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Vernacular earth constructions in Hungary

Multilayer analyze on Hungarian vernacular, residential, earth construction in the domain of sustainability and design

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Kurzfassung

In den letzten Jahren steigt der Bedarf für die Nachhaltigkeit, Nachhaltig zu bauen. Ein großer Anteil des Energieverbrauchs kommt von der Bauindustrie. Er beträgt zirka 30%. In den letzten Jahrhunderten war die Bedingung der Umwelt mehr oder weniger einheitlich. Die voneinander unabhängige Regionen der Welt haben ihre eigenen Reflexionen an die Zustände der Umwelt entwickelt. Wir können an die spezifische Tragwerkstrukturen oder an die interessante urbane Fabrik der Dörfer. Manchmal wurden diese Reflexionen durch Beobachtungen und Ansprüche entstanden.

In meiner Arbeit möchte ich eine multilayer Analyse bearbeiten. Die Arbeit basiert auf drei grundsätzliche Fragen.

Erste. Was ist die vernakulare Architektur in Ungarn, mehr spezifisch in den Transdanubien? Auf ersten Blick ist die Frage ziemlich einfach und Profan, aber für eine detaillierte Antwort muss man noch ein Stück tiefer gehen, und die Umstände der traditionellen Bauform analysieren. Die Wurzeln der Vernakulare kommen aus dem sozialen Kontext, dem Klima, Material und aus dem verfügbaren Werkzeug (Stand der Entwicklung der Region). Alle diese Themen können für uns helfen, die Entwicklung der architektonischen Reflexionen der Vernakulare besser zu verstehen. Sie haben eine Einwirkung an den Grundriss, die Fassade, die Technologie der Konstruktion oder die Proportion.

Zweite. Die traditionellen Bauformen wurden in einem langen Prozess entwickelt. Das Material hat seine eigene Geschichte. In vielen Fällen war der Ort der Herstellung des Materials, und der Ort der Verwendung des Materials ziemlich das gleiche. Wir können einfach Stampflehmkonstruktionen denken. Dies stellt die Frage der Nachhaltigkeit. Kann eine Antwort für Nachhaltigkeit das lokale Material sein? Die Verwendung, Weiterentwicklung der lokalen Konstruktion kann die PEI-Wert reduzieren, und die Atmosphäre zelebrieren, die durch die regionale Architektur erzeugt wurde.

Dritte. Nicht nur das Material und die Konstruktion gehört zur DNA eines Gebäudes, sondern auch die Konstruktionstechnologie. Meiner Meinung nach es ist interessant zu sehen wie in den unterschiedlichen Regionen die gleiche Konstruktion vorkommen. Im dritten Teil der Arbeit möchte ich auf die Methoden der Stampflehm in dem 21. Jahrhundert konzentrieren, denn die traditionelle Konstruktionsmethode können der Stand der Technik der Vorfertigung sein.

Diese Themen können die folgenden Fragen liefern: Was können wir von der Vergangenheit lernen? Welche sind die architektonischen Elemente, die wir heute neuverwenden können? Zusammenfassend, diese drei Themen: Typologie, Material (Nachhaltigkeit, Konstruktion) und soziale Muster können die Grundlagen für das Konzept des Entwurfs sein. Der Zweck der Studie ist die Interpretation und die Anpassung des Wissens der traditionellen Baukultur in Ungarn, Transdanubien. Ein Entwurf, der reagiert auf dem Kontext. Ein Objekt, das kein Eins zu Eins Kopie oder eine schwache Interpretation der vernakularen Architektur. Aber ein Objekt, das durch Berücksichtigung entwickelt wurde. Das Filtern könnte ein Weg sein, ein logisches Konzept zu erzeugen.

Keywords: vernakulare Architektur, Stampflehm, Elementen der regionalen Architektur in Ungarn, Nachhaltigkeit und die vernakulare Architektur

Abstract

In the last years there is bigger and bigger demand on sustainability, because the energy consumption is growing. A big part about 30% of the used energy comes from the building industry. The environmental condition was always more or less constant through the last centuries. In the past each region had their own reflection on the condition of the area and developed their own way of living. We can think on their specific structures or the unique layout of villages. Sometimes these principles were created by observation and claims.
In my work I would carry on a multi-layer analyse. The research would stand on three main columns. Firstly, what is the vernacular architecture in Hungary, in the Transdanubian region? This question is very simple and profane, but to give a correct and detailed answer some deeper topics should be discussed and studied. The vernacular, regional responses has its roots in social context, climate and material and tools. All these complex topics together could give a better understanding on the development of the vernacular architecture. They have influence on floor plan, façade, construction technology or proportion.
Secondly, the vernacular and regional responses were developed during the centuries. The use of the materials has its own root. The root is not just in time, but also its physical root. In most cases local materials were used. This raises the question of sustainability. An answer for a sustainable approach could be the use of the local material. This could reduce the PEI value of a building and celebrate the atmosphere, which is created by the regional architecture.
Thirdly, not just the construction, but also the construction technique belongs to the DNA of a building. In my research, I would like to focus on the method, that was developed in the region. In some cases, the same or similar methods were developed in other regions, in totally different part of the planet. In the third part of the research, the focus is on the methods in the 21th

century, because the vernacular construction techniques are, and can be the base of state of the art, prefabricated structures.
All these topics could bring answer for such simple questions like: What can we learn from the past and regional architecture? or What are the architectural elements, that we can adopt for today? All in all, the three topics in vernacular architecture: typology, material (sustainability, construction) and social pattern, could deliver a concept for the design of the thesis. The purpose of the study, research is to adopt the knowledge in an architectural design, in Hungary. A design, which reacts on the context in a sensitive way. An object, which is not the one-to-one copy or loose interpretation of the regional architecture. But an object, which was developed after detailed consideration and design. The filtration of the research can be a way to find solution for a logical concept development.

Keywords: vernacular architecture, rammed earth construction, elements of regional architecture in Hungary, sustainability, interpretation of the Hungarian vernacular

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Köszönöm! Rebeka Fejes

My Parents

My Brothers

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Introduction

Overview

The main purpose of the research is to make a research about the weaknesses and potentials of the vernacular architecture in Hungary, and after the evaluation of the information to make a consideration of the topic. The study can help for a better understanding of the area and can help to make interpretation of the future use of rammed earth construction for housing. After the research part of the thesis, I could develop a design strategy and design.

The significance of the research is the field can be to make a wide point of view of the traditional architecture and evaluate the learned information with not just the conventional methods like climate usage through the history or development, change of the society but with state of the art technologies, standards like the sustainability. This method can help to understand why could, should we use the holistic, alternative methods in a local specific site and not just follow the current trends, which has little connection to local givens.

I think it is important and I find it interesting to evaluate vernacular architecture not just with numbers, but also with social patterns, and with the ingeriants of architecture, like plan layout or context. Compare it with current constructions and housing. I have the belief that someone would build his or her house with a traditional way if he or she gets the intention that it makes more reasons in different levels: ecological – tradition – economical. [34]

Motivation

Since I study architecture and before it in Highschool I had always the motivation to understand the present.

As Lord Norman Foster said:

"As an architect, you design for the present, with an awareness of the past, for a future which is essentially unknown."

After this kind of thoughts, I have the motivation to make a research about the vernacular earth construction in my home country, in Hungary. As the way, I see it in architecture the context and local "patterns" are very important to make an efficient design, which suits for the local conditions, in terms of material, typology, construction for the climate, landscape or urban scale.

Erna Ruzsovits: no name (1950) ill. [01]

Background

Most of the cases the vernacular architecture, due to the methodology, it creates its buildings out of low-cost, and natural materials with the investment of gentle mechanical energy. A significant part of the sustainable construction literature concentrates only on human uses of a building. As a result of ecological building tasks, a designer follows the needs for the function and external-internal constraints. These criteria must be take into account simultaneously. We can sum the criteria in different levels with some pairs: Structure - Material, Creation – Construction Techniques, Local Resources - Constraints, Energy - Material Flows, Resources of Internal Spaces - Constraints of Internal Spaces. [81]

In Austria and Hungary earthen buildings are still conserved, which can be conserved by targeted measures in order to present the use of earth construction to a broad population.

In terms of the environmental issues , earthen material is a material that promotes an ecological way of life and is associated with a lower cost compared to industrially manufactured materials.

Following the accomplishment of these tasks, the study looks forward to the certainty of the folk architectural toolbox in rural residential building and parallel to the architectural trends of contemporary sustainability. Further, in this context, the formulation of a new level of building use requiring a more sustainable issue. It would be a good idea to compare folk architecture as a compilation of old proven solutions with the set of new and holistic ecological solutions. [61]

Material concepts are typically categorized according to design phases and design levels or components. Many strategic approaches, however, do not refer to a particular design-level, which usually means that it can be used to achieve improvements at various levels.

However, economic function is one of the many important functions of

the earth. The problem is that the modern market economy treats the land and nature not in its complexity, but in its function, as a factor of production, mainly as a source of raw material. If we put everything in the economy, our civilization faces an unsustainable future. Fortunately, there are also sustainable environmental economic models. [29]

For R.C.R. model the continuity stays in the middle. Tries to create an ecological environment through its three principle, which is its name: reduce – conserve – recycling. The reduce of the use of land and the reduction of the material, water and energy. And the reduction of the accumulation of the waste and waste water. On the other-hand we need to try to conserve the creatures, cultures, and the result of it: the variety of the built environment. The last column of the model is recycling, which can be connected in the building scale to the materiality and the way we build our buildings.

The ecological house is not new. Its routes can be found in the vernacular architecture. The generation gave the knowledge to the other and so on, which results the continuity of tradition and skill of craftsmanship. The cultural thinking is a reflection on the nature. It considers the geography, wind, nature, vegetation, natural light and water resources. [24]

It is obvious that through history most human settlements have been out of the country necessarily sustainable. It is only in the last century that cheap energy and mechanical heating and cooling of the buildings influenced the architectural thermal comfort. The art of living in harmony with nature and reducing the ecological, natural use of local materials and technologies relieves the finite energy resources and saves protects the environment from further destruction. The vernacular buildings provide us with a large supply of natural cultural heritage, that has a real and symbiotic relationship with spirit of a certain place. This relation-

ship is mediated by knowledge and values can be a valuable lesson for the mainstream architecture of the 21st century. We should represent the ecologically sensitive issues of the region, the climate and the environment Culture to achieve sustainable human settlements.

Rammed earth structures are often used for sustainable and environmentally friendly buildings. There is just a limited number of design standards. Technical decisions are often based on rules of thumb that can lead to a rather conservative or unsafe designs. In cold, stoves are commonly used for heating. This traditional indoor fire, with the lack of ait out take can decrease the comfort inside and can also lead to health problems. [62]

One aspect of the research on the vernacular architecture is to find solutions for problems which are nowadays solved in more developed areas.

As we can see there are a lot of research about the topic vernacular architecture out of rammed earth construction, as a holistic, sustainable construction method. After my research on my topic I have noticed, that a lot of research was done in China. These researches cover a great variety of topics, like the thermal comfort, construction method or the stability of the construction technology. [58]

A lot of the researches see potential in the vernacular architecture, if we are speaking about sustainability, because the local materials had an impact on the culture and context.

I have found many researches, materials about sustainable design approaches, also about the vernacular architecture and cultural history in Hungary, but I found not so many discussions, specific about the vernacular architecture in Hungary as a sustainable construction method. As there are materials both about vernacular architecture and sustain-

able design, I have the feeling, that it can be possible to put the two topics together and create a whole.

More specific, I would like to create a more detailed research about the vernacular architecture in Hungary. In the research field I would put my focus on different layers, to get a clear view about the backgrounds. It is very important for me to understand, why they built as they built. For this question we need to understand the climate, resources, social life, typology. As the way I see it all these topics are relevant, if we discuss construction techniques (rammed earth) and sustainability.

This big range of research of the vernacular architecture is very important, if we want to deal with the local patterns, because I think all different field of architecture, geography, climate and history shows an impact on our presence. Also, craftsmanship, and way of working in everyday life influenced the building typology. It is interesting to see for example, that the house typology has a continuity in the past, but with the modernity a totally new architecture language was introduced, which has a little, or probably no connection with local textures.

The other value of my research could be the analysis of rammed earth. As we know although the many positive qualities of earth constructions, there are some weaknesses, that is why it important for me to have a look references from the 21st century, what are the new methodologies that are exists, like how can we solve the problems of insulation (waterproofing in foundation), or the problem of cracks on the walls. [63]

This part of the research is important to get ideas, how can we deal with the local material (rammed earth), with the standard of today. These new methods and techniques and the potentials of sustainable thinking could help people to show the advantages of the local architecture language.

In my opinion critical thinking is very important in most of the field of life. This is also true for architecture. The conclusion of the research is the evaluation of the information we get from all the past and future. Critical thinking would be important in my research because all these data, is the basis of the possibilities of the interpretation, and results. Results, that can show possibly the right way to create the design proposal.

Methodik

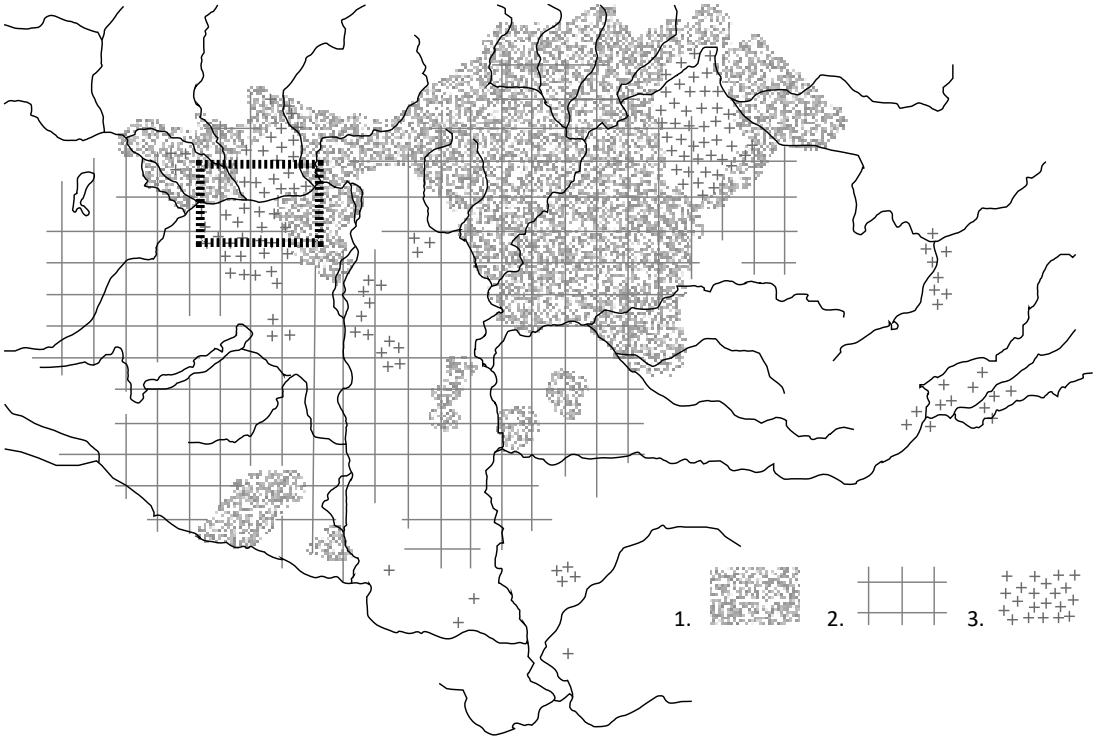
The vernacular residential building in Hungary as a whole

Location

Street from a Hungarian village ill.[02]

The focus of the research is on the anonymous, vernacular architecture in Hungary, specially, on the Transdanubian area "Kisalföld". To have a clearer view we need a closer look at the location of Hungary. The country located in Central Europe, in the Carpathian Basin.

From my point of view, the materiality and construction techniques in the vernacular architecture is a major issue, because it shows a certain development of technologies and the current condition of available materials, such as wood, stone clay at that time. In the 18-20th. century the main material was clay, or earth. [15] The map [03] shows the distribution of earthen technologies in the region. The focus of the research is on the region of "Kisalföld" (Little Hungarian Plain) because the area has a special condition, that all the major earthen construction techniques lived next to each other, and it gives the opportunity to study them almost in the same environment.



1. clay walls 2. rammed earth 3. placed wall

Distribution of the construction technique ill.[03]

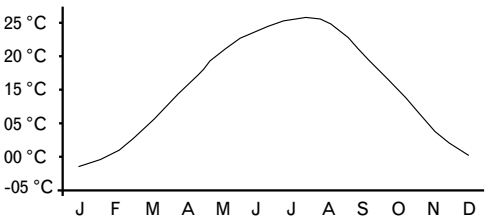
Climate and the change of the material in the region

Architecture is created in general to provide a safe interior space to secure the inhabitatnts from the danger and the cahnges of the environment. In a way the architectural spaces were at first not to create a cozy atmosphere, but to protect. In this sence a lot of technical solutions in the world of vernaculare architecture were made to fight against nature.

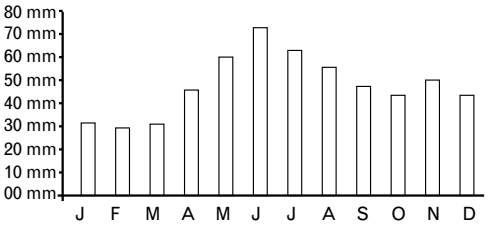
To understand these actions, interventions we have to have a closer look to the climate of Hungary and Kisalföld.

After the Köppen climate classification the country is situated in the cathegory "C" (Temperate/mesothermal climates, this means that the mean temperature of the coolest month is between -3 °C and +18 °C) and in the cathegory "D" (Continental/microthermal climates, this means the mean temperature of the coolest month is under -3°C, and the mean temperature of the warmest month is above 10°C). [84]

More correctly the region is in four under-cathegories, such as "Cafx"



Temperature ill.[04]



Distribution of rainwater ill.[05]

Temperature diagramme ill.[06]

(the mean teperature in July is abouve +22°C, with an even distribution of fall during the first half of summer), "Cafxz" (the mean teperature in July is abouve +22°C, with a primary maximum of fall at the begining of summer, and a secondary maximum in autumn), "Cbfx" (the mean temperature in July is under +22°C, with an even distribution of fall during the first half of summer) and "Dbfx" (the mean temperature in July is under +22°C, with an even fall, but with a maximum during the first half of summer). [86]

To get a clearer view we can examine the climate of Hungary with the Trewartha climate classification scheme, which is based on the Köppen climate classification. The Area is "D1" (continental climate with longer summer) and "D2" (continental climate with a shorter summer).

