

Collective-house (v.)

How To See Housing As A Communal Verb

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“If you wish them to be brothers, have them build a tower. But if you would have them hate each other, throw them corn.”

Antoine de Saint-Exupery, “Wisdom of the Sands”

Abstract

In this proposal, we will study and criticize contemporary housing dilemma and try to propose an almost forgotten way to provide people with proper housing. We will as well, present a housing project conducted based on this approach.

Acknowledgments

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And with love for our parents...

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The Housing Dilemma

We started the project with a personal question about housing in *Sweden* and continued to investigate the contemporary housing approach and tried to find what is lacking in this approach that it has been years people are struggling with housing problems.

Introduction

When we rejected the university's student housing offer, hoping to find our desired house in *Malmö*, we would never anticipate how long it might take to find a house. The house that we found luckily and by accident and about which we did not have any information, except for where it is. This was way too far from what we expected. Our first encounter with the housing dilemma in *Sweden* became more shocking when we met the building and our residential complex. Staying there got so hard for us that suddenly we found ourselves running away from it all the time instead of settling in it. Although that building was one of the best instances of the "*Million Program*" in *Malmö*, we could still see traces of all the heavy criticism we could hear in our academic environment of the circumstances in these buildings. Later we figured the housing dilemma and its most repeated instance, Mass Housing, is one of the main challenges of European countries while their advancement and progress in this subject is far away from their other progress and achievements. Considering our residency temporal, we could withstand the situation but later, we understood lots of people have to be in the queue for years to get a contract for a house like the one we were in second-hand living in.



Fig 1 . The House We Were Living In, Hallingsgatan, Lorensborg, Malmö

Despite this disorder, throughout the 20th century, the right for everyone to have access to an adequate home and to be able to pay for it was considered one of the vital tools in the fight against social inequality in *Sweden*. The authorities were struggling to provide equal housing conditions for everyone on the way toward an egalitarian and democratic society. Many efforts were made for over 50 years and finally, *Miljonprogrammet* was conceived as the key strategy to deal with the final blow to the housing problem, but it failed. It failed miserably and its failure is continuing to affect society all these years. Almost after that letdown, long term policies came to an end and *Sweden* gradually surrendered and assigned housing issues to the private market. In the private market, two main streams can be observed. One stream is neglecting the lower classes and is meeting the needs of the upper classes, and another one is reproducing the same Mass Housings with a contemporary expression. This approach led to class differences and inequality in benefiting proper accommodations. An imbalance that might not be found in other fundamental aspects of human rights in *Sweden*.

All these years, the objective has been: to produce houses and method has been: Mass Housing. Different labels were attached to it in different periods, but houses were being produced with the same approach. In other words, Mass Housing has always been present, while some influential parameters were changing over time. The problem of quantity and quality was still there. Is it possible to conclude that there has to be a meaningful relationship in this more than 50 years of conflict between man and Mass Housing method? In this project by study Mass Housing, we will raise the question of whether it is possible to find an alternative to this reoccurring cycle and approach toward housing considering the contemporary social situation.



Fig 2 . Mass Housing Is Being Reproduced, Around Tehran, Iran

Mass Housing As An Antithesis

To provide an alternative for Mass Housing first we need to define it. We must then try to identify its mistakes and avoid repeating them. When we address Mass Housing, we mean an approach in which house is seen as a product that is supposed to meet one of the human needs or the need to be housed. In this regard, a plethora of houses are being produced to fulfill the needs of a mass of people and are then handed over to them.

As *Christopher Alexander* states in his book *Notes on the Synthesis of Form*, to design a project, we unconsciously identify and consider factors and forces that are influential on the design (meanwhile, we may dismiss some other vital forces and elements). Then we assign a magnitude to each of these forces based on their significance in our idea; the vectors' sum or the resultant is the final force which leads us toward a result.

In today's Mass Housings, we quickly dismiss the forces allocated to the individuals and disregard their influence on the resultant force. We merely aim to magnify the force of construction of plenty of houses simultaneously and as a result, the orientation of our designs is toward that objective. It happens a lot that we are longing to know the people we are designing for but it is not possible because it does not fit into the current framework of housing architecture. These forgotten forces create mutual weaknesses and faults in all of the Mass Housing projects regardless of their good or bad design. This is mainly because the Mass Housing structure is neglecting these forces. In other words, it does not matter who is designing a Mass Housing project and under the authority of who this project is being designed, the forgotten forces are anyway missing in this structure. Obviously, there are lots of differences between projects done by different architects and some are far better than others but all of them suffer to some extent from the absence of the forgotten forces in this method.



Fig 3 . A Mass Of Houses Being Reproduced, Around Tehran, Iran

The Forgotten Forces

To Take Possession

The first and foremost forgotten force is the human being's desire to possess where they live. One's feeling of possession is fundamentally different from one's property. Here, it is not about whether something is yours officially, it is not about signing a contract, but it is about an act: the act of taking possession. It is with this act that thing becomes different for one. How bad it would be to live in a place where nothing makes a difference for you. How bad it would be to live somewhere that you do not possess, somewhere that does not belong to you. How bad it is "to be lodged in an environment which is no part of "you.

To have the feeling of possession, one must leave traces of themselves. But Mass Housing not only dismisses this vector but also strictly suppresses this feeling. Mass Housing, after appearing, is firmly after rigidity. It does not allow people to make any change or to leave any trace because it does not recognize houses to be under the possession of their residents despite being their property. With propaganda, it is trying to persuade people that where you live is exactly what you want; if you do not accept that, it will use its second way, which is coercion and direct police power. Which of these two ways of enslaving man is the worst is a much-debated question. Nevertheless, sometimes this suppression is not strong enough to eliminate the demand for this feeling inside people and turns it into hatred. Physical and social vandalism are ways people try to possess spaces negatively.



Fig 4 . Elemental Project By Alejandro Aravena, Offers The Opportunity To Take Possession

The Forgotten Forces

House As An Object Of Desire

Mass Housing, with another mistake, excludes residents who can be economic, psychological, and social actors in housing design. But how? This approach believes architecture, and especially a house, is an object of needs. When it is asked: what are the needs? It does not have any definite answer for that, thus instead of considering the concept and significance of this question, presents some diagrammatic and one-dimensional notions as needs to find which you should explore the designer's mind instead of investigating real life. Then, it typecasts its unknown target audience and, based on the different typologies of people and using the one-dimensional notions, produces a uniform solution. They claim that with this uniform solution, a possibility is left for every typology of people to settle in the house based on their needs. While the uniformity may seem like the smallest act they could have done, it would limit the residents and makes it almost impossible to reside in their way.

As we mentioned before, this mistake is rooted in seeing architecture as an object of need instead of an object of desire. Noticing the desires and designing based on that will not create houses with odd shape and organization which are unique and one of a kind, but what will be the fruit of this action is to build houses which match resident's identification.

This is the case when, for instance, one moves into a new house. At this time, the person tries to use the spaces and facilities based on their lifestyle and this is highly dynamic and is changing over time. There will be no serious problem when the person can relate their life to the house, but when a conflict arises between their desires and priorities and the uniformed house based on typecasted people, living in that house will become difficult and sometimes impossible for that person. Here, the person can every day see deficiencies that someone else has created for them. Finally, if possible, they may move out of the house and seek their desires in another house and neighborhood, like a *modern nomad*.

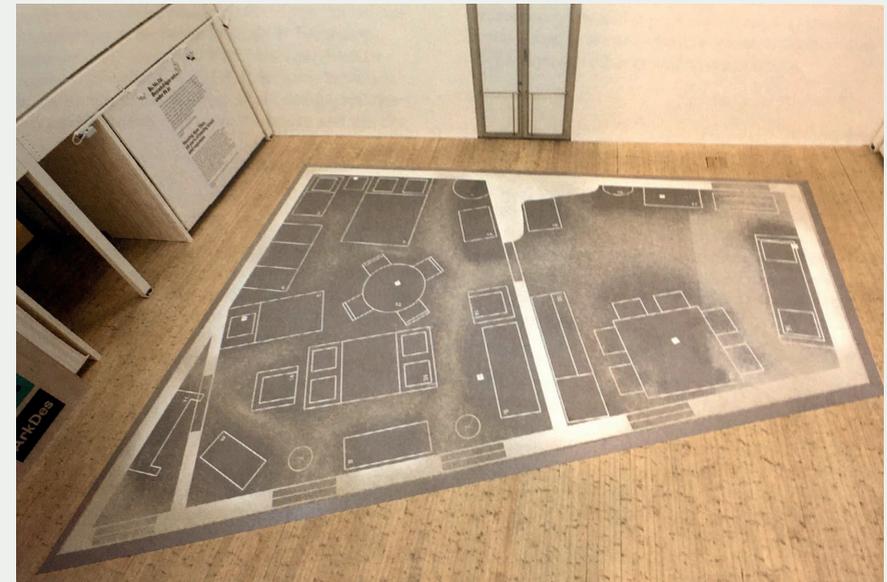


Fig 5 . Recreation Of A Floor-Plan Of A Flat From The 1910s, Bo. Nu. Dã. Exhibition, ArkDes

The Forgotten Forces

Social Space Is A Social Product

Mass Housing believes socializing is one of the human needs and treats it the way it treats other needs. It believes socializing is a contained which needs a container and a label on that container. In other words, in this approach, common space is shaped between private spaces of residents and is labeled as social space, and this space is now ready to host residents' socializing. While this space cannot guarantee a social incident, following this mistaken belief, some architects still believe malfunctioning of social space is due to the faults in its physical body. This might be true but is not necessarily the reason. If one adjusts and modifies social spaces with this insight, one has repeated the same mistake.

Social space is a social product. It is a product of social actions, and social activity does not take place with an architect's order and not even within a well-designed social space.

Social space is alive, and like all other living beings need to be born naturally. Social space is alive, and like all other living beings in nature needs time to mature.

All of these forgotten forces are interwoven.

To have a community, we need time, to have enough time we need to stay, to stay we need to belong to somewhere and feel possession for it, to take possession we need identifying and solutions based on our desires. Every moment this cycle is not happening in a Mass Housing building.



Fig 6 . Sometimes It Is Not Necessary To Have A Special Space To Celebrate

We Need An Anarchist Approach

As we mentioned in the previous chapter, the problems in Mass Housing can be generally defined this way: Mass Housing perceives housing as a product and as a noun, and not as a verb and a process of actions by the residents as the subjects and actors. This perspective is present in the housing projects, whether the state is directly responsible for the housing or the responsibility has been resigned to other markets by the state. But why?

State or its representative and agent always perceive society as a mass and as a number and is always controlling it centrally from above, while most of the time components of this system are far from the center of control. This way individuals are not perceptible for the state; thus, the housing process we wish for is meaningless in this framework.

We need an anarchy.

Anarchy, with its particular definition: Anarchy as a contrary to authority.

Dwelling As An Anarchy

Our anarchy is dwelling. Dwelling as a verb defines a dwelling as a noun. Our anarchist approach is a comeback to the fundamental meaning of dwelling. Dwelling is what relates humans to their environment. This relationship is formed by the actions human does to relate themselves to the environment. As *Habraken* states in the book *Supports*, “*Dwelling is indissolubly connected with building, with forming the protective environment.*” Thus, “*every human action in this regard is dwelling, from knocking a nail and sawing a wooden piece, to changing the lighting.*” Dwelling cannot be disconnected from building. They are one.

Dwelling is building.
Building is dwelling.
The man who builds, dwells.
Dwelling is the joy of building.

Heidegger states this fundamental human concept in the article, *Building, Dwelling, Thinking*:
“*What, then, does Bauen, building, mean? The old English and High German word for building, buan, means to dwell. This signifies: to remain, to stay in a place.*”

If one talks about anarchy besides the philosophical concept of dwelling in academia or private practices, the first thing which comes to mind is that these concepts are not convenient for the main body of society. To follow these concepts, one has to have a bohemian lifestyle. Thinking like this, like other anarchist ideas for being released from the dominance of state toward freedom, will only assist the state to continue to march in its mistaken path. In what follows, we will present some practices that realistically executed housing projects with people’s participation and are not freed from the state and have not built bohemian houses. These projects are the result of a determination from an architect in the first place and support of society as well as authorities.



Fig 7 . When Are We Moving In, Daddy?

“Dwelling” Case Studies

Residents’ participation as actors in the project is an approach that is present in many projects, each of which varies in the extent and method of engagement and the essence of the project itself.

Owner-built houses in the *US*, the *Elemental* project by *Alejandro Aravena* in *Chile*, *Christopher Alexander’s Mexicali* project in *Mexico*, and *Walter Segal’s Self-build* project in *Lewisham, London*, all benefit from participation in their way. These practices are sometimes fundamentally diverse and have different contexts, but studying and investigating different methods of involvement and how it influences the project helped us define our approach more precisely. In what follows, we will briefly present these projects and will discuss the aspects that were influential for us.

Owner-Built Houses In The United States

This method is a common way of housing in this country. In other words, it is almost the only way people can own a house for a large portion of their population. In these housings, families generally supervise different steps of construction and design and, in some stages, benefit from the assistance of professionals. Families can participate in projects in two ways:

First, the family works as labor: in exchange for the physical job they execute for the construction of the house, they will earn “*sweat equity*”. It means, instead of making money for their body labor, they will have a house.

Second, the family hires labor, and it only observes: the family in this method is not participating directly in the building process but is responsible for every stage of it.

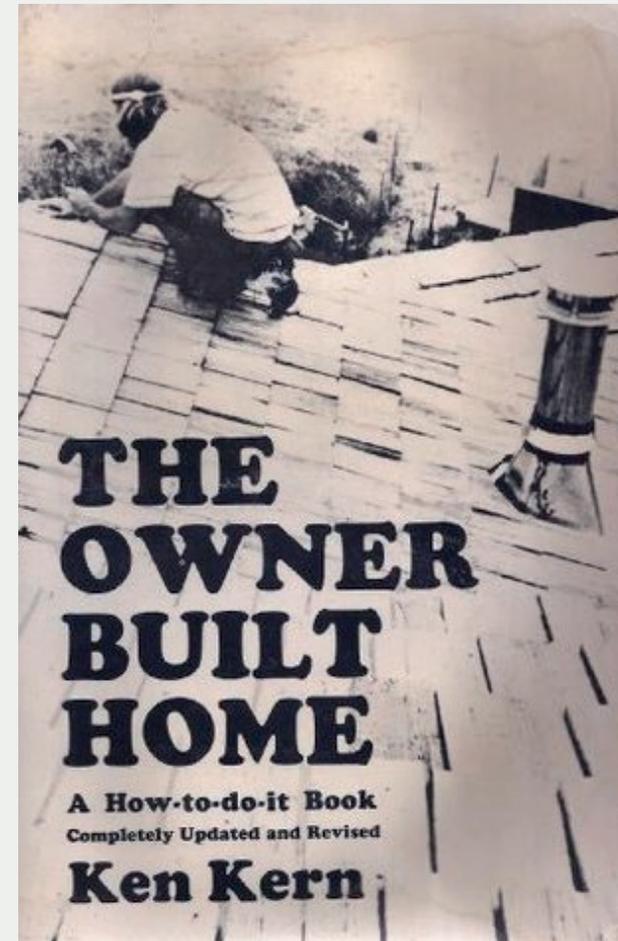


Fig 8 . This Book Is A Popular Reference For Those Who Want To Build Their Own House

Mutual Self-Help Community

Over time, one vital fact initiated a fundamental evolution in these kinds of housing, and it was that despite the families were the subject of the verb of housing and the house was built in a process, but this subject was always singular. The singularity in the process would only result in single-detached homes. This evolution happened in search of a more mature local social relationship, a growth from owner-built homes to aided and mutual self-help communities.

In these projects, several families would simultaneously build their houses in one communal action, and due to the collective effort of building, strong social bonds were created between them, which continued to exist even after the project was finished. What is essential in this approach is to keep in mind that physical improvements are of no value unless supported by social development. In this approach, people are building families and communities as well as their homes.

Just as participation can be implemented in a wide variety of practices, there are plenty of examples for mutual self-help communities which their different perspectives toward this issue will make them seem like different methods. To clarify this, we will present two practices which were significant in the manner and also in the result. After analyzing them, we will state our approach.



Fig 9 . People Help Each Other To Lift The Frame In A Mutual Self-Help Community

Self-Build Communities In Lewisham, London By Walter Segal

To renovate his house, *Walter Segal* starts to build a small temporal house for his family in their garden. To do so, he implements a simple construction method, which made it possible for him to build it on his own. The result was a simple wooden house with attractive aesthetics and tectonics, which were made by the hands of *Walter Segal*. After a while, a number of his friends and also some other private clients became interested in the house in the garden and asked him to design houses for them using the same technique. These implementations and experiments, as well as some of the clients' demand to build their own houses, made him develop this technique toward user-capability and simplicity. Briefly saying, this construction technique consists of a load-bearing timber structure, which is later on complemented with light-weight wooden panels.

In this method, he tried to minimize the presence of professionals to the construction of foundation and some technical servicing and simplify the structure and the construction so that the residents are able to do them. On his way to reach this method of construction, he knew his priorities very well and bravely sacrificed things that did not match his preferences. For instance, he was not so much concerned with the energy efficiency of the buildings.

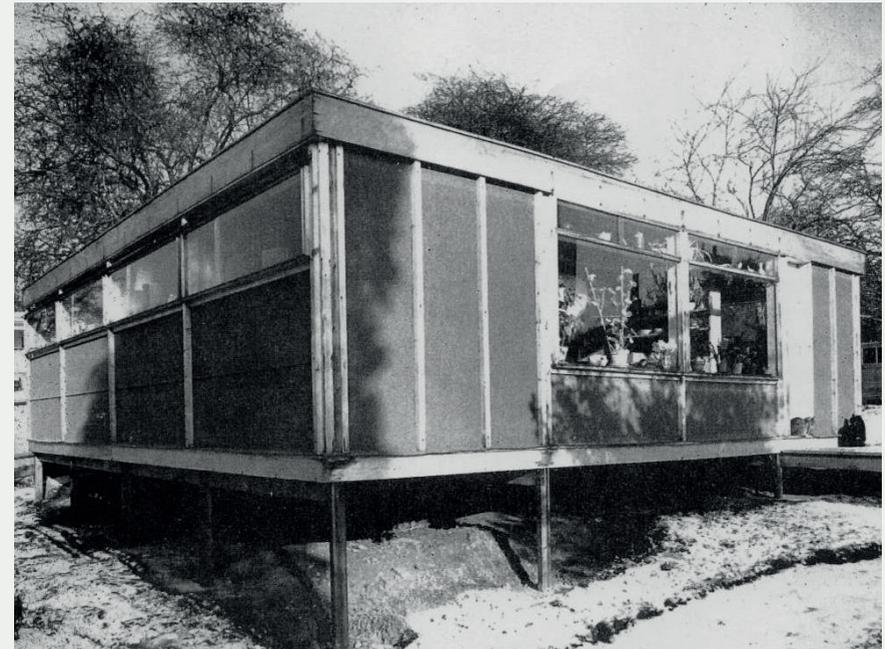


Fig 10 . Highgate House By Segal, The First House With Segal's Method, Built In His Garden

Believing in the simplicity and user capability of his method, he decides to start a self-build project in *Lewisham*. This neighborhood was not so much interesting for construction companies due to its nature and topography. Then, several groups of people in the queue for housing in *London* gathered, and a specific number of them were chosen by lot in a draw.

The chosen people had to go through some education and evening classes to learn how to work with wood and how to read details and so on. *Segal*, with the assistance of *Jon Broome*, starts a dialog with each family and draws plans for them based on their wishes in a way that it would match the system of construction. Afterward, people would start to build their houses and the communal act of building starts to take place. This socializing during the building process makes the cul-de-sac of houses perform as a completely mature social context for their activities. This can be seen in the interviews of residents and their satisfaction with the atmosphere, as one of them states: “*Here is a good place to raise our kids.*”



Fig 11 . The Self-Build Housing Project By Walter Segal In Walters Way, London

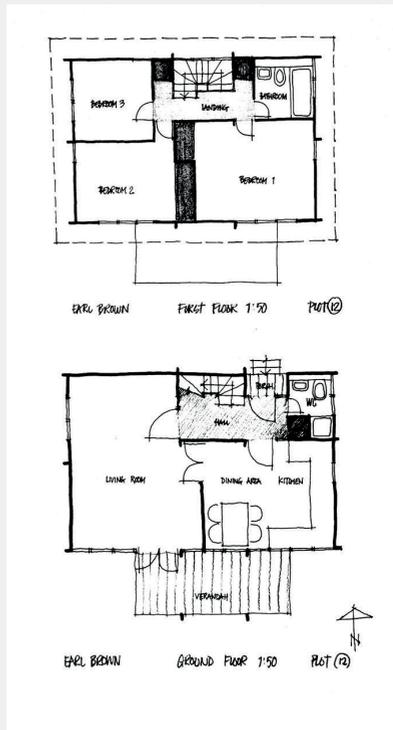
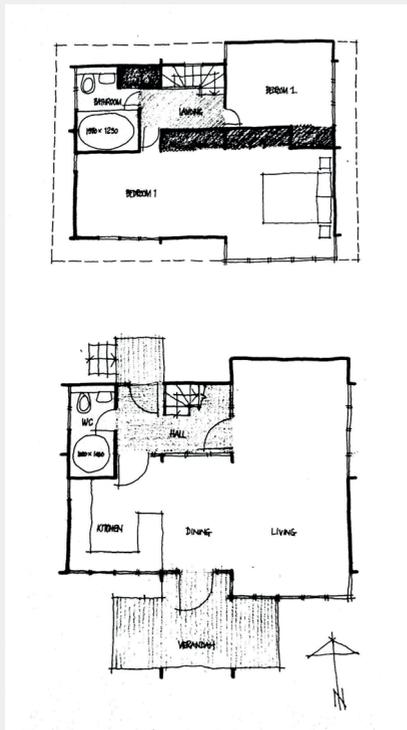


Fig 12 . Plans Of Two Different Houses In Walters Way, London

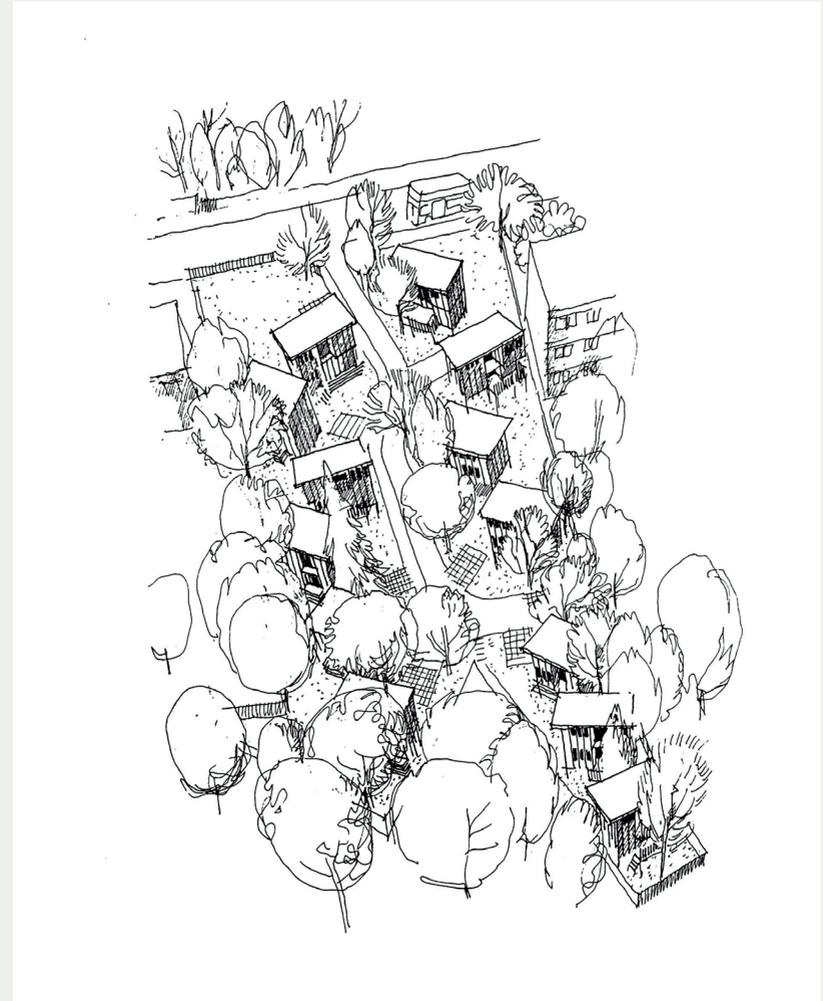


Fig 13 . Aerial Sketch Of Walters Way By Brian Richardson



Fig 14 . The Roof In Place (Walter Segal Is On The Right), Houses In Lewishm

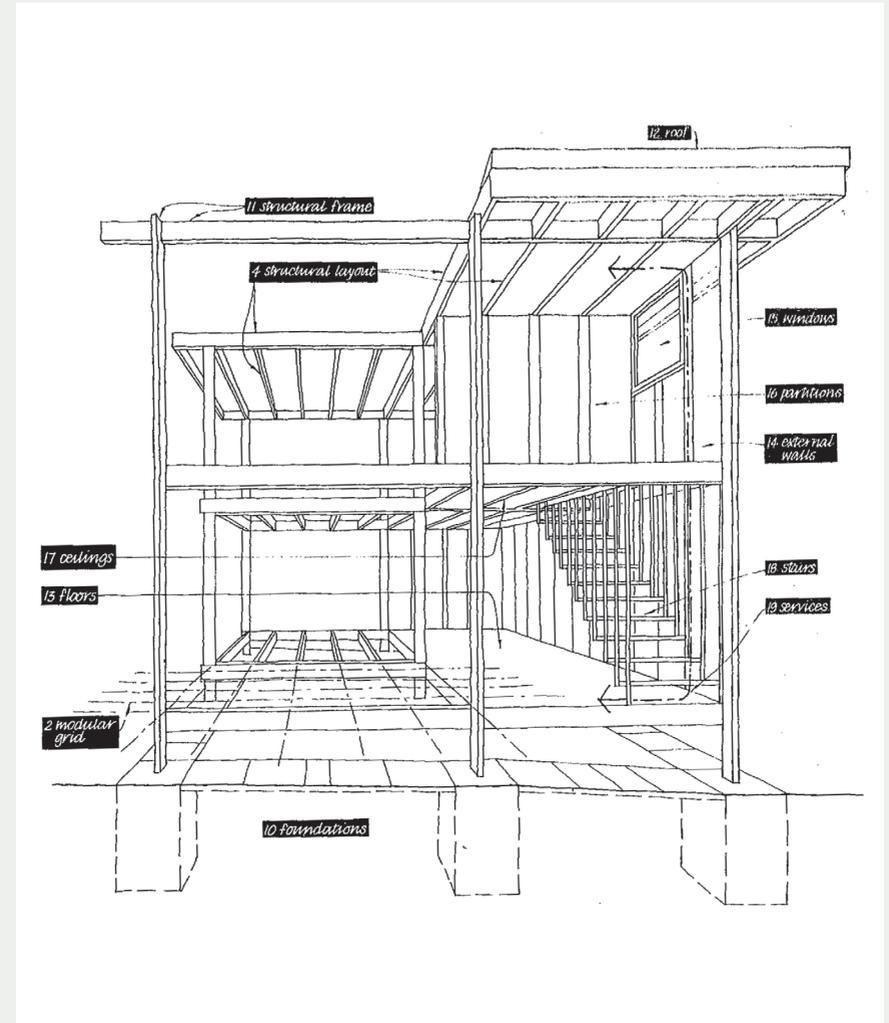


Fig 15 . General Arrangement Of The Various Elements Of Segal's Method



Fig 16 . Interior View Of One Of Seven Properties On Segal's Close, Lewisham, London

