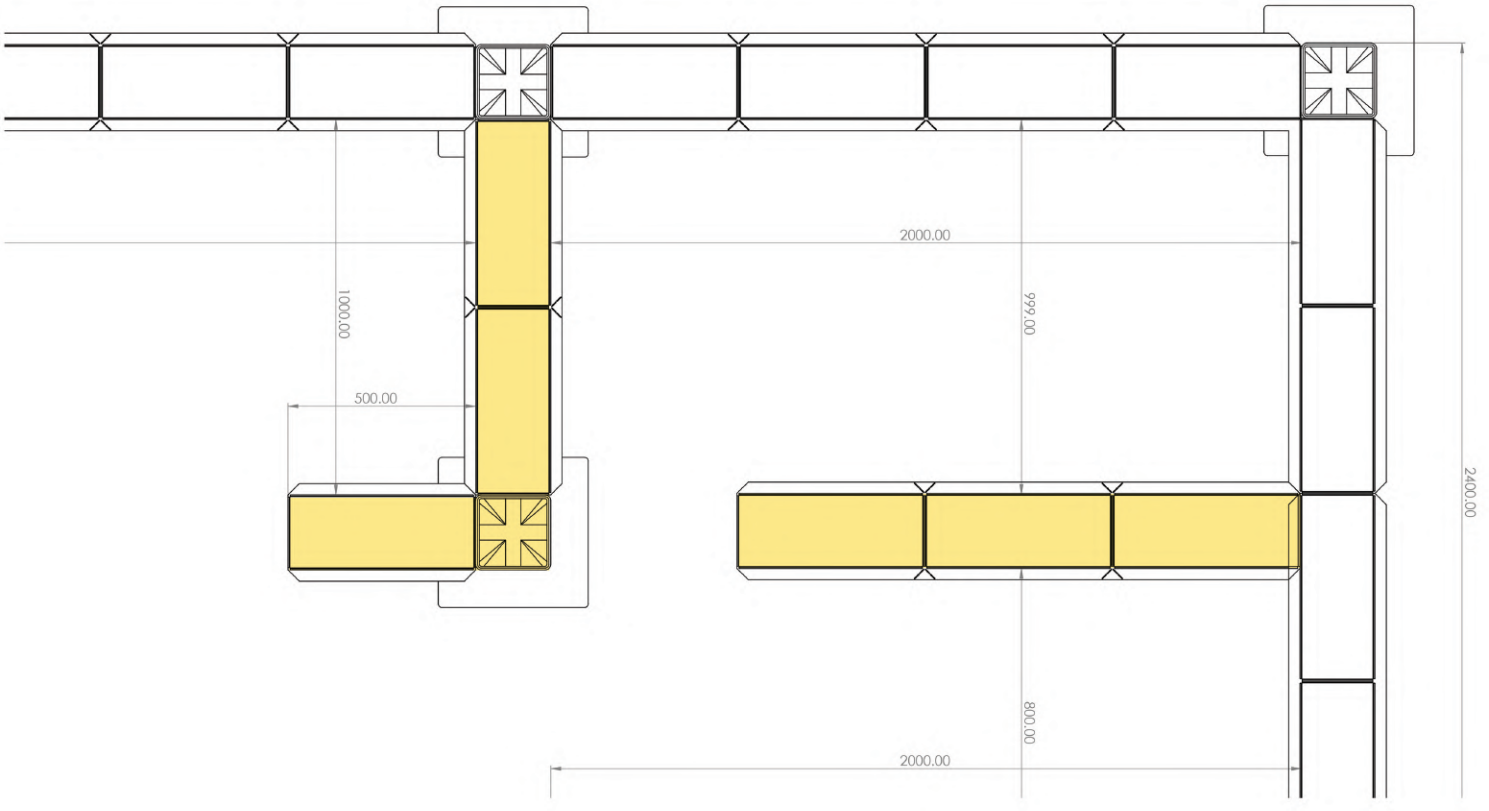
Filled Moulds & Clip Plates
Starting from below the base row of blocks,
clip plates go between ever row.