In Kisalföld the effect of the basin is not so strong, but the impact of the ocean is perceptible. The fog is not

solar radiation	4250-4350 MJ/m², 1900-2000 hours, 60-65% cloudy
mean temperature	9,5°C
avrage snow-covered days	21°C
avr. coldest temperature	-17°C
avr. warmest temperature	34°C
wind directions	northwest
wind speed	2,5-3,5 m/s
avrage snow-covered days	35-40 days
avrage thickness of snow	25-40 cm
precipitation	~600 mm

Peak temeparute values in Hungary ill.[07]

so present, but it is one of the most cloudy region of Hungary. The area has a temperate climate, with a temperate dry winter, and it has the most wind in the country during the year. [85],[86]

The context in time – anonymous architecture

The vernacular architecture is also understood as the architecture without architects. As Robert Brown and Daniel Maudlin are writing in their article "Concepts of Vernacular Architecture":

"it is also known as "the architectural language of the people" with its ethnic, reginal and local dialects. All in all, the product of "non-experts"." [54]

The terminology of vernacular architecture as traditional of folk, appears first in the post-war period, to legitimize the widespread, accepted theory of the time. The vernacular architecture was described as a functional envelope, to provide shelter for the people, a place for animals, and to store. In one phrase "built to meet needs". [54]

There is a conflict between critical regionalism article, in which he stated that "regionalism should not be sentimentally identified with the vernacular", because in his thinking he asks for self-conscious, and critical thinking. As an example, Adolf Loos statement: "The peasant builds a roof. It is a beautiful roof or an ugly roof? He does not know – it is the roof as his father, grandfather, and great grandfather had built the roof before him". [52] In his point of view the critical regionalism should lie beyond style. On the other hand, vernacular architecture, as Nezar Al Sayyad observed "for anything to be considered vernacular, it has always been assumed that it must be native or unique to a specific place, produced without the need for imported components and processes." The two statements about vernacular and critical regionalism raise the question: The vernacular architecture is an optimized building method, in terms of use the local materials, to create purely functional spaces, or it is in a way against the development? In my opinion we cannot answer the question, if we try to understand the regionalism and vernacular from the view of aesthetic, because in that time the physical needs and sacral habits were strong part of the culture, which formed the aesthetic and

innovation. [54]

To get a clearer view we can analyze the traditional architecture not in the term of vernacular nor regional, but as the anonymous architecture. It is interesting to study the land houses, because they are free in all form from the fine art. At the same time, we can collect suggestion to develop our work, project. The Abot of Saint Denis created a word "anagogy" from analogy and pedagogy, in which we can adopt the knowledge from a foreign condition and different time, to our work. To understand anonymous architecture Julius Posener divided the analysis in three sub elements. [53]

1. The program: this type of housing has the focus in the function. If we look at the townhouses in Lübeck, all the primary programs come from the usage. The office spaces on the ground floor, the storage in the attic and in-between the living spaces with the garden. Or from the 18th century the Georgian house, which usage reduced only just living. Moreover, the Victorian townhouse had the program like it was, because each activity needed its own unique space. All in all, in anonymous architecture the program reacts to the needs. [53]
2. The difficulties of materials: J. Posner introduces the quality and value in the effort. As Semper stated, the in Egypt the masters use granite for the sculpture, which was extremely hard to work with in that time. [53]
3. Tradition creates typology, which is present for a specific time and culture. It is not possible to differ from. The only possibility to vary it a little. The typology is acceptable and logical, because it is developed from a specific working / living condition. Although there are examples e.g. the Malaysian House, which cannot be explained with a function, but with tradition. All in all, tradition must be alive. Only in this case can anonymous architecture bring quality and

The clean room in Hungarian vernacular ill.[08]

shape in the design. [53]

From the 20th century the study of vernacular architecture interested in the surface, formal qualities. In cases vernacular architecture is positioned as „other". This definition can lead to a more precise and permeable understanding of architecture. The phrase „other" provoke a duality. In other words, what does it mean „other"? Complete/ incomplete, art/ anonymity, tradition/modernity, specific/universal? These questions can challenge the process within design. To work with vernacular, anonymous architecture it is essential to understand all level of its nature. [54]

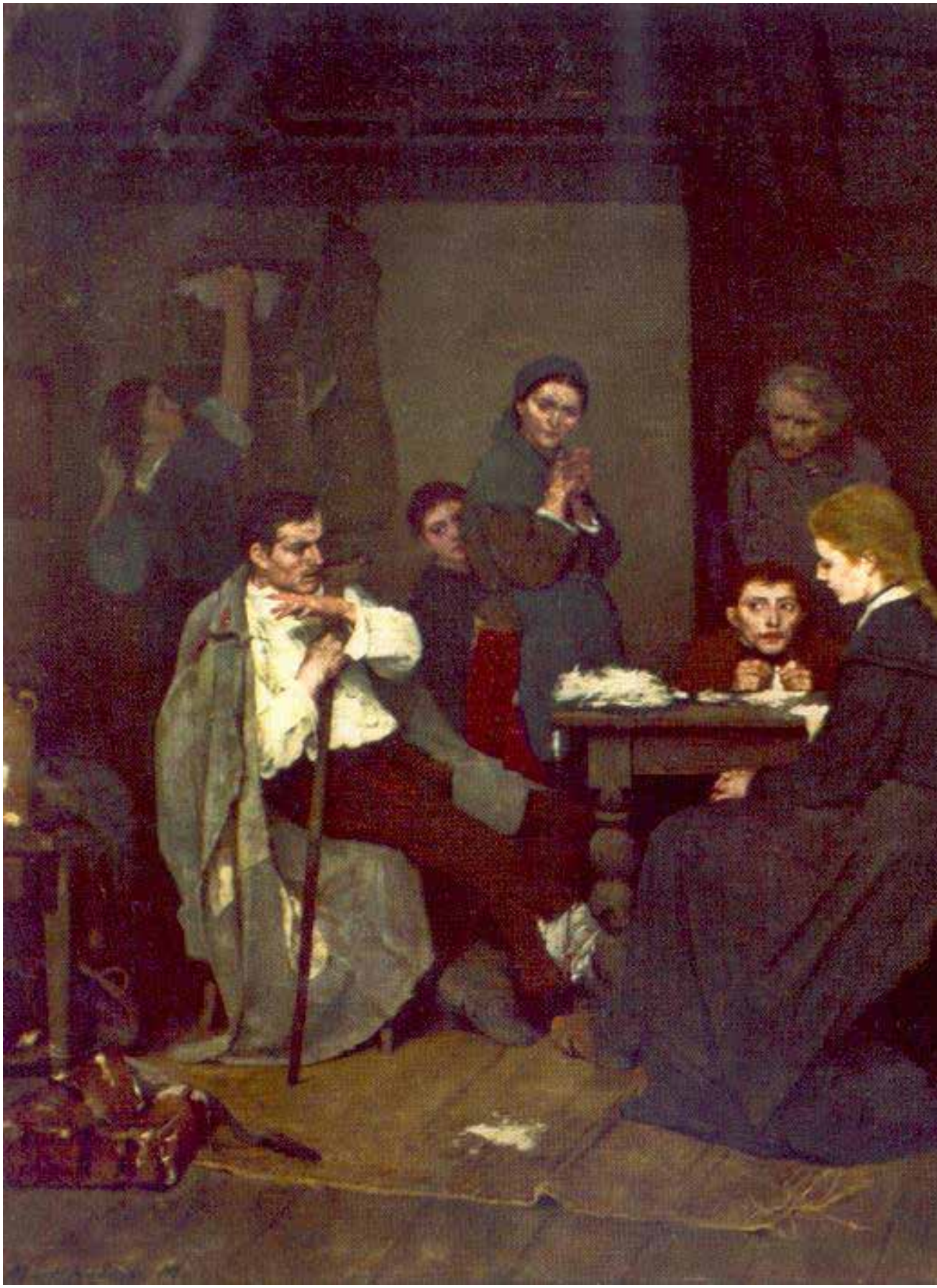
Social context – everyday life in the house

Their lifestyle was influenced by the origin, and the region. [11], [12] The Hungarian peasant pursued a traditional lifestyle, referenced by the traditional rural noble lifestyle. This meant equal inheritance, marriage within the same social group and the traditional production of products. The division of work within gender had a rigid, strict structure. [14] The subject of dressing, festive meal and the decoration of the "clean-room" (in Hungarian: "tiszta szoba") was in focus, and a prestigious topic. Apart from the two major cleaning in a year (before Easter and Christmas), there was almost no cleaning in the house. Later from the 19th and the 20th century the big-family lifestyle began to change to smaller families. When a boy child received his heritage, he moved to a separate house and married from or around the village. The maidservants in the city continued to be returned home. The family was often held together by the woman. [39]

The heart of the house was the stove. The family gathered around it. The stove had a double function. It provided heating and cooking facilities. For children it was not allowed to sit with adults, and they had a separate seat on the oven bench.

The guests were welcomed in the room in the front part of the building. This space was the place for the special occasion. The meal took place here during holidays, the birth of the child, and the founding of the dead. All the finest furnishings, handicrafts, homemade altar, signs of prosperity and family pictures located in the room. [40]

In West-Transdanubia the wide, flat, rectangular furnace, the bench all used to sleep. Resting, and sleeping on the stove, is widespread among the vernacular architecture in central-eastern Europe. In winter, the warm of the stove made these spots popular. In the 1860s, men and boys were lying on the wide benches of the atrium / kitchen, covered with fur and sheepskin. The head of the family, the women and the young children



Munkácsy Mihály: Tépéscsinálók ill.[09]

slept inside the house, also on the marshes made along the wall. [39]

In most households three or two generation lived under a roof. In the three-generation family household, 25-30 people lived under one roof. From 1838 is also known, that in the room lived just the host, his wife and the smaller children. All other married couples had place in the small pantry with a little window. All their property is in this place, and they spend there also the coldest nights. As the family multiplied, the shed, the atrium / kitchen, was transformed into a pantry. On frosty nights, the air in the pantry was improved with live coal in a pot. [39]

Since the 19th century, the sleeping time during wintertime in the two-generation peasant family has been influenced a lot by the layout of the room. In the corner there were two or three beds. The bed with sheet, was located at the corner of the street-façade, and in most cases, it was not used for sleeping. If there was a boy in the family or a valet, the host slept in the room, with his wife in the same bed. Until the host had no valet, the farmer slept in the stall, on a hand-made couch. The shed was never left alone, the host or the tenant took care of it all night long. [39]

Until a year old, the baby slept in a cradle. In poorer families, they slept in a small tub placed on a bench or chair next to his parents' bed. Later they got place between the bed and the stove, where usually two people could fit in. At that time there was a special movable bed, which was suitable up to 5, 8-12 years old children. They were covered with blankets and coats. Girls and boys slept together until school, between the age of 8 and 10. When the smaller movable bed was not anymore big enough, the bed in the room became their place.

If there was a big girl in the family, the room could not miss the bed with a big amounts of pillows and heavily decorated bedsheet. Its location was in the room corner next to the

street window. Usually it was made the bed, that the bedsheets folded over the pillows out of white linen, and the pillows were placed on top of all. Even a small-peasant family had at least three pillows on the bed. Until the family could not afford goose feathers in the pillows, they filled them with straw or chip. In a smaller household, there were a total of six pillows in two rows on the made bed. Among the wealthier families there was nine pillows on a single bed. [39]

In general, boys over 12 years of age regularly slept in the stall. In rural regions it was common to sleep in there in an early age. Although in East part of the country the stall was the place of the sleep, after the boys enter the age of 17. The peasant, and the farmer, slept there during his work as a farm hand, until he got married. [39]

Until their first child was born, young couples slept mostly in the chamber in the winter, setting up a bed in one corner. After giving birth, the wife moved in the room. Elderly, ill family member in the room usually lay on the bed behind the door, where during the day the children were lying and playing. From here comes the proverb: "The place of the child, and ill people is behind the door". [39]

The most common place for sleeping during the summer is the atrium / kitchen, where they slept on a canvas, or woven mat, the head towards to the doorstep and the feet towards the space inside. In many places, straw was laid on the ground of the atrium / kitchen. In other cases, straw bags were placed there. Some preferred to rest and relax in the cool chamber, but in hot weather, married couples, lads, elder girls usually stayed outside the house: in the barn, in the shed, where they sleep at the base of hay, straw, or on the haystack. [41]

In conclusion, in general the farmhouse had fewer beds than family member. The spouses, except for some shorter or longer periods, shared the same bed. Several children regularly slept in the same bed

	man, if there was a valet	man, if there was NO valet	woman	children 1-12y.	children from 12y.	young couple no child	young couple w. child	elderly	ill members of the family	valet	man, until marriage
Room 01 “clean room”											
Room 02		+	+	+			+	+	+		
Atrium / Kitchen											
Pantry						+					
Shed											
Stall	+				+					+	+
Outside											

Pattern of the place of sleeping in winter ill.[10]

	man, if there was a valet	man, if there was **NO** valet	woman	children 1-12y.	children from 12y.	young couple no child	young couple w. child	elderly	ill members of the family	valet	man, until marriage
Room 01 “clean room”											
Room 02		+	+	+				+	+		
Atrium / Kitchen					+	+	+			+	+
Pantry											
Shed											
Stall	+									+	
Outside					+	+	+			+	+

Pattern of the place of sleeping in summer ill.[11]

*The “clean room” ill.[12]

and the parent slept also with their same-sex child. In addition to beds made by carpenters, hand-made bunks are common too. In winter the bench of the stove / furnace was widespread to use from resting and sleeping. During the summer the structure of sleeping was more hectic. They laid on cribs, benches, or on the ground. [39], [41]

The ritual and sleeping habit had some hundred years tradition, moreover, resting on the ground comes from the early 1000s ages. In the modern sense, comfortable rest and sleep were mostly unknown in peasant homes. In a wealthier family from the 20th century couples from their 30s and 40s, man and woman sleep in separate beds. Since the middle of the century, separate sleeping has been expanding, but has not become common. In this families, other family members also got to separate beds sooner. [39]

*The rhytmical repetition of the volume in Feröszéplak ill.[13]

For the understanding of the vernacular especially residential architecture it is crucial to analyse the spatial layout and arrangement of the urban environment. We need to discuss not just the interaction between the inside – outside, building – yard, yard – street and building – yard, but also the urban development, and typologies. At first, we need to ask ourselves, what is a village?

"a group of houses and other buildings that is smaller than a town, usually in the countryside"

* Cambridge dictionary

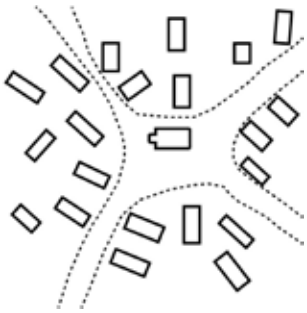
In the Antique, Aristoteles described the village like,

"when several families are united, and the association aims at something more than the supply of daily needs, the first society to be formed is the village. And the most natural form of the village appears to be that of a colony from the family, com-

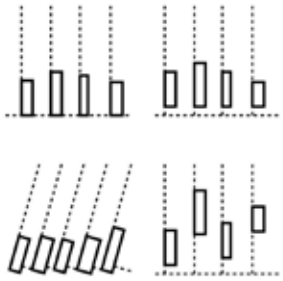
Typology	Feature
1. conglomerate	• un-arrayed • unorganized • radial
2. ribbon	• linear yards • “comb” type • multiple row
3. spindle	• linear • in the middle getting wider
4. strip	• two rows of houses • branch

Example

Hajdúböszötmény



Szany



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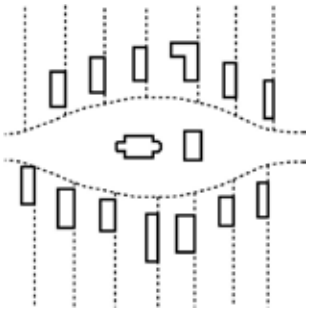

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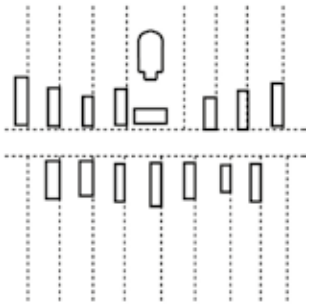


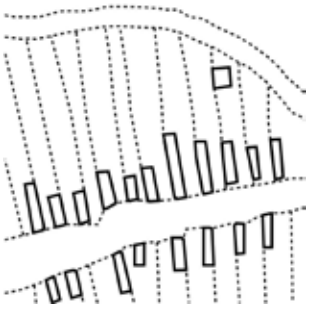
Typology	Feature
5. “next to a pond”	• a pond runs through the yards
6. row	• the yards run till the edge of the village
7. raster (crossed yard)	• like a chess table • blocks 90° turn to each other

Village typologies in Hungary ill.[14]

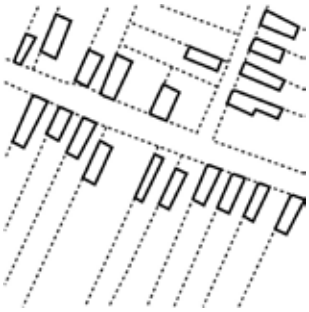
Example

Nyésta

Sima



Sóstófalva



posed of the children and grandchildren, who are said to be suckled 'with the same milk.' And this is the reason why Hellenic states were originally governed by kings; because the Hellenes were under royal rule before they came together, as the barbarians still are. Every family is ruled by the eldest, and therefore in the colonies of the family the kingly form of government prevailed because they were of the same blood."

*Aristoteles; Politics; 350 B.C.E

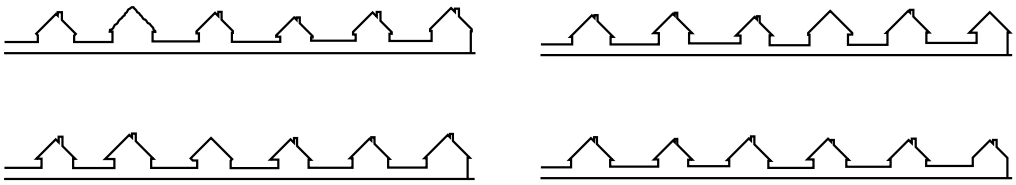
As we can see from the definition, if we talk about the village, the agriculture is in focus. Parallel to the functional structure of the village, it can be divided in two main parts. First, the urban land, with all the residential area, and community-, public spaces. Second, the periphery with all the agricultural land, which gives place for work. As the vernacular buildings located in the urban land, the focus is on this area.

As the table shows [14], we can discover a great variety in the structure. On the other hand, the base structure is very similar to the one and other. The similarity comes from the geometry of the yard. In most cases it is three, or four times longer than wide. This gives the result, that residential building has also a similar width to length ratio. Moreover, to have a better connection to the street and community the objects are mostly at the edge, front of the yard. The façade sits on the street, only in some cases we can discover a front yard, which gives a strong identity, character, almost a skyline for the village.

As the following diagrams [15,16] represent, the strict structure of the village gives a rigid rhythm for the skyline. The variety comes not from the vivid differentiation of the volume or the geometry, but from the composition of the façade. We can recognize a pattern, but we cannot find any object in one village, which is identical to others. [17]

If we compare just the skylines, it is challenging to tell the significant difference from one to other. They create a context, and a pattern, which is

*Relation of the typical facade and “skyline” ill.[15]



The silhouette of the general “skylines” ill.[16]

common mostly just in this area. If we do not examine the materials, we can realize a coherency, which rules and gives the context.

Firstly, the layout and structure of the yards and urban land results a frequency and rhythm. The buildings have the same schematic design in terms of layout, proportion and massing. As in the urban land there is not much functional mix, and until the 19th – 20th century there was predominant equality in the social hierarchy, the result is clear. A homogenous village, urban land with almost the same density. The almost same cultural identity and identical social background indicates a similar perspective on life, aesthetic. This all generates the context, which amplifies a special atmosphere.

The volume

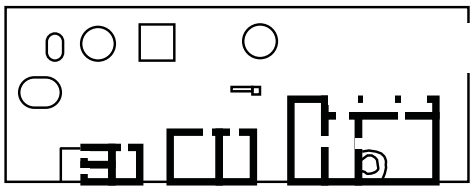
The analyze of the volume is crucial, because as we saw in the chapter (The urban context – the village and its structure), the structure of the urban land gives an answers and proposal for the volume. The context of the long yards and the volume cannot be independent. The top - down analyze can bring answers to understand the vernacular architecture as a whole. This chapter tries to find answer for the volumetric articulation.

The volume of folk houses is usually very simple, a block which is, usually a rectangle. This form is very grateful, as it is also compact, so it is easy to construct. Moreover, the geometry is very compact, which is advantageous from a thermal point of view. This mass was crowned by the roof, the shape, and slope of which were often determined by the material of the roof. [42]

From the 16.th century, the first changes and the differentiation of local influences were noticeable. It has been strengthened since the 19th century and has developed local building practice. However, some basic features are worth noting: the Hungarian house has generally one tract; in contrast to many European territories, vertical growth is not observed during its development; and while its width has also not changed (varies between 4-5 meters), its length varies greatly. The expanding of the length can be explained by the increase in the number of houses and the number of rooms. To compensate for the disproportion caused by such growth, in many places (for example in Eastern-Hungary), lower and narrower parts of the building were fitted to the main body. Different roles could also be expressed in this rational section. [42], [43]

Typology – floor layout

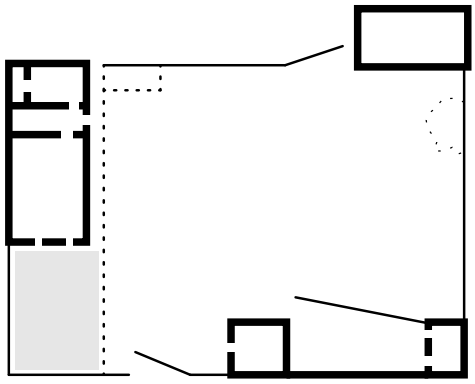
In the house typologies one of the main, basic unit is the garden, which contains the residential house and the "farm" building, buildings for economical use. There were basically four type of yard typologies. [28]



Linear yard ill.[17]

A. linear yard

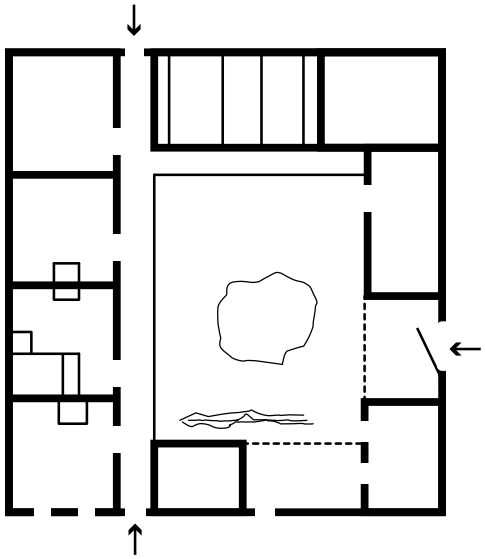
One of the most important parts of the plot is the yard including the residential and business buildings. In addition to the varied, often custom-made image of the yards, there were some forms that reflected some similarities. Linear courtyard is one of the most common variants. On the narrow plot, the buildings are lined one after the other, their entrances usually look south. [13], [28]



Grouped yard ill.[18]

B. grouped yard

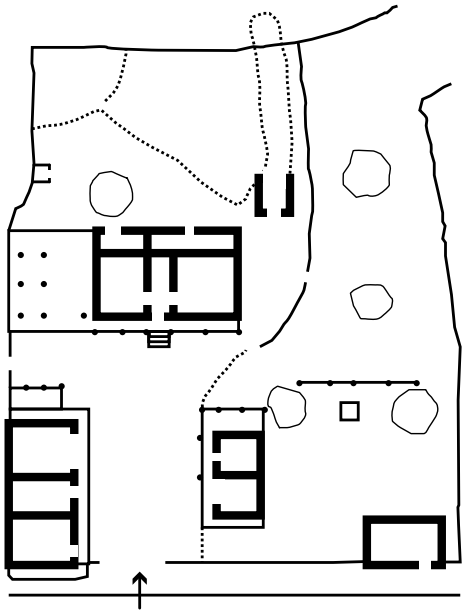
Buildings of a group yard are on placed in blocks, forming a non-assembled group. The typical type of settlement of West Danubian is the enclosed courtyard, which is enclosed by three or four houses, from the residential building to its farm-, business buildings. [13], [28]



Yard with boundary ill.[19]

C. **yard with boundary**

There were farm buildings in the first part of the yard separated by a fence, while the dwelling was occupied behind the stables in the inner courtyard. [13], [28]



Double yard ill.[20]

D. **double yard**

In the recent years, there were only remnants of the so, called double yard, which was mostly wide-spread in the East-Hungarian territories. The typology had also the nickname "poultry-yard". [13], [28]

The development of the typology from the 16.th century.