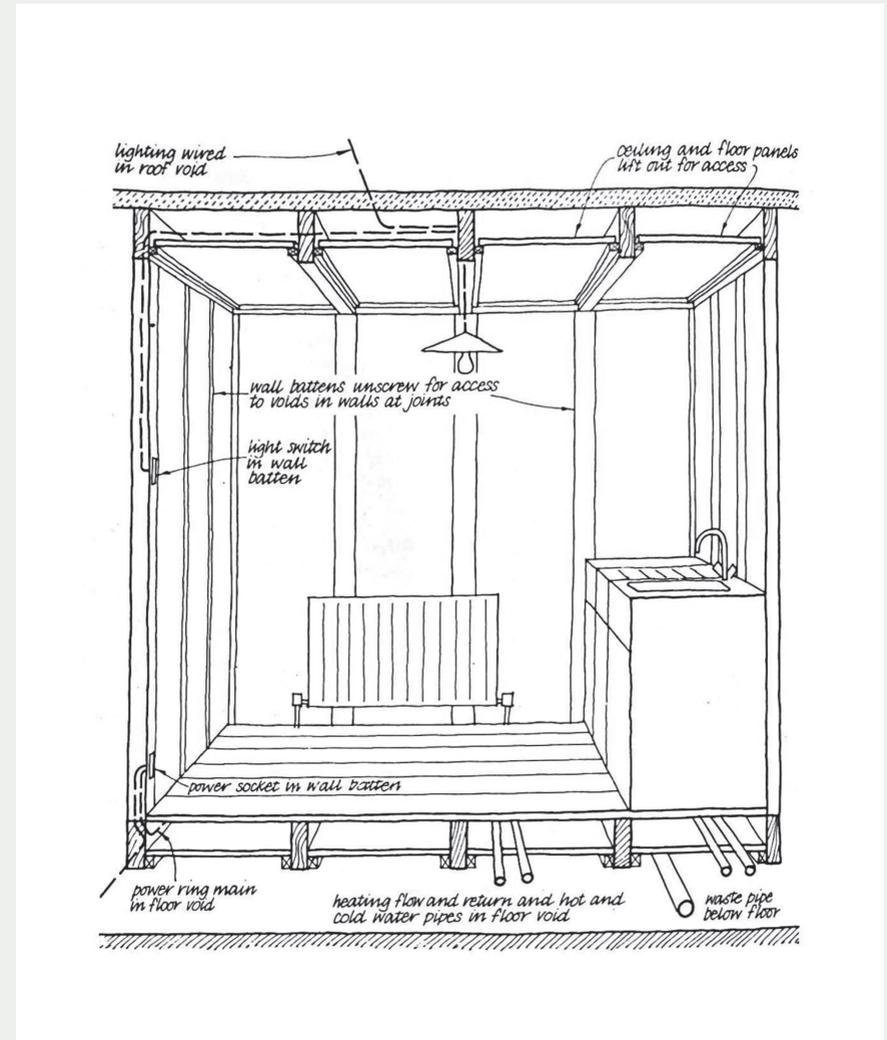


Fig 17 . Arrangement Of The Interior Construction Details

Mexicali Community, Mexico By Christopher Alexander

The project was executed from the year 1975 to 1976 by *Christopher Alexander* and the local people of the neighborhood in *Mexicali*. In this project, *Alexander's* approach is based on his previous researches and studies in the books *The Timeless Way of Building* and *The Pattern Language*.

There are significant differences between this approach and *Segal's* approach, which were enlightening for us.

Here, instead of proposing a construction system that determines the progress of the project, as *Segal* did, the architect focuses on the patterns of every family's lives. The determining factor here is not the architect's mind but is the pattern language that is formed after dialogs with the families. In this project, the role of the architect does not go beyond a translation of the patterns to architecture.

Another difference with *Segal's* approach would be that besides designing individual houses using the pattern language, *Alexander* tends to have a scenario for the shared space. This part is more framed and formed by the architect himself.



Fig 18 . View From The Mexicali Community

After the design is finalized, a proper and simple building technique is selected by the architect and the project starts to get built. They ran a small block-making factory on-site, and by using soil-cement instead of raw concrete for the blocks, they built the walls. The vaults were woven baskets of thin lattice strips, with burlap and chicken wire stapled to them, and the shell of the vault then plastered over the top.

Architect in his project is defined as Architect-Builder, who is different from modern architects and is more reminiscent of traditional master builders. Under the constant supervision of Architect-Builder, members of the community start to build their dwellings. In addition to the times they have to do a common action, the community helps each other when doing a tough job. The sprouts of the social actions which were born during the communal building process will mature after the project is finalized.



Fig 19 . People Collectively Build Lightweight Roof System For Their Houses In Mexicali

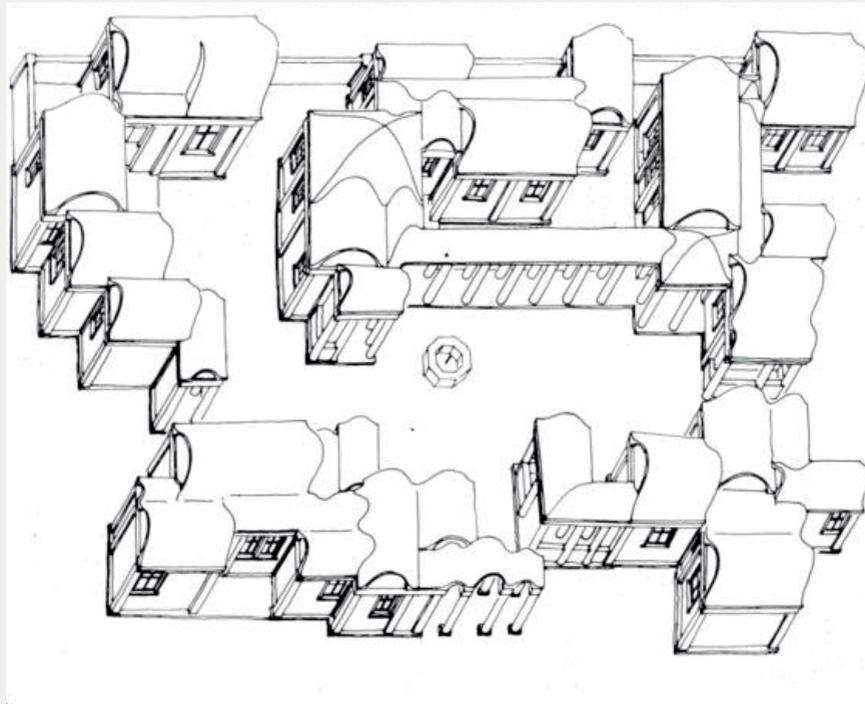


Fig 20 . Axonometric Drawing Of Mexicali Community

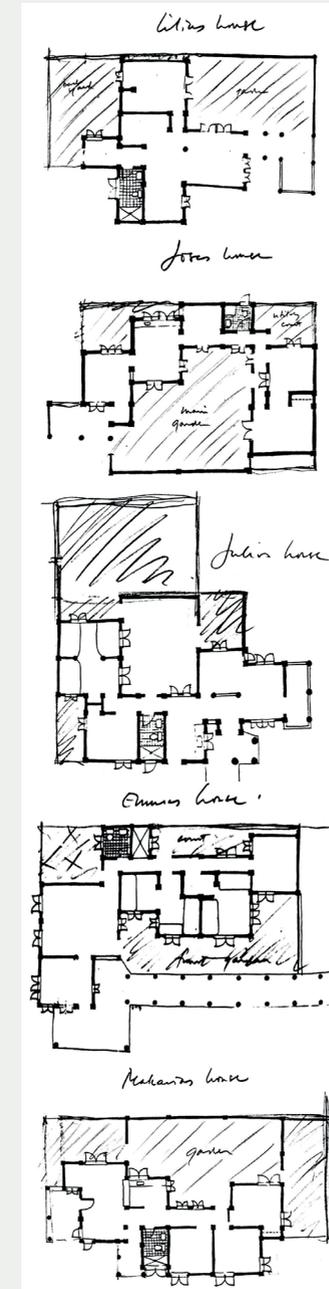


Fig 21 . Plan Drawings Of Different Houses In Mexicali Community

Toward Our Principle

After concluding that dwelling is a verb, and housing has to be done by people in a process, and investigating different projects and approached toward participatory housing projects, we started to determine our principle with analyzing what we have learned this far.

In the following there are some analyses in various aspects that lightened the way for us.

We will wrap up with the presentation of our principles.

What Are We Talking About When We Talk About Participation?

How people participate in the building process is crystal clear in both projects. The question is, how were the people engaged in the design process?

This point of the proposal was very challenging for us to the extent that it made us do fundamental alterations in our approach several times.

In the beginning, we were assuming that the architect's role in the project would be to lead and advise people on how actually to build their houses. Moreover, people are, to a great extent, aware of their priorities and patterns of life. They can get to their desired design with the assistance of a professional architect. On the one hand, the architects of these kinds of projects would claim that the residents, themselves, do the design of the houses. On the other hand, the residents were repeatedly showing their satisfaction from the houses they have designed themselves. These claims were proofs for our mistaken idea that people are the ones who determine the design.

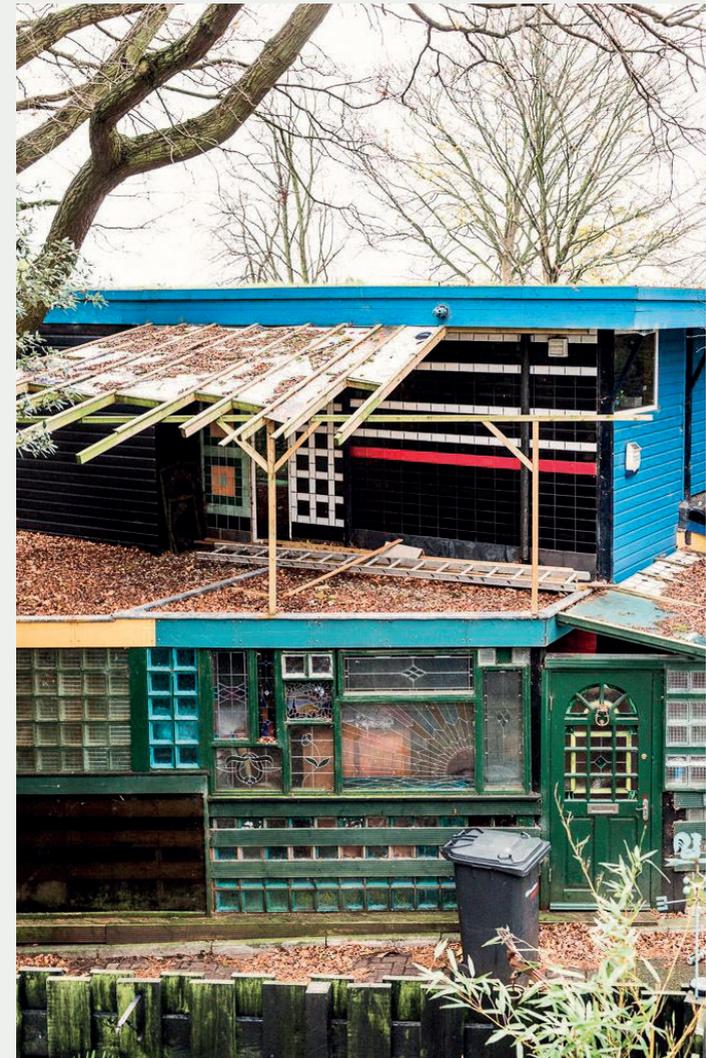


Fig 22 . A View To A House In Walters Way With A Lot Of Identifications

This wrong thought was mainly because the design process in these practices is a result of constant dialog and negotiation between the architect and the resident, as a result when these practices are presented as the common way of presentation in architecture, the role of the resident and the extent of their influence is not so clear to determine.

After investigating these projects deeply, we figured out many similarities in different houses. This brought about two conclusions for us who were about to propose almost the same approach:

1- The essence of people's preferences and priorities is not in a way that can be the determining factor shaping the design. It requires a framework to act upon it. So in these projects, there should be an architect who, based on their ideal and constructional structure, will be influenced and inspired by the priorities and demands people have.

2- People's priorities and demands that can be influential in the design phase are not unattainable complicated unique facts, but are simple basic points by knowing which in the initial steps of design the architect can reach their ideal house.



Fig 23 . A Picture From An On-Site Dialogue Between Segal And The Dwellers Of Walters Way

Where Is A Community In This Game?

In both of these projects, the communal act of building formed the roots of the social relation between the community members. In the end, they reached an incomparable success in community formation.

Segal treated the community very clearly. The social bonds shaped during the communal act of building is adequate for him. In *Segal's* project, no specific design is done for the communal space and also the relation between houses; there, detached houses on each side of the way form a cul-de-sac.

On the other hand, right from the beginning, *Alexander* is looking for a designed communal space between the connected houses, so that this space would be a context for the continuation of social bond that was created during building. However, this space that was shaped by the side-by-side designed houses was considered with less priority compared to the individual houses during the design process. Consequently, the result is far from his initial expectations.

So to put it briefly, it can be mentioned that in both projects, the social bonds are a product of the communal act of building, and the communal space is not so much influential on that. If the community aims for a communal space that is enhancing the social relations, then the architect has to be involved more in the spatial design as well as the organization of houses concerning the common space.

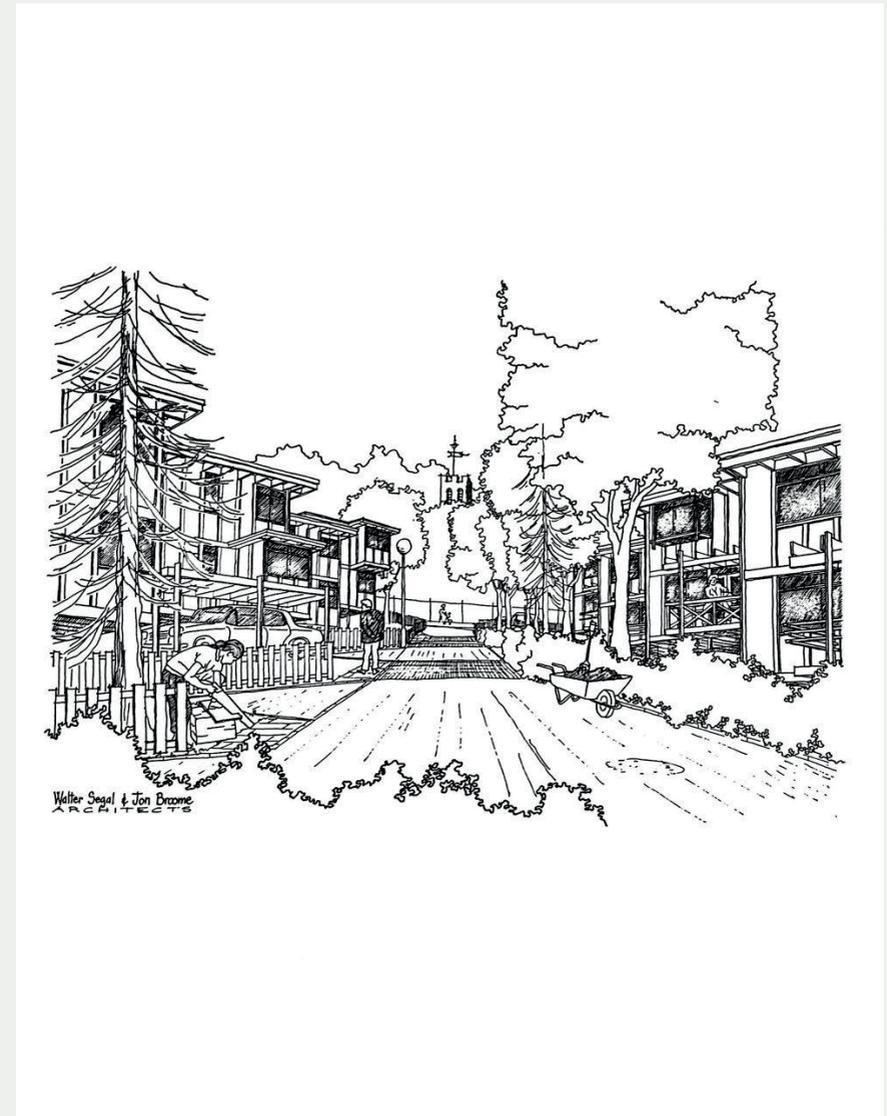


Fig 24 . Segal's Vision of The Community Before Starting The Project

Our Principles

After the investigations above on practices with the same approach, we demonstrated our principle:

-People should be present in the building process.

This presence does not mean they have to do all of the construction. Some parts need to be done by professionals, and some can be done by either one of them based on the project's particular situation.

-People's participation is not independent; instead, it is along with other members so that the building would become a communal act.

-The result of the communal building is a communal housing.

-The design phase is done by the architect and considering the priorities of the residents.

These priorities would consist of several spaces, both shared and private, the means of lighting for each space, and the connections between different spaces.

This principle can be the core of several methods, each of which can reach these goals in their own way. To continue presenting and examining our ideas, we needed to develop our own method based on these principles.

collective-house verb

col·lec·tive·house | \kə-'lek-tiv-hauz \

collective-housed; collective-housing

Definition of collective-house

The act of building a collective house by a community

A Manual To Collective-house In Skåne

In what follows, we will present a proposal to collective house based on the previously mentioned principles, from the first steps of design to the last steps of construction. We need to mention that it is impossible to do a participatory project without the engagement of real people, but it was the situation with our project! We could not stop here. We tried to transform this massive obstacle to an opportunity by aiming to explore and examine the possibilities and capacities of the method of design as well as construction techniques, so we imagined a community with different people with different desires who assisted us through the process!

Material And Technique

The chapter that explains the choice of material and technique and the consequences of this choice on the proposal

The Choice Of Material And The Building Technique

Alike every architectural project in which choice of material and tectonic directly influence the design process and the final architecture, in these practices, the choice of material and as a result building technique are determining factors in the process of the project. In better words, the technique and material chosen by the architect have to serve design and be a means of participation, not a hindrance to achieve it.

At this point, and in order to continue the design method, we made a choice based on our previous experiences. Our choice was to use earthen materials and, more specifically, Rammed Earth.

As we mentioned before, since earthen materials benefit multi-dimensional characteristics, architects and builders go for them in different situations and with different scenarios. It may sometimes be an excellent choice for sustainable projects, and another time is chosen for its aesthetics. Regardless of why this material attracts one, when it is chosen, one should follow its language and embrace all of its characteristics. For us, though, the main attractive character was its user-capability.



Fig 25 . Interior Photo Of The House Rauch, By Martin Rauch, Schlins, Austria



Fig 26 . Interior Photo Of The House Rauch, By Martin Rauch, Schlins, Austria

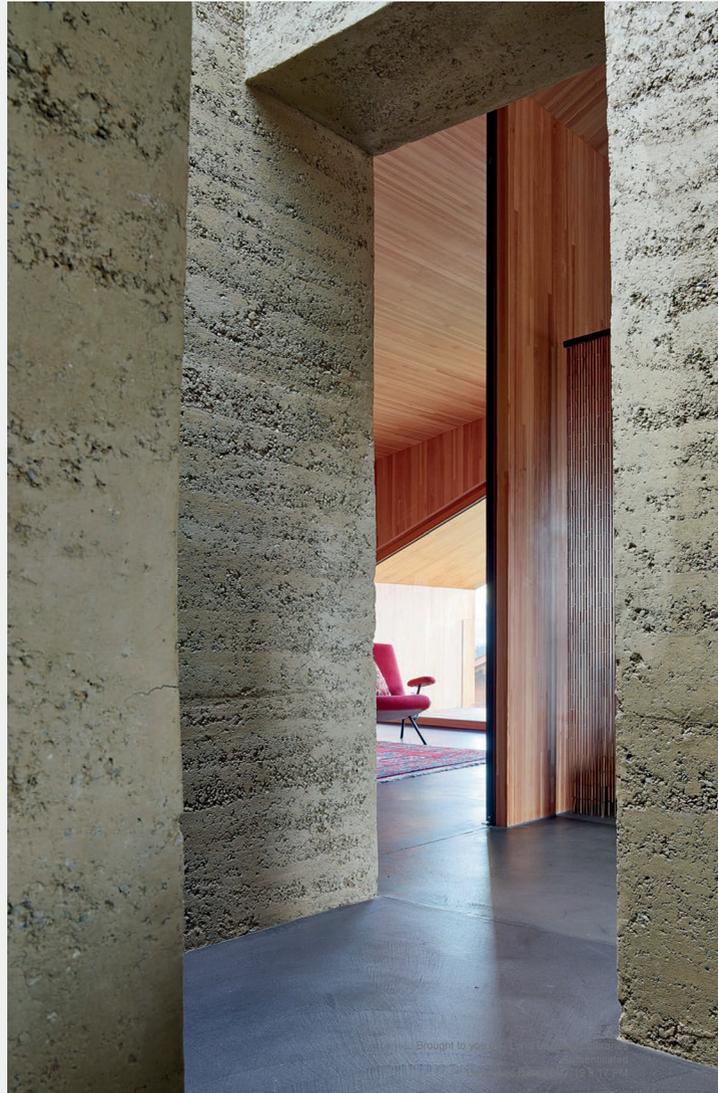


Fig 27 . Interior Photo Of The House Rauch, By Martin Rauch, Schlins, Austria



Fig 28 . Photo Of Mezzana Agricultural College, By Martin Rauch, Mezzana, Switzerland

Words On User-Capability

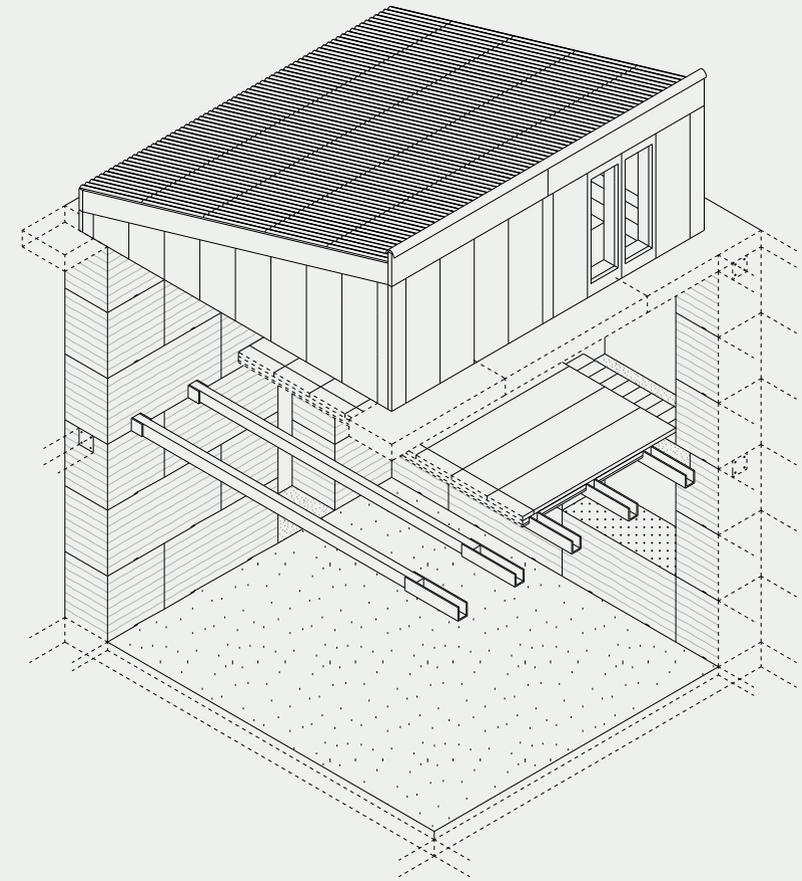
The process of house construction as a fundamental part of human life, all that is gone, one more way in which people have been robbed of the necessary experience by the march of technology. Thus, any statement about participation in house building and the skills it demand seem impossible and far from the ability and skills of ordinary people. If this circumstance is accepted, to have a project matching the basic levels of ordinary people, the design should be so primitive and simple that no one will live in it! Moreover, this would be an end for this approach and will only limit it to some experimental projects. However, User-capability in our idea is defined by the extent one technique is easy to learn and what equipment and tools and what kind of raw material it requires. Provided that people have to participate, they should learn some techniques like other fundamental skills they learn during their lives, and this skill would benefit them in their future life.