Internal Walls

The easiest way to build internal walls is to connect them to the corner blocks with shallow foundation at every 90° turn or intersections. This way we can ensure the internal walls are as stable and sturdy as the exterior walls.

If the wall is built to cover wet areas like kitchen or wash-room, make sure to attach a vapour barrier and layer it with cladding, not plaster and paint.

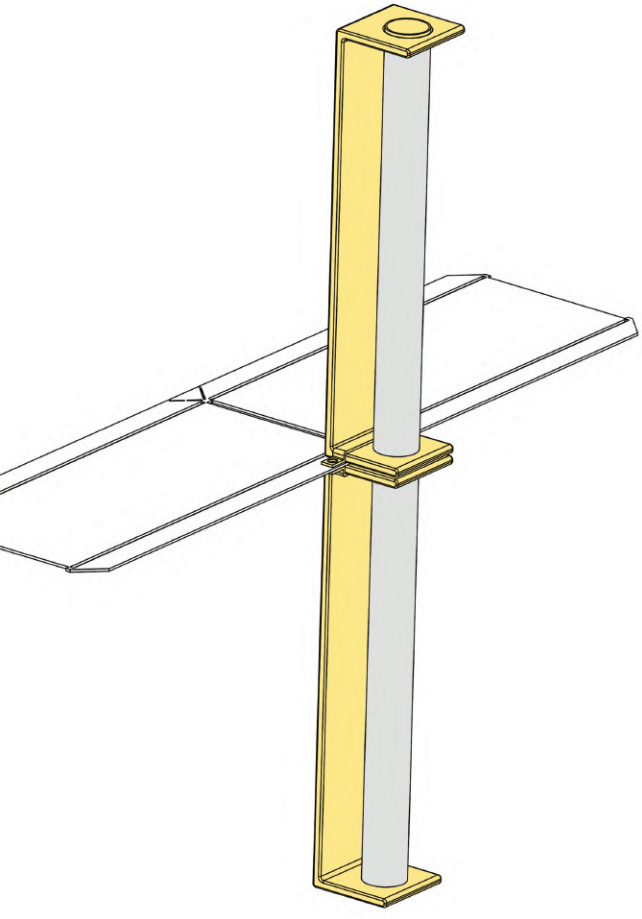


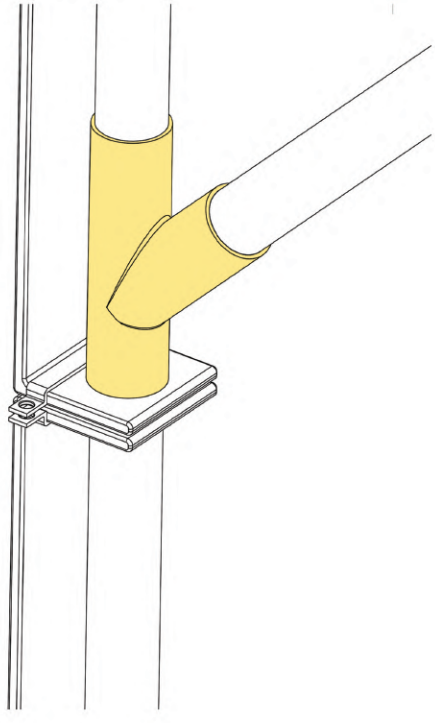
Scaffolding - Supports

The weight of the wet straw facilitates for easier stacking. The scaffolding is to make sure the structure is aligned and stays aligned throughout the growth period.

1. Put the C supports between the clip plates at signed spots. Use the lock clamp to tighten the two supports with each other. Insert a steel pipe or bamboo of < 5cm diameter through the hole punch to stabilise the structure.