The Hungarian word for house, for a long time, marked a single room, where the most important everyday activities took place. [42] This term also refers to the one-dimensionality of the Hungarian residential building. At the beginning of its development still meant a building, that was digging in the ground. [36]

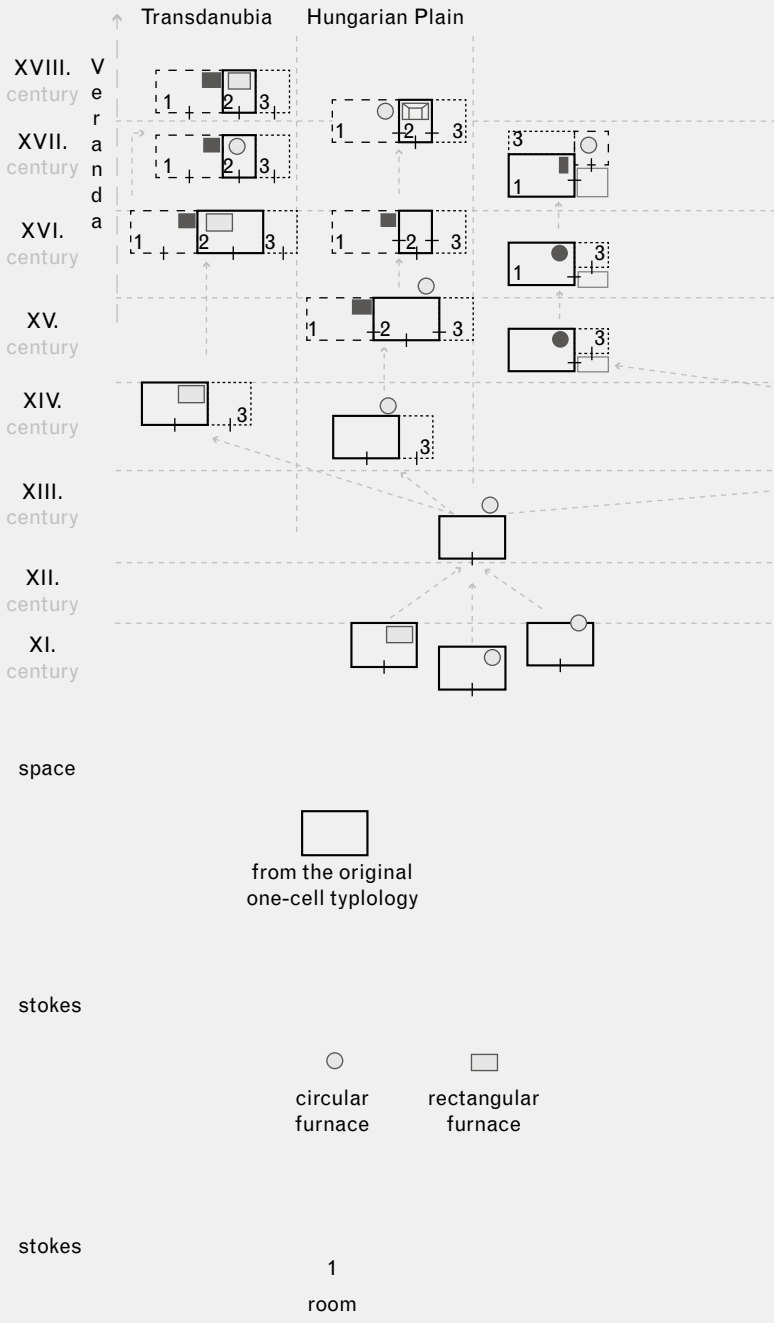
In terms of floor plan development, the most widespread type, is the so-called three-cell house, which is usually a room-atrium/kitchen-pantry layout. It is typical of Transdanubia that the spaces have separate entrances, while in the rest of the country, the other rooms open from outside. The significant deviation from these systems can be observed mainly in the Transylvanian territories and the houses of the settlements of Örség. Although the premises are consecutive buildings, the three-cell house can be considered central because of the central role of the atrium. [29] With the appearance of the verandah, this function has lost its significance, especially if the building and the storage capacity have increased. There is the need for new cells. In some cases, a new cell was added to have enough capacity.

The intention to establish the permanence that is based on the of the economic environment of the family is resulting in any transformation of the existing building. The groth of the family or the need of a bigger storage space is expressed only in the expansion and further development of the house. No new solutions can be found when it comes to rebuilding after complete demolition or building on empty land. This is an ancient habit that retains elements throughout the transformations, even if the signs of their origin have disappeared. [43]

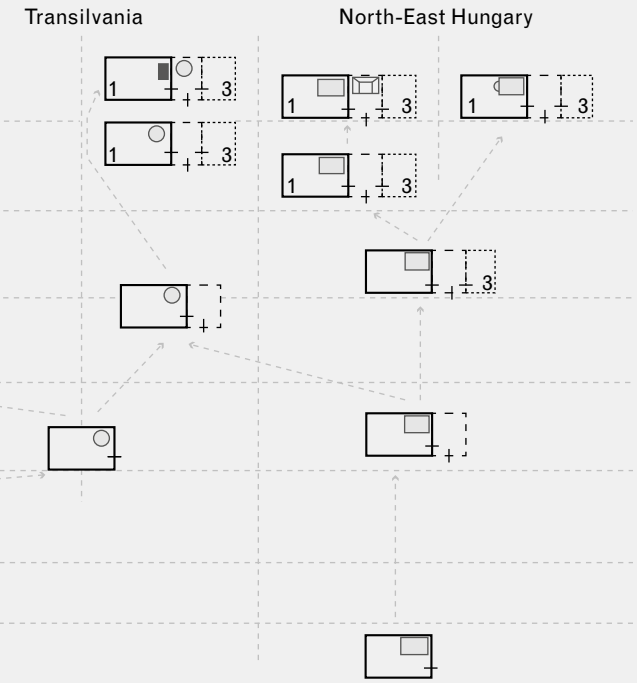
From the 10th century onwards, a building type appears that differs from the general picture. In Northeastern Hungary, there are houses dug in the ground that are rectangular, usually made of stone. Next to the entrance on the shorter side is the stove. The door also looks at

Sequence of the space creates the rhythm
ill.[21]

View from the kitchen / atrium to the room
ill.[22]



In the development of the residential part of the yard the place of the beehive oven ill.[23]

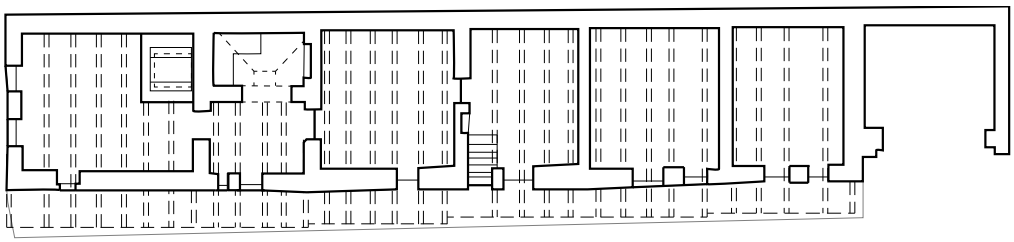


it. In addition to the Danube Bend, and then beyond the boundary of the Tisza line, such buildings were dug in the border of Tatabánya. In the north-eastern corner of the Carpathian Basin, in Radvenka, near Ungvár, such buildings has been buried so far, but it is not excluded that it can be detected in the northern part of Transylvania. This is nothing more than the Eastern European furnace houses from the 10th century on the outer edge of the Carpathians, a form that has evolved from the former.

The social and agrotechnical changes took place in the 13th century resulted in a significant increase in the population living in the village, which had a short-term impact on the residential building.

As a result, the 14th century could be the turning point when a single-cell residential building had become the two-cell one. The increased demand for storage as a result of expanding production was no longer covered by the original construction and storage space like the stack, therefore the residential building was first expanded with storage space. However, this process was not the same in countrywide. In the Transdanubia and Eastern Hungary, the single-room residential building with a long-side entrance can expand without any difficulty with a chamber. The chamber reached the full width of the building. The entrance opens free from the facade.

In the 15th century, the discovery of the stove in the villages indicate that there have been major changes in the stoker since then. In Transdanubia, there is no new room with additional functionality in the century, probably only the number of chambers will increase, and in some cases the differentiation in use. Here, the furnace could have spread a little more than a century ago, compared to the other parts in the country. However, there is a fundamental difference, while in the Great Plain the room with the stove opens always from the room next to it, from the former living space, now the kitchen. Meanwhile,



Typical floorplan of a residentail house with linear yard ill.[24]

in Transdanubia it opens from the outside. In both cases, the stove furnace can be heated from the former living room, near to the room. In Transdanubia, the oven is still there. Here, the stove furnace remains in its original function, only the heating system and does not take over the function of the oven. [15], [36]

The main issue and problem of the centuries is the subject of smoking and its ventilation in the nature. Before the 17.th century, the ventilation happened through the door or a small opening in the wall of the kitchen.

In the 17th century, free chimneys at the back of the kitchen, already known and used in cities and noble-architecture. The fully-ventilated residential building happens for the first time in the history of Hungarian folk construction.

In the western part of northern Hungary, it is about one-hundredth of a delay compared to the east. Only in the 18th century, the partly smoke-free solution of the room appeared. A vertical system built over the opening of the indoor heating furnace, which directs the smoke uprights onto the attic.

There is no progress in Transdanubia in the solution of smoke, although there is already a smoke-free living room heated outside with stove. The kitchen next to it is still smoky, and the changes will only take place in the 19th century. [18], [19], [20], [21]

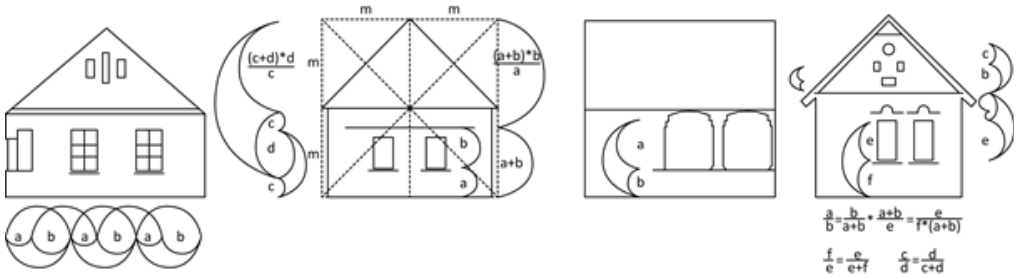
Front façade

In the Hungarian folk architecture, the two main facades of their houses are the shorter, street-facing, and the longer, courtyard-facing. As a result, these two sides received more attention during the construction, and in fact, these two sides were the front of the house. [43] It is no coincidence, therefore, that there is a focus on the expression of healthy human rivalry in creative decorations and formal solutions. As a result, as the structural solutions become more sophisticated, the right proportions and the concept of beauty are also ripe in the collective spirit.It is interesting to note that although the proportions of facades in the whole country were very similar, even in some major regions, even nearby settlements were able to produce clearly the formal features that characterize them. [44] Territorial typology even divides the Hungarian Plain into five different areas. Instead of analyzing them separately, it is possible, generally, refer to facade design and interesting editing proportions.

The facade is determined by two additional structural elements. One is the shape of the roof structure: jerkinhead, or in another way jumping in front of the wall, for example, a total ornamented roof where the gable wall extends over the roof. An important difference with these is that the gable wall is boxed out with timber or made with masonry. The other determining structure is the doors and windows. Initially, he was looking at a window to the street and then to the 19th century. By the end of the 20th century, the façade with double window became common. [29] Likewise, the size of the windows changed, the small square openings initially made of four segments grains to six segments. The triple-window façades appeared in many places with the porch spreading across the porch's street wall. This door could be a door instead of a window. [29]

It is noticeable that in these buildings without prior engineering and artistic design, how beautiful the golden ratio was.

Front façade, Tényő, HUN ill.[25]



Proportions on different facades ill.[26]

It should be noted that these golden ratio ratios are not the result of conscious design decisions, not the works of chance. The conscious pursuit of a more balanced ratio is an important feature of Hungarian folk architecture. [29]

The facades facing the street are like human faces with different individualities. Serious, cheeky or grim. Somewhere, the face of the gable represents the background and cultural orientation of the owner. The individuality of the people can be read well from the facade.

Of course, there are basic features, that make these gables similar and helps to fit in a context. The most important of these is the structure of the roof. The beams at most of the time are in right angles, determine the silhouette of the property. In some cases, however, the gable wall may close a dull angle. [6]

The triangular base can get freely different decorations. The actual facade (the wall of the room facing the street) and the gable are separated by a horizontal line at the height of the ceiling of the living space, (in context with the structural height). This ledge changes from simple, flat plaster finish to prestigious installation, often with a cover, shingle, tile. Separate the gable walls, a completely different form of language has been developed to decorate the facades. This was further enhanced by the further fraction of the surfaces. [6]

Fertöszéplak 01

Fertőszéplak 04

Fertőszéplak 02

Tényö

Fertőszéplak 03

Façade typologies in Transdanubian region ill.[27]

Veranda and eaves

The eaves were an important element of the face of the building. In one hand, protecting the house and its inhabitants from the rainfall, but also had an aesthetic aspect. By the shorter facade, the desired effect is achieved with varied roof shapes.

As a result of the development of the eaves and the increased demand for the indoor space, the porch was created, which became an important sign for the place in the hierarchy. This probably explains that in a short period of time, from the 1850s to the 1910s, it became a dominant element in almost all Hungarian folk architecture and produced varied formal and structural solutions. [42]

The layout and form are varied. There is also a porch that encompasses the house on three sides, but in the Central Transdanubian-region, there is a front porch, that formed by the merging of the side and gable. Meanwhile, in the Hungarian Plain, the use of a broken porch was more frequent. [42]

The load above the roof structure is transmitted by a columnar-beam or arched structure to the ground. Columns can also be very diverse, distinguishing between wo od and masonry structures, and they also occur in many variations by region. It is worth mentioning how soon the folk creature discovered this architectural element, that we still use as a tool.

Fertőszéplak - Landhouse ill.[28]

Kóny - Landhouse ill.[29]

Door and Window

"The window is... a place of silent monologue and dialogue, of reflection on one's own status between the finite and the infinite." J. A. Schmoll

The windows allow you to look out of the building, and the doors provide a physical connection between inside and outside. The size and proportion of the windows and doors of traditional houses was influenced by many circumstances. Windows and doors show the current technical knowledge as well as the financial possibilities of the owner.

The concept behind the windows is simple and functionalist. The aim to create a dialogue between inside and outside, and to transmit light form outside. All room has its own window. The size, and proportion depend on the space and function. The size and design vary from room to room. The room facing to the street has a vertical proportion. Until the 19th century the typical size was 60x90 cm, but from the 20th century it increases to 90x120 cm. The parapet

J. Rippl-Rónai: Fényes ablak előtt; 1905 ill.[30]

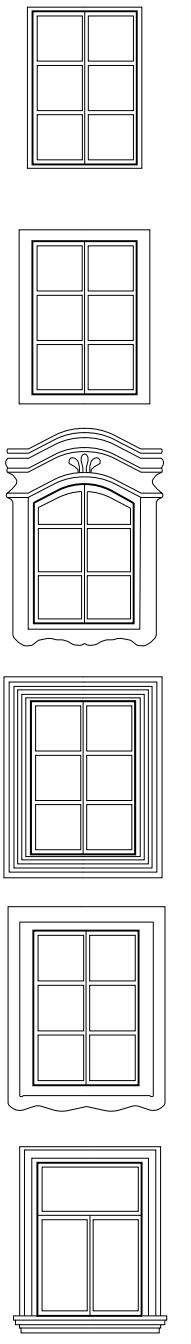
H. Matisse: La Pastiche the window; 1916 ill.[31]

is between 80-90 cm. The window of the room facing to the street divided in six glass parts, but it can have different layouts, but the base grid of 2x3 is visible in all typologies.

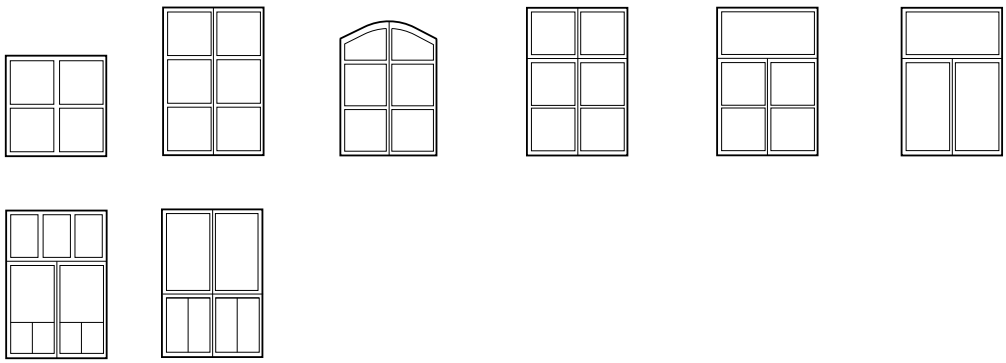
The rooms which are not so representative, like the chamber or storage has a smaller window, almost with a proportion of 1:1 or 2:3. The grid of theses windows is mostly 2x2, with a size of 40x60 cm.

The doors are made of wood, and both are coffered. The design of the doors can be different inside and outside. The doors inside has sometimes a window above the door panel. The doors outside are most of the time single door, but in some cases we can find double door (f.g.: in Pilisszentlászló).