Fig 29 . Volunteers In Worms Cathedral Hand-Ramming The Altar, By Heringer, Rauch

Our Tectonic

Our structural system is a system consisting of rammed earth load-bearing walls that will carry the load of wooden roofs and ceilings. Since we wanted to avoid making the system more complex with adding columns, we will keep a span of 4 meters, and all of the spaces made in the design process are formed by the adjacency of modules of 4 by 4. Each of these modules has an independent roof and ceiling. The independency in the roof gives the opportunity to the residents to extend their houses upward using the same wooden construction used in the roofs. Since loads of the ceilings and the roof are carried by two facing walls out of the four walls of each room, the span should remain 4 meters or less in only one direction, and the other span can vary in dimensions. Although, in the exemplary project we did, we kept the four by four modules in most of the spaces and will only have eight-meter span in some of the top rooms on some occasions.



-A Complete Module of 4*4 meters-

Design Method

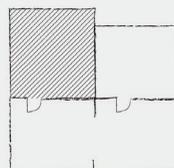
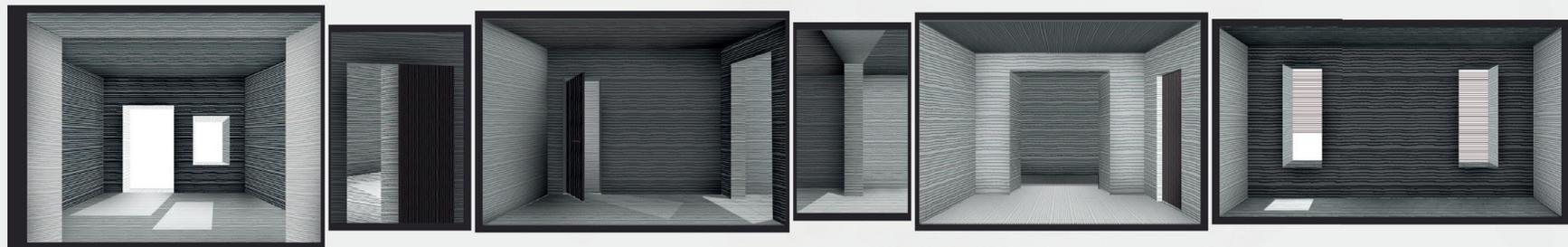
The chapter that explains the method used for designing the community and the way people are engaged

In our method of design, the architect forms a community consisting of a specific group of people; the goal for this gathering is to build a collective house. This collective house consists of gradients of different spaces allowing the residents to be always in a state of sociality they desire. In order to do so, the architect starts dialogs with every group to comprehend what gradient of spaces, and with what relationship, each group desires. In other words, every group should express:

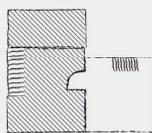
- How do they see common space?
- Considering common space as a part of their home, what other spaces do they need privately? And how do they want it to be?
- How is the connection between their private spaces and the common space?

Knowing these tendencies, the architect makes a collage for every house, showing the qualities of the space and the sequential relationship between them. Then, the architect, while keeping these relations, tries to reach a combination of all of the spaces. With this combination and initial spatial arrangement, the architect will start to arrange servicing facilities, as two wings in the sides of the building, for each house.

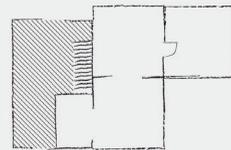
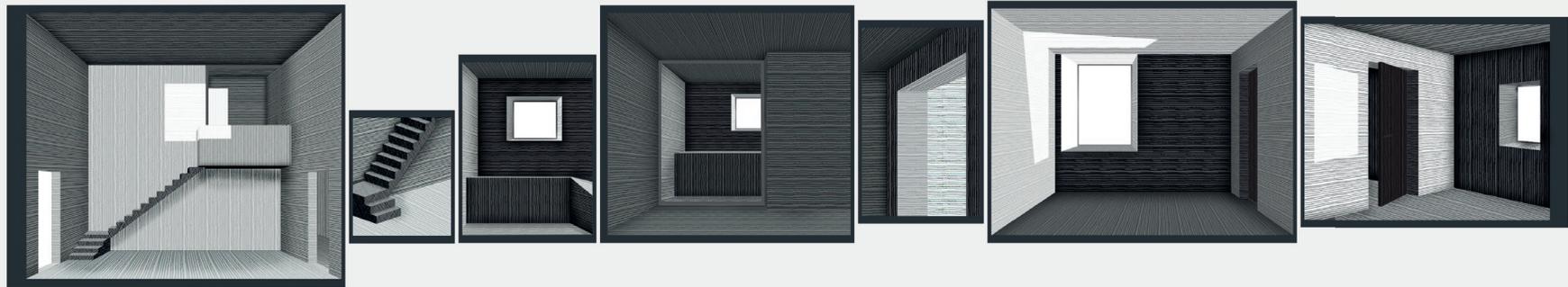
It is worth mentioning again that in this project, we were not able to gather people to form a community, so we conducted the project based on imaginary people. What is presented in the following is the result of an imaginary dialog between the architect and the community members. Our approach in this imaginary adventure was to provide an example to introduces the potential of our method both in spatial and structural aspects.



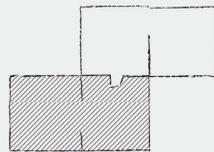
-The Sketch Of Sequence And Gradients Of Spaces For House #1-



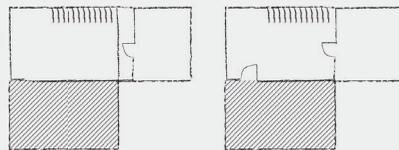
-The Sketch Of Sequence And Gradients Of Spaces For House #2-



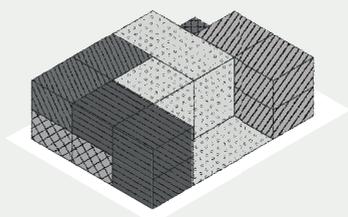
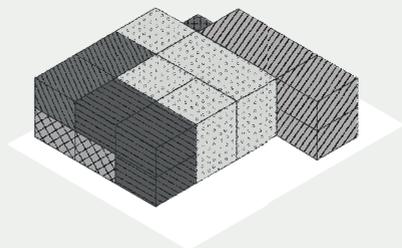
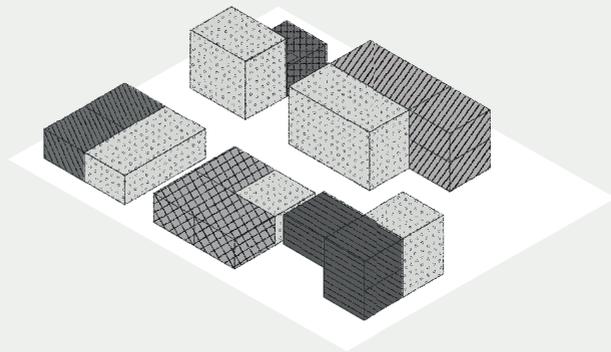
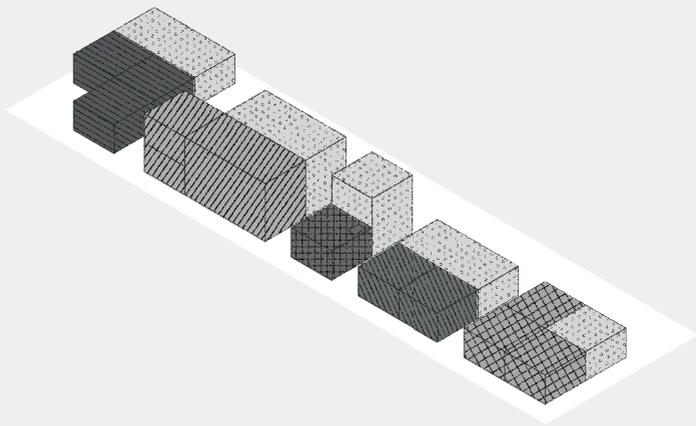
-The Sketch Of Sequence And Gradients Of Spaces For House #3-



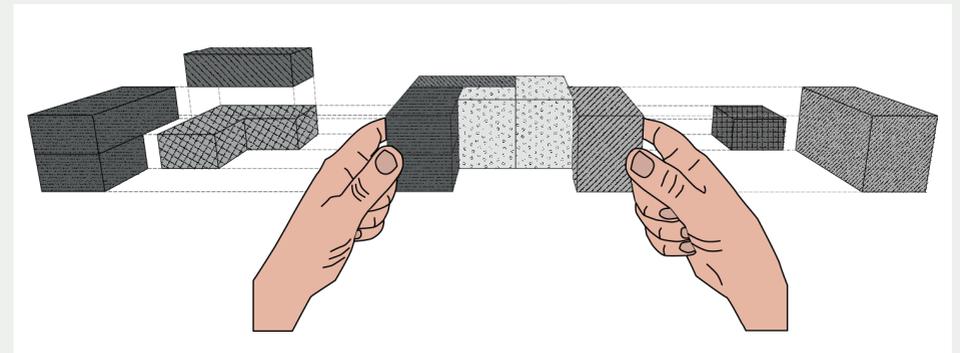
-The Sketch Of Sequence And Gradients Of Spaces For House #4-



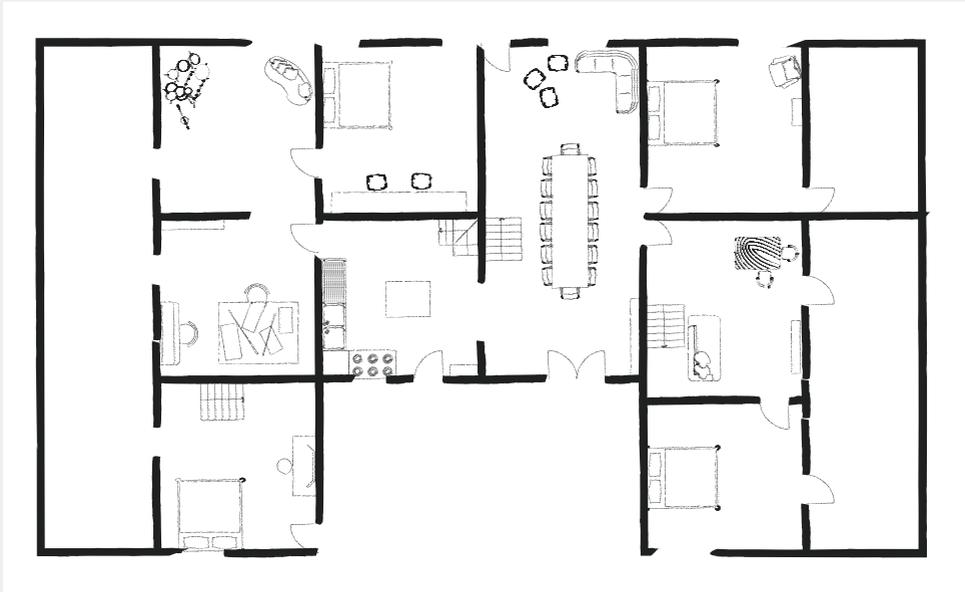
-The Sketch Of Sequence And Gradients Of Spaces For House #5-



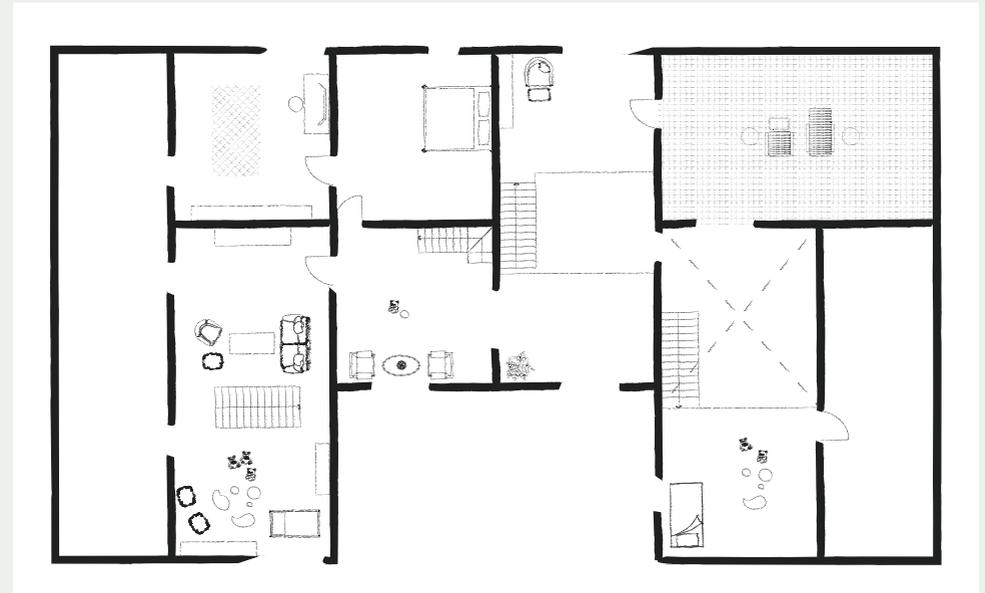
-Negotiating To Move From Sketches To Volumes-



-Combination of Houses By The Architect-



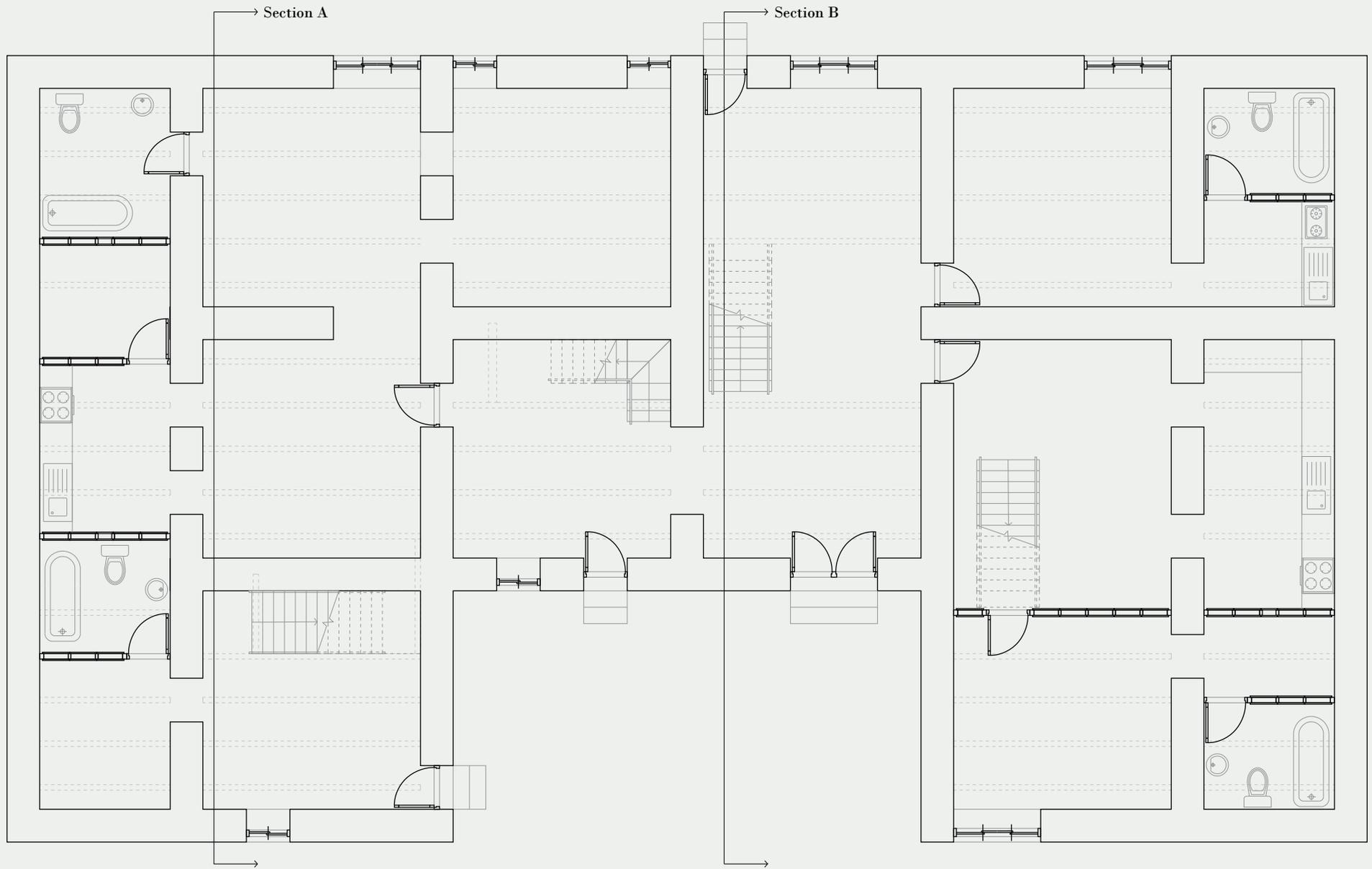
-The Sketch Of Ground Floor Plan By The Architect-



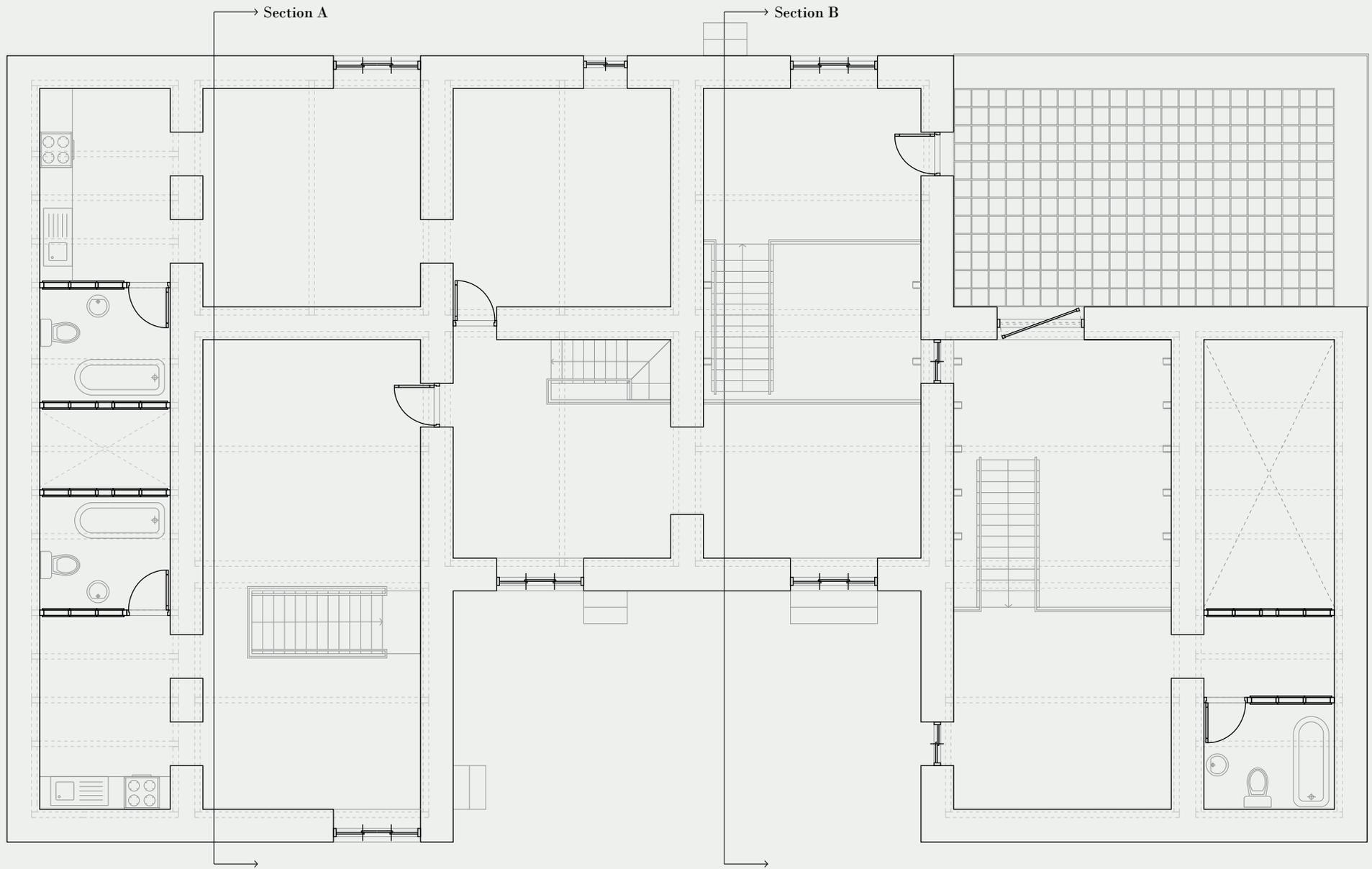
-The Sketch Of First Floor Plan By The Architect-

Building Anatomy

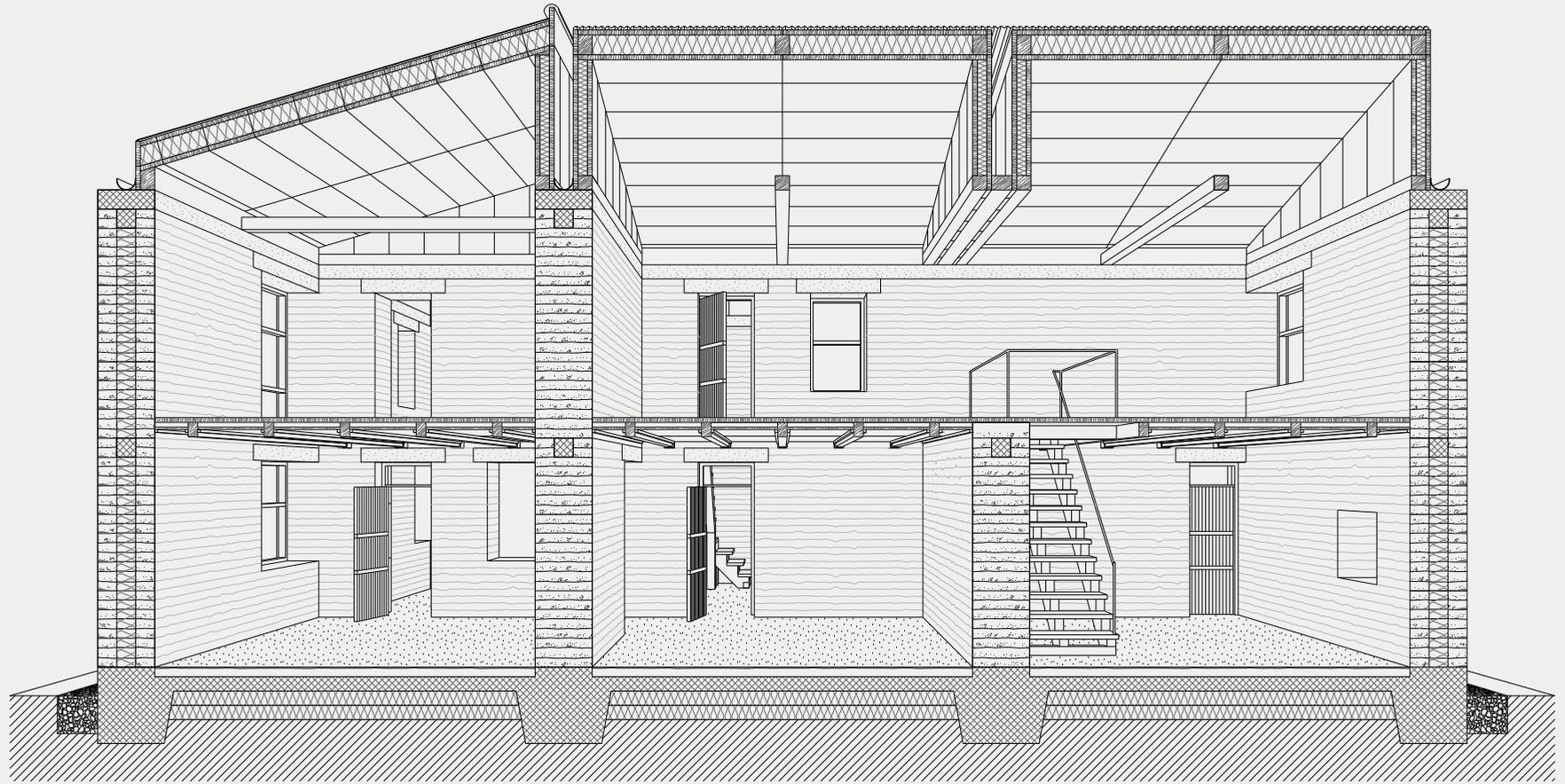
The chapter that shows the possible design with the method and how it corresponds to the construction technique and material