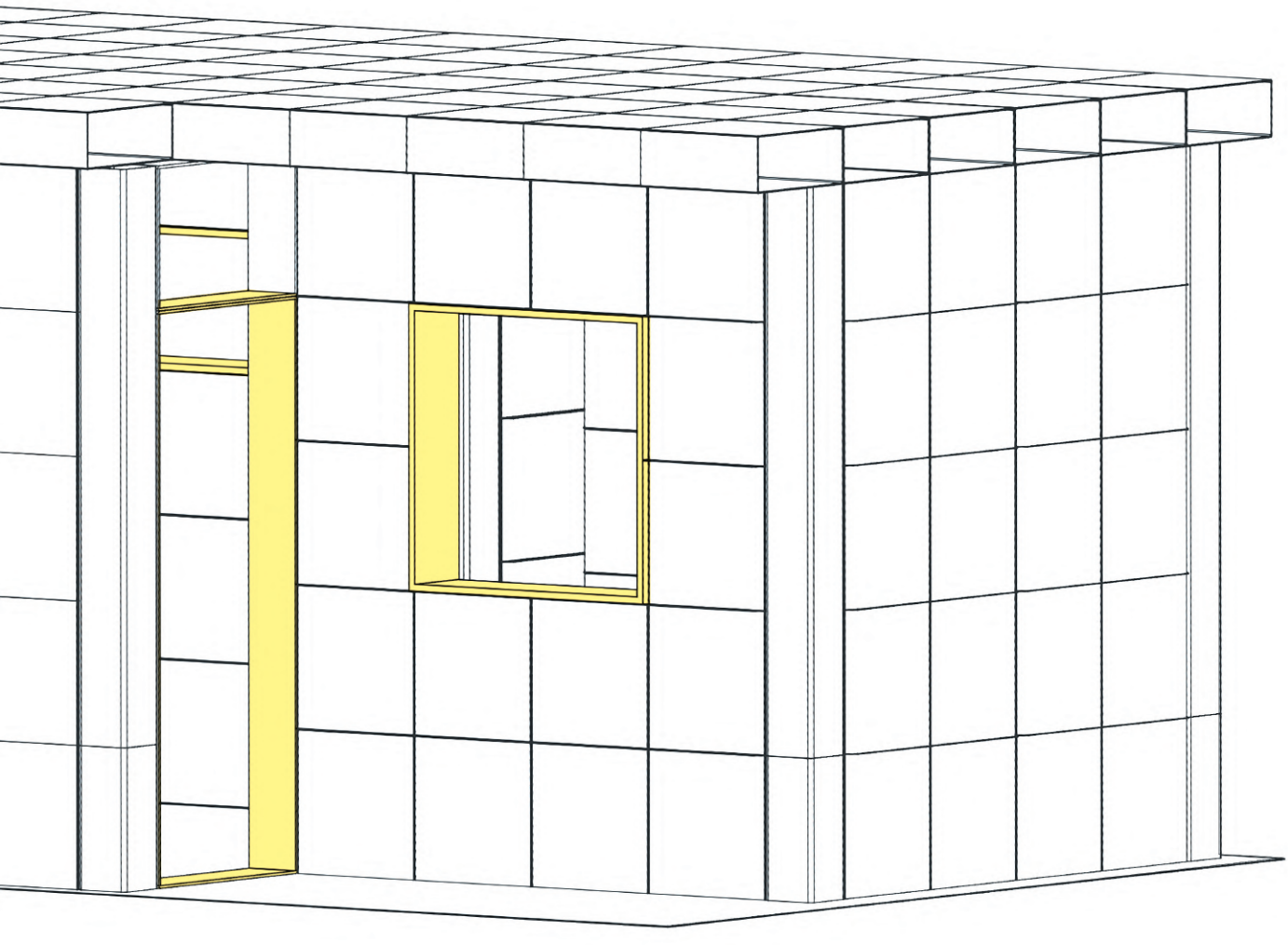
2. Use a 45° angled pipe tee joint to add the angled pipe to support the ceiling strcuture.