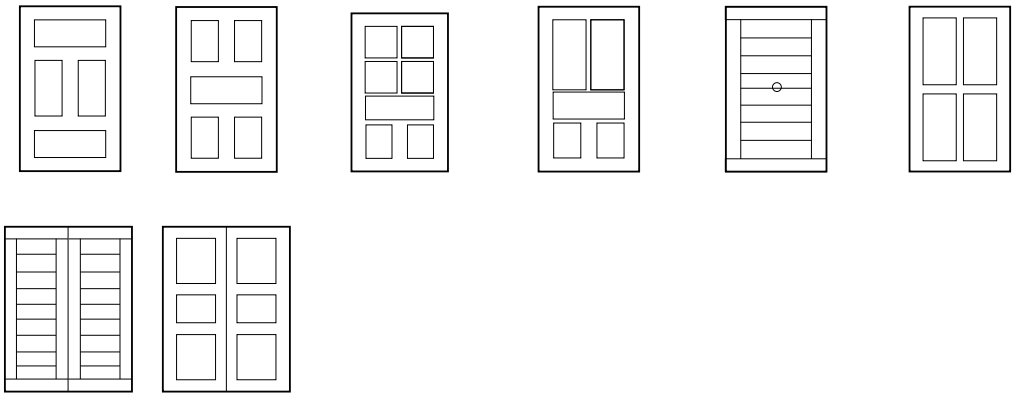
In homogeneous walls, like rammed earth walls, the doors and windows are cut out after formwork. In the wall, which is not yet solid, a hole is cut with a hack or a spade. Then the vertical wooden structures of the door are placed in. Then the carpenter measures the dimension and



Ornaments ill.[32]



Frames ill.[33]



Doors ill.[34]

creates the door frame. The wings are usually made in a workshop and are placed by a specialist or a skilled craftsman. When structure is made of clay bricks, the frames and blinds are placed at the same time as the wall is erected. In this case the dimensions can be determined on the basis of already existing or prefabricated doors and windows. The doors and windows can be placed in right after the construction. At least every two years, the wooden structures are always painted and carefully repainted. [66]

Window – “clean room” ill.[35]

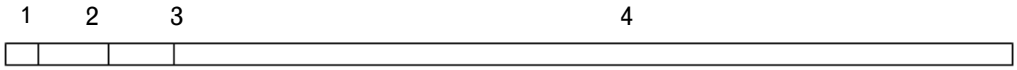
Window – room ill.[36]

The Structure

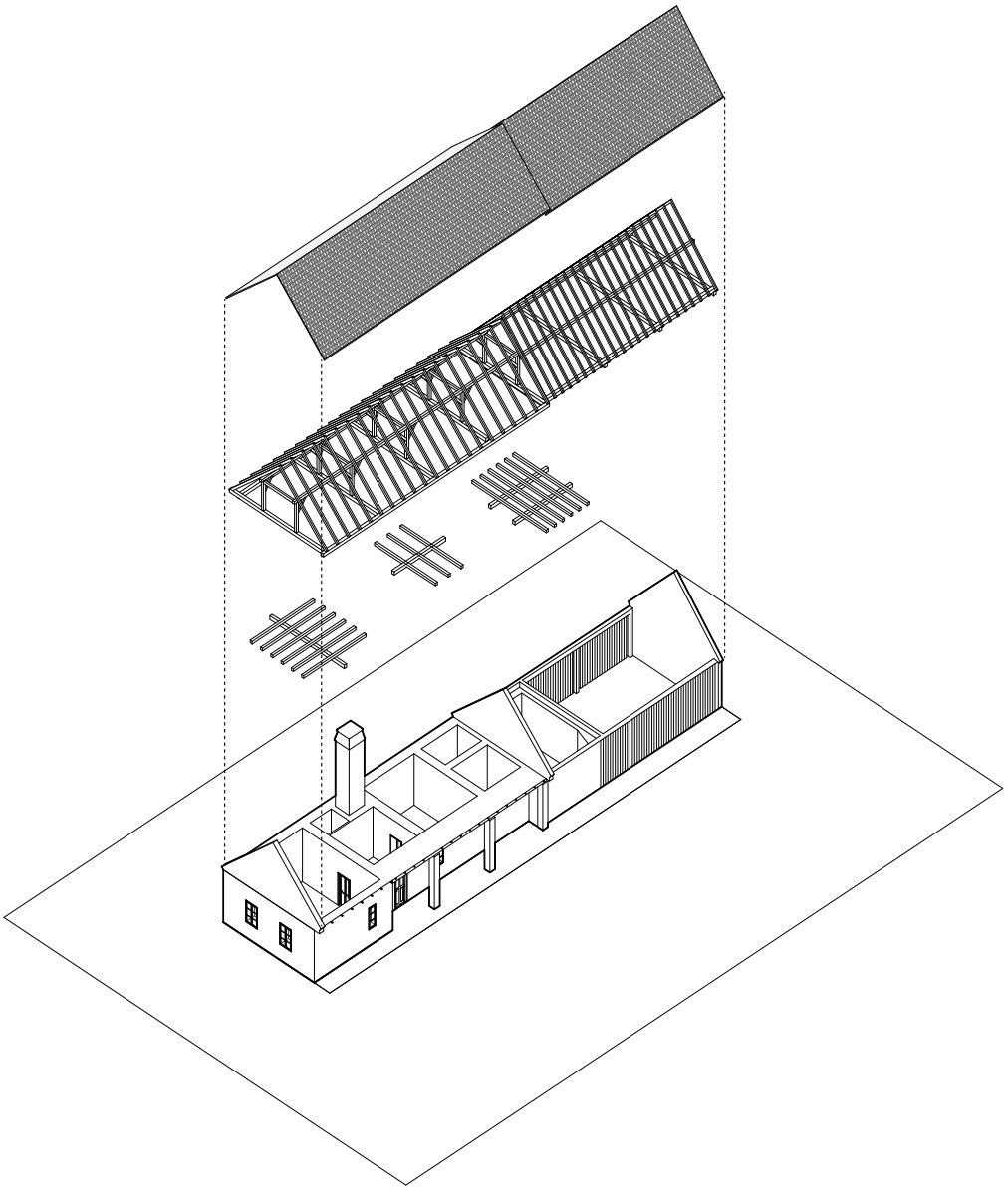
Before the details of the structure and structural elements (foundation, slab, roof), the diagram shows an example from the real life. The building which was analyzed for this study locates in the Transdanubian village ("Kóny"). The building is a good example to get impression about the materials, which were built in these buildings, and the quantity of those.

1.plaster (inside + outside)	2.terracotta	3.wood (pine, linden)	4.clay / earth
7,04 m^3	15,40 m^3	14,13 m^3	180,70 m^3
3,24 %	7,09 %	6,50 %	83,17 %
			Sum: 217,27 m^3 / 100%

*Quantity of materials (in m^3 and %) excl. foundation and openings ill.[37]



Distribution of materials (in %) excl. foundation and openings ill.[38]

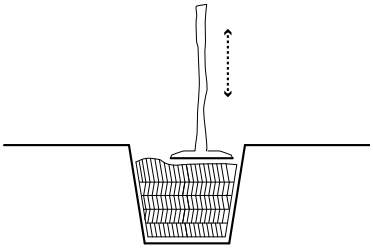


Structure – Kóny (traditional house) ill.[39]

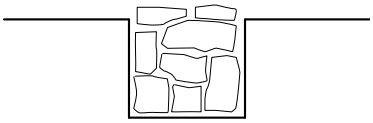
Foundation

The significance of the foundation was only slowly recognized by folk architecture. The primary reason for this is that the timbered construction method did not require any major technology other than at the corners placed stones or timber blocks in the wall joints. [42] To understand the slow process, we need to know, that before the 16th century the primary wall construction was out of wood, but in the period of the small ice-age around that time, society had to find new other ways to replace timber to earth.

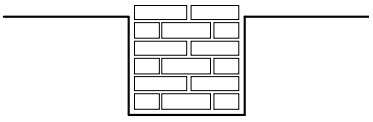
Of course, they were not built directly on the lawn, but one layer down to a harder ground. The removal of the humus layer, followed by a backfill with earth or clay, was already a very advanced procedure. [43] In the case of frame structures, some large pieces of stone served as a foundation and occasionally in the positioning of the building. In the ground, solid foundations can only be established in the 19th century. One form of this is the "locally grafted" technique, where



1 - Donged foundation



2 - Stone foundation



3 - Brick foundation

Foundations ill.[40]

the quicklime was placed between the stone rows, which was poured with water into the final piece there. Only in the 17-19th century, after the proposals of the building authorities, appeared the modern brick or stone foundation. [29]

The insulation of the walls and the plinth, which was almost completely unknown, is the main way to protect against moisture. Also, in the region of the Hungarian plain it was common to search for the highest areas, or they built artificial hills or began to build a collapsed house.

The structure, which is directly in contact with the ground at the foundation, is the floor of the one-story houses. This kind of structure can be hardly called as foundation, it is more like flooring or finish. The end of the 19th century was a widespread solution, that a timber layer was dig and rammed in the ground. Then a thin layer of mud was placed on the top. This very simple structure required annual maintenance, depending on usage. [29] Only from the end of the 19th century became the strip flooring popular, where the strips were placed on a thin sand layer.

Slab

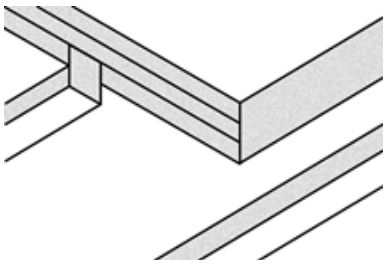
The word for the ceiling in the Hungarian language was an unknown term until the middle of the 20th century. Instead, the word attic was used. Although some slab structures have been in use since the middle ages, they got widespread after the theme, that the buildings were erected above, and not in the ground [29], [18]

The types of the vernacular slabs are distinguished primarily by the filling structure between the beams. The slab beams are usually located every 90cm at 1m. Up to the 20th century, the most common double-sided reed slab in the Hungarian Plain.

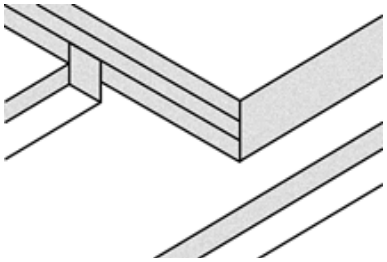
All wooden-based slabs are based on the beams. The slabs are usually made of with the "large beam", which cross-sectional dimensions were not rare at 30x40 cm and not less than 20x25. The "large beam" was the most valuable part of the house, so it was reused after the demolition. To date, we have counted pieces from the 17th century. Except for Transdanubia, where the "cross-large beam" was widespread, there was a "large beam" running parallel to the longitudinal axis of the house across the country. The big beam, as a structure, became rarer in the second half of the 19th century, and then disappeared from houses built at the turn of the century. This was probably due to the shrinkage of the proper wood and the experience that a slab of normal size would suffice for a medium-loaded attic. [29], [18]

Here, the beams were covered with planks, directly next to each other, or overlapping, and then the reed or straw timber was laid, which was also covered with patches in the attic. As has already been said, folk dwelling houses are single-story buildings whose attic was only used for storage. That's why the load-bearing capacity of the slabs is considerable. [18]

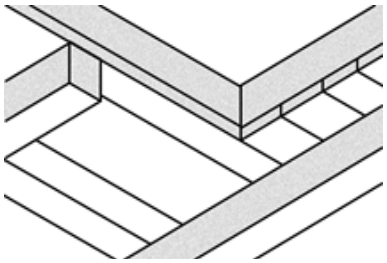
Master beam ill.[41]



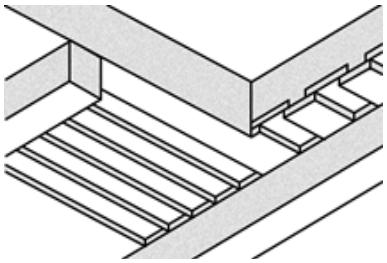
1 – ceiling w. beams and dong



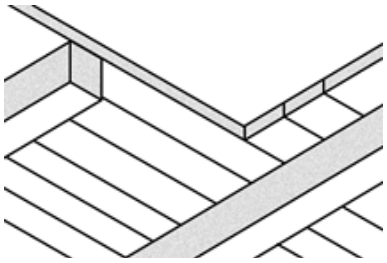
2 – ceiling w. beams and reed cover



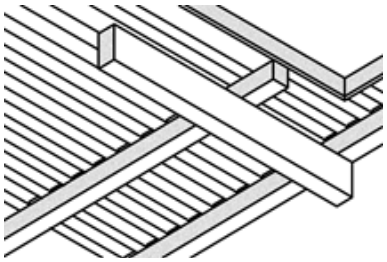
3.a – ceiling w. beams and boards



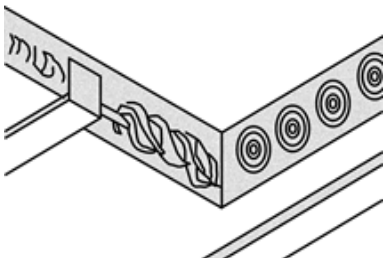
3.b – ceiling w. beams and boards



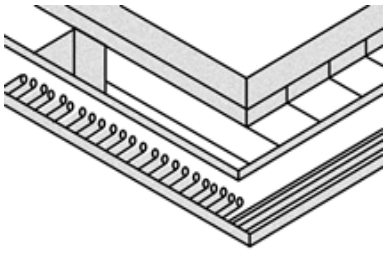
4 – ceiling w. beams and board flooring



5 – ceiling w. beams and “master” beam



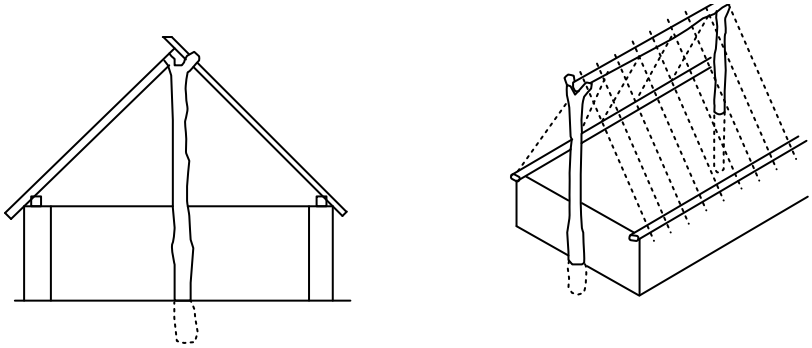
6 – sticked ceiling



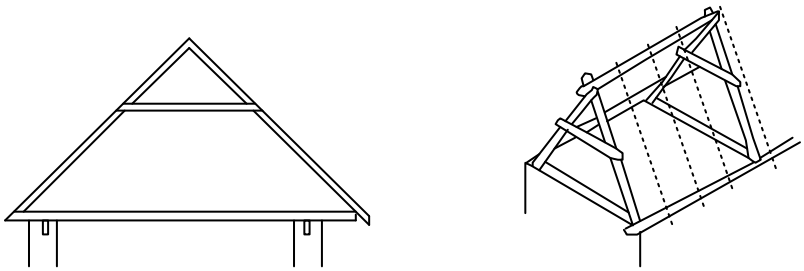
7 – covered ceiling w. beams

Variety of slabs / ceilings ill.[42]

Roof constructions

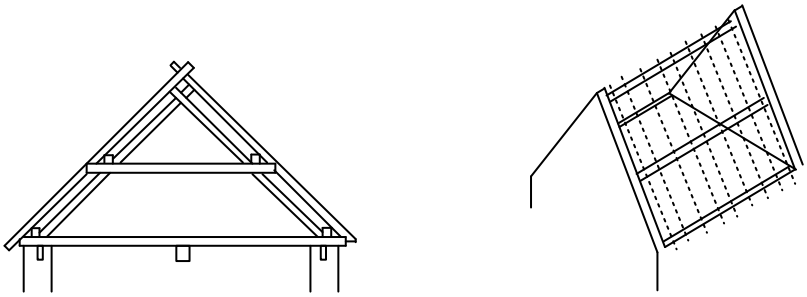


1- s. “king post” and ridge pole

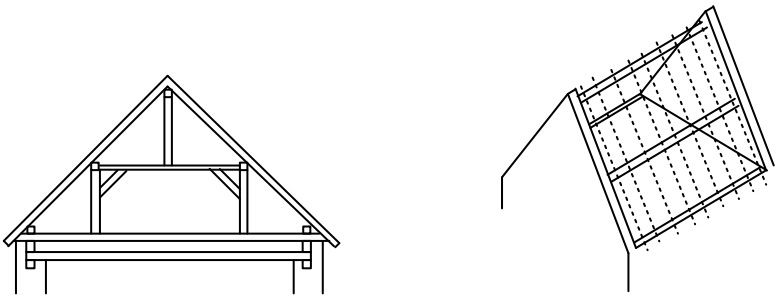


2-“scissor” roof

In Hungary, the most common roof structure before the 17th century is the timber roof construction with “king post” in the junction of the two rafters, which is the surviving structure of the archetype of huts with tent roofs. As the slab becomes common in the vernacular building habits, the slab gave the opportunity to transport the horizontal loads of the roofs, so the hanger became unnecessary. Later, the “székes” roof structure was released, which was distributed by the learned carpenters in the country. With the advancement of structures and the emergence of building regulations by the end of the 19th century, the slab and the



3a-w. gable and ridge pole



3b-w. gable and ridge pole

Roof structures ill.[43]

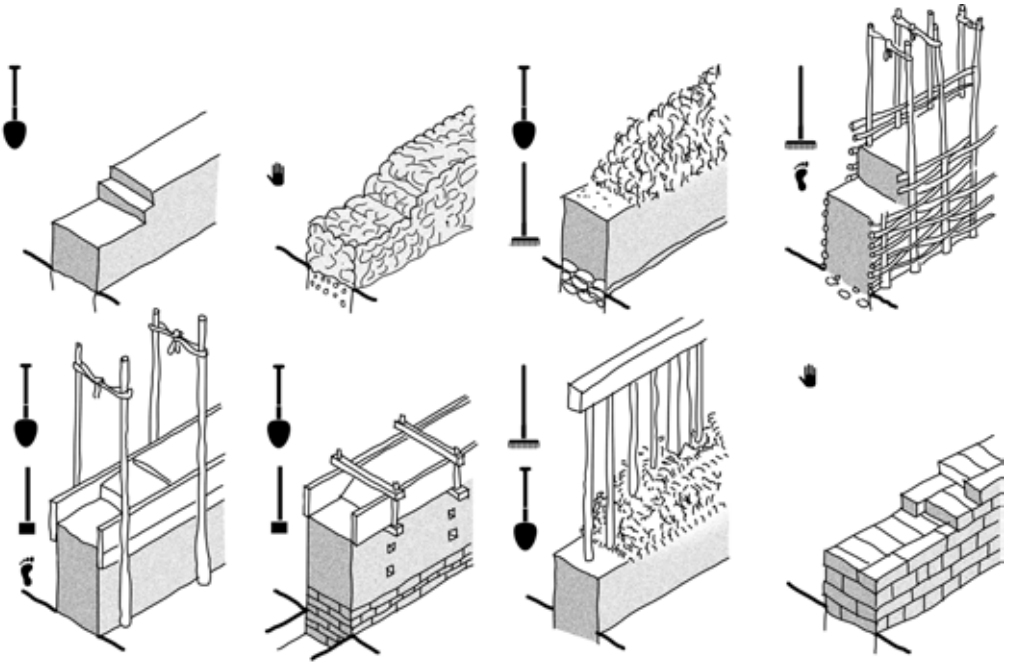
roof were independent again. [4], [42] The shell, or roofing, comes from the Hungarian ancient vocabulary. In the folk architecture, the material of the shells, apart from the burnt tile, is also a natural, mostly phytogenic material. They can be grouped according to their material, (reed, straw, wood, slate, burnt tile) and their structural "shape" defining their construction. Such as hollow cover, which means stump-like and trampled straw cover; whip cover that includes reed and crown cover; as well as scaly covers that are shingles, natural slate, and tile shells. [18], [43]

Walls

Homogeneous earth walls were made, using a variety of techniques. One of the most ancient forms is the mud wall, which was made by hand. Small pieces were torn out of the prefabricated clay/earth, slightly drained and then individually built into the wall. [19]

As with the earth walls in general, it was built in 80-100 cm high sections. After each stage, after completion, approx. it was let to dry for a week. The more practical version of this technique is the stacked wall, which differs only in the way the material is built into the wall, not by hand, but by the use of a pitchfork. In terms of development and technological sophistication, the next level is the rammed wall. Here, on the outside and inside of the wall in every 2.5-3 meters, rods were dug into the ground at a distance of one meter. Then on the inside made of planks, movable formwork was created. In the space between earth and clay was stuffed or, in other words, beaten in. All three techniques are characterized by the fact that the doors have been left out of the wall, but the small window openings have been cut off afterward. [43]

The technology of earth-wall construction can be called the most industrialized earth-brick wall. In terms of its history, it has a history of 8-10 thousand years in architecture, but in Hungary, it has only appeared with the spread of the earth walls. There are three steps to prefabrication: an admixture of clay and earth, then the drying of the material. It is very varied in size, for example: 24x32x14 cm or 13x14x27 cm and many more are known. [19], [43]



Methods to creat a wall out of earth ill.[44]

Stacked mud wall

Stacked mud wall ill.[45]

The stacked mud wall is made of straw or other plant-based materials. The carefully designed and restrained mud is folded by fork or by hand and the wall will be raised from it. Soil is used to make the wall, which is produced from the site or from the far away. If the soil is not suitable for the area around the house, then it is carried away from a distance from the border. For a house of 15-20, sometimes 30 carts of land was needed. The good mud is obtained from clay-yellow soil or gray-clay soil. The amount of soil, which is needed for a day of work is already carried by a 4-5 m diameter, 40-50 cm high heap and then sprinkled with water. The wet soil is first to cut through, then plant-based material is sprayed on it. Lastly, it is trodden out by a horse. The additive is most often straw, but in some regions, it is reed or hay. [5]

The portion of the mixed plant-based material can be up to 40% of the earth's weight. There may also be a minor divergence in the development of the mud, for example, in the Matyó country, the stacked mud was several more times followed after the horse treaded it. If the plant-based materials were well mixed and the mud was smooth, they were ready for the composite material. The mud was rested overnight. The wall was laid with a fork and then put in position. Occasionally the side of the wall was adjusted with a fork. They could put the wall of balls, in the diameter of 30 cm. The balls were placed in a row by hand, stacked them well together. When they finished one loop around the whole building, the front was dry and could continue to work. The height of each section was 80 to 100 cm high. When a section was finished, they left 1-week rest. Be-

The earth is compressed by horse-power ill.[46]

fore the wall had dried, the wall of the wall was cut straight and carved. In general, the location of doors and windows was left out during construction, but there were times when the location of the openings was cut before. The thickness of the finished wall was 50 to 60 cm, but in some cases, it was 70 to 80 cm. Some places formwork was to the stacked-mud wall. [5], [19]

The work was organized by putting one or two people on the ground with a fork, and one man on the wall with a fork to fix the wall. When the building material below ran out, the man standing on the wall checked again the wall and straightened the surface. The cut-off, rest material was rebuilt in the wall. The top of the wall was covered with straw against strong sunshine and rain. Before the second sequence of soil was put, they sprinkled the first wall sequence, which was left to dry for one week. The whole wall consisted of three sequences.