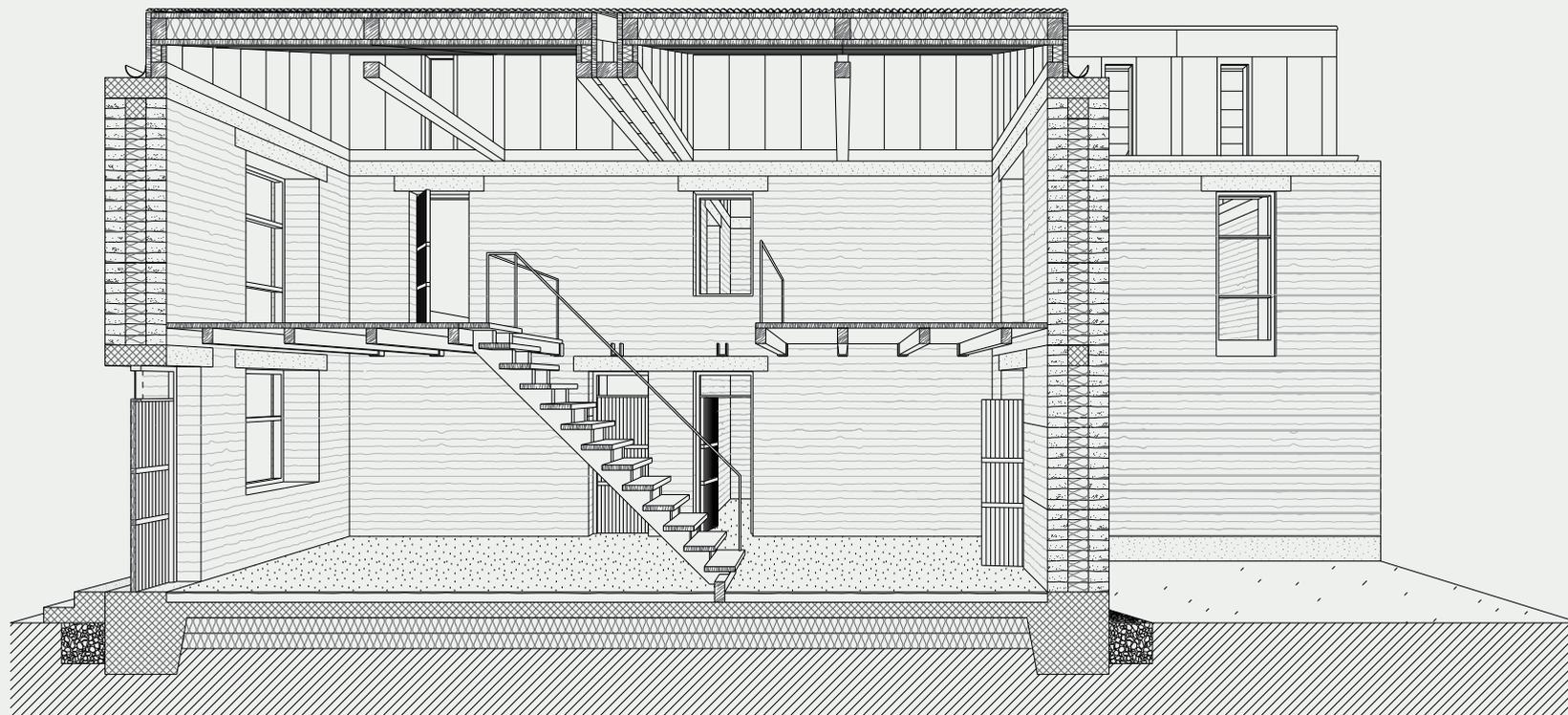
-Ground Floor Plan-



-First Floor Plan-



-Perspective Section A-



-Perspective Section B-

Preparing The Soil

The chapter that explains how to prepare the soil mixture for the load-bearing rammed earth structure

Soil Selection

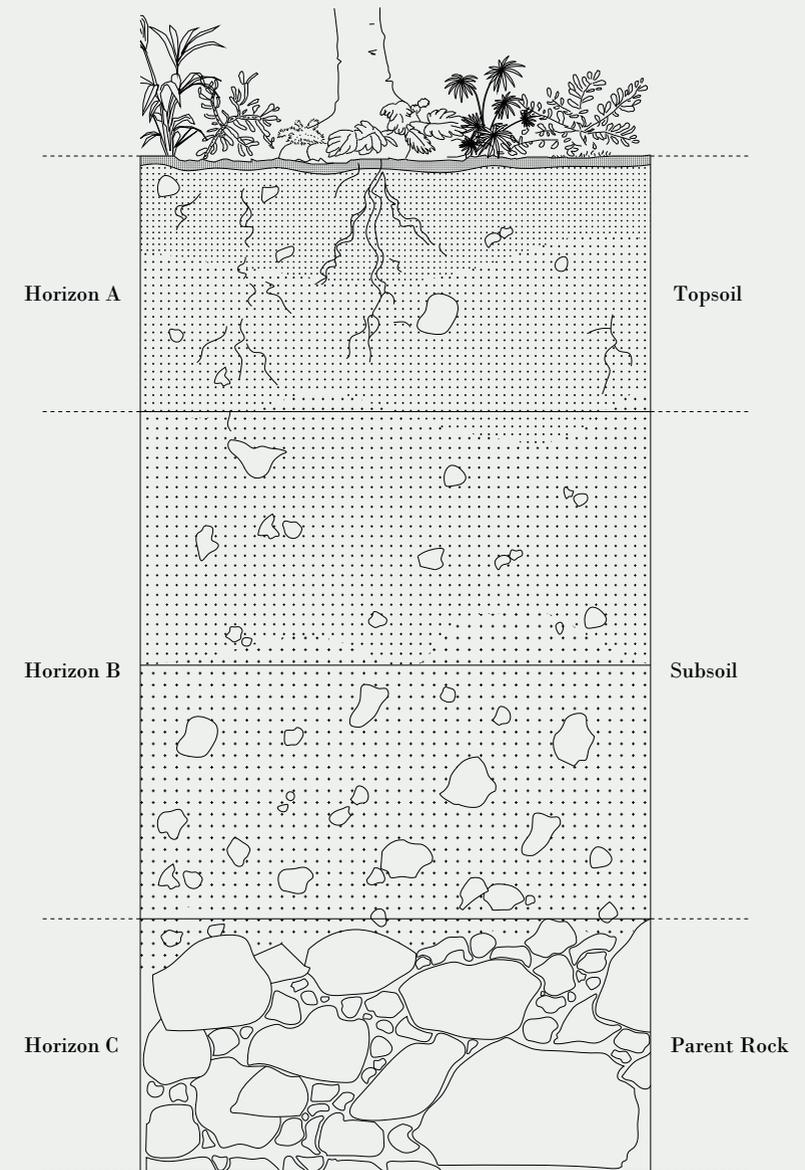
One of the essential responsibilities of the Architect in this project is to provide the builders with soil needed for the projects. The Architect also has to continually control and evaluate the quality of the mix design and its moisture, because if the soil mixture is designed correctly, it is farfetched that any irreparable mistakes would happen in the rest of the process of the rammed earth construction. Due to the cruciality of the valuating and mixing of the soil, it has to be done under an expert's supervision, either architect themselves or an external person.

Considering the different soil mixtures and contents in different parts of the planet, here a question is raised: Is the soil of *Skåne* suitable for Rammed Earth?

There is a wide range of experiments and examinations to evaluate the contents and the proportions of the soil in every area, from in-site tests to laboratory experiments. One can also search for buildings constructed with the same technique in the area, which will, to some extent, confirm the suitability of soil in the area for that technique.

These all make sense when in-site excavated soil, which is from the top layer of earth, is used for construction while, Today, with the deep excavations of the soils all over the world, we are reaching to layers of soil which were not available in the in-site excavations. These deeper layers are, to a great extent, different from the layers above in proportion and give a wide variety of different contents of soils. This precious resource is nowadays considered as waste, and different municipalities have different plans to deposit them somewhere unknown.

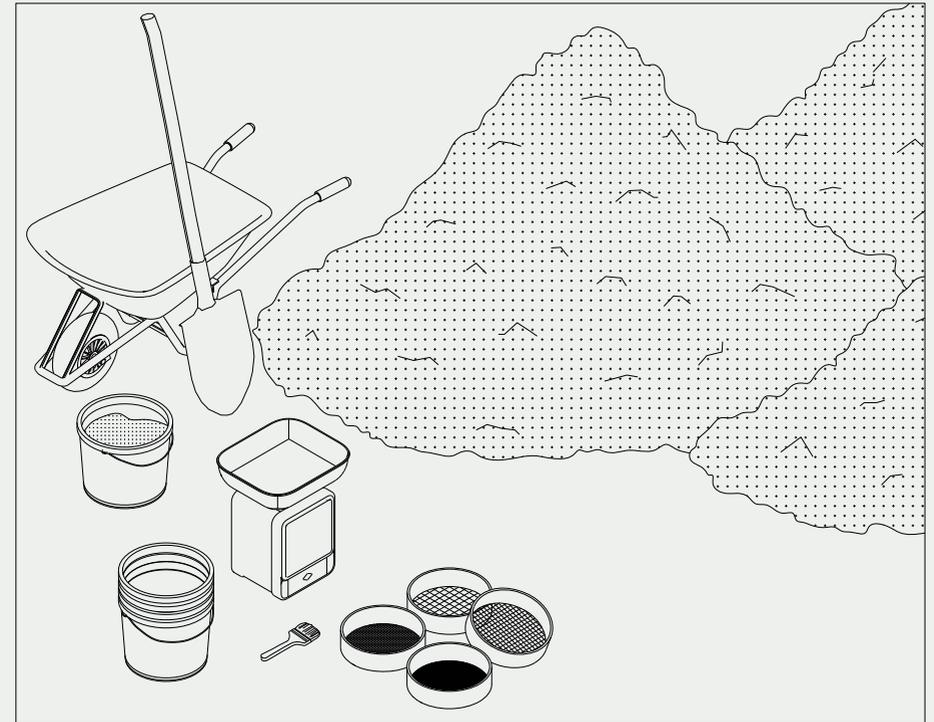
To sum up, using excavation soil will supply us with a valuable source of Earth that can be recomposed if necessary, to reach the perfect mixture.



-Soil Layers-

Sieve Curve Test

In this test, different sieves in different sizes are used for the sedimentation of soil particles based on their granular size. The more sieve sizes available, the more precise the curve test. In order to test the soil using this method, the soil has to be completely dry, because the humidity of the soil makes some finer particles to stick together and be considered as a bigger particle. Since there are limits in sieve sizes available in the market, it is hard to reach the very exact result, and this is another reason for the necessity of the presence of a soil expert. However, this test is very efficient for ordinary people to understand the proportions and compositions of the soil and design a mixture that is suitable for rammed earth construction.



To execute this test, we choose a sample from a well-mixed soil that ensures the homogenous distribution of particles. The sample has to be sieved from the largest mesh sieve to the smallest. Each compartment of the sieve is then weighed. The table should be filled using these data. With the numbers that are calculated in the table, we will draw the curve. The graph will give a percentage of each loam component that is present in the sample.



SIEVE ANALYSIS DATA SHEET

WEIGHT OF CONTAINER (g)

WEIGHT OF CONTAINER AND SOIL (g)

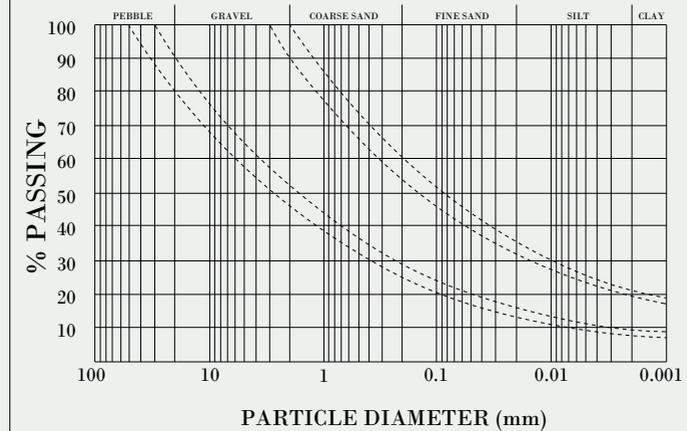
WEIGHT OF DRY SAMPLE (g)

DATE:

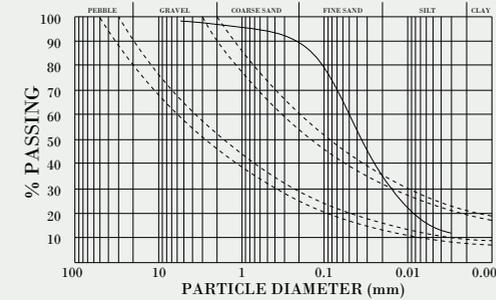
SAMPLE NAME:

DIAMETER (mm)	SOIL RETAINED(g)	SOIL RETAINED(%)	SOIL PASSING (%)
20			
1			
.2			
<.2			

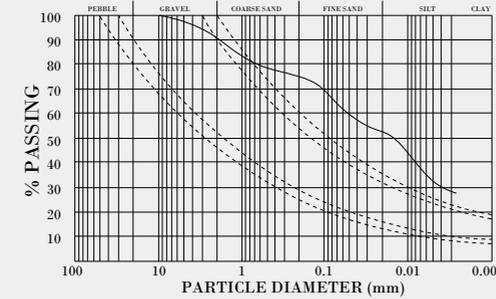
TOTAL



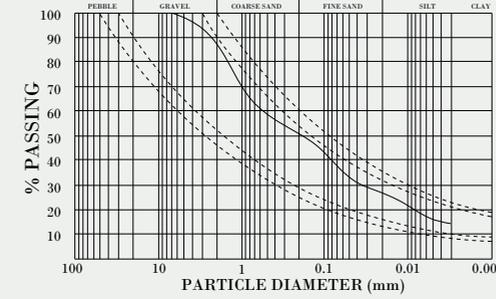
Every curve can give us plenty of information and will help to reach to the composition of the soil suitable for rammed earth application. In the graph, sudden falls or rises, signal a missing or excess particle in the mixture. The four dashed curves in the graph show the range of soils suitable for rammed earth applications. If the curve we draw locates within this range, the soil can be used for rammed earth. If not, by analyzing the graph, we recognize the missing and excess particles in the soil that has to be added to or removed from the soil mixture. This process is called recomposition of the mix design.



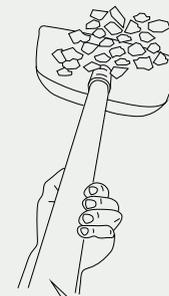
This curve indicates a high fine sand content.



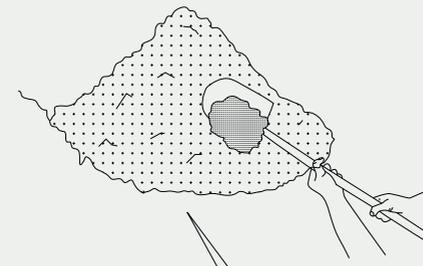
This curve indicates a high clay content.



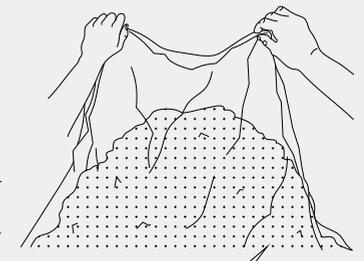
This curve indicates a suitable sample.



If your soil needs an additional mix of aggregates, try to use angular-shaped aggregates.



Mix the earth in order to reach a homogenous mix! We need a homogenous mix before adding moisture.



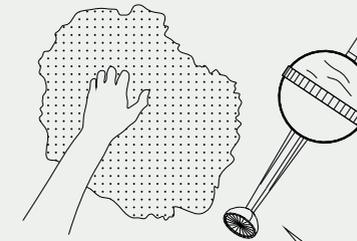
Cover your soil with plastic sheet while you are not using it.

Ball Drop Test

Using the sieve test and by analyzing the dry soil, a recomposition can be done if necessary. For rammed earth applications, the soil should have a specific content of moisture. The best way to find the desired moisture content for the soil sample is the ball test. In this test, we should take a handful of earth from different homogeneous moist loam and squeeze it firmly to compress it in our hand. By dropping these balls on a solid surface and observing their decompositions, the sample with perfect moisture content can be recognized.

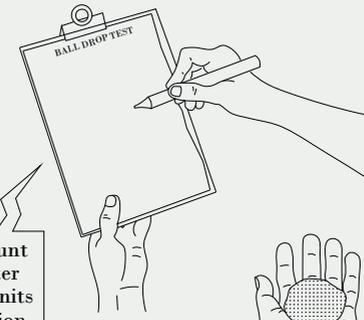
The sample's moisture content changes over time if exposed to air. Thus, it is recommended to only prepare stockpiles with perfect moisture content enough for one day. In other words, unlike the sieve test that can be done on the whole stock of earth for the project, the ball test should be repeated several times during the execution of the project. For this test, like the previous test, the presence of a soil expert is necessary, but over time, people can feel the good earth and adjust the moisture content of the soil they are using themselves.

This test should be repeatedly done to reach the perfect result.

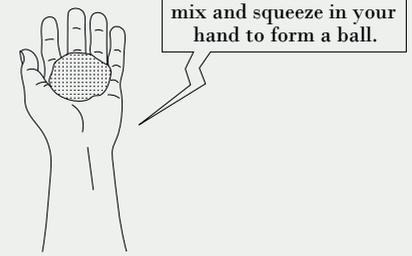


Add a specific amount of water to a certain amount of soil.

Gradually add water in every step.

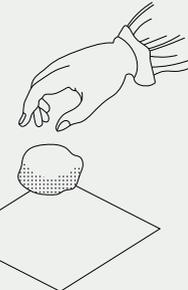


Right down the amount of soil as well as water using the measuring units that suits your situation.



Take a handful of the mix and squeeze in your hand to form a ball.

Drop the ball from 1.5 meters above ground on a hard surface



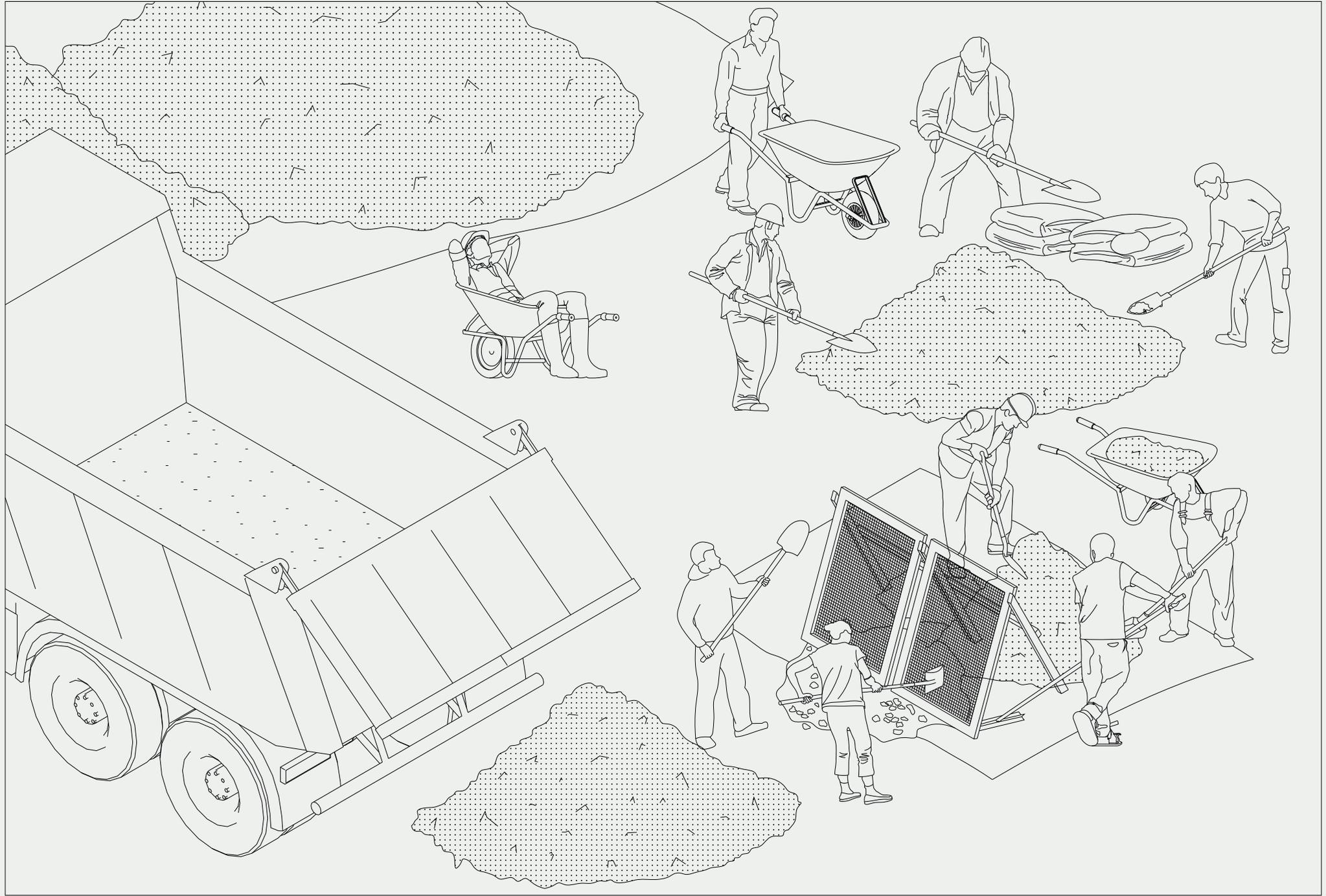
The way ball decomposes gives us a signal.

If the ball crushed completely, the moisture content is too low to make the clay particles sticky.

If the ball stays in one piece, it is too wet. Add more soil.

If the ball broke into 6-7 pieces, the moisture content is enough.





-Collective Act Of Preparing The Soil-

Producing The Formwork

The chapter that explains how to make a wooden framework to compact the soil into load-bearing rammed earth blocks

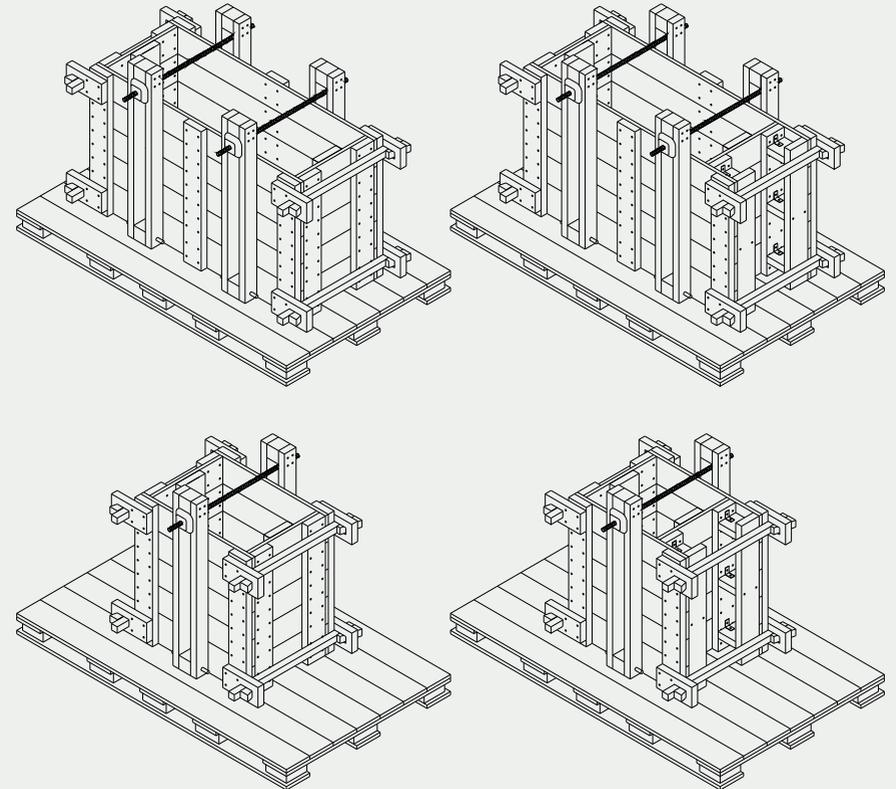
Prefabrication

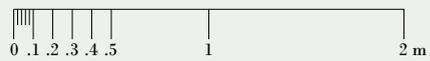
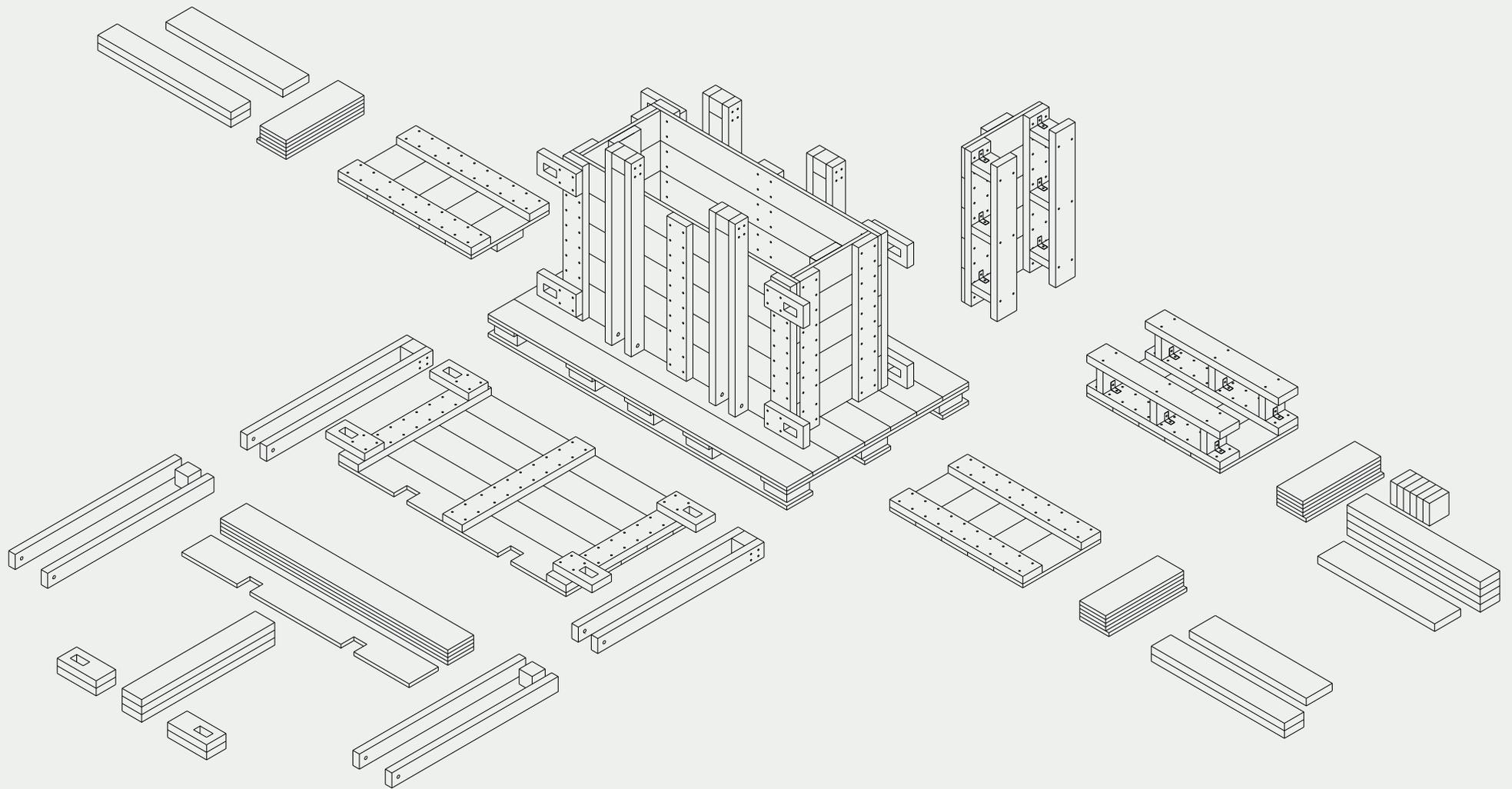
Generally, a rammed earth wall with enough thickness should bear a load, whether it is the load of another row of the wall or the load of the roof. There are two ways of treating the rammed earth wall during construction in-site:

1. Waiting until it reaches the load-bearing capacity since the wall has some extent of moisture inside when the framework is detached and needs time to dry and harden completely.
2. Keeping the formwork of the lower rows while ramming the higher rows. During the ramming process, the whole wall should be kept dry and safe from the rain.