Doors & Windows

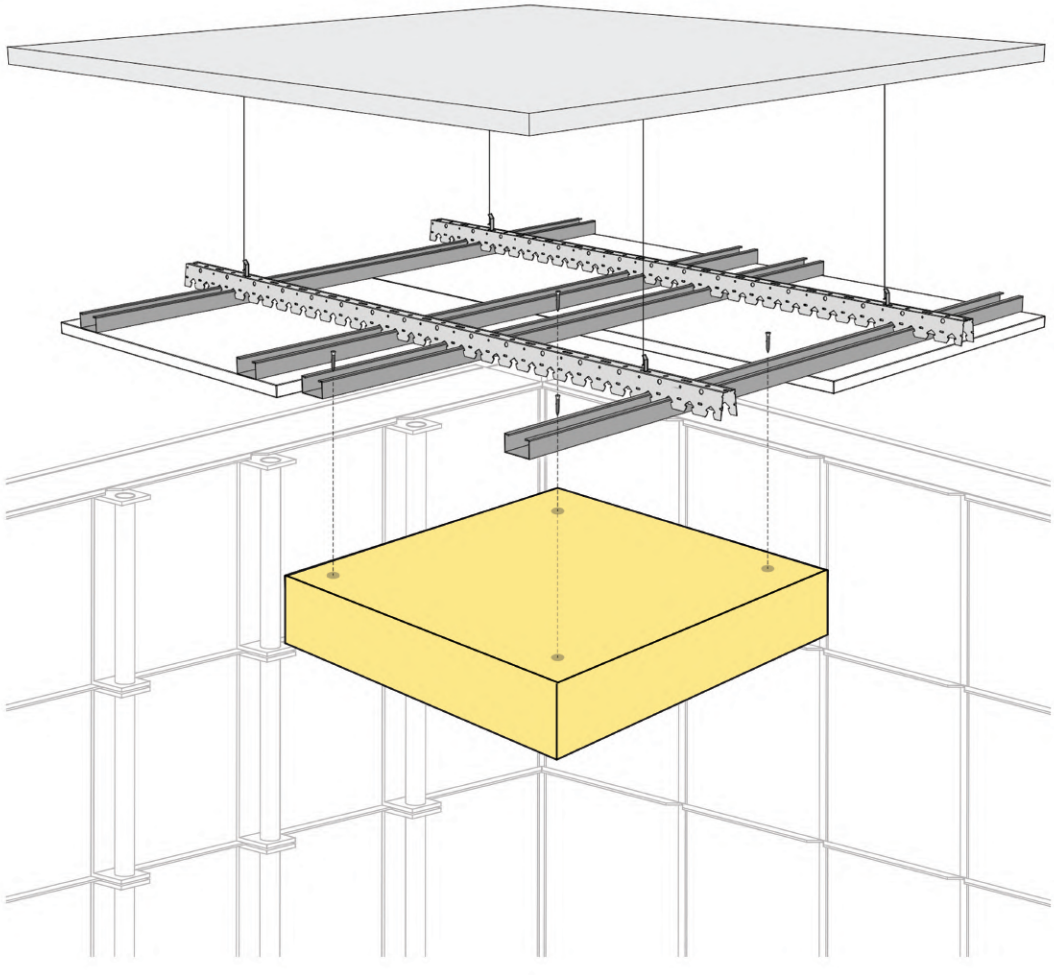
For doors and windows, wooden frames could be put in place with diy supports till the structure dries. There are several ways of installing these. One is to bolt them on the surrounding blocks till the structure dries and then removing the bolts at the end. Another way is to install a placeholder frame which can be later removed to install a thicker wooden frame which can be glued or fixed on any other way.



Ceiling Assembly

The structure shown here is for a room bigger than 3 x 3 m The truss support structure can be made with a variety of steel or bamboo members. Attach the truss to the scaffolding to secure the ceiling. The mycelium lattice blocks can be layered on the top of it, or hung at the bottom, depending on the strength of the materials used for the structural support.