Construct a building involves the whole family ill.[47]

Rammed earth wall

Construct the rammed earth wall requeres the family and a brigade ill.[48]

The rammed earth wall is made of soil with natural moisture. Almost all kind of soil, except the humus of the earth, was suitable to use. Although, the best was the slightly clayey soil. If the earth was heavily clayey and shrunk during drying, it was mixed with soil taken elsewhere. The earth needed for house building was preferably taken from a location nearby. If the terrain was on a slope, then the soil was placed from the end of the house or to front of it. There were some who dug a hole in the yard, and they got the building material from there, that was suitable for the use. In some cases, the land was taken somewhere further. [5]

There are two versions of the formwork. At one of them, on two the sides of planks, boards were dug down, 70-100 cm apart, in the ground. When using beams at a distance of 150-200 cm. These beams (formworks) were usually the rafters of the house. The rammed earth wall

Texture of rammed earh wall ill.[49]

was usually 50-55 cm thick, but in Transdanubia, the walls were 60-80 cm. The earth and soil were placed at a height of 20 cm and then rammed down to 10 cm. However, in some areas, a 10 cm wall was rammed down to 5 cm. The wall was done with a special tool. The most sophisticated wooden tool showed a widening shape. Interestingly, in some regions were multi-sized tools. Such as in Táp, where there was in 5 different sizes. Each size had a specific task in the construction. [5], [19]

If the ground was too wet, then a layer of powder was laid on each layer to prevent the wood from sticking. However, if the heat quickly dried the wall, then water was sprayed on it.

In the wall, the location of the doors and windows was paved with a board, and they were left out during the construction of the wall. In some cases, a beam was previously laid in the construction. Therefore, after the masonry, only the part under the

Construct a rammed earth wall in Kóny, HUN ill.[50]

beam had to be cut, which greatly facilitated the construction.

The masonry was done in fractions because it was not possible to make the whole formwork for the whole house at the same time. If they wanted to avoid the structural joints caused by the joint of the formwork, they used movable formwork, that can be moved forward, horizontally.

Smaller or larger teams were organized to produce the rammed earth walls. The smaller groups consisted of 10, while the larger groups consisted of 25-30 people. 4 people used the barrow, 5 people stood on the wall and rammed. The last man steered the whole process. In the case of a team of thirty, work was done in a division of labor similar to a team of 10. The work required great attention and had to be done rhythmically, so they sang meanwhile. [5]

Also, dwellings, sheds, summer kitchens, chambers, and barns were built with this technique. Like the rest of the earth walls, they have the advantage: cost and the time of production, and in summer they gave the family a cool room temperature, but in the winter it is safe. Its biggest enemy is moisture.

Earthen / Clay brick wall

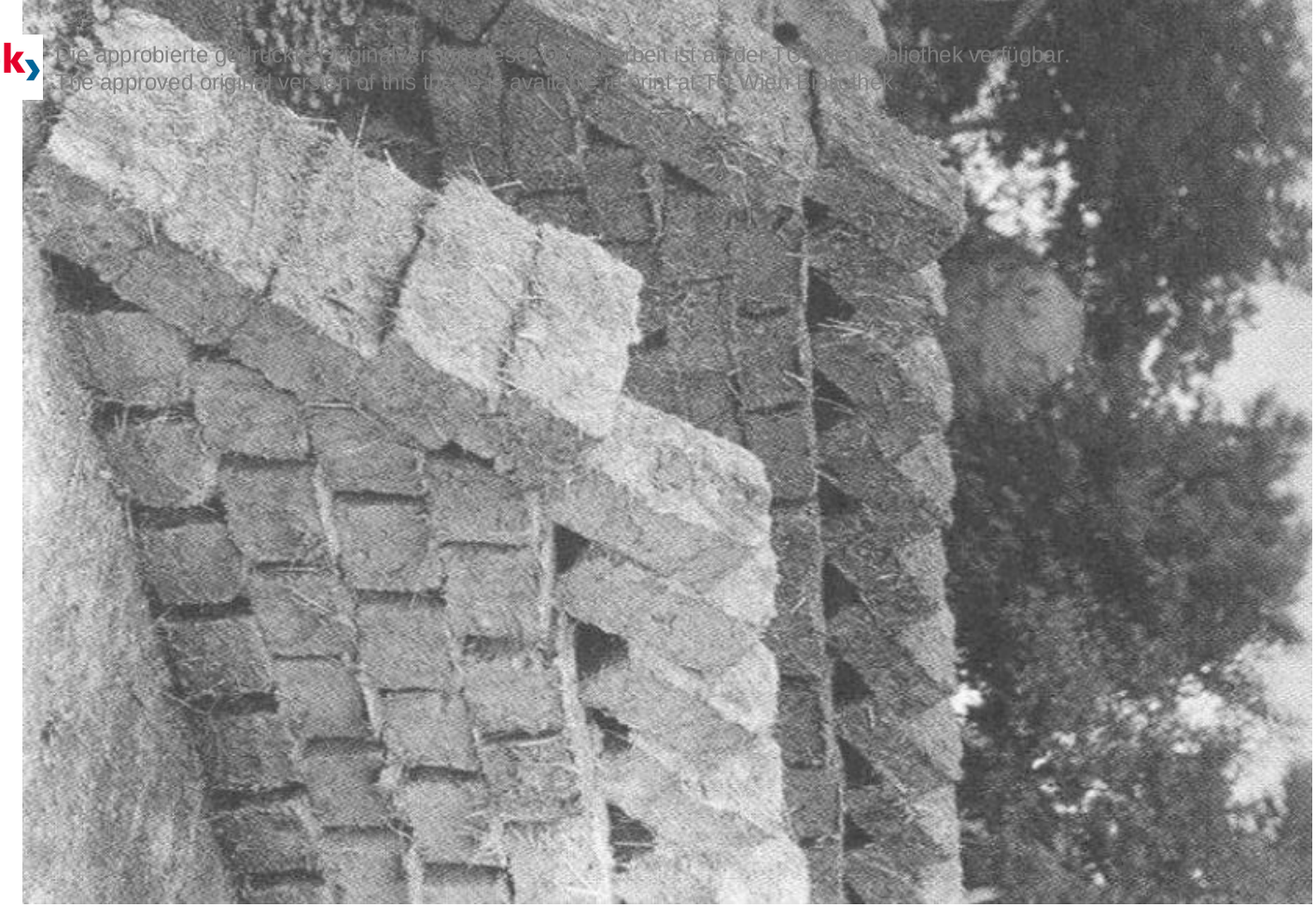
The earth-brick-walls were made of mud and with sun-dried bricks. The wall was bonded in the same way as the brick. The bricks were shifted above, not to align the gaps. A softer material was used for the binder. It also happened that reeds were placed between two rows. The walls were 40-50 cm wide.

In the past, the width of the wall was given by the width of a brick, and later a wall width was one and a half brick widths. The earthen bricks were not only used for masonry but also for vaults, such as the vault of the kitchen. An average house required approximately 10-12,000 bricks. Generally, the earth brick was produced by three different groups. [5], [19], [57]

There were those who only produced it for themselves, for their stable, for their house. The other group is the farmers who made bricks besides their original profession, but only spring. The last group was the ones whose whole livelihood was covered by making the earth brick. Therefore, they had accumulated stock all year round.

Brick wall out of earth ill.[51]

Brick out of earth/clay ill.[52]

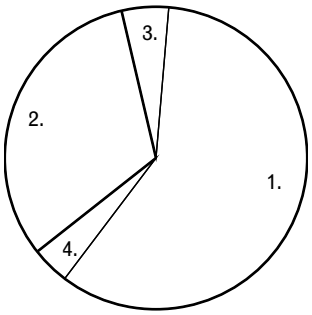


Sustainability

There are many books and references, so we can ask the question: How should we do the first step in the sustainable construction design? What is the better direction? Which are the actual sustainable materials and construction techniques for example in terms of embodied energy? In the further research I would also take these questions above, into consideration.

Demand on sustainable approaches in the building industry

There is the need for sustainable approaches especially in the building industry, because the it gives about 10% of the GDP of the EU and produces about 33% of the waste. These two numbers represent quite well the dominant role of the building industry for the more environmentally friendly way of living. We can raise the question, but which "crisis" could stand behind the result and demand of sustainability?



1. raw material – 59% 2. production – 32% 3. packing – 5% 4. transport – 4%

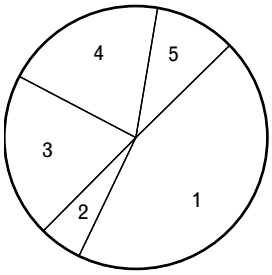
Distribution of GDP and waste to the whole ill.[53]

Ecological crisis

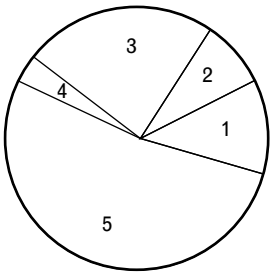
There are several dimensions of the energy content used: Primary energy, fossil energy in natural state or renewable energy sources (coal, oil, natural gas, sun, biomass); the secondary energy is the energy content of the refined, converted energy carriers (coke, gasoline, heat, electricity); the utility energy, is the energy coming from the energy carriers through an intermediary system. The efficiency of our systems, the ratio of energy and primary energy. A consequen examination and comparison of any system and product can only be based on primary energy content. There is also a need to define the so-called "grey energy". it is an ecological indicator that measures the amount of primary energy used for the production, and installation. [29], [81]

To understand the type of energies and resources we can conclude them in two classes.

1. **Operational resources**: materials and energy for using and operate a building



1. building
2. construction
3. transportation
4. industry
5. others



1. hot water – 11%
2. cooking – 8%
3. transportation – 26%
4. lighting – 1%
5. heating – 54%

Distribution of used energy use in sectors and operational resources of households ill.[54]

2. **Embodied resources**: materials and energy for construction processes themselves.

Nowadays, the unquestionable dominance of energy from fossil fuels is still prevalent. 90% of our traffic, on the ground, on water, in the air, driven by oil. 95% of all items available in shops are produced by the use of oil. 95% of the food we consume can only be produced with oil.

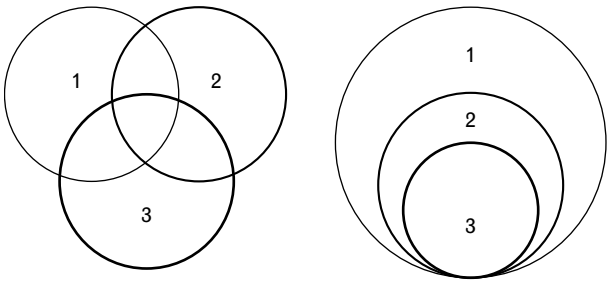
In addition, it should be noted that the realization and operation of the real estate sector and our buildings account for 50% of total energy consumption. The reasons discussed above are showing our dependence on fossil fuels and their expected exhaustion. it seems to make an energy panic unavoidable. Therefore, an important task for the energy policy and the construction industry to prevent our buildings and households from facing crisis. [81]

Economy crisis

Perhaps, the economic and financial crisis, which has been spreading globally in 2008 and has been officially launched since 9 August 2007, is the most immediate and most obvious crisis phenomenon for everyone today.

However, instead of analyzing the economic crisis, it is better to examine our current economic model and compare it with other economic and environmental policy theories. In general, our model is based on money, and therefore on the variety of the technological innovation that causes the seek for a great amount of energy. The basis of its system is progress and ruthless competition, and the belief in an unlimited resource. Perhaps this is the biggest mistake of the model, that it expects endless possibilities in a finite system. In some theories, we have already reached the so-called overrun in 1978, when the ecology footprint calculated for all humanity crossed the 1.0. This figure was 0.7 in 1960 and was 1.2 in 2000. [24]

The problem is that the modern market economy treats the earth and the living and inanimate nature together with it, not in its complexity, but only in its function as a production factor, mostly as a source of raw material. [29], [81]



1. environment 2. society 3. economy

The “strong” and “mild” concept of sustainability ill.[55]

Social crisis

It is difficult to decide from the social crisis whether the consequence of the above is a self-occurring phenomenon. It is a huge task in itself to deal with the fact that today we are living more than 7 billion people on the planet. At the beginning of the 20th century. It has already been stated above that the Earth's ability to hold the earth has been exceeded. This situation is only exaggerated by the fact that today almost everybody is mechanized, even though the unemployment is huge. The mass of redundant people has appeared, and the existential gap between the social level is growing. [24]

"For every Culture has its own Civilization. In this work, for the first time the two words, hitherto used to express in an indefinite, more or less ethical, distinction, are used in a periodic sense, to express a strict and necessary organic succession. The Civilization is the inevitable destiny of the Culture, and in this principle, we obtain the viewpoint from which the deepest and gravest problems of historical morphology become capable of solution. Civilizations are the most external and artificial states of which a species of developed humanity is capable. They are a conclusion, the thing-become succeeding the thing- becoming, death following life, rigidity following expansion, intellectual age and the stone-built, petrifying world-city following mother-earth and the spiritual childhood of Doric and Gothic. They are an end, irrevocable, yet by inward necessity reached again and again." Oswald Sprengler: The decline of the west [56]

Despite the overwhelming atmosphere of these thoughts, returning to the purpose of the thesis, there is only one task for us: to examine the possibilities of exit from the crises.

Principles sustainable design

To create a clear view that connects the two topics sustainability and vernacular architecture together, it is crucial to clear my and the literature's understanding on sustainable construction.

"Our cultural achievements in architecture are closely linked to the availability of raw materials and resources, as well as to energy, climate conditions, cultural identity and social attitudes. Autochthonous building traditions and vernacular architecture have bestowed us with an incredible diversity of typologies and building materials. The identity of towns and regions are also often directly linked to these underlying circumstances. Traditional buildings are consistent with our current understanding of sustainability, simply because their development was determined by restrictions and constraints.

In reference to the use of resources, there was often a debate about the value and merits of construction materials. In the Middle Ages, the value of limited resources was already used to express a particular feature of a building. Stone, for example, became a very representative material due to its moisture resistance, durability and the many different ways in which it could be worked (in contrast to the more commonly used timber frames). New construction materials did not come into use until the industrialisation. New manufacturing techniques for bricks, steel and glass increased the volume of production tremendously, which in turn enabled the construction of large and impressive buildings, such as factories, workers' housing estates and town houses."
Paul Wallot, 1894

Until the Industrial Revolution the materiality was a continuous topic in the building industry, because the resources and the production were restricted. At that time, the manufactures introduced new techniques for the production, and made the transportation more effective. The international style was introduced, and not just the optic of the objects,

but the local techniques and regional materials became available in the other regions. One of the results was the mix of the materials and techniques. [80]

From 1970s the energy efficiency of the building became a strong point in the architectural discussion. To reduce the environmental impact of the buildings new sustainable products were introduced in the last years and decades. Although the many environmentally friendly products and methods in most field of architectural engineering, the sustainability can be defined in various ways. They can be local products, to decrease the used energy for transportation, products from renewable materials, or products with low primary energy input. There are some other concepts, which see the sustainability in the flexibility of the structure, so the building can be adopted for a totally new use in the future. [80], [82]

MIPS Concept – Material input per service units

The concept was introduced in 1987 in Germany by Friedrich Schmidt-Bleek and Wuppertal Institute. The aim of the theory to measure the environmental performance of the activity.

It asseses how much material input is needed for producing any item and compares it with the performance offered by the solutions measured in "unit of services". The analyzis helps for the better understanding of the life cycle of the object. [80]

„ Could technology provide goods and services, that offer undimished end-use satisfaction with substantially less natural resources than is the case today?" - Friedrich Schmidt - Bleek

For the better understanding of the life cycle and the MIPS concept we need to clear the basic voabulary of the method.

Material flow:

People move material from natural resources more than the environ-

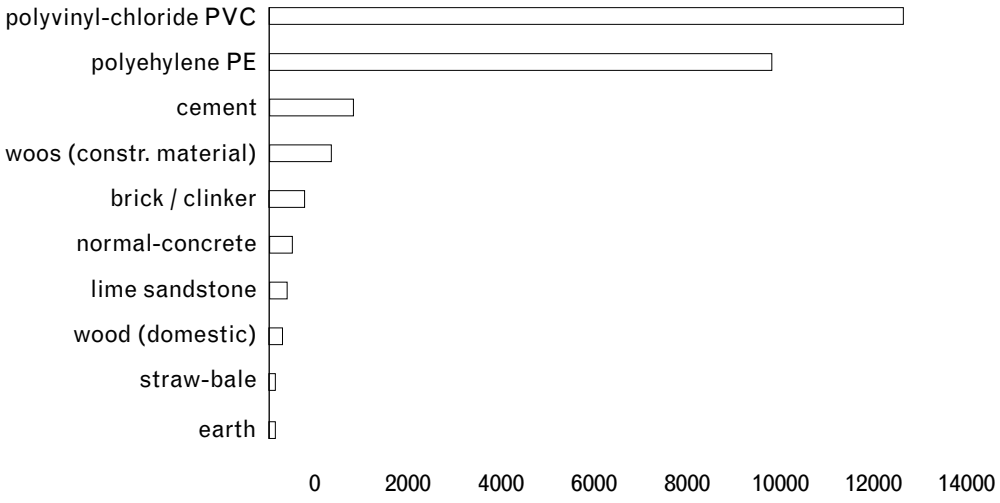
ment could through wind and water, through volcanic eruptions or erosions. People control the face and the ecological frame of the earth, not the process. For our own survival interest and for the Interest in the ecological component of stability, in which and of which we live, we should give it a chance to the environment in order to regulate its ecological formwork. This condition requires us to run our economy carefully. [80], [81]

"The more 'environment' required for the product, the worse it appears from an ecological perspective" - Friedrich Schmidt-Bleek

Ecologocal rücksack:

The ecological rücksack expresses the weight of all natural raw materials that are produced for our consumption. That means all products have value including their production, use, and disposal.

All raw materials added together, give a measure of the strain on the environment. Because all material withdrawals and deliveries cause changes in the natural material flows and cycles. Sooner or later, each material input will become an output

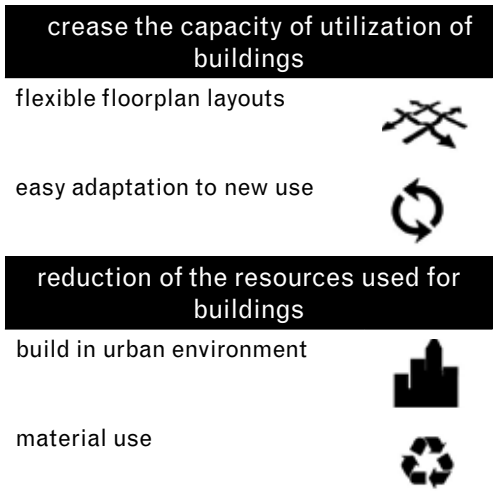


*PEI value of building materials ill.[56]

again, waste or emissions. [80], [81]
The ecological rücksack is often much heavier than the final product itself. For example, in some part of the world, the production of 1 kg wool needs more than 40,000 litre water.