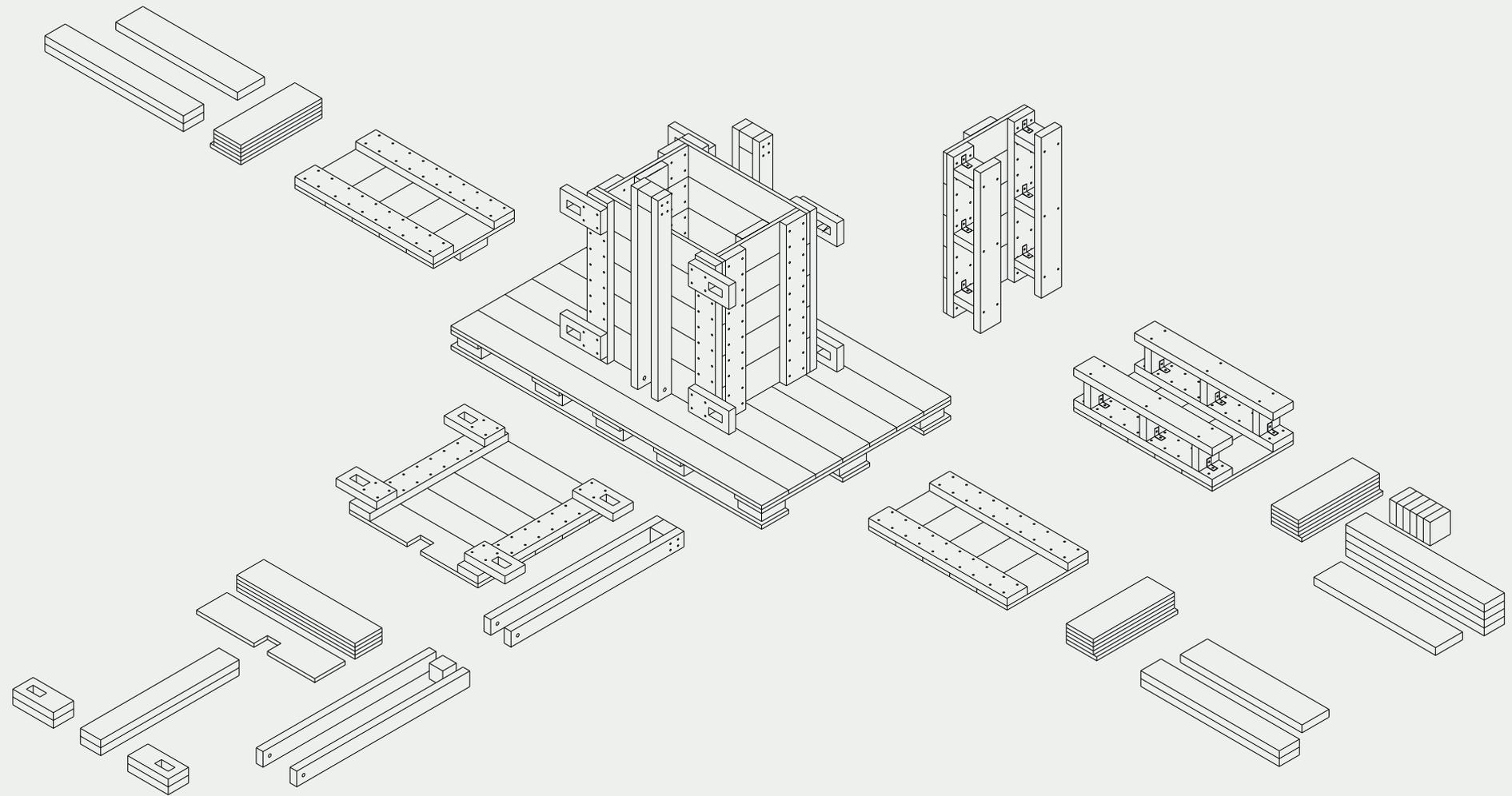
When imagining this project to be executed in *Skåne*, there are restrictions and limitations which do not allow any of these two methods of in-site rammed earth construction to be implemented. *Skåne* is humid and rainy; thus, it takes longer for the walls to dry completely so that another row of the wall or the roof can be mounted on top of it. In this case, we need to keep the formwork or another support to hold the previous rows when ramming the new rows. Furthermore, we will need scaffolding for higher levels. This method is expensive, time-consuming, and hard to conduct. Besides, executing some details to improve the function of rammed earth wall against erosion or thermal insulation during construction on scaffolding and in height would be hard.

Our alternative to this is using pre-fabricating rammed earth elements but instead of buying them for around 1200 Euros per square meter, building these blocks on site, under a temporary shelter which allows working in any condition. After the preparation and drying of the blocks, a truck crane will transport the element to their place.

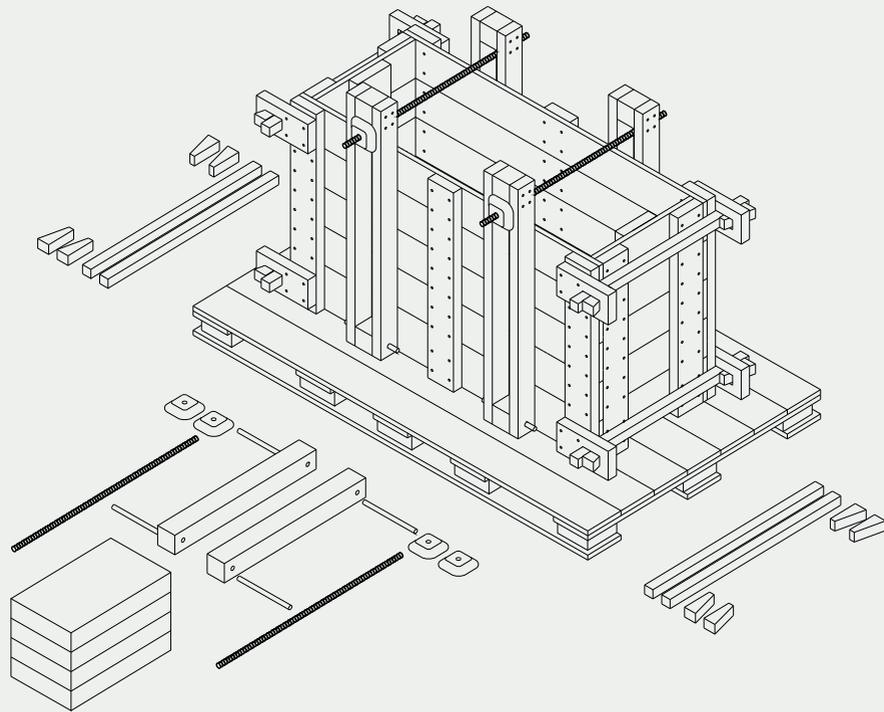




-The Elements Of The Formwork For 160 And 140 Centimeter Long Blocks-



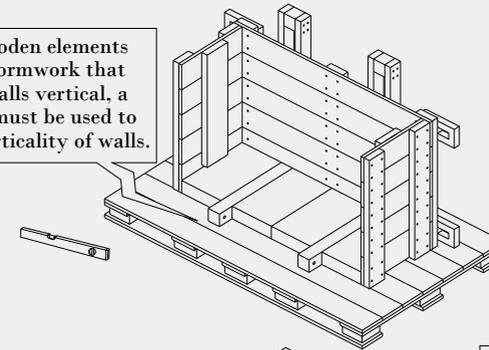
-The Elements Of The Formwork For 80 And 60 Centimeter Long Blocks-



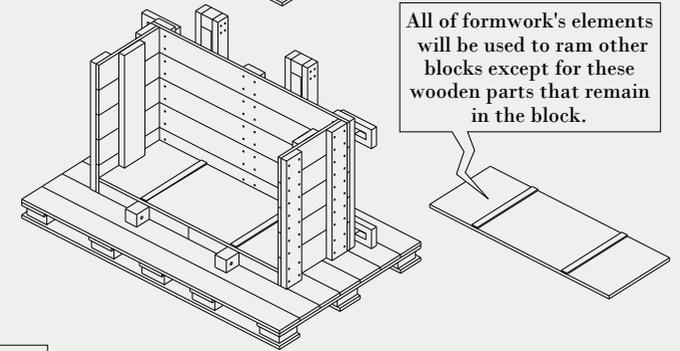
0 .1 .2 .3 .4 .5 1 2 m

-Stiffening Elements And Assembly Of The Formwork-

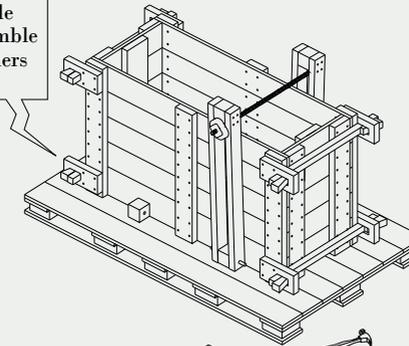
Besides wooden elements inside the formwork that make the walls vertical, a level spirit must be used to assure the verticality of walls.



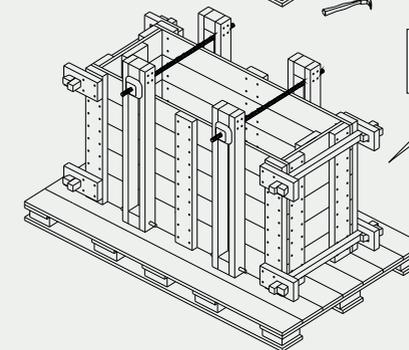
All of formwork's elements will be used to ram other blocks except for these wooden parts that remain in the block.



If two or three people work together to assemble formwork, the stiffeners will fit better.



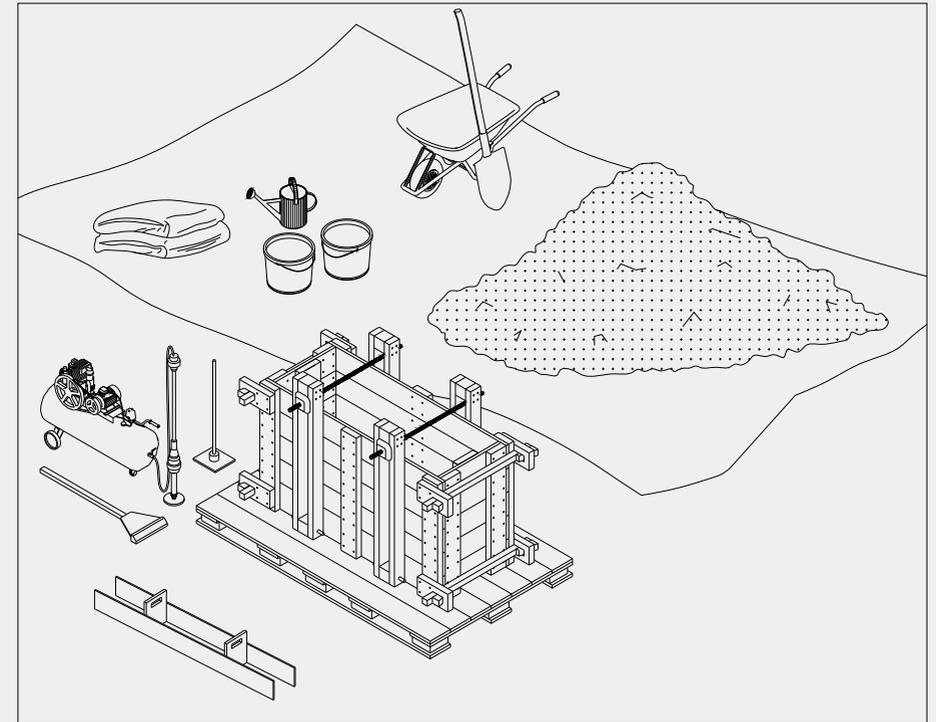
The formwork is now ready for ramming earth!



Producing The Blocks

The chapter that explains how using the formwork, different blocks are produced for the load-bearing wall construction

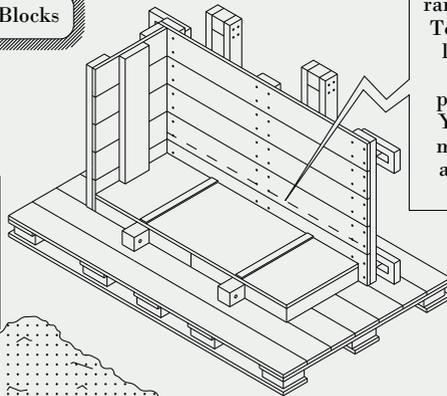
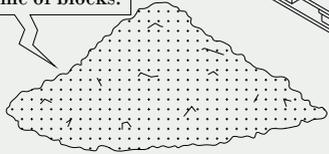
In the chapter Producing the Formwork, we mentioned that we need different sizes of blocks to build a wall with rammed earth blocks. Like brick courses, we should avoid having the seams between blocks over each other since it weakens the stability of the wall. Another parameter that makes the blocks different is whether they are forming an interior or an exterior wall. The interior walls are simply rammed earth that can simply be done by people under the supervision of an expert, but the exterior walls are refined to improve the way building functions in the future. These blocks can also be made by people if they want, but need more accuracy and attention to the details while producing.



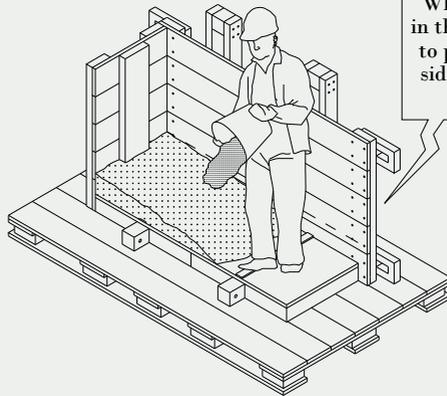
-Tools And Materials For Building The Rammed Earth Blocks-

Building the Interior Blocks

Earth loses 1/3 of its volume when rammed. So it is necessary to prepare soil 40% more than the volume of blocks.

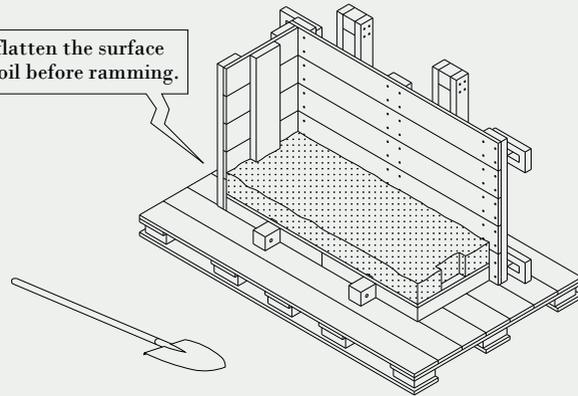


There are 8 layers of 10 cm rammed soil in each block. To pour the soil for every layer, we need to mark 15 cm above the previous layer's surface. You can do it easily by making a piece of wood and mark a 15 cm line on it.

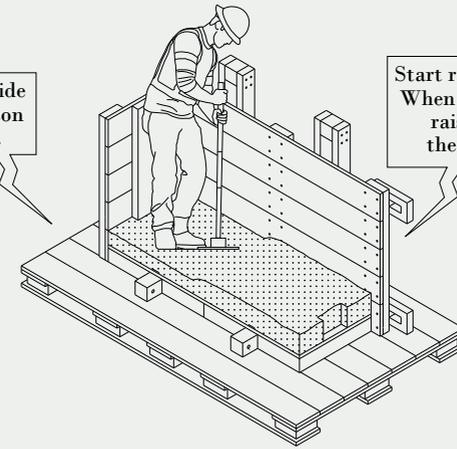


When filling 15cm of soil in the formwork, it is better to pour the soil toward the side walls of the formwork as much as possible.

Try to flatten the surface of the soil before ramming.

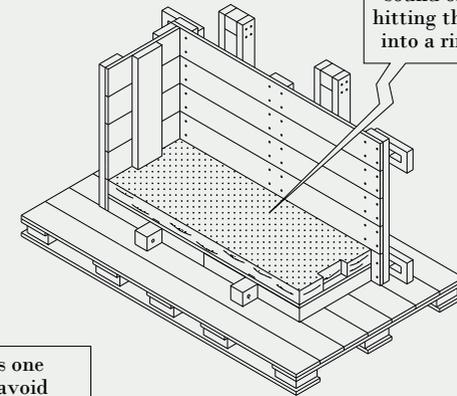


The Formwork is wide enough for one person to work inside it.

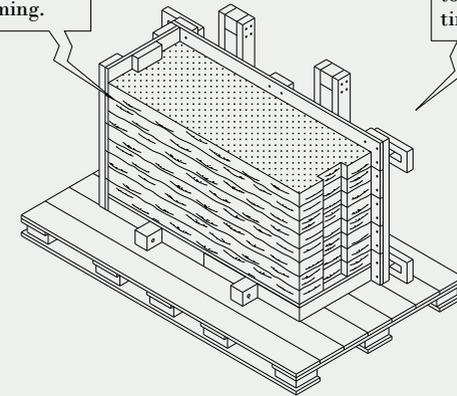


Start ramming from one side. When using a hand rammer, raise it 15-30 cm from the surface and drop it.

Ram until you hear the sound of the rammer hitting the surface turn into a ring-like sound.



Try to ram layers one after another, to avoid horizontal cracks between the layers. So prepare enough soil for every block before starting the ramming.



Repeat the steps to make a layer eight times for every block.

Until here, we explained how to make interior blocks, which are almost 50% of the blocks. Due to their simple construction process, these blocks are entirely compatible with being built by unskilled people under the supervision of an expert. However, the exterior blocks have a refined design to be able to stay against the climate and outside environment. considering the context we were designing in, we need to heed two parameters:

- Environmental comfort
- Rainwater erosion

Environmental Comfort

When talking about earthen materials, especially rammed earth with its thick walls, the first environmental characteristic that comes to mind is its high level of thermal mass ending up to the fast conclusion that it is suitable for desert climates with tremendously hot days and freezing nights (high temperature difference between day and night). But this notion is merely one characteristic out of several critical environmental qualities benefiting which, earth creates comfortable microclimates. In order to get to other environmental qualities, it is necessary to point out influential factors in building climatology, considering all of which beside each other form a desirable interior climate:

- Temperature
- Humidity
- Air Circulation
- Radiation

People can feel fluctuations in temperature clearly, but cannot sense the humidity changes, while it is a crucial factor in environmental comfort and health. Earthen walls, floors, and ceilings maintain indoor “Relative Humidity” to an ideal extent of 50% which is the optimum amount to create a healthy atmosphere for the lungs, mouth, nose, and other respiratory organs. This material maintains the humidity using its ability to compensate for the lack of humidity inside, by the fast release of humidity and to increase the humidity, by fast absorption of the extra humidity inside, like a smart system.

Nevertheless, using raw earth in the context of *Skåne* is not failsafe because the differences between day and night temperatures are not so much. On the other hand, there is a significant difference between indoor and outdoor temperatures. That is why we need thermal (and not moisture) insulation.

We will benefit Misapor cellular glass between the layers of soil to insulate. This material has the potential to be rammed along with the earth that is very valuable since it maintains the consistency of the wall compared to other types of insulations.

Rainwater Erosion

The fear of the wall being eroded when facing rain is one of the most frequent fears among people as well as professionals when it comes to using earth as a building material.

Among the users of this technique exist different methods of confronting erosion. Methods like:

- #1- Having a good hat and a good pair of shoes.
- #2- Adding additives or stabilizers to the soil mixture
- #3- Calculated Erosion

#1- The first method is feasible and roots back to the traditional buildings, but considering the modern aesthetics and also the constraints and restrictions in land and neighboring is not sometimes the best solution.

#2- The Second method will act in two ways:

First, by using glue to fix the particles (gravel, sand, silt, and clay) in the wall and not allowing them to be washed off. (For example by adding cement)
Second, by wearing a raincoat. In this way, a waterproof plaster is applied on the exterior side of the wall (For example by applying Linseed Oil).

Both of the ways mentioned above make the rammed earth wall vapor barrier and, as a result, kill the permeability and breathability of the wall. These characteristics are precisely the main environmental characteristics of an earthen wall, which allow it to maintain the indoor relative humidity!

#3- In the Third method, the wall is left to erode like all of the other natural elements, like the rocks and the mountains. However, this erosion is calculated and under control. To do so, we should decrease the speed of the falling water on the wall by ramming lime powder every 30 centimeters during the construction of the walls, so that the rainwater will not wash the wall so heavily and starts to penetrate the wall three centimeters deep. The clay particles of the wall, when got wet, expand and close the holes in the wall and also retain in their position. However, the finished wall is flat and cannot stop the rainwater, so the rain washes the wall. But after 3 centimeters of erosion (in a 60-centimeter wall), the lime layers will protrude enough to slow down the falling water on walls.

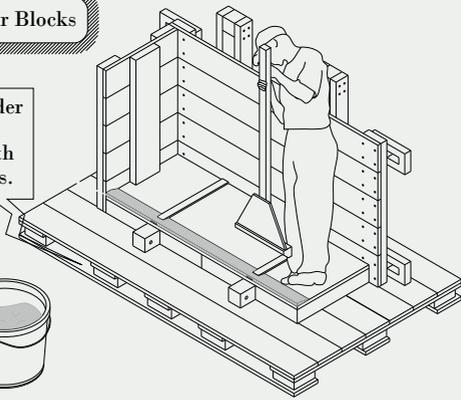
We chose this method to weather-proof our rammed earth walls.



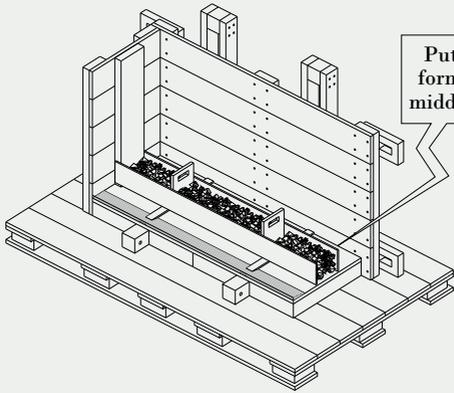
-Process Of Calculated Erosion-

Building the Exterior Blocks

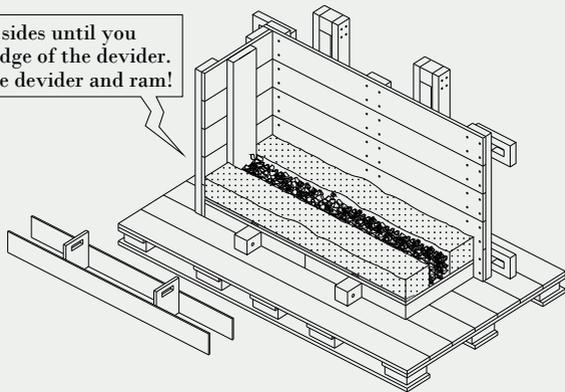
Pour 5cm lime powder on one side of the formwork. Ram with the angled rammers.



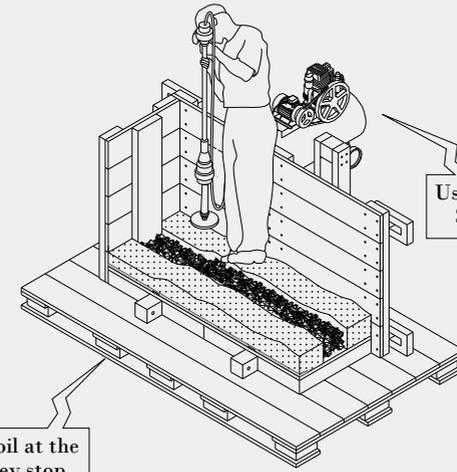
Put the dividers in the formwork. First, fill the middle part with Misapor.



Fill the sides until you reach the edge of the divider. Remove the divider and ram!

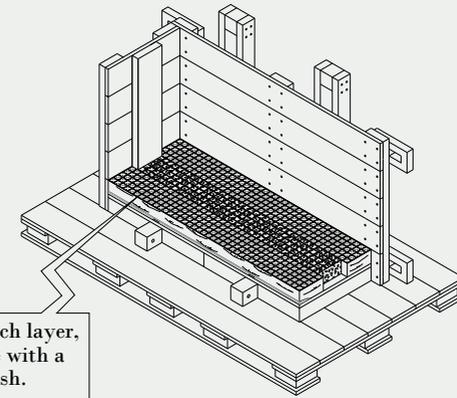


Ram Misapor and soil at the same time until they stop getting further compressed.

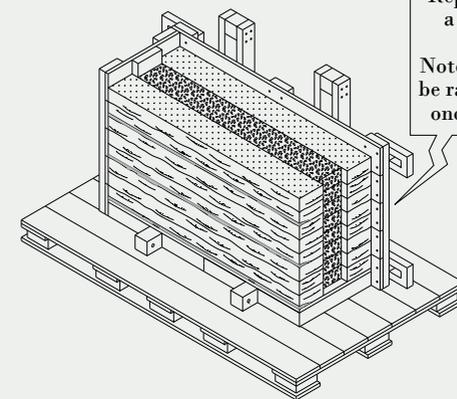


Use Hydraulic tampers to Speed up the process.

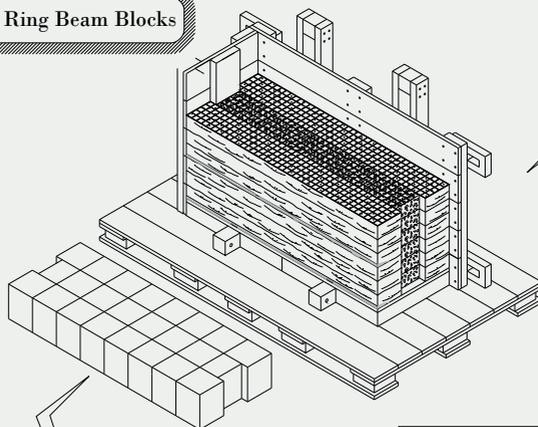
After ramming each layer, cover the surface with a Geo-grid mesh.