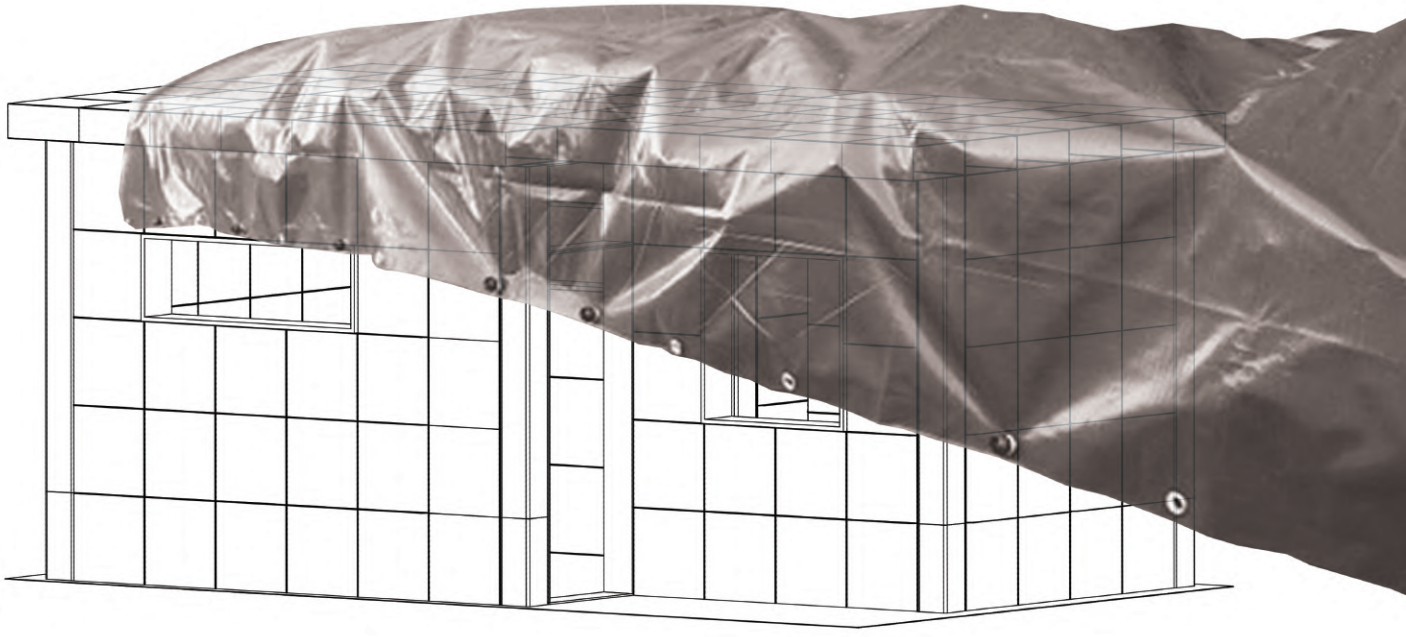
Make sure no block is hanging without support of the scaffolding or the bearing walls.



Weather Barrier

Use a tarpoulin to cover the structure entirely. This vapour barrier will prevent outside contaminants to enter the moulds.

There is no need for a separate barrier for the interior.



Inspections

Keep the tarpoulin covered on the structure for atleast two weeks. Within these two weeks, ensure to regularly inspect the growth of mycelium with thoroughly washed hands. If there is excess moisture on the inside, You can remove the tarpoulin partially for a few hours after 3 or 4 days. You may repeat the activity 2 or 3 more times within next two weeks.