Dematerialization:

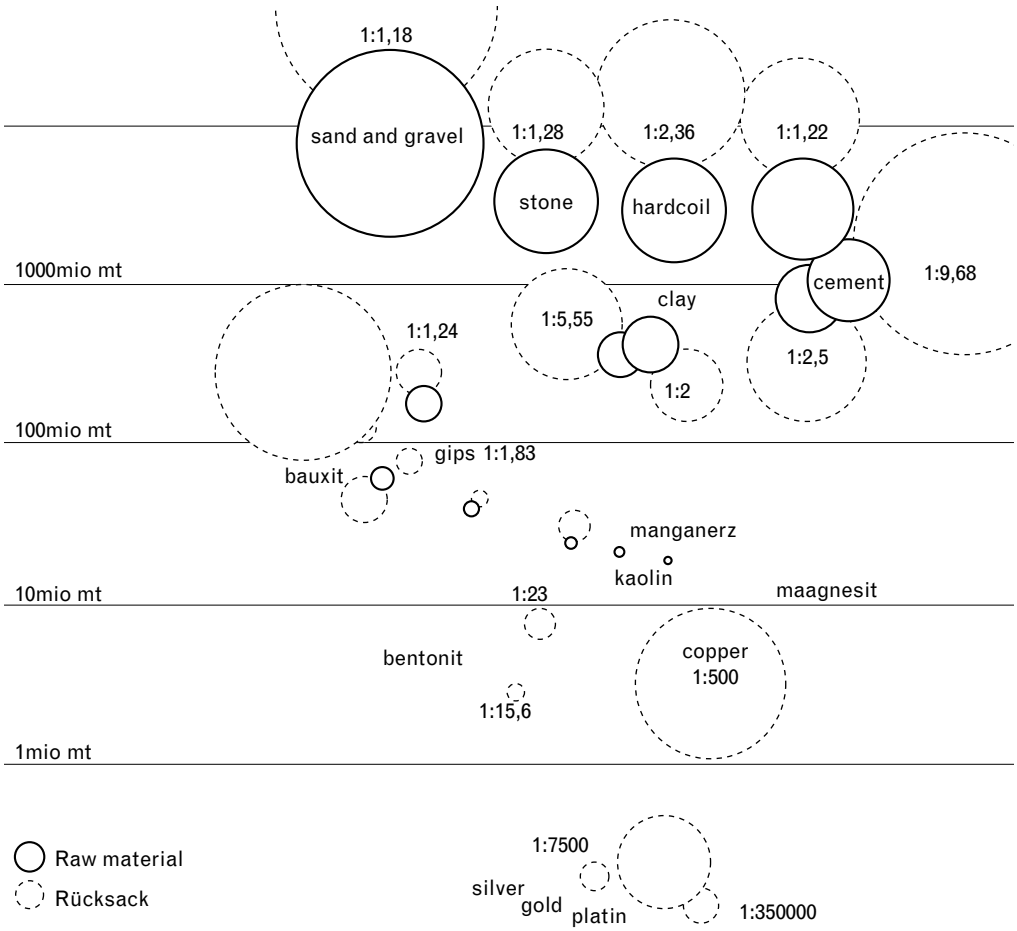
Dematerialization is about slowing down and reducing the gross wasteful movement and the misuse of materials and energy. The goal is to stop the waste and reduce the environmental impact that we are now imposing. [80]
But how can we translate the MIPS concept in the language of architecture and buildings?



*The translation of the MIPS concept [82] ill.[57]

PEI (kWh/m3)	Building material
0-30	earth
5	straw-bale
300	wood (domestic)
800-1500	wood (construction material)
500-900	brick / clinker
1700	cement
450-500	normal-concrete
350	lime sandstone
15000	flat-glass
63000	steel
195000	aluminium
7600-13000	polyethylene PE
13000	polyvinyl-chloride PVC

PEI value of frequently used materials in building industry ill.[58]



The Ecological Rucksack of Some Materials (Based on the world production of different economical goods in 1983) ill.[59]

Health-based building design

The well-known issues of health issues of the building materials in the 1970s like asbestos contamination has determined the need and must for health-conscious design. In last years the interest in health-consciousness among the population is growing.

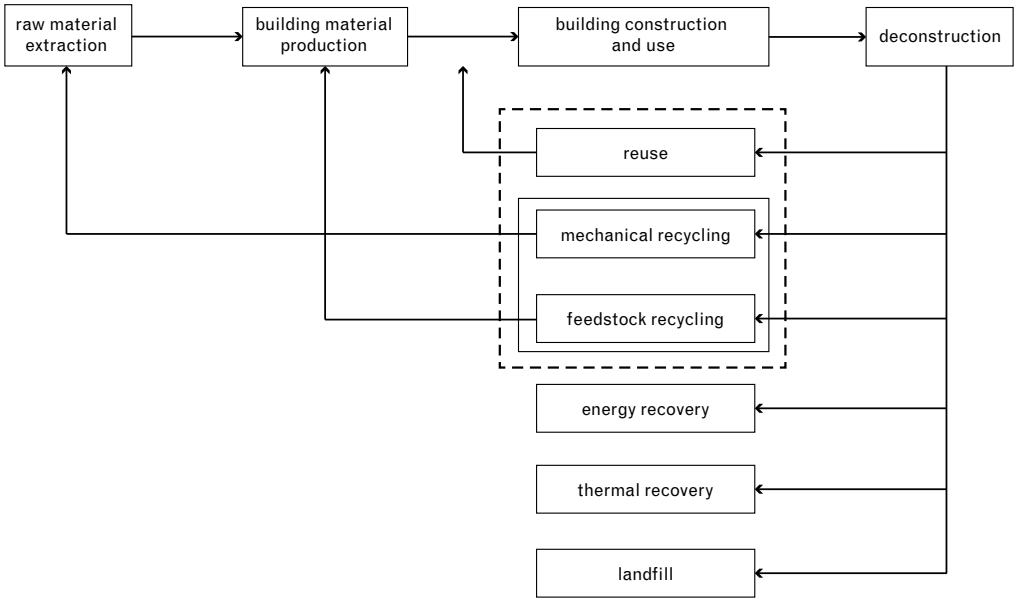
The range is great, from eating habits to physical exercises, but the building materials are also coming in conversation if we are speaking about health issues.

Resource-saving design

"The next architecture will have to be an architecture of atmospheric respect and ecological restraint" - Peter Sloterdijk

The problem is more on the consistent material concept, in which building materials suitable for sustainable construction. The optimization strategy can vary depending on the type of use.

Based on the three aspects of sustainability (consistency, sufficiency and efficiency). Consistency is a



Reuse and return material into material cycle diagram after SCT ill.[60]

design method that uses technologies that are compatible with natural and ecosystems without destroying them. It can be determined as a basis for design and construction work. Efficiency is a design concept that takes care of the productivity of resources. The third concept is the sufficiency which propose the concept of the reduction of resource consumption. It is indisputable that the task of selection materials is a basic skill that must be controlled by architects and all other planning specialists. [81], [82]

Reduce waste – on prefabrication-based design

Reduction in the number of building materials by focusing on some specific ones, promotes the repetition of details solutions. Although the development of a single detail can be assumed a considerable time and effort, the total investment in specific design held the design within reasonable limits. The repetition of the same detail solutions increase the construction quality on the site. In addition, due to the increased use of less materials tend to make rest materials reused, which can cause less trimming waste. Finally, when it comes to the deconstruction of the building, the amount of mono materials is larger which leads to more economical recycling process. [81]

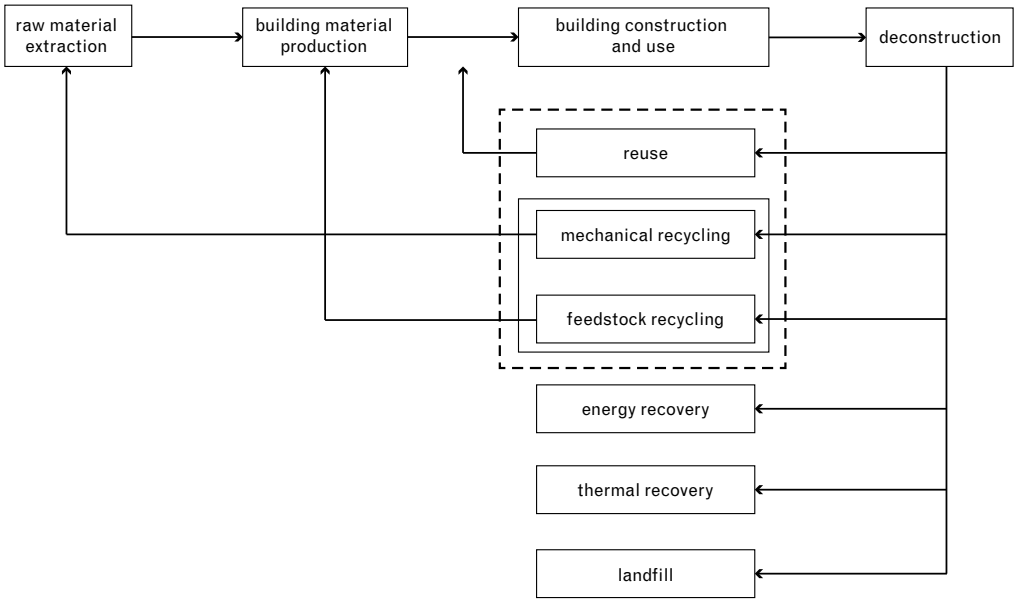
Structural degradation on the other hand describes the general minimization of Connection details and thus the reduced effort for construction work. Structural reduction tends to always mitigate the environmental impact of the component manufacturing process. Simplified elements geometries and the reduc-

tion of joints facilitate maintenance and service processes in the usage phase and consequently lower costs. Material concentration and structure Reduction strategies are particularly effective in the case of a small-scale materials with recurrent joining methods. Masonry is a historical technique, that expresses this methodology. In the case of roof-structure the joints, structural connections, corner details, and gutters have a bigger impact on the life cycle assessment as the functional layer itself. All in all, the fewer materials are profitable in terms of the whole life cycle of the building. [83]

Reusable materials – recycling based design

As in modern times, so are we currently at a stage where new insights ask new questions.The return of the construction materials in the material cycle is an important consideration. But it is exactly this field still burdened by many unresolved problems. Is there a possibility, for example to recover the metal coating in high quality Glazing systems? Is it necessary to recover the metal or become a new material? It is at least controversial whether all components of a building must be restored to their original state in the material cycle. [81], [82]

The value of each component is finally linked to the value, the resource at the time of removal. [81] The recycling industry can work effectively, if material quantities and clear descriptions are provided. In this regard, a new way of documenting all parts built and installed is the minimum requirement.

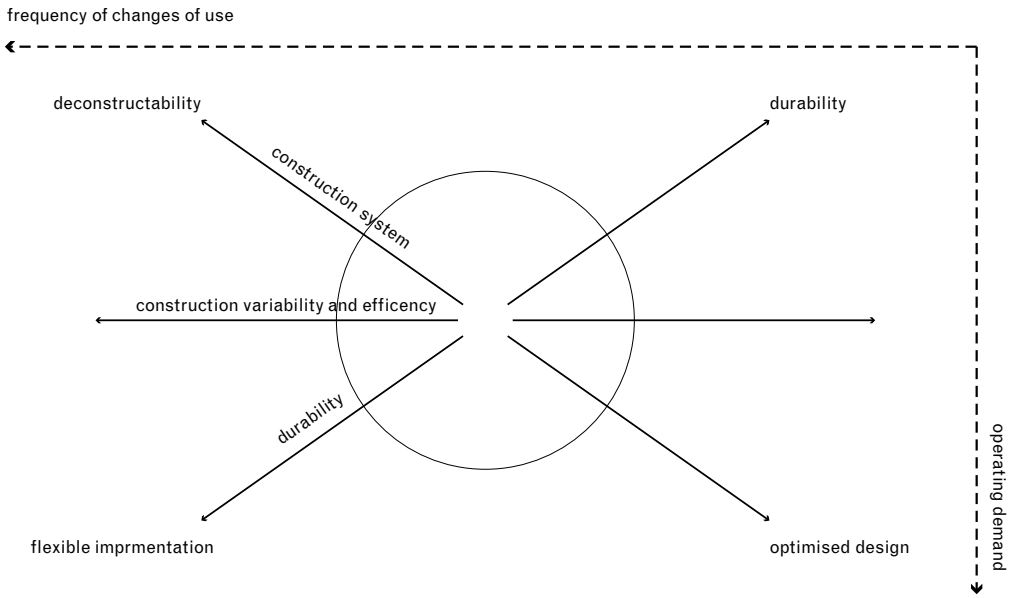


Reuse and return material into material cycle diagram after SCT ill.[61]

Design for flexible adaptation in use

The use of the building is one of the most important aspects of any design. The performance and user behavior during the use phase have a significant impact on the design and selection of materials as well as the relationship between the construction and operation of the building. Possible changes in use determine the length of the observation period in relation to the use phase in the life cycle.

Many sustainability assessment systems for buildings assume that a change in use can be prepared by planning. If, in this case, the load-bearing structure and the floor plan layout, typology can be maintained, this significantly reduces the environmental impact. In practice, however, this assumption is not universally valid. In relation to residential buildings, it is necessary to judge according to the location, whether a change of use is realistic at all. The commercial relevance of the site, based on certain qualities, is important in this regard. The use of buildings in suburban residential areas, for example, rarely changes. For planning purpose, it is therefore worthwhile to categorize buildings into different typological profiles and to use them as leading indicators for the development of the material concept. [81], [84], [82]



Design decisions for new use, in terms of flexibility ill.[62]

Social life requires to deal with animals ill.[63]

Changes of the way of living in the village

The highlighted area shows the latest development in the village "Kóny" ill.[64]

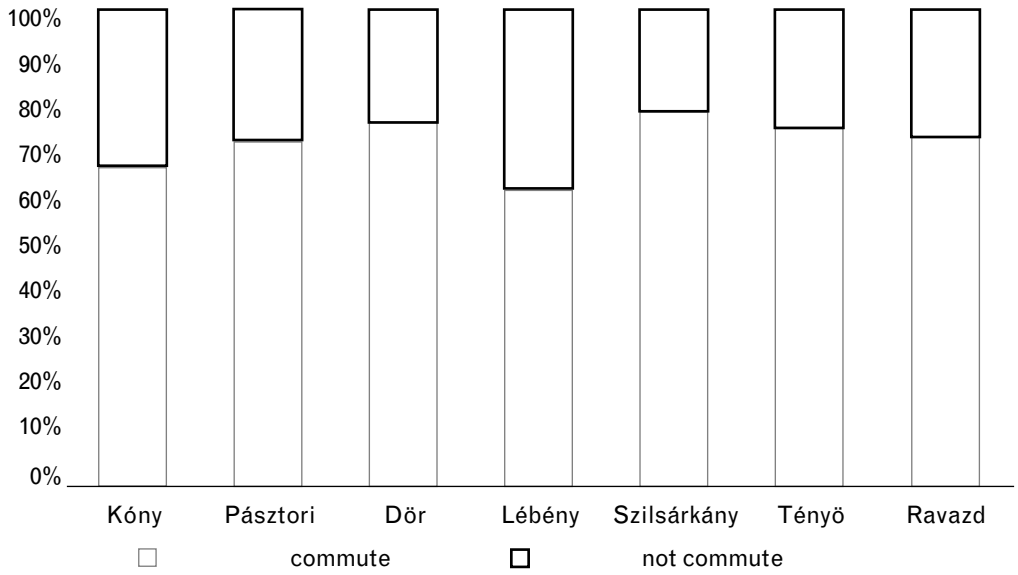
The knowledge transfer in the last century has changed. The aim of the chapter is not to get the whole coverage of the problematic but get sense why the knowledge is not anymore there to build with earth.

Basically, the answer should be searched in the society, and the way how the building was built. As the previous chapter (2.2.4 Walls) showed, to build a building, it was not just a work done by experts, but also the locals helped the others.

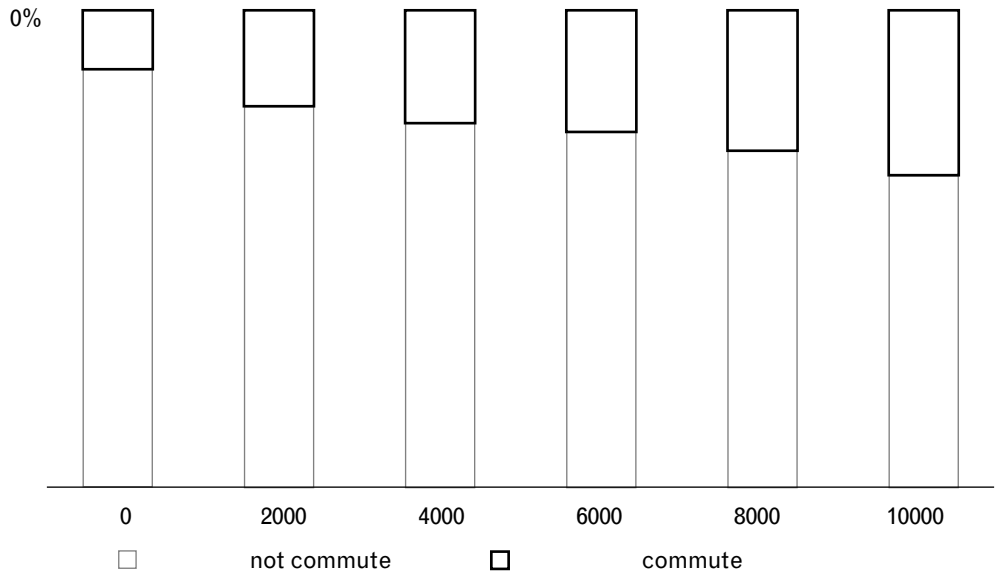
The whole social structure of the villages has changed in the 20th century. As the diagram shows the distribution of the commuters has linearly grown in the last 50 years. The diagram deal with the earliest and latest data, available showing the distribution of commuters. It includes all the villages and cities in Hungary.

The data from 2011 is more detailed and it gives a clear view that the working pattern has changed. Most people over 70% are not working and living in the same place. It could happen because the agriculture is not the main

Kóny – Mátyás király street ill.[65]



Distribution of commuters and not commuters from 1960 to 2011 ill.[66]



Distribution of commuters in Transdanubian villages in 2011 ill.[67]

Kóny – Kisfaludi street ill.[68]

working sector. People working in the cities. As in the past, between spring and autumn, the animal pastures together. For the evening they come back to their home and they spend the evening at their owners.

This fact connects to the architecture with three aspects. On one hand, the social activity to build together is not as strong as earlier. Secondly, the building materials are not local as in the past. For example, the bricks are transported from the surrounding cities / villages. Thirdly, if we analyze the villages, such as "Kóny" the function of the new buildings has been changed. As most of the people are working in the cities, and they do not work in the field of the agriculture, the living space has been grown and the space or storage and animals has shrink.

As the images shows, the vernacular typology is not so present in the newer development, and one answer can be the changes of the building habit and the changes of the social patterns, such as the number of commuters.

Knowledge transfer from the 20th century

From a global perspective, the long tradition of the earthen construction is at a risk. There was hardly a craftsman who could pass on the knowledge: The technology was steadily declining, there was no one left to teach the next generation, the result was that nobody was available to practice it. [67]

The industrialization one of the reasons of the decline of the earthen construction techniques. As the price of the transportation and building materials became less and less, the manpower became more and more expensive. These technologies with all the working steps consume a lot of time and craftmanship. In compare to other technologies it was not so economical. On the other hand, in the developing countries the earthen buildings are popular. Two-third of the world population still lives in earthen structures. Not just in the western countries, but also in the developing ones, these structures are associated with poverty. They do not comply with the requirements of the codes for water pfoofing, or durability, but there is big potential to develop. The importance to develop the construction technology and to adapt it to our current knowledge and needs is in foreground. It is therefore necessary to look in both the historical examples that still exist and to examine the requirements of the present, because it can give new directions to the development. [67]

Earth / Clay construction techniques in the 21th century

Material

Soil is a mixture from the nature that results from weathering processes. It contains binder materials, such as clay and silt, and materials from sand to stone components. The mixture can be very different in some cases, but in all cases, it contains clay. Just like the loam, clay is created by weathering processes. The raw materials are minerals from prehistoric rocks, such as feldspar, which can be found in the granite. The components of feldspar absorb water molecules. Due to fire it will be released. In the nature the mineral rocks and stones can be found in a mixture. There are different types of clay, which are defined by the quarry and the mineral components. [61]; [57]

The durability of the construction and the erosion are controlled by the quality of the soil mixture. This characteristic also determines whether the soil is fat or lean: a fat soil can survive the rain better than a lean one. But the lean soil can be processed much easier and shows fewer shrinkage cracks. The portion of the clay brings a moisture-regulating effect. All these parameters must be considered. [67]

In addition, the additives are decisive for the appearance. The amount of leaching determines whether the gravel is clearly visible in an eroded wall or it is in the layers preserved. This directly affects the structure and appearance of the wall. The high proportion of stone also has an influence on the weight (between 1850 and 2300 kg / m 3). This influences the performance of the building, such as heat capacity. Both the grain size and the proportion and density influence the thermal conductivity. [61], [67], [57]

Fabrication methods

Rammed earth walls created on site are using formwork. Similar to the concrete, the negative of the wall is first made of a formwork. The major difference is that the formwork sections of the concrete are as high as the wall and the next stage docks to them on the side. In the case of rammed earth, is vertically segmented, however the layering of the pattern should be as consistent as possible. Then the earth is poured into the formwork and then rammed. The house is growing layer by layer. This means that the formwork must not be too high: With a width of only 35 or 45 cm.

Fabrication w. formwork

In order to divert horizontal forces, similar to a brick wall, a reinforced ring anchor should be installed. A continuous reinforcement is inserted into a recessed channel, over the entire wall.

The quality of the material is tested like the stability of concrete. Small blocks are produced, to determine the static values. The skilled worker is necessary during the testing of the recipe. To build on site needs a lot of experience. As the construction is time consuming, there is a time to react and solve the problems on the construction site. With the experience of the specalist it is possible to react and make decisions that correspond to situation with the state of the art of knowledge.