Repeat the steps to make a layer eight times for every block.
Note: Lime powder should be rammed between layers, once in every three layer.



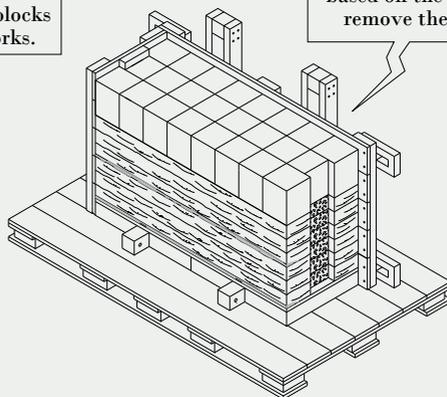
Building the Ring Beam Blocks



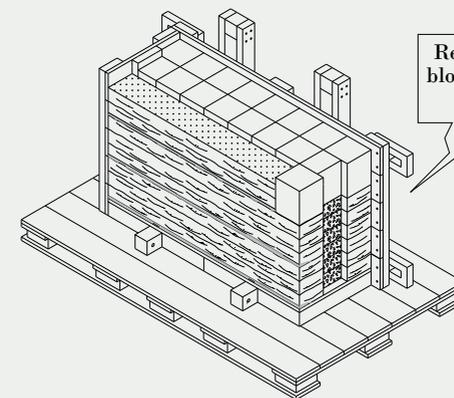
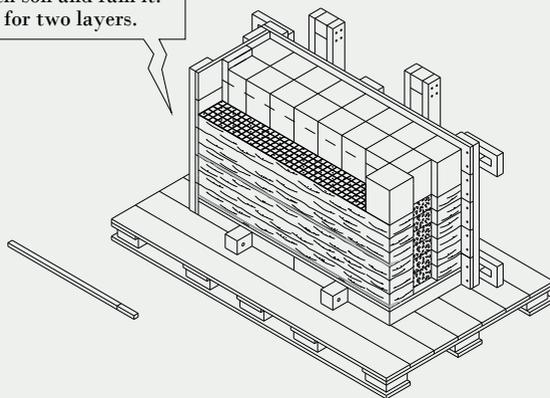
Do the first six layers as before.

Prepare wooden blocks of 20*20*30 cm. These blocks fit all of the formworks.

Fill the empty space with the blocks. based on the plan of the ring beam, remove the blocks step by step.

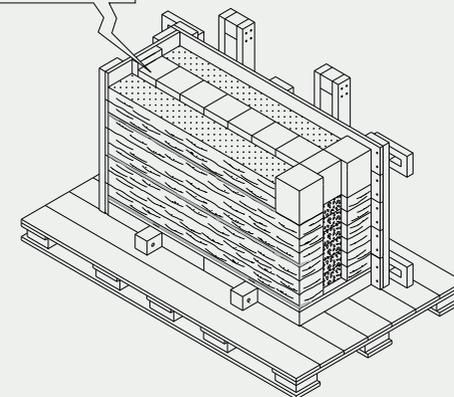


Mark 15 cm from the surface, and fill with soil and ram it. Repeat for two layers.

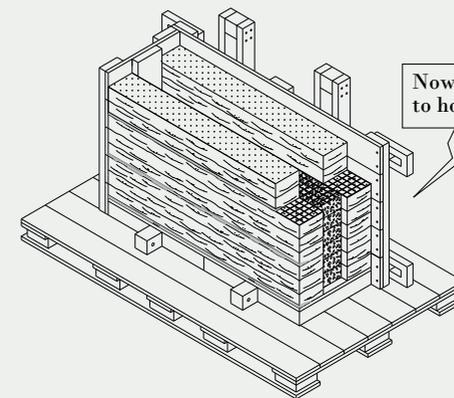


Remove another series of blocks to make the desired shape.

After ramming the reductions, remove the wooden blocks.



Now we have a block ready to host ring beam's concrete.

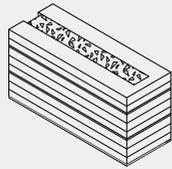


BLOCK INFO SHEET

Responsible Group:

Date:

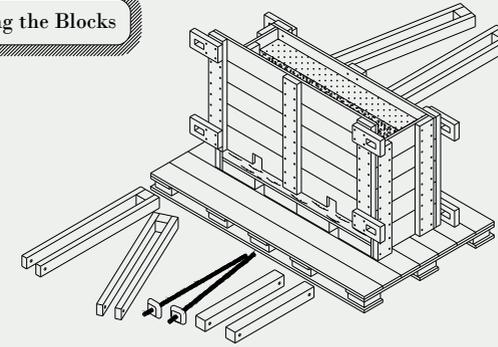
Code	Length	Location	Corner	Reduction
B-024	160	exterior	yes	no



Please attach it to the block after operation!

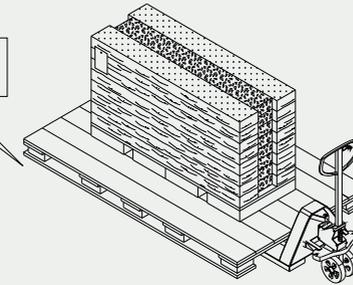
For every block, you should make a "Block Info Sheet" that summarize the properties of each block. After making the block, stick the sheet to the block.

Transporting the Blocks

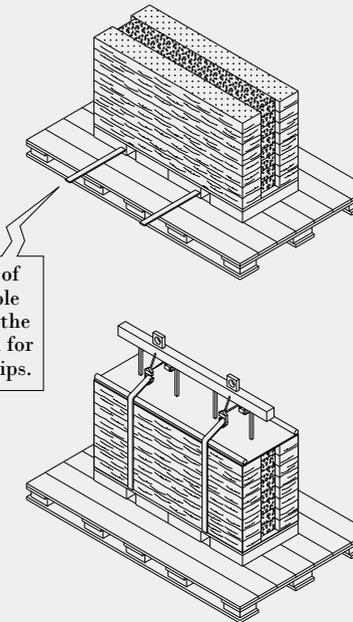


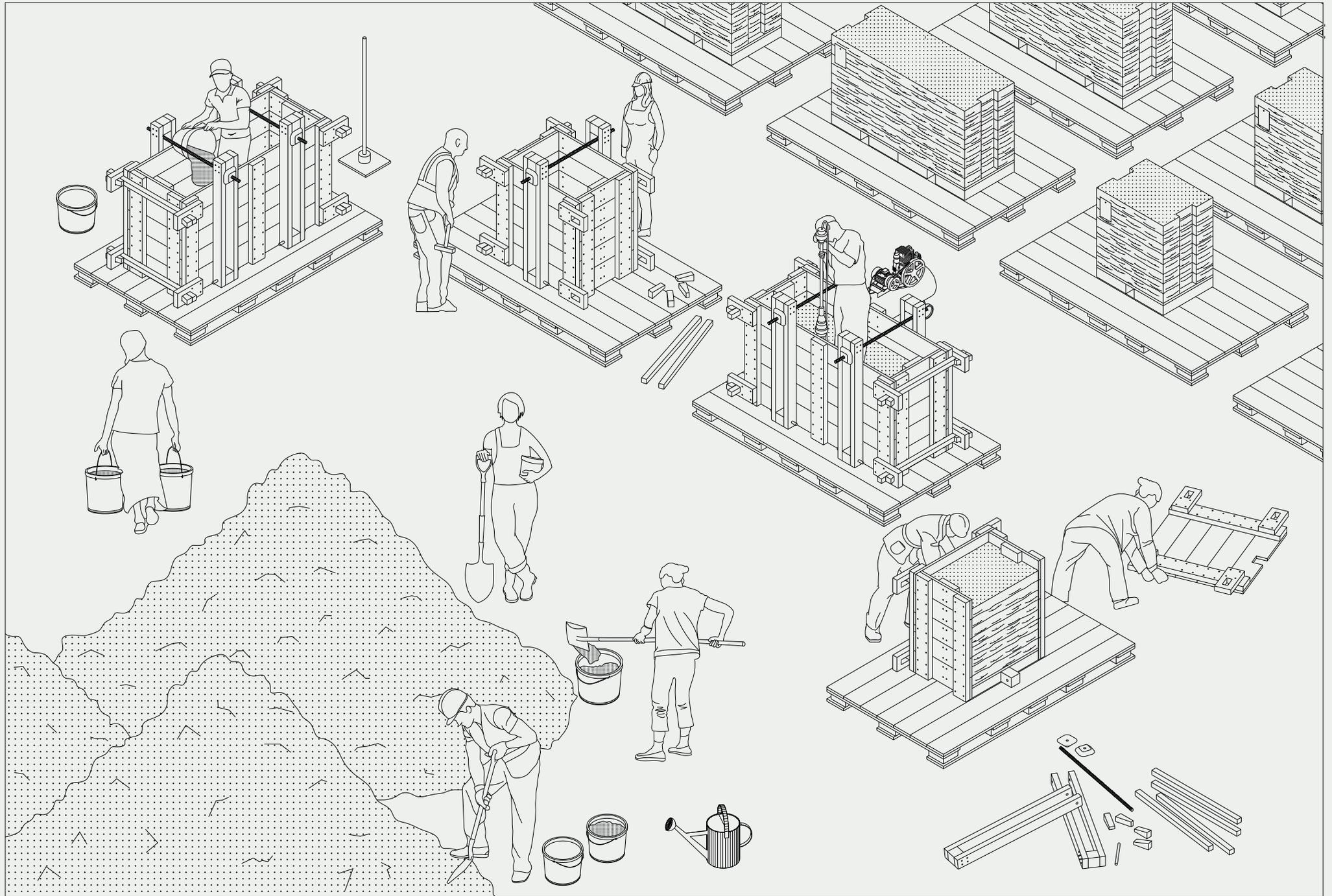
For removing formwork first slide up the formwork then hinge it away.

Use pallet jack to move the block.



Thin wooden sticks of 5*1 cm are removable from the bottom of the block to make room for the transporting strips.

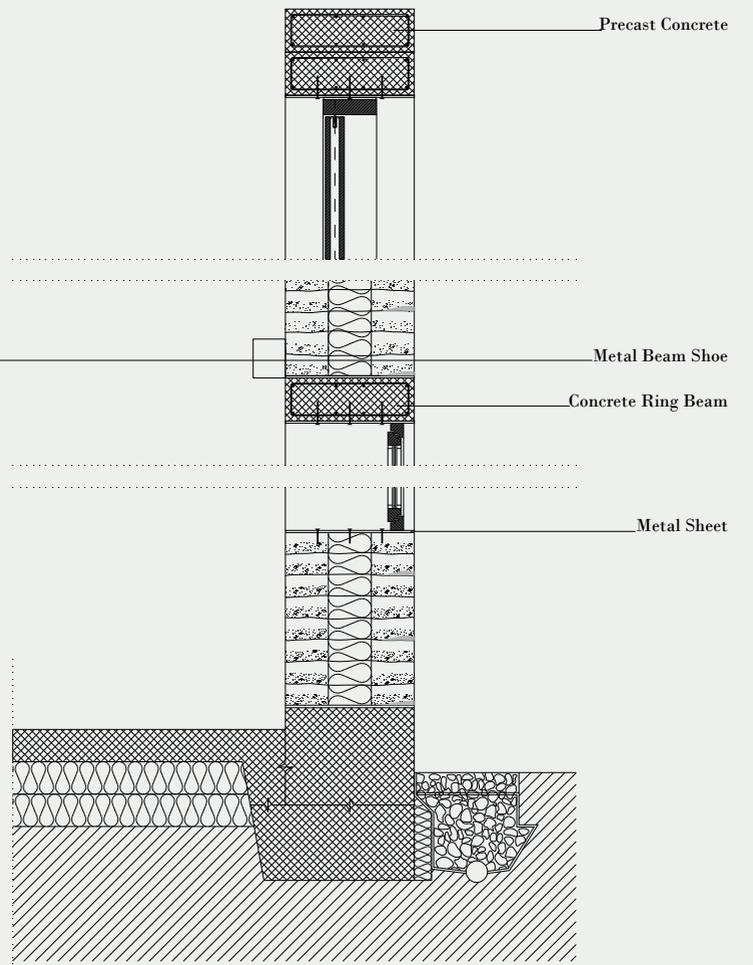
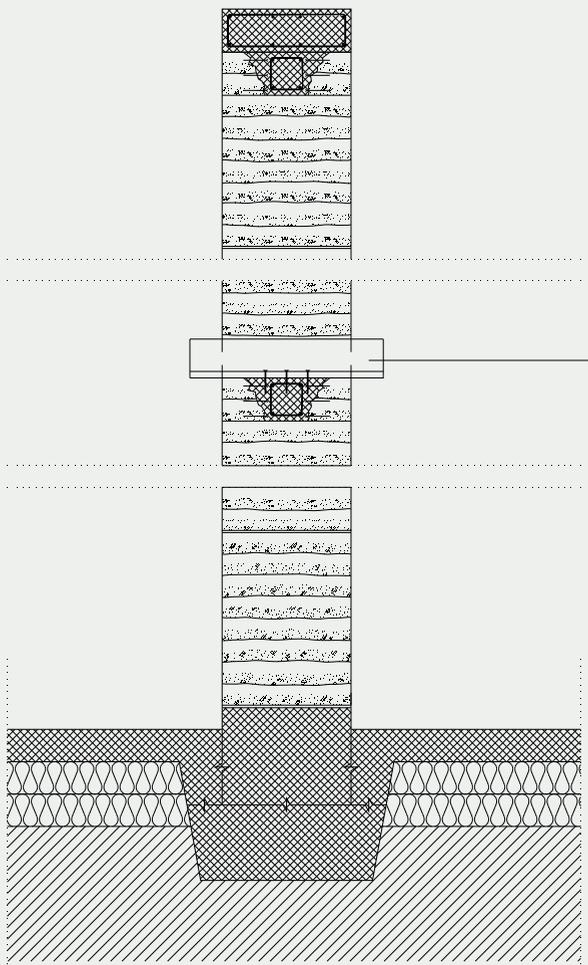
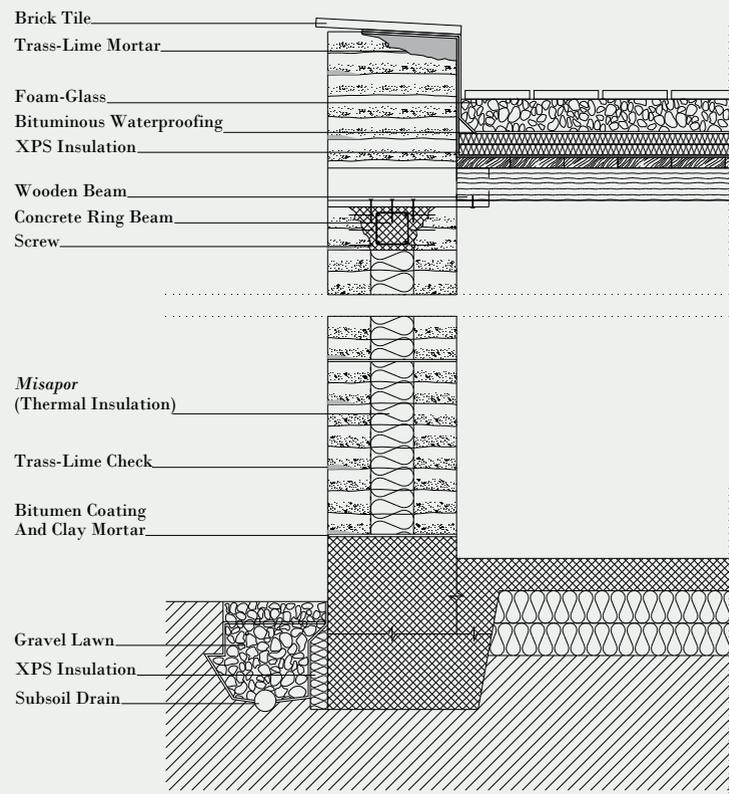




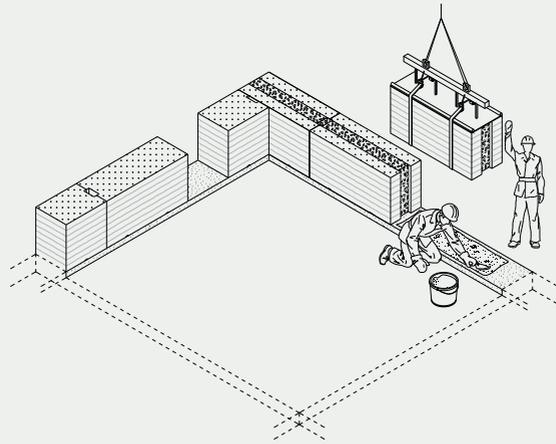
-Collective Act Of Building The Blocks-

Contractors' Task

The chapter that explains briefly how should the contractors build the foundation, assemble the blocks, and make the ring beam

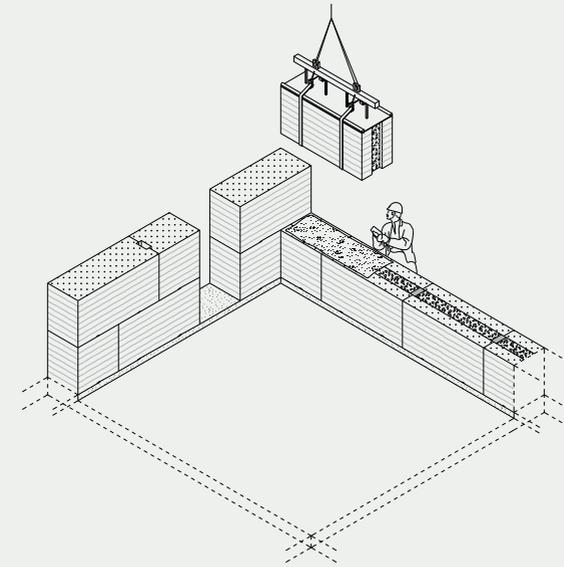
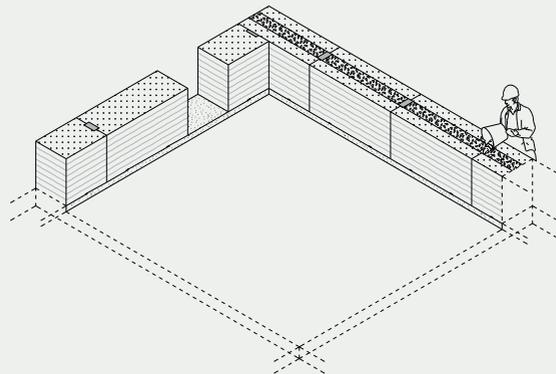


-A Collage Of Different Details Of Building -



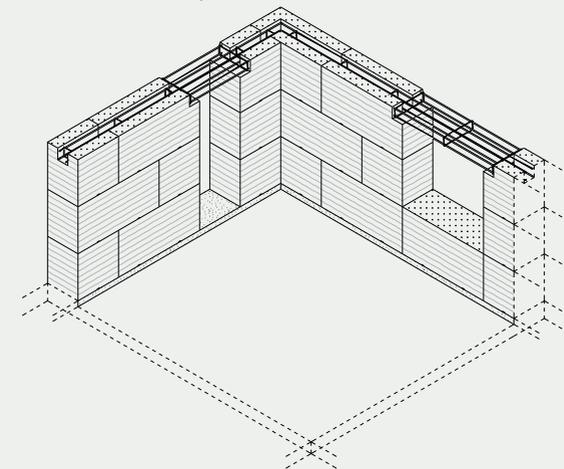
Applying Bitumen and rich clay mortar between the foundation and the blocks before putting the blocks.

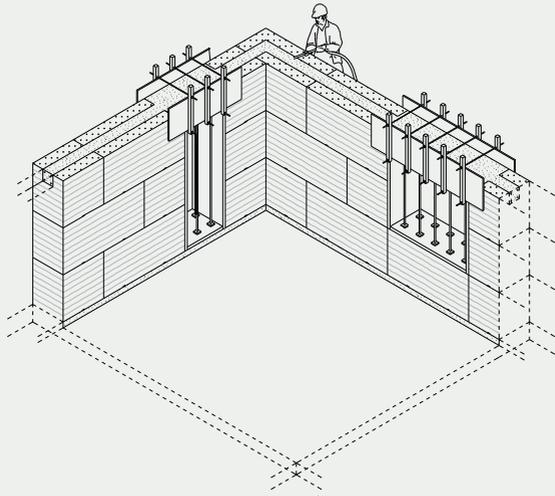
Pouring lime mortar in the hole between the blocks created by the formwork to complete the tongue and groove connection between the blocks.



Applying rich clay mortar on previous row of blocks before placing the blocks in place using a crane.

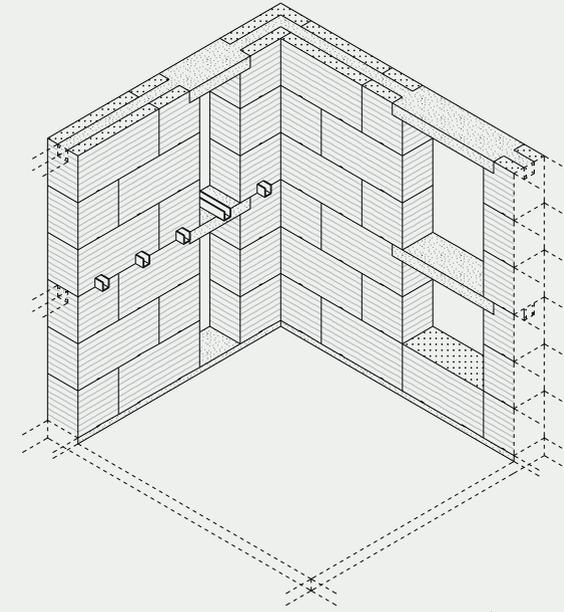
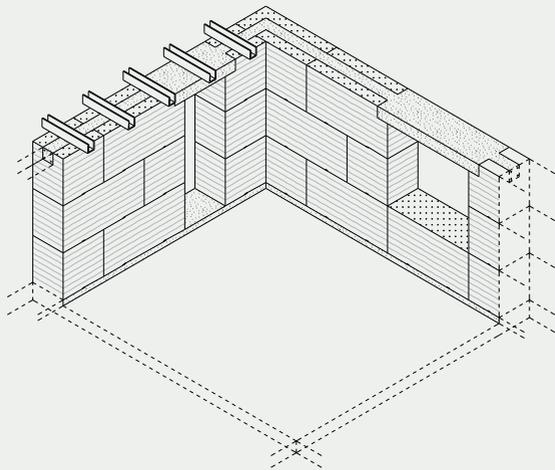
Putting the reinforcement metal bars inside the reduced blocks and extra strengthening of the lintels.





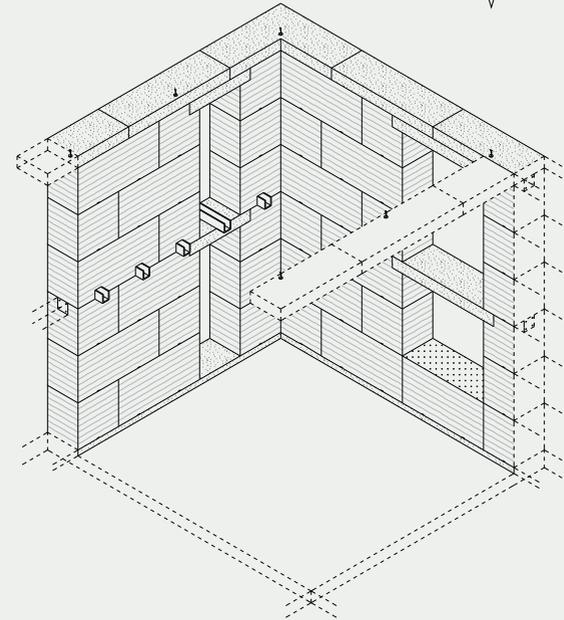
Pouring concrete inside the reduction in the blocks for the first floor's ring beam and putting formworks for the lintels.