Removing the Weather Barrier & the Scaffolding

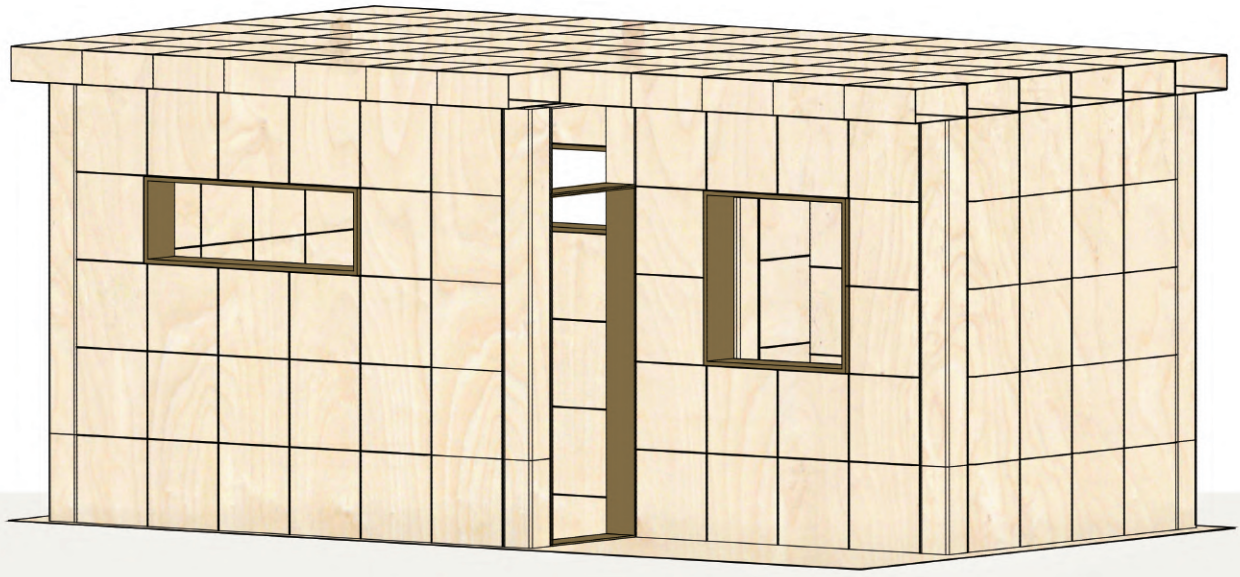
After two weeks of installation, remove the Vapour barriew and scaffoldings. Ensure the structure is not under the sun left to dry yet. Once exposed to more oxygen, the mycelium will grow exponentially and cover all the gaps and pores.

Keep a tarpoulin tied to a height to keep the structure under shadow.

Drying & Treatment

In the fourth week, check the growth and accrodingly let the structure out in the sun to dry. Apply a layer of fungicide like copper sulphate to avoid contaminants in this last phase.

Wait for atleast a week for the structure to dry thoroughly. Apply a spray on vapor barrier or plaster to make the structure withstand unwanted moisture and pollutants.

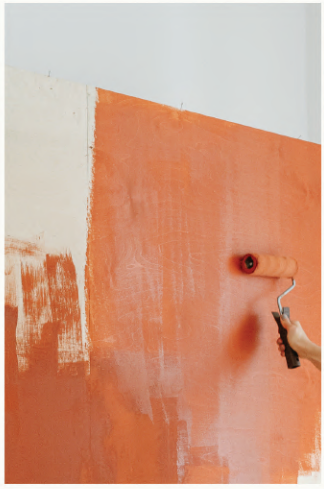


Exterior Coating

There are a number of different ways you can finish the interior and exterior of a Samudaya structure. The most common ones are -

Plaster the walls to even out the interior and exterior surface then,

Install a vapour control layer (to prevent condensation forming within the walls) then,



Paint or texturise the walls & ceilings as you please

finishing with plaster-board/ cladding

Additional Guides

To be launched by November 2023. Any suggestions are welcome. The improvements will be open sourced as well.

GENERAL DESIGN GUIDE

- Extensive understanding of Auxetic structures
- Blueprints for testing
- Mycelium testing guide
- References and locations of suggested materials
- Open files of tried and tested architecture models

GENERAL MANUFACTURING GUIDE

- Suggested approaches
- Extensive understanding of lattice and materials
- Factory Setup
- Handling files and new designs
- Machines and settings
- Production Workflow
- Tolerances
- Waste

GUIDE FOR LOCAL AUTHORITIES

- References and contact information of the core team
- Regularly updated testing details
- Precedants
- Samples

A BUILDING THAT IS AFFORDABLE, ACCESSIBLE, AND FAIR

BUILDING REGULATIONS

The mycelium composite is en route to being tested under the code of BIS (Bureau of Indian Standards). The aim is to certify the material and process for ground-level housing through lobbying and ecouraging policy changes.

IT IS ALL OPEN SOURCE

The blueprints of Samudaya are open source. That means you are free to use, modify or improve them at your own risk. However, any modifications you make must be re-shared and awaited for peer review.

Samudāya