However, this does not replace cooperation with other planning participants such as architects, structural engineers and building physicists. In any case, the rammed earth, in interaction with the other trades, sets the building pace. The completion of the house progresses in his rhythm.

Since the technique involves a large amount of manual work, a mud house takes a lot of time and manpower. [67]

Fabrication of a rammed earth wall on site ill.[69]

Prefabrication

From the 1990s there is a possibility to produce rammed earth construction in factories and transport it and place it in on site. It has many advantages, such as it does not require as many manpower, and the climate does not influence the construction. Normally there is a short period of time for ramming on site, because it is not possible during frost. Moreover, the formwork should not be produced on site.

The task on site remains , to join the prefabricated elements. It is also possible to dissolve the joints, and to create a homogenous structure. Moreover, to give back the effect of layering, so the horizontal continuous layering is the only visible pattern. It is possible to retouch the pattern, because large pieces of wall segments are produced, which cut in smaller pieces. The joints are 1-2 cm wide, which placed in rhythm of the water proofing. This is important not just visually, but also technically to deal with erosion.

As we can see in the process the most manpower is needed during the assemble and the editing the joints. The machine makes it possible to create the walls thinner, as no one must stand on it during the ramming process. The machine creates long strips of elements, so a whole wall could be produced, which will be cut in smaller segments. [67]

Fabrication of a rammed earth wall in a factory ill.[70]

Projects

In this chapter projects are shown from the last 10-20 years which has a special characteristic in topics like fabrication, how it reacts to the weathering process or the combining of the materials.

Fabrication of a rammed earth wall in a factory ill.[71]

Herzog de Meuron – Kräuterzentrum Ricola – Switzerland – 2014

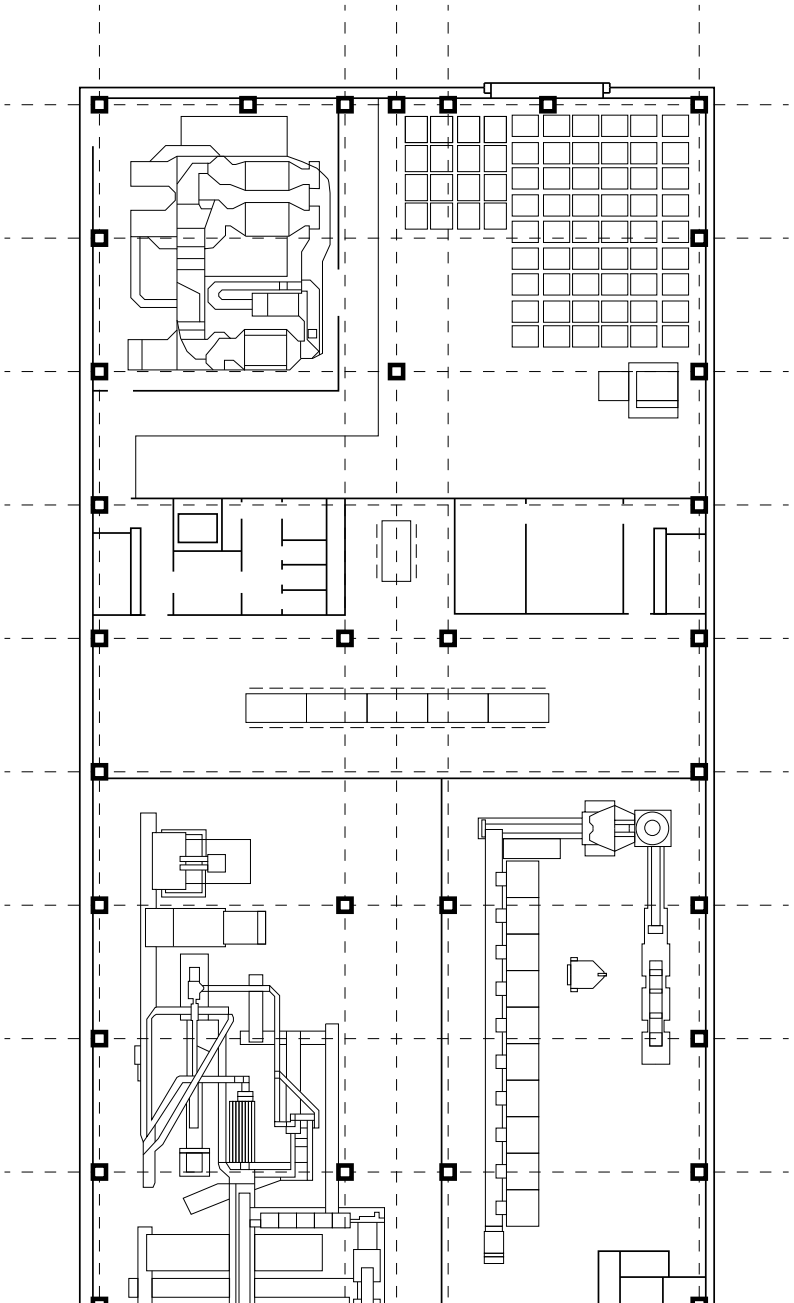
The facade of the 100 x 30 m and 11 m high herbal center of the Swiss company "Ricola" consists of prefabricated components made of clay and concrete. The 45 cm thick, self-supporting outer walls are attached to the structure made of precast concrete. [68]

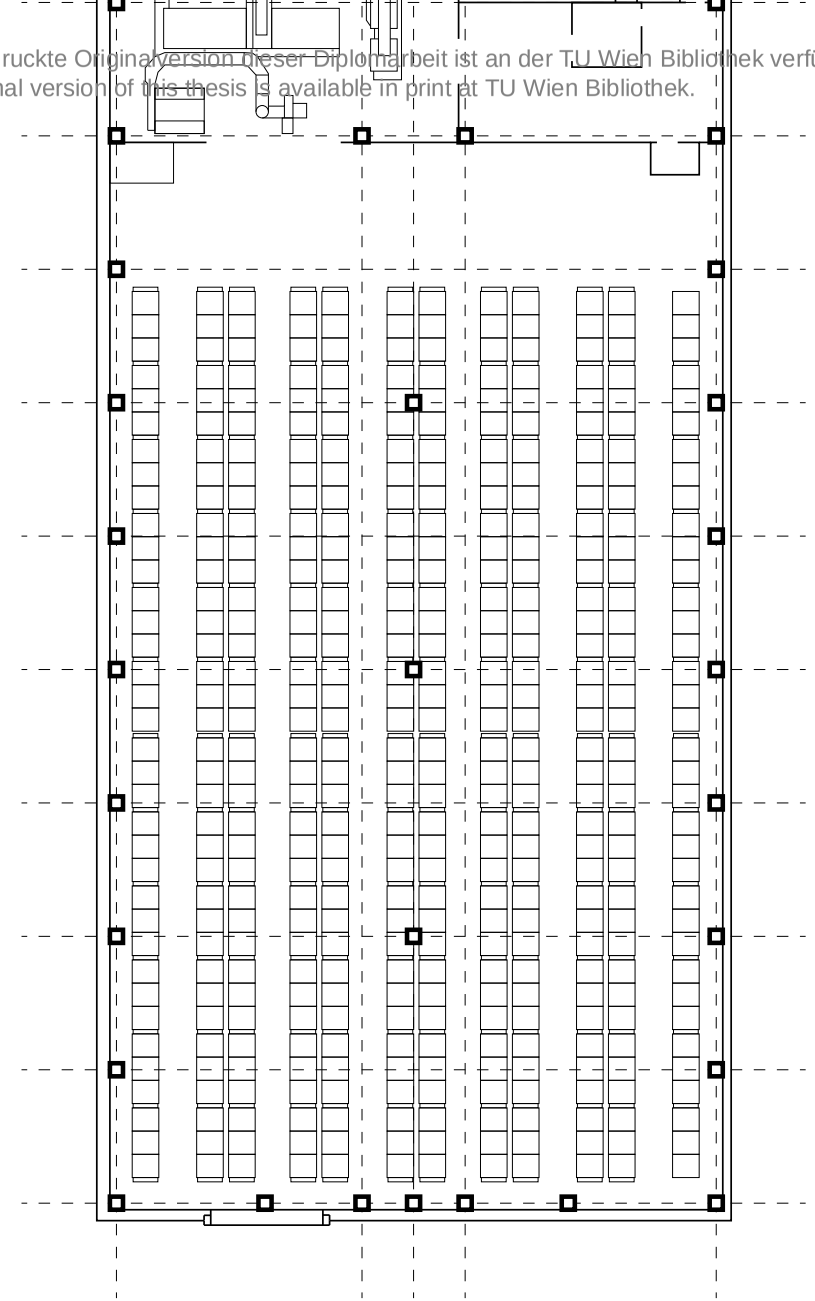
The rammed earth expert Martin Rauch has already made it possible for several single-family houses to use his own composite material to use for buildings. [69]

The almost 700 rammed earth blocks were prefabricated and assembled within five months from earth, gravel and marl within a radius of less than 10 km. The 45 cm thick, self-supporting outer walls are attached to the structure made of precast concrete. The building material clay ensures that a constant humidity of 50% is maintained inside the building with almost no additional energy consumption. The prefabricated rammed earth elements were leaned and anchored parallel to the assembly of the concrete elements on the supporting skeleton.

In this hybrid construction, every material is used according to its strengths: the precast concrete construction absorbs the wind forces and prevents the outer walls made of rammed earth from tipping over. Up to 17 columns including foundation could be assembled in one day. [68]

Energy and sustainability are not simply treated as technical aids. They are integrated into the architecture and the essential features of the entire project. The earth as a material for regulating air humidity has a positive and sustainable effect on energy consumption and general air conditioning. Photovoltaic modules on the roof and the use of waste heat from the nearby production center also help to improve the ecological balance of the herbal center. In a special visitor center on the top floor, visitors can watch the processing and mixing of the herbs. [70]

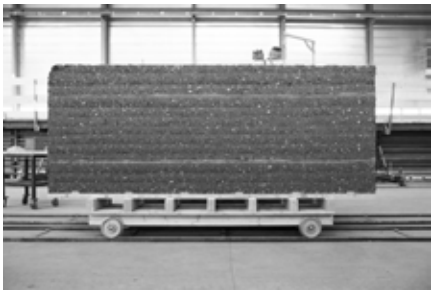




Floor plan ill.[72]

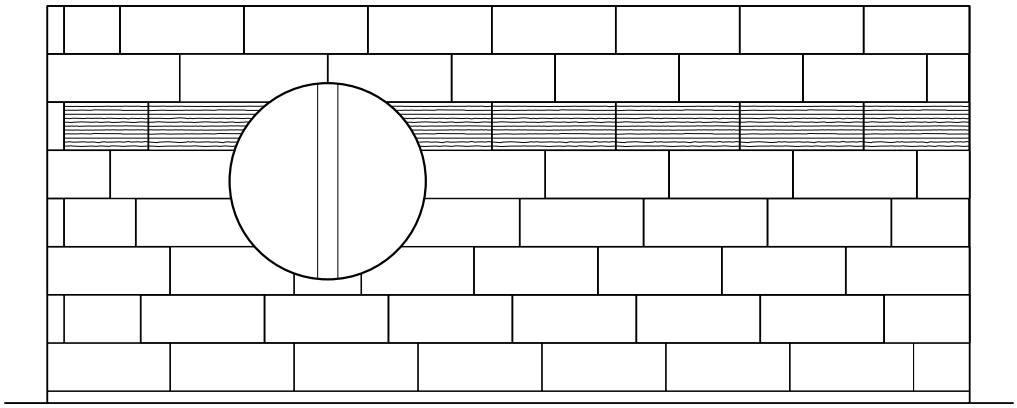
Faication of the walls ill.[73]

Receipt ill.[74]



Finished prefabricated wall element ill.[75]

Assemble ill.[76]



Pattern of the rammed earth elements for the construction ill.[77]

Renzo Piano Workshop – Emergency Hospital – Ghana – Ongoing

„Quality architecture of Emergency's quality medical services", is the summery from Renzo Piano of his new building under construction in Uganda. [73]

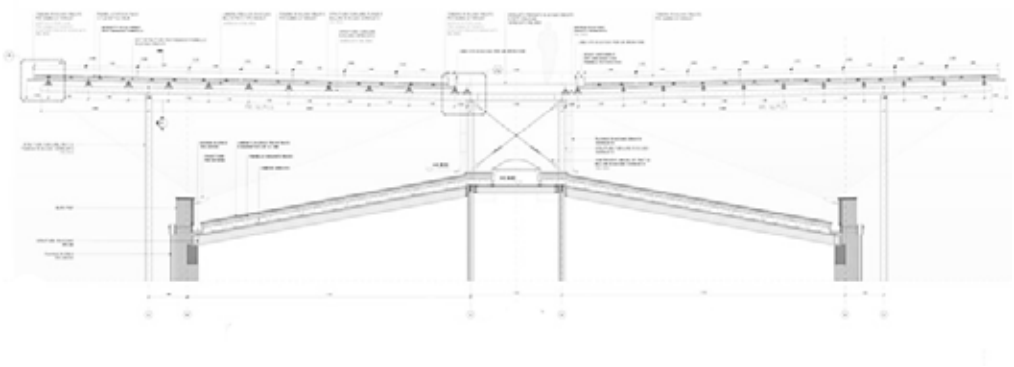
„Emergency" was founded in 1994 and is an independent and neutral Italian organization that provides high-quality medical and surgical care for victims of war, anti-personnel mines and poverty. During Milan Design Week in 2019, the organization will present its surgery center, which is under construction in Uganda. The hospital was designed by Renzo Piano. It is the first project by the Italian architect in Africa. [73] In the centre of the vision stand the position of Africa on the canvas of the world. It is the frontier of an evolving word as the architect stated. The challenge for the team was to bring the vernacular architecture in Uganda together with the requirements of a hospital for pediatric surgery. As the architect wrote, to create a model of architecture, which is rational, tangible, modern, beautiful, but firmly connected to tradition. To create an architecture which is complex in meaning and adecvate for the high requirements of the 21st century hospital.

The project has its symbolic meaning, a promotion of health care, and importance not just in Uganda, but also in whole Africa.

The material is not an arbitrarily choice. Earth is still an important material for building material in houses in many parts of the world and Africa. As the architect and the team described:

"We were fascinated by the idea of giving back some dignity to this technique, using the excavated land to build the load-bearing walls with the rammed earth technique. The rammed earth technique is an ancient building method involving a mixture of earth, sand, gravel, binding agents and a little water, compressed in wooden or metal frames or moulds. The great advantage is that the material is available locally, and there's no need for cement or highly specialised workers.

Rammed earth wall and the rhythm of the openings create atmosphere ill.[78]

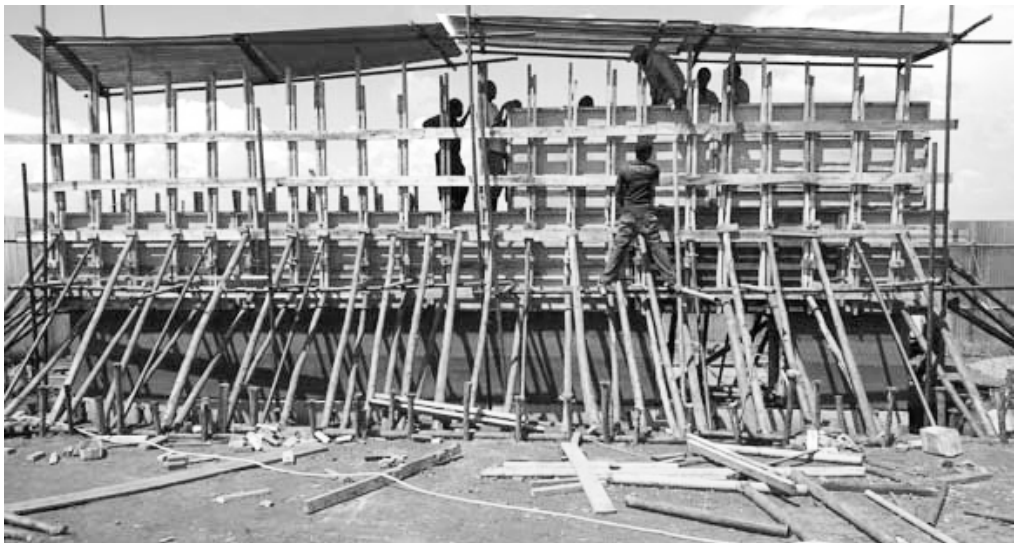


Double roof and the joint of the slab and roof with reinforced concrete ring anchor ill.[79]

An eye on sustainability, right from the construction phase." Renzo Piano Building Workshop [71]

The hospital, which was made of the earth, collects its energy from the sun. 9,800 square meters of photovoltaic modules ensure that the hospital is supplied with electricity during the day. The system is also connected to the main line and supplies the surroundings with energy in times of low consumption. The photovoltaic roof "floats" over the building and guarantees shade for the hospital and uncovered walkways and protects the structure. [72]; [74]

View to outside – rammed earth wall with reinforced ring anchor ill.[80]



*Creating the formwork and rammed earth wall ill.[81]

Boltshauser Architekten – Schulpavillion II, Switzerland - 2012

The school pavilion next to the Allenmoos schoolhouse, which was built by Jacob Pardutt in 1958, was originally intended to give way to a new educational pedagogic school. However, this school was never realized. The existing pavilion was instead transformed into an attractive facility for kids. During the renovation, the pavilion was expanded to include an open porch, creating an intense, direct relationship with the green surroundings. The reorganization of the rooms offers an optimal spatial arrangement for the care of the children. [77]

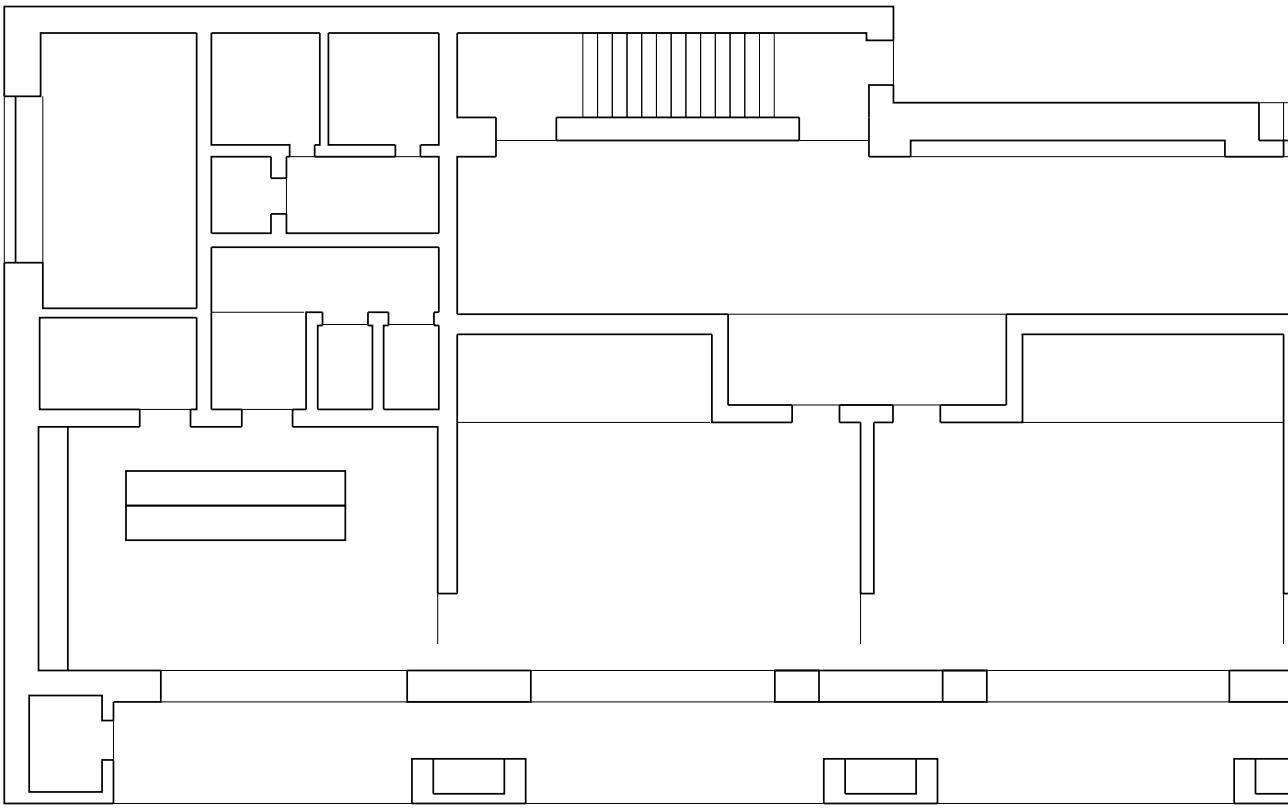
The innovative use of traditional building materials gives the small pavilion a strong personal charm. The outer walls consist of rammed earth and clinker bricks, while inside there is plaster and casein. These traditional materials ensure a pleasant and healthy indoor climate. Thanks to the thick insulation and controlled ventilation, the building meets the Swiss energy standard of „Minergie" for new buildings. The clinker tiles used in the interior were developed by the artist Marta Rauch as part of a school project with students from the Allenmoos school building. [77]; [78]

„A very important point that leads to the unusually high acceptance within educators and parents is the materiality." project director Daniel Christen (Boltshauser Architekten). Soil (clay), whether fired as clinker cladding or rammed earth as on the columns of the south facade, determines the exterior of the entrée. Because of the costs the rammed earth functions as a U-shaped cladding around the columns, which can store in their niches for outdoor plays.