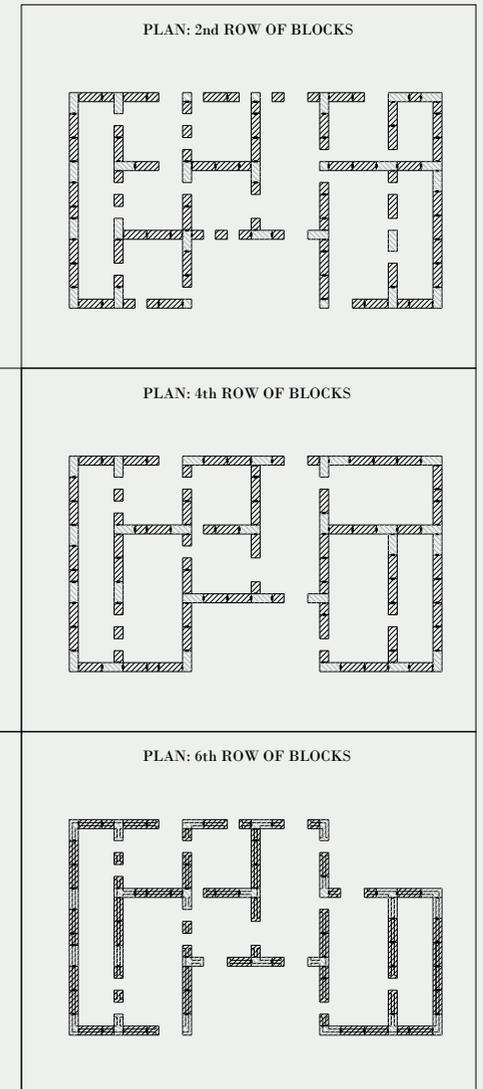
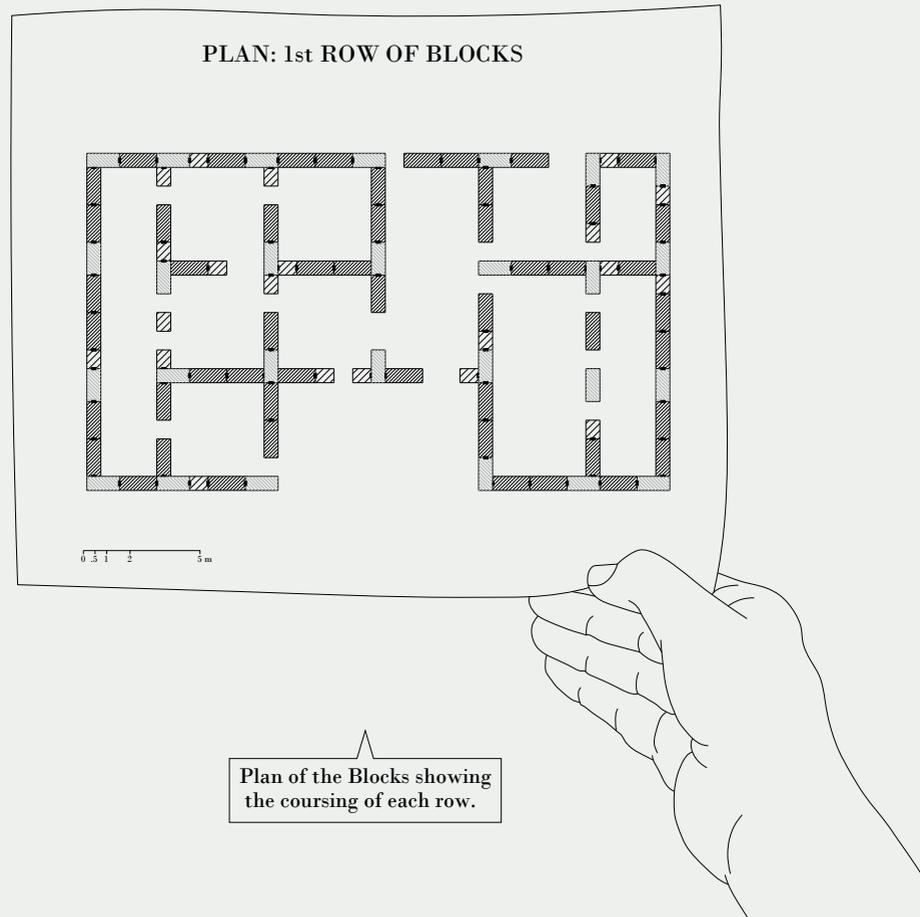
Placing the metal beam shoes on the concrete ring beam and fixing them in place for future placement of the ceiling beams.



Pouring the cast in place concrete for the second floor's ring beam.

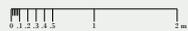
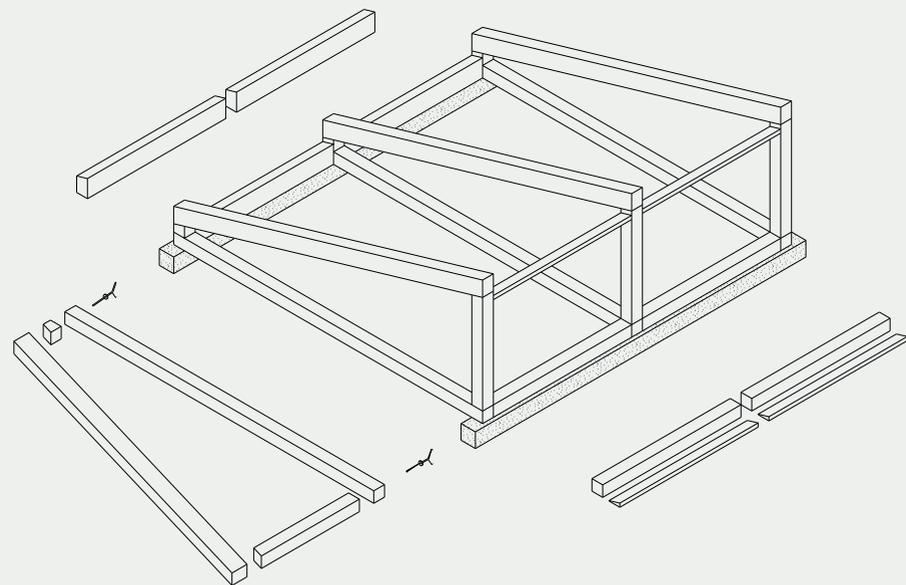
Placing pre-fabricated concrete with embedded anchor bolts for the roof structure.



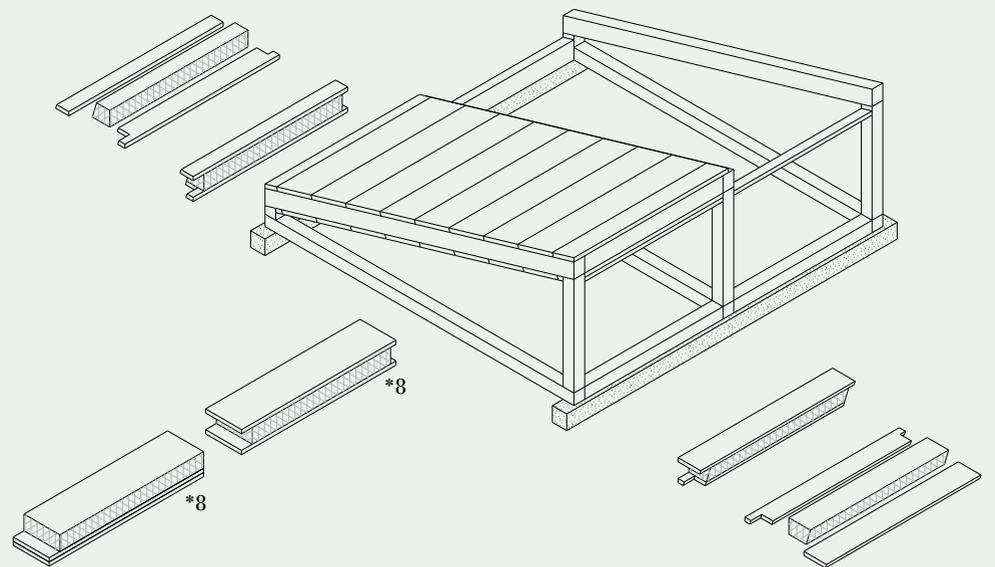


Constructing The Roofs And Interior Elements

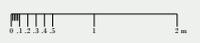
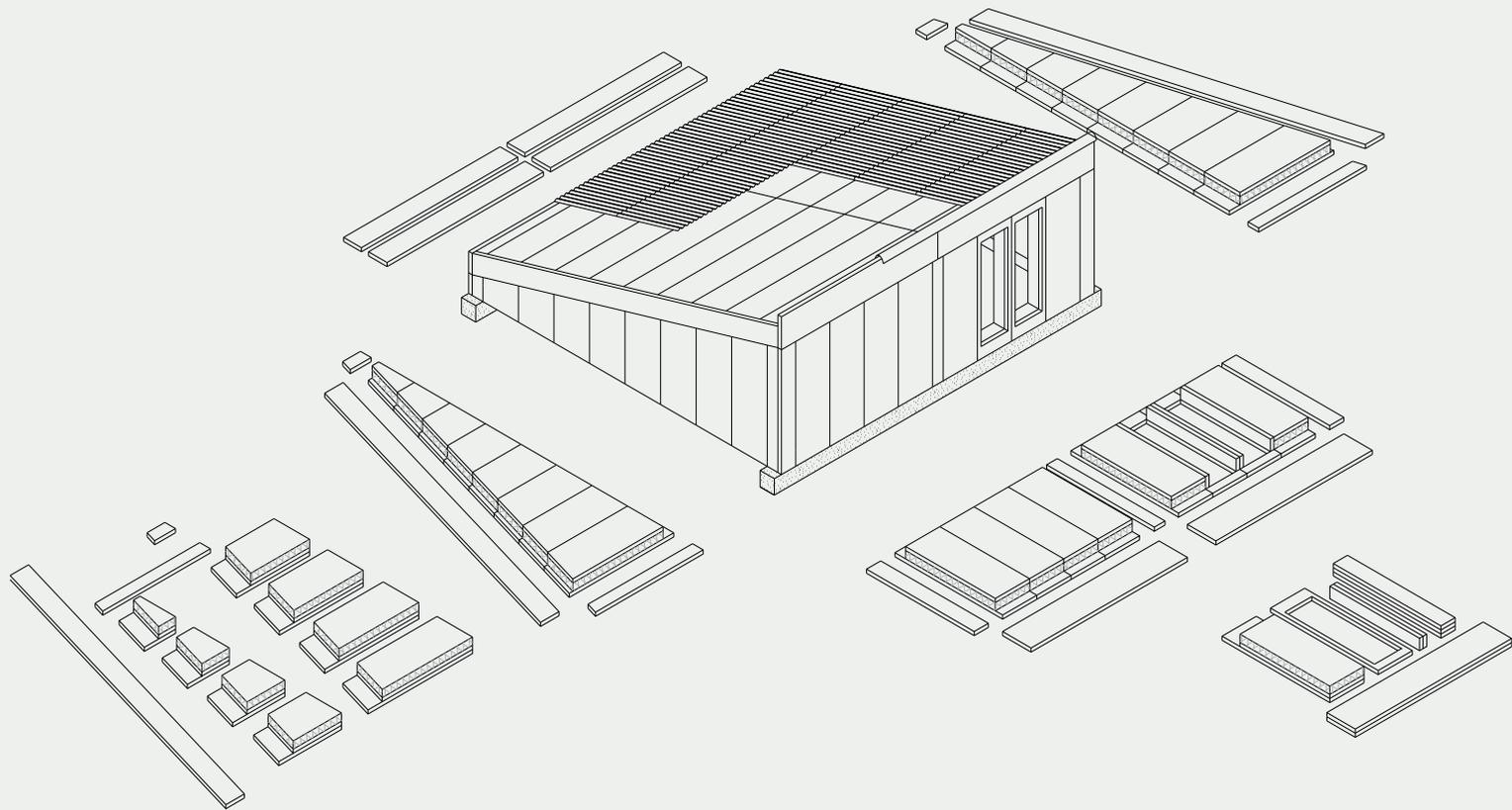
The chapter that explains how the roof structure and panels are constructed for the timber roof as well as how different interior elements like ceilings, stairs, etc. are constructed and assembled



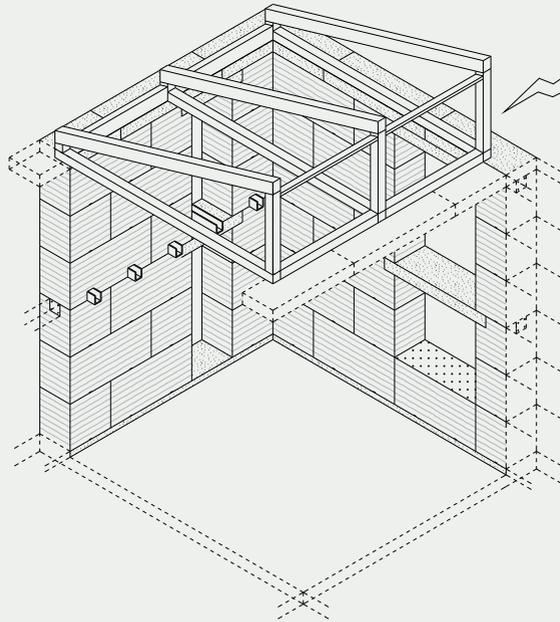
-The Elements Of The Roof Structure-



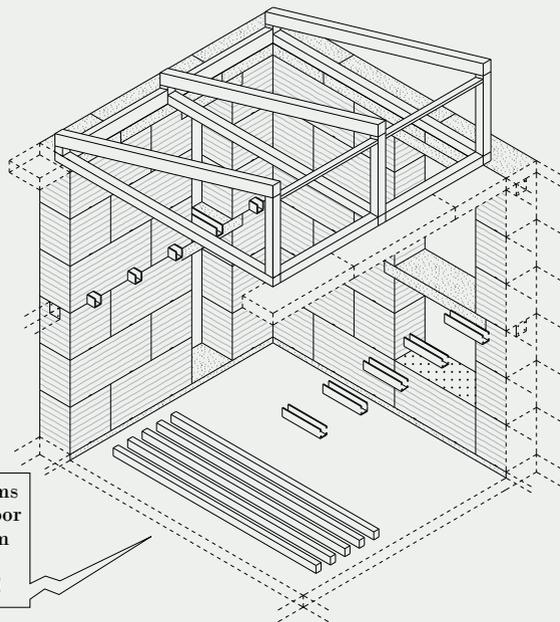
-The Panels Of The Roof Top And Their Pieces-



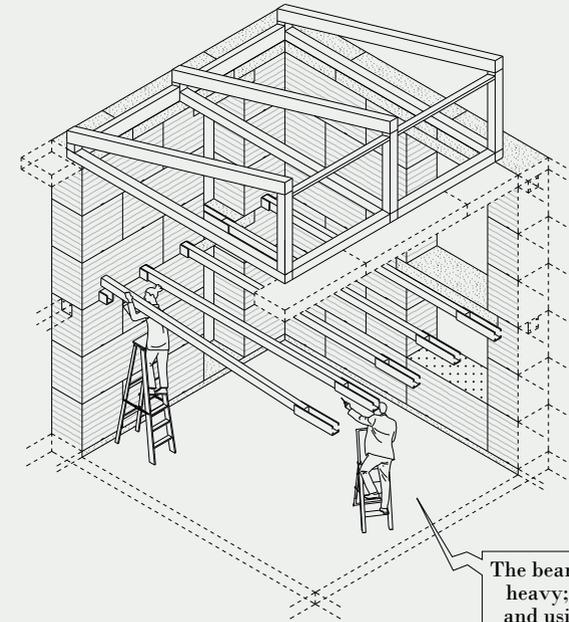
-Side Panels Of the Roof And Their Elements-



Except for the roof structure that is assembled by the contractors, other roof elements are mantled by people.

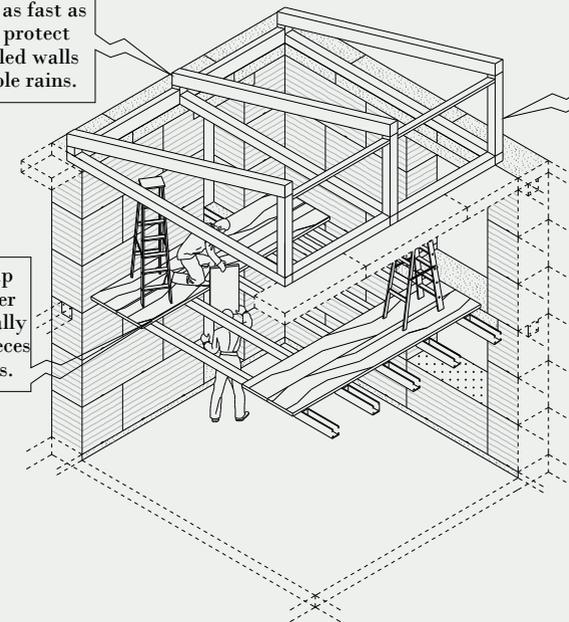


Prepare the beams for the second floor in 15*10*400 cm and be ready for assembling!



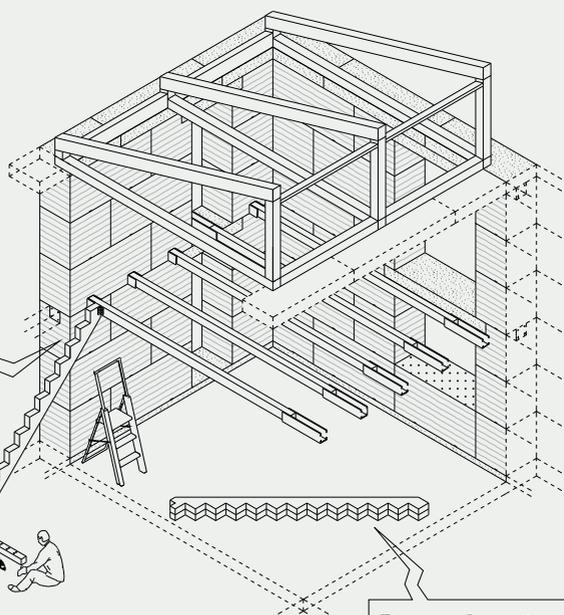
The beams are not so heavy; raise them and using a ladder place them inside the beam shoes located in the walls. Fix them in place using screws.

The roof needs to be constructed as fast as possible to protect the assembled walls from possible rains.

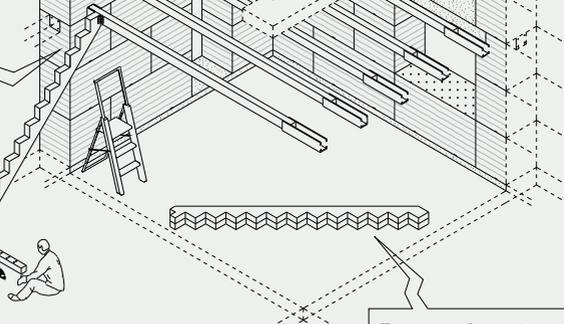


Using some cheap waste wood, cover the floor temporarily to put in place pieces of the roof panels.

To keep the interior visible, we do not show the roof panels in these drawings!



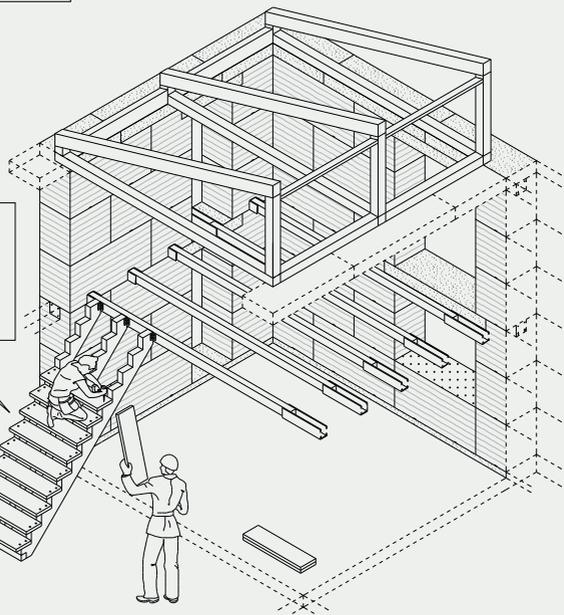
Attach the upperpart of the structure to the beams using provided connectors.



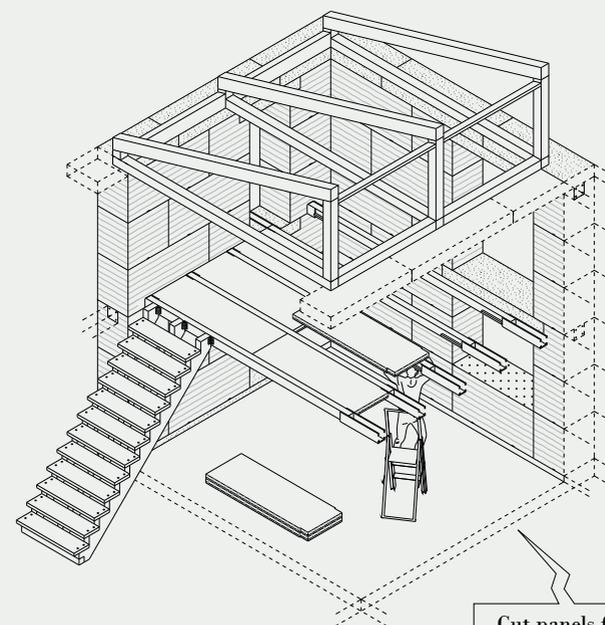
Connect the bottom part of the stairs to the concrete floor with provided connectors.



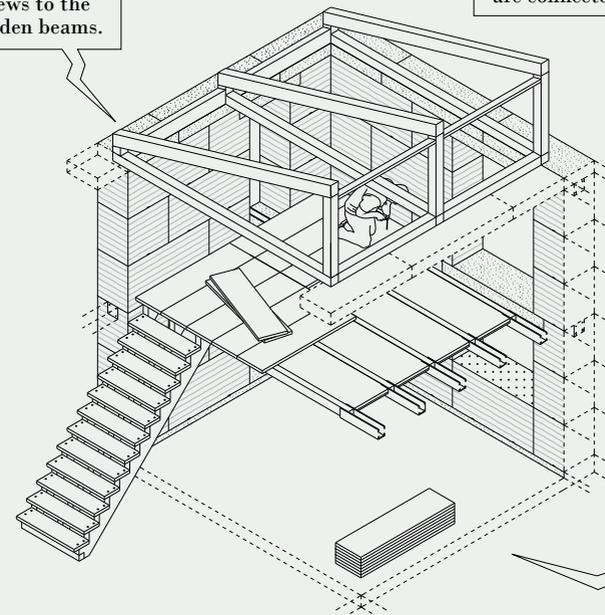
Prepare three pieces of the stairs structure for each stair.



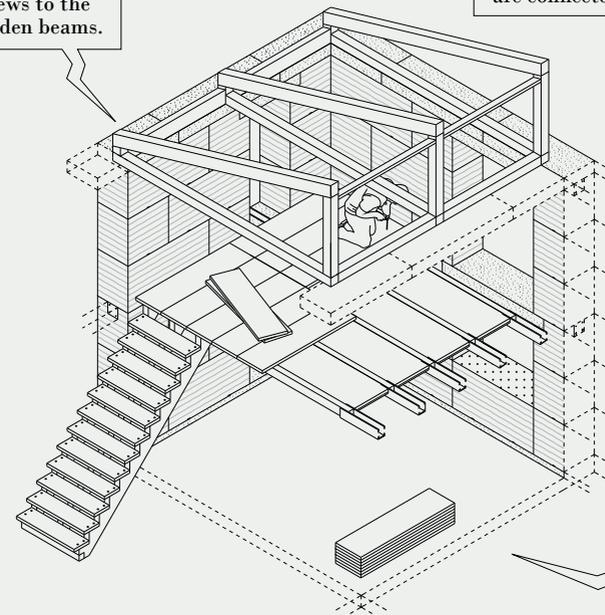
Place the treads in place and fix them with screws to the structures.



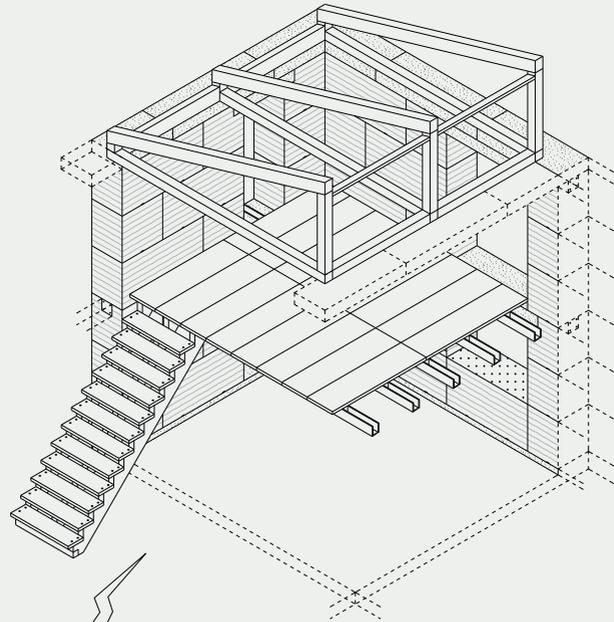
Cut panels from XPS foam board of 5cm for in-between the beams in 70*200 cm dimension and place them from above on the wooden fixtures that are connected to the beams.



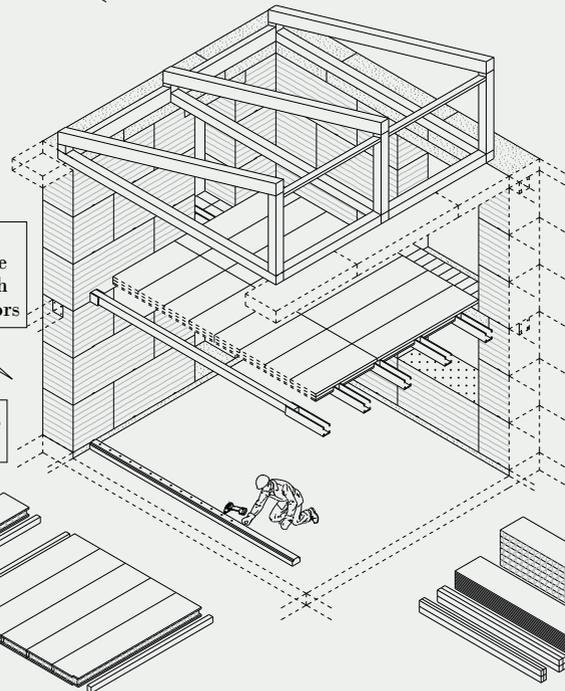
Place the panels in place and fix them with screws to the wooden beams.



Cut floor panels in the same size of 200*50 cm. prepare to put them in place.



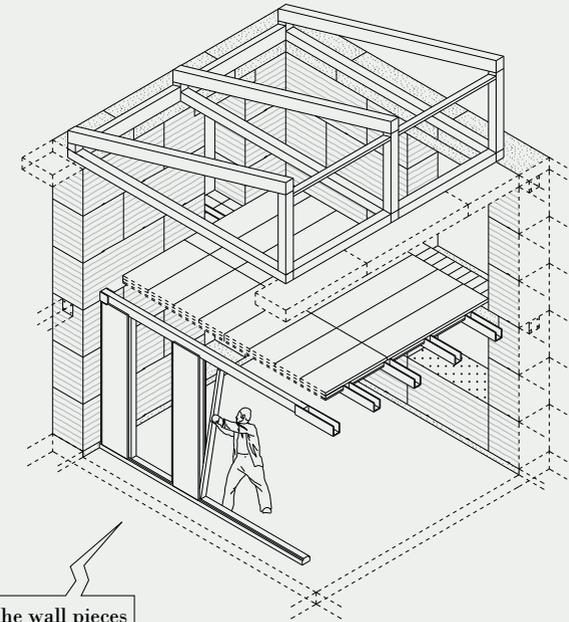
You are done with the basic parts!



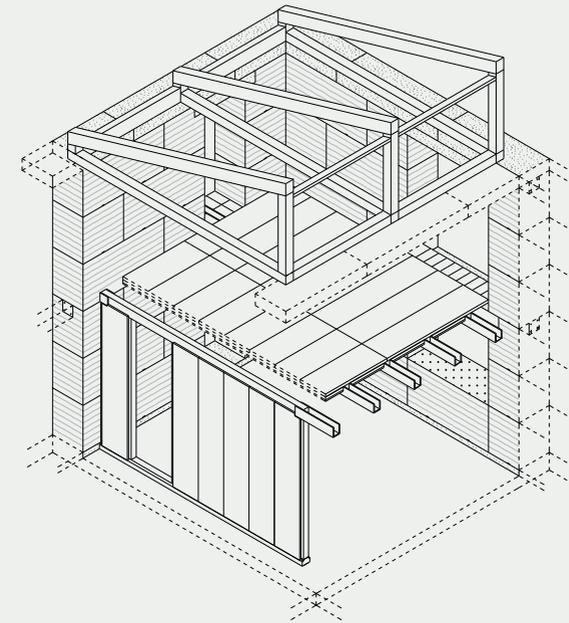
Attach the wall connection to the concrete floor with provided connectors

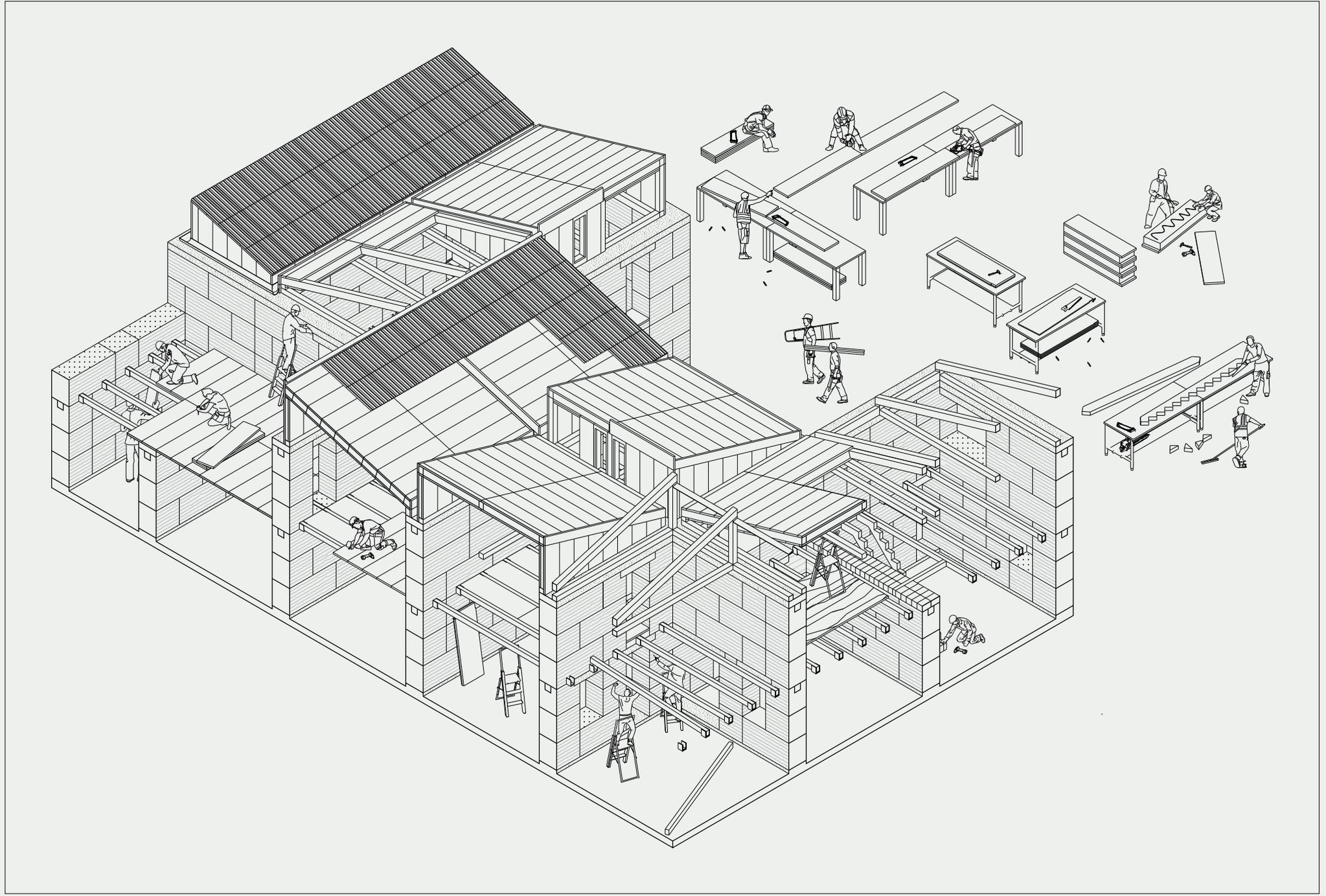
Assemble the panels into wall pieces.

Cut wood panels, XPS panels, and connecting parts of walls.



Assemble the wall pieces on the connector element on the ground. fix them from above to the beams.

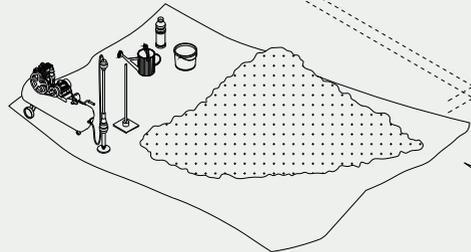
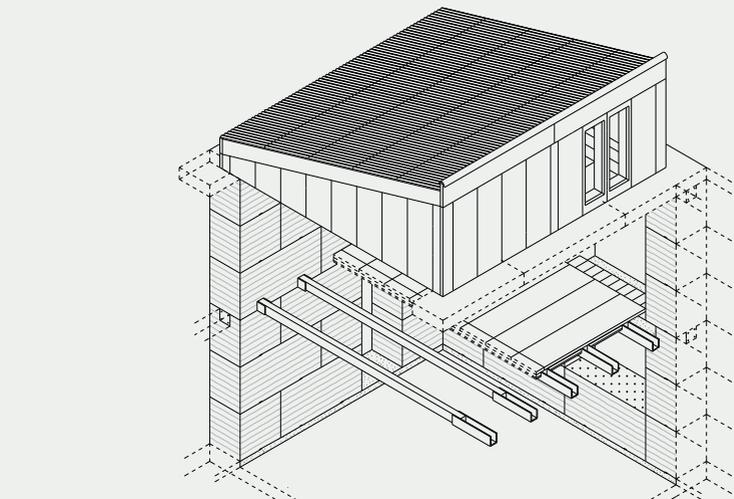




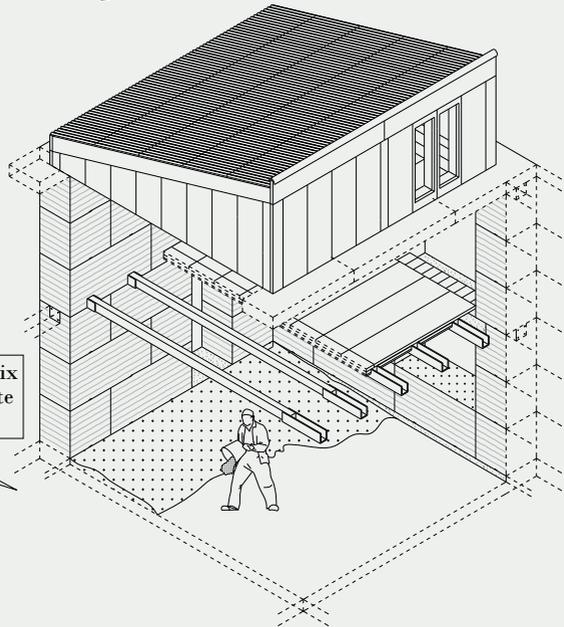
-Collective Act of Building The Roofs And The Interior Elements-

Finishing

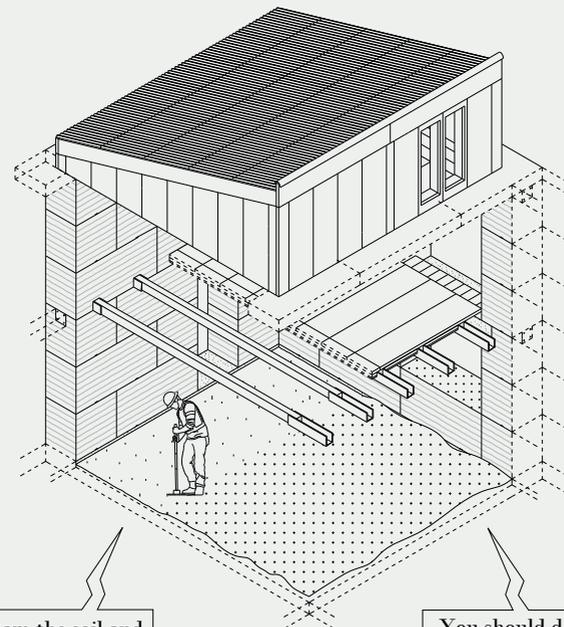
The chapter that explains how to execute the finishings of the building



Prepare the same mixture that you used for the wall blocks.

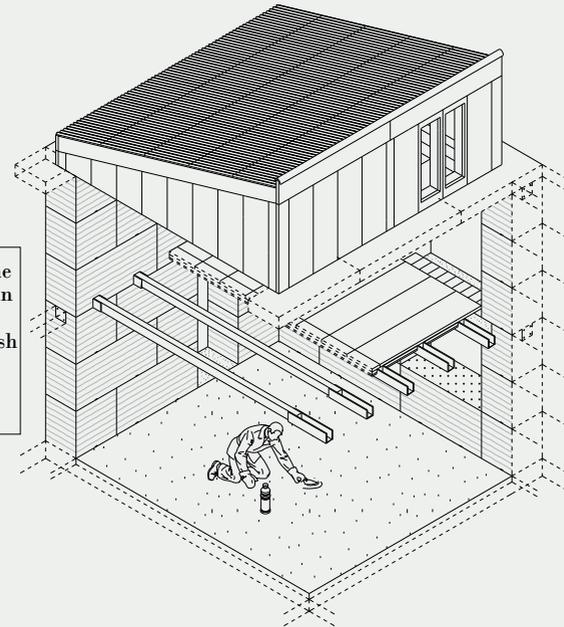


Pour the soil mix one the concrete floor evenly.



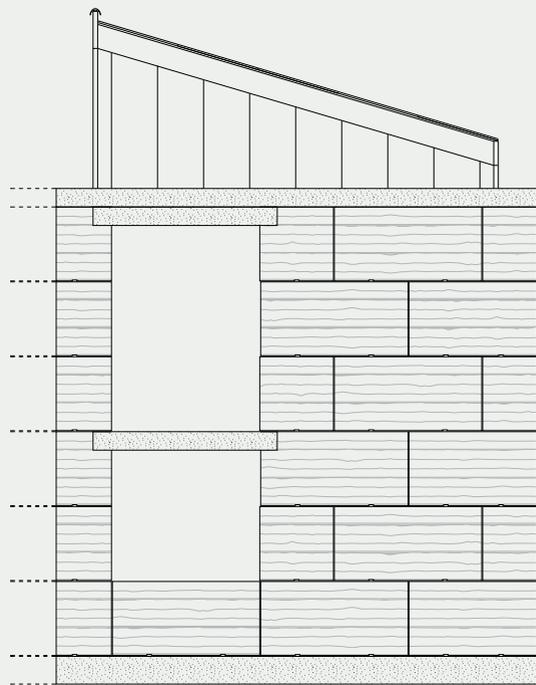
Ram the soil and create an almost even surface.

You should do this and previous step twice to reach proper height.

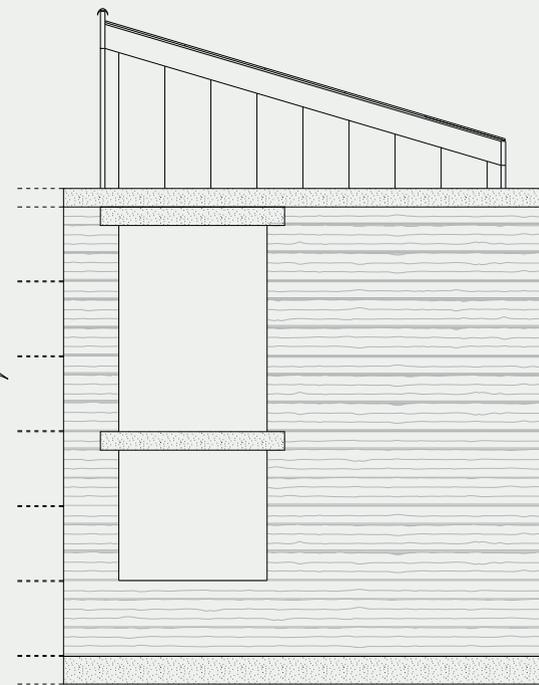


Polish and wax the surface to create an even surface. The more you polish the more shiny surface you will have finally.

You need to repeat this step throughout the life span of the building.

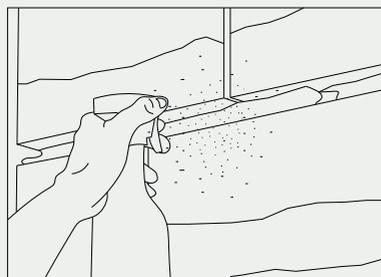


The building before retouch

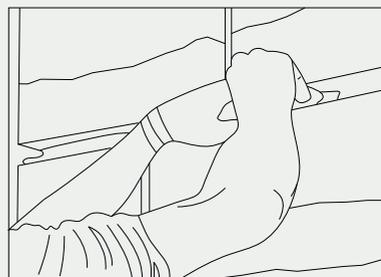


The building after retouch

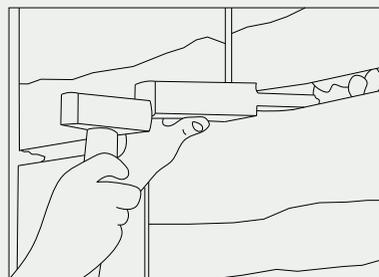
Retouching is not a necessary action and the wall is able to function without it. However to keep the aesthetics of a finished and complete house we provide instruction on how to do that. This technique is also used to maintain and repair possible future damages in the wall.



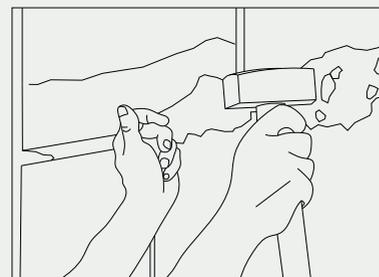
Spray water to the joint you want to retouch and make it a bit moistured so that it will conect to the retouches.



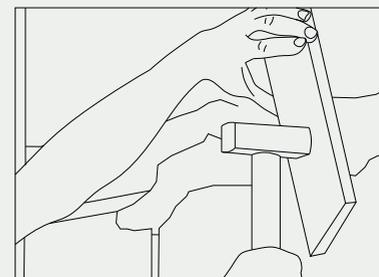
Fill the gap as much as possible with bigger aggregates



Use a hammer and a wooden piece to compress the aggregates gently.



Apply the same rich clay mortar used for assembling the blocks in the joint and press it gently with a hammer so that it covers the gap completely.



Use a piece of wood and a hammer to compress it from outside as much as you can. remove the excess soil to create an even surface and let dry.

Postscript On The Context

This project seems like a non-context project, but it is not. To some extent, we had to fix some contextual qualities to be able to design an example. Here, we will talk about some of the choices we made in order to solidify our principle by example:

- In the initial choice of material and technique: In choosing our material and technique, we were concerned with the feasibility of the technique with user-capability, soil condition of the area, and the availability and abilities of the contractors. These conditions may vary in another context. Thus, the feasibility of the parameters we mentioned earlier should be checked in the step of choosing the material and technique.

- In technical solutions: Climate affects the technical solutions that form the details of construction. The cold weather and heavy rains of *Skåne* brought about details that should differ in another climate.

- In the design method: Since the design method is interwoven with people's participation, the design method we chose here is compatible with the desires and culture of people in the area of *Skåne*. So if another community with different intentions to share are the subjects of the project, some modifications in the design method should be applied.

What we consider universal in our approach are the principles we mentioned earlier. *What is universal is the importance of participation and collaboration between the architect and the dwellers.*

Thanks For Your Participation!



-Photo Of Life #1-



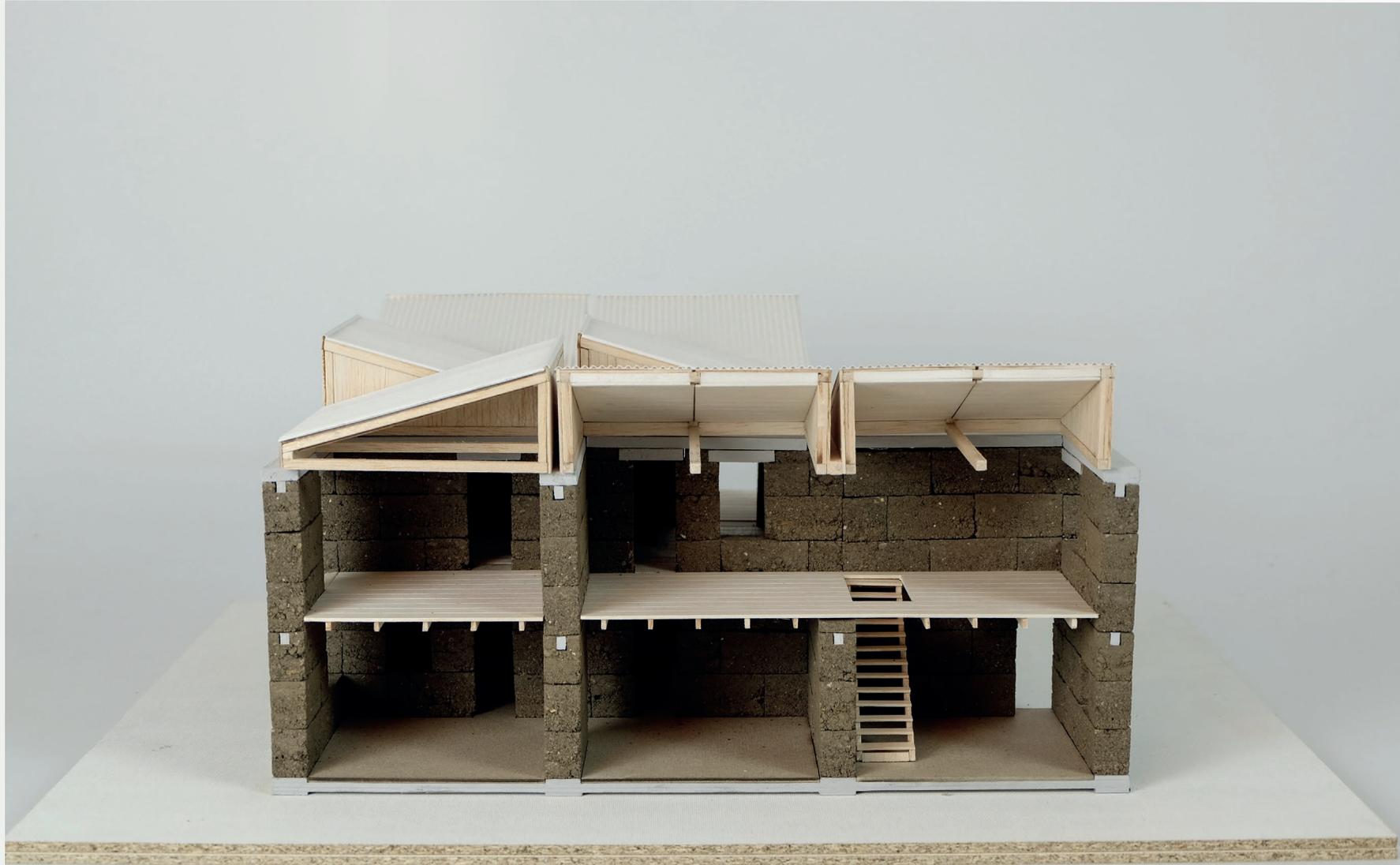
-Photo Of Life #2-



-Photo Of Life #3-



-Photo Of Life #4-



-Photo Of The Section Model 1:40 #1-



-Photo Of The Section Model 1:40 #2-

Appendix

During the project, and even before starting it, we tried to keep ourselves updated with the latest knowledge about the technique we were aiming to use. Thus, we participated in different courses about rammed earth to get the technical knowledge required to design a project using that material and to know the details and situations that it has when used as a building material. Here, we will present a short report of two courses we participated in about rammed earth.

Course Of Advanced Studies In Regenerative Materials ETH Zurich, Zurich, Switzerland, February 2020

Nowadays, earthen materials are undergoing a renaissance after decades for exclusion. A lot of universities and construction companies are now investigating and exploring it, and the main reason for it is earth's significant potentials like sustainability and its unique environmental advantages. In order to get the latest knowledge about earth and to learn techniques to evolve rammed earth into a highly efficient and professional building material, we participated in the Course in Advanced Studies at the university of ETH Zurich about regenerative materials. This course aimed mainly to introduce the potentials of regenerative materials like earth and bio-based materials to construction companies and professionals from all around Europe. In this course, successful professionals and researchers working with these materials lectured about their experiences and their findings during their experiments and constructions with these materials. We also visited recently built projects with these materials. We had lectures from the builders and the owners of these buildings concerning the material and their experiences from using earth as a building material. During the course couple of experiments and hand-on workshops were executed by the participants in order to become more familiar with the characteristics of the earthen materials. Professor Sophie Claude and Guillaume Harbert were our secondary supervisors and also the coordinators of this course who helped us a lot in developing the project.



Fig 30 . Former Cement Factory Used To Produce Prefab Rammed Earth Blocks, Brunnen, Switzerland



Fig 31 . A Workshop To Build A Sample Of Rammed Earth Block



Fig 32 . A Sample Of Rammed Earth Block



Fig 33 . An Earth Building With Prefab Rammed Earth Blocks, Basel, Switzerland



Fig 34 . The Trass-Lime Checks Are Visible Between Rows Of Earth



Fig 35 . The Basel Zoo With Rammed Earth Technique, Basel, Switzerland



Fig 36 . The Erosion Checks, Extruding The Wall After A Shallow Erosion



Fig 37 . The Earth Dome, ETH Zurich, Switzerland



Fig 38 . The Erosion Is Evident In One Side Of The Arch



Fig 39 . Preparation For A Set Of Different Tests On Soil

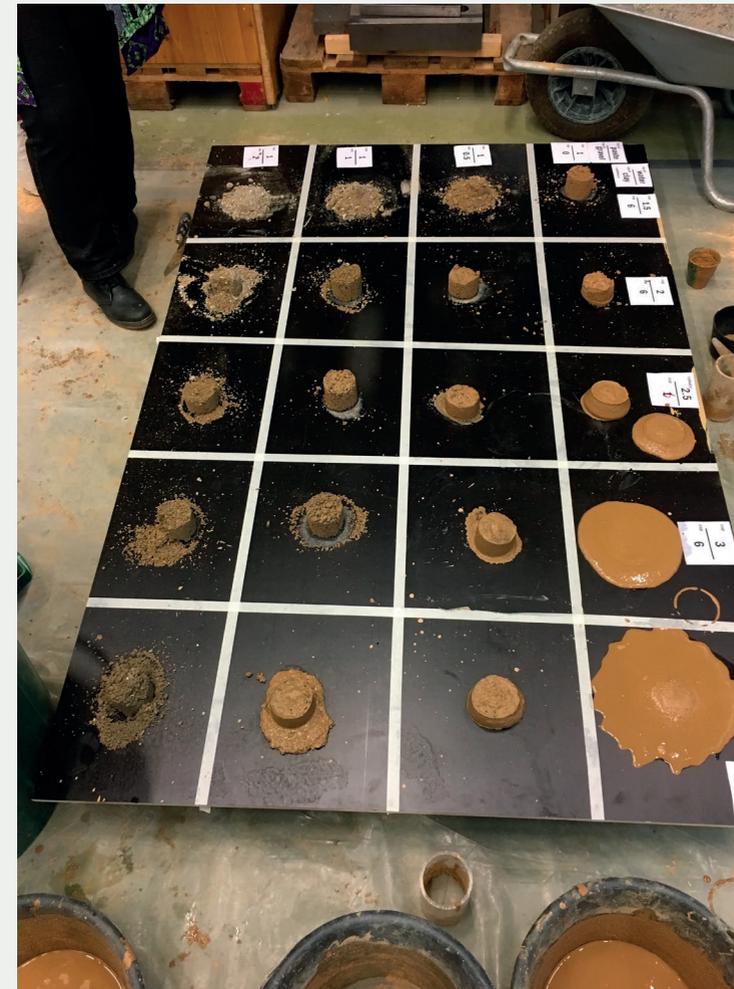


Fig 40 . A Test About Function Of Additive On Soil Characteristics



Fig 41 . Instruction On How To Do Sieve Curve Test



Fig 42 . Sieve Curve Test Result On The Excavated Soil Of An Area In Basel

Workshop Of In-situ Rammed Earth ArTUR, Bratislava, Slovakia, October 2019

This workshop was held in the countryside of *Bratislava* and ended up in building an earthen bench.

The participants of this workshop were ordinary people with different occupations who were all there to learn a construction technique to build different things. Someone wanted to repair a wall in her grandmother's garden, and another one wanted to build a small house for his family. The clear goals that participants had in mind made the workshop tutors go through different details and aspects of rammed earth application, from choosing the right soil and different methods of testing it to building an excellent formwork for ramming earth.



Fig 43 . Visiting An Excavated Area To Take Soil, Bratislava, Slovakia



Fig 44 . The Stored Sand And Gravel For Recomposing The Excavated Soil



Fig 45 . A Test To Understand The effect Of Moisture and Ramming On Soil



Fig 46 . Formwork Installation With Cheap Wood Boards



Fig 47 . Testing The Moisture Continuously With Ball Drop Test During The Construction



Fig 48 . Ramming Earth



Fig 49 . The Rammed Earth Bench

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