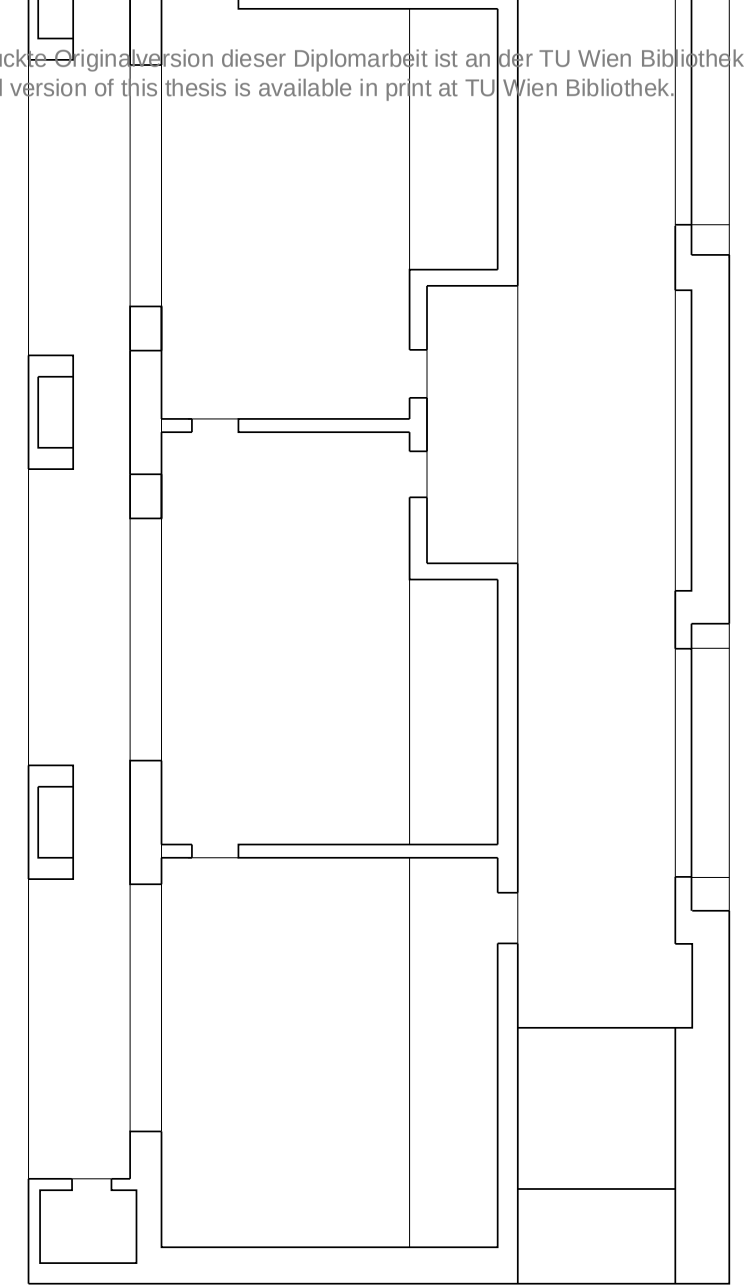
The horizontal rows of narrow, slightly cantilevered clinker plates are placed between layers to reduce the effect of the erosion. The damage of the soft material by children's hands, feared by the owner, has not yet occurred. Perhaps because a certain amount of respect appears touching the archaic components. [79]

The rammed earth columns, with the

The effect of the harmony of materials and textures ill.[82]



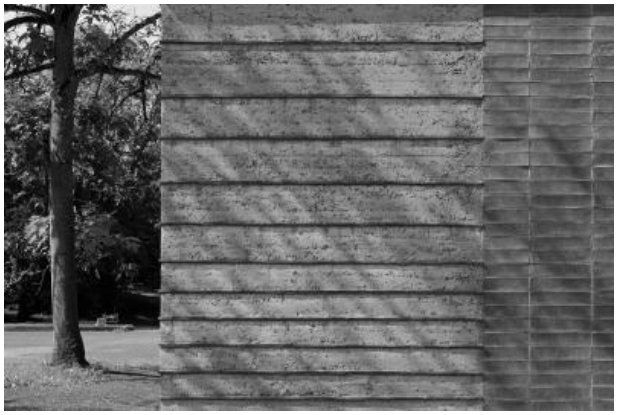
Floor plan – the introduction of low-tech material as the first layer of the building ill.[83]



dark gray window frames and the canteliver presents the park itself as a small stage. The concept of the automatised window blinds simulates the image of the slowly moving stage curtain. [79]

The plinth and the building itself as a theater stage in the park ill.[84]

The plinth and the building itself as a theater stage in the park ill.[85]



The plinth and the building itself as a theater stage in the park ill.[86]

Discussion

The aim of the research was to understand the manifesto of the vernacular building in villages in Hungary until the 20th century, focused in the architectural elements like construction technique, windows and plan layout. After the research we can note that the most important elements of the typology, which could be used for the interpretation of a contemporary building are:

- the atmosphere, which is created by the window, structure and climate in the room.
- typology, which determines the rhythm of the space, and the social life in the building.
- construction technique, which is mainly influenced by the development of the technology.

In the following chapter I would like to sum up these previous points. The three points summarize the research and give direction for design approach in the Hungarian village context.

On the other hand, the chapter 2.5 Earth / Clay construction techniques in the 21th century stated that the social patterns influenced the existence of earthen constructions. The two main features are the lack of knowledge transfer, and the association with the poor, although the projects showed, that nowadays the advantage of this construction technology is not the cost, but the architectural value like authenticity, atmosphere or tradition, and thermal comfort that it delivers. The typology in terms of function is not so important, but what counts is the sequence of the spaces. As we saw in the last 100 years the living standards and habits has changed, the storage / chamber and the place for animals are not any more the center of life and daily routine. But it is important to say that the typology and context does not mean function.

Entrace of a vernacular building in Kóny ill.[87]

The atmosphere

The window and structure makes the atmosphere ill.[88]

After the research, we can notice that the atmosphere, which is created in the context, has a strong value that must be preserved and be part of the interpretation if we touch the topic of vernacular in Hungary. As the research stated, the special character of the buildings is transmitted by the interfering of the wooden ceiling with beams, the white plaster walls and the proportion of the openings.

Typology

Sequence of the spaces 01 ill.[89]

The typology of the floorplan has a great value in the Hungary. It has two important aspects.

On one hand, the historical analysis showed the case how the new spaces and functions were added during the history. The longitudinal floorplan layout created not just a central space (kitchen / atrium), but also showcases a room-sequence which gives a rhythm and layering of the spaces.

Secondly, the floorplan development shows how the kitchen / atrium space has a core function in the life of the vernacular house. Moreover, it has always stayed an important social space during the time. The social pattern showed how it gave also a place for sleeping besides cooking, and daytime activities. All in all, the long geometry, with the ad-

ditive space structure is one of the most important features of the typology. It cannot just be read from the sequence of the interior spaces, but also the exterior is erected after this principle. The veranda, eaves and the division of the roof structure are signs of the additive principle. The eaves differ from itself in one single building. Although the roof structure has the same technology in the whole building, but the simple triangular geometry changes at a new function.

Sequence of the spaces 02 ill.[90]

Construction technique

One keyword of vernacular is the local material, or probably more important is the process, white which technology is available to get a building which supplies a standard in both architecture and building physics. The projects made of earth from the 21th century showed 3 different reactions to the problematic of building with earth. But building with earth is still a topic of the architecture discourse. It is because of the environmental issues. It can help to reduce the PEI of the building industry, because PEI and production has the greatest impact on sustainability.

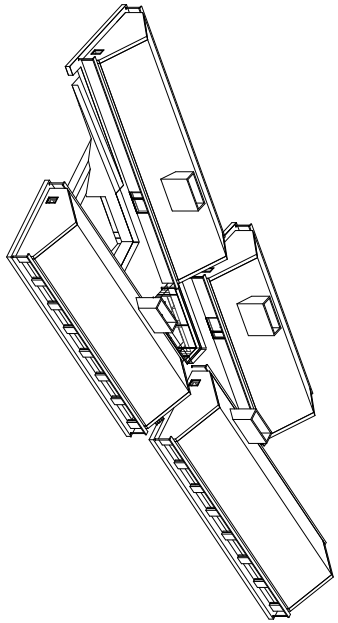
Secondly, the research was important to realize, that in the western world earth is not the material of the cheap building. It is suitable to achieve great thermal comfort in the building, and through rammed earth get a special character for both interior and exterior spaces.

On the other hand, projects showed that in the recent years the construction technology has developed, and it is possible to achieve todays building standards, by installing insulation or insert reinforced ring anchor to increase stability.

The new state of the art technologies and the architectural solutions help to get the best feature of the earthen walls.

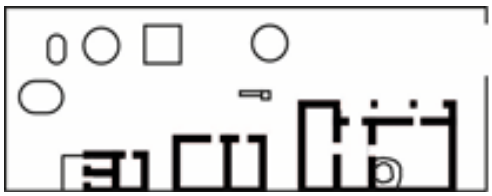
It is important to recognize that the other value of the building in terms of material, is not just the sustainable earthen wall structure but also the wooden ceiling. For further interpretation these two materials and structural solutions are important, if we want to deal with authenticity. As we can read from the research the geometry has a strong relationship with the social patterns like craftmanship, and the availability of local materials. The size of the spaces is influenced by the size of the wood and timber.

Design

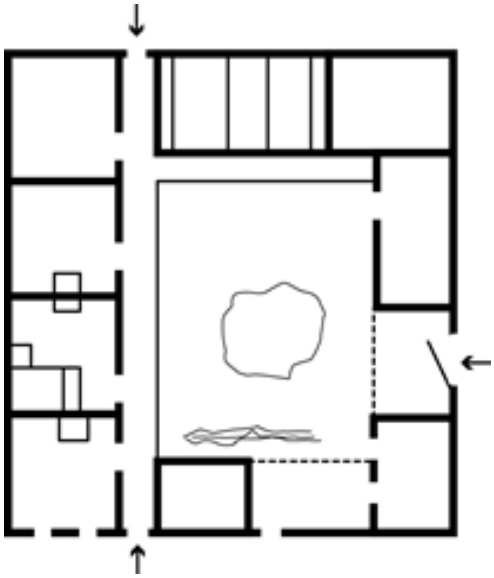


Interpretation

Typology



Linear yard, see ill.[17]



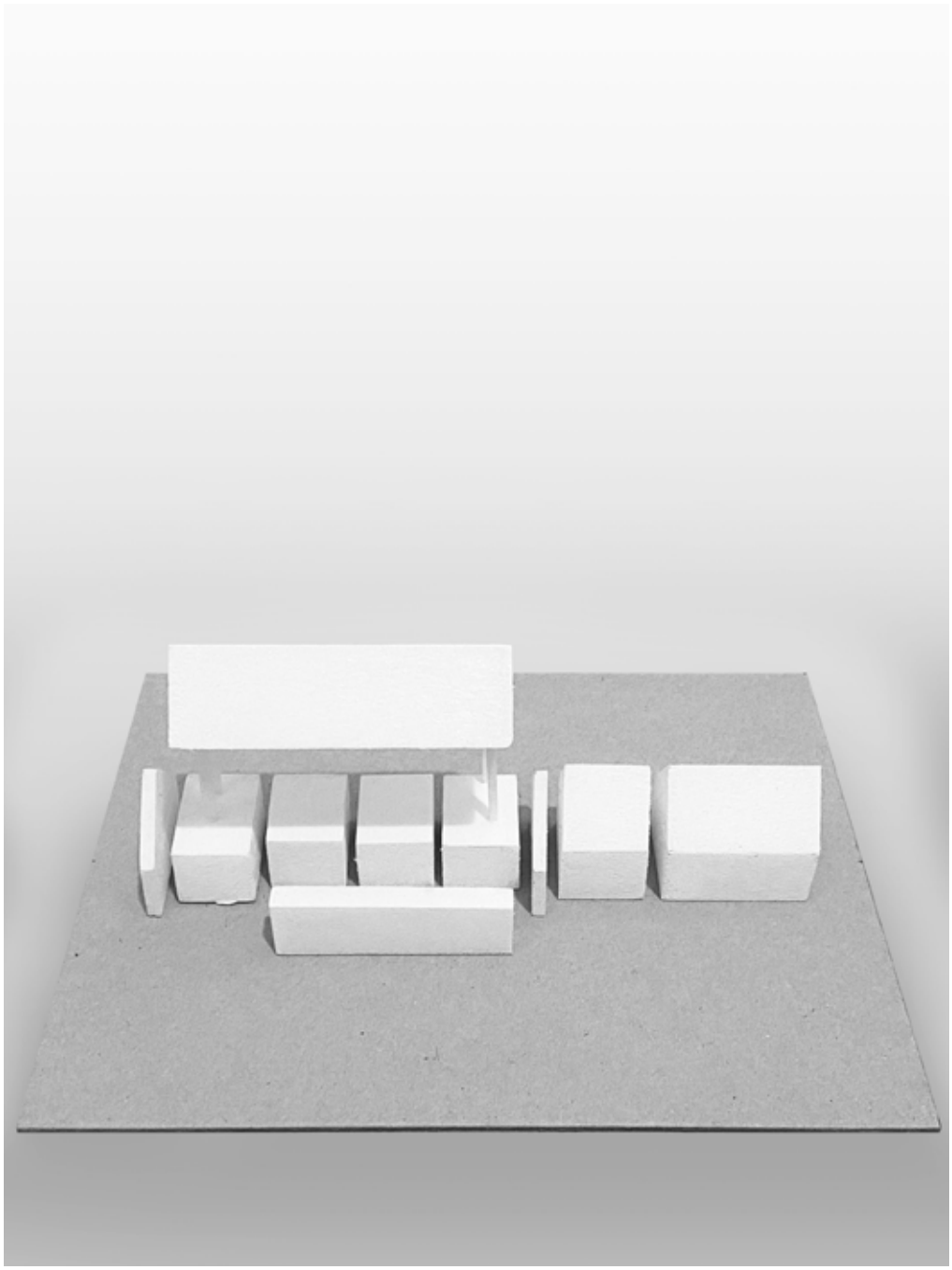
Yard with boundary, see ill.[18]

The two floorplan diagrams show courtyard typologies in the vernacular architecture in Hungary.

At first the typology of the two examples are totally different. One the other hand, base structure of the buildings is the same. In both cases there are the same functions, such as farming and living. Moreover the floorplan is developed from the same structure. We can read the repetition and addition of the same elements. With simple drawings and models we can showcase it.

As the repetition and addition are an important in the hungarian vernacular architecture, it can be used in the concept during the design. In this case not just the addition of the base structure important, but also the rhythm of the loadbearing, structural elements such as beams and columns. The rhythm and repetition of the spaces and structure raises the question of a modular system.

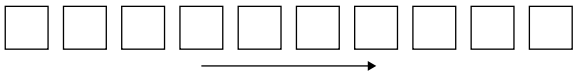
In the further testing and interpretation of the layout, I tried to model three different appraoches. The models show basic spatial relationships, which influence the circulation, and the privateness in the building.



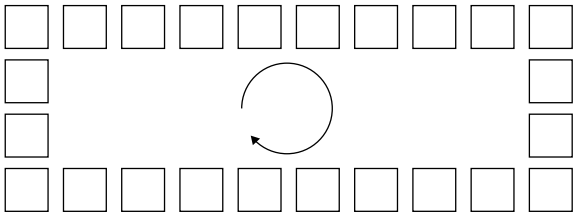
Module - structure

Interpretation of the typology - rules

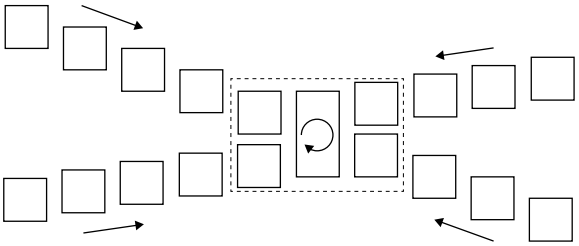
Linear - typology. This is the one to one translation of the linear yard of the Hungarian country house. The linear repetition of the same module provide a weak connection between the spaces. Moreover, The strict structure gives the feeling of an endless addition.

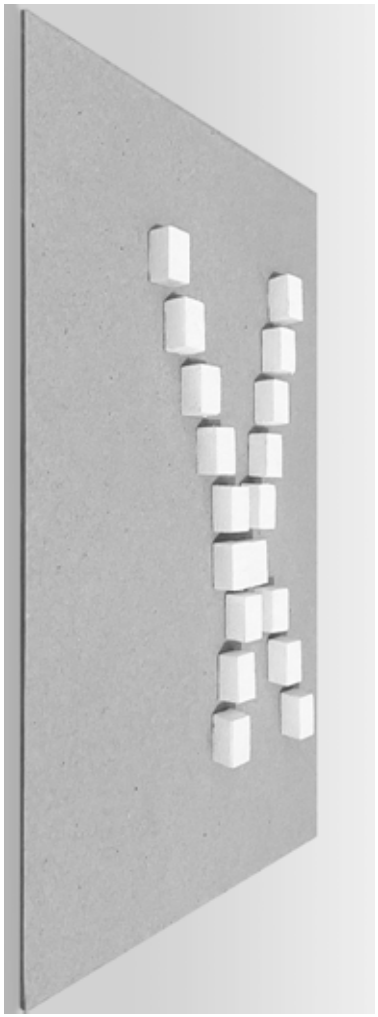


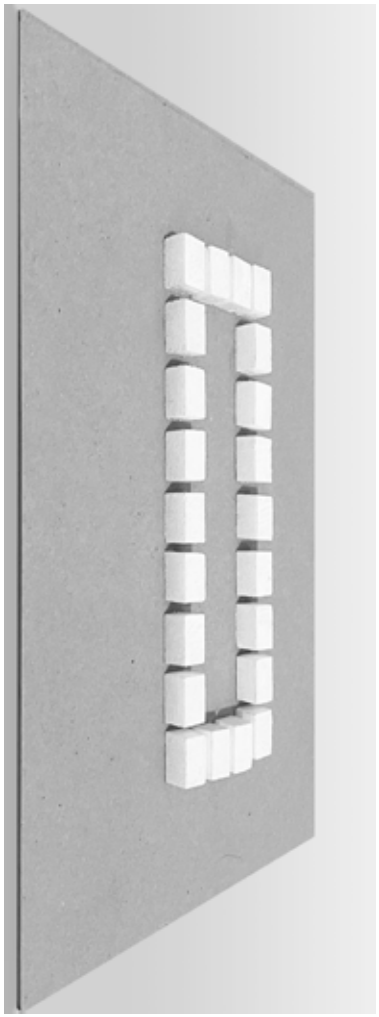
Circular - typology. The base of the system is the typology "yard with boundaries". The closed structure create an intimate space the middle.

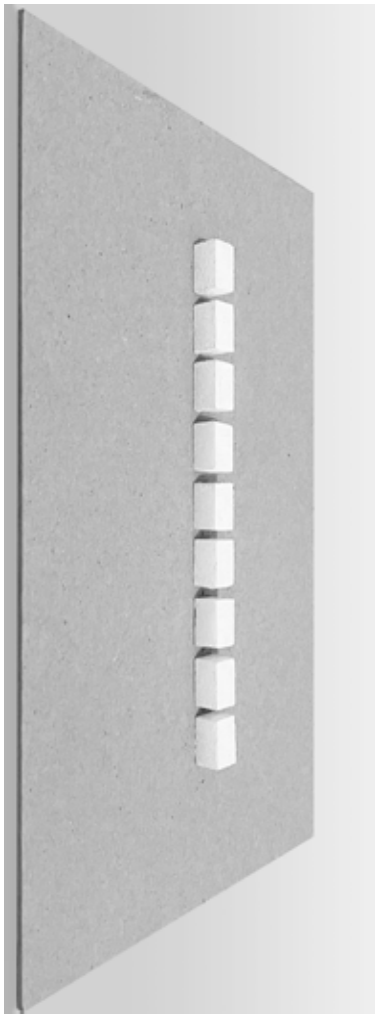


Combined - typology. The interpretation of both linear and circular typologies. It gives the opportunity for privaciy in the wings, and the social connection in the middle. This typlology has also appeared in contemporary references f.g.: Sergison Bates - Care home, Wingene, 2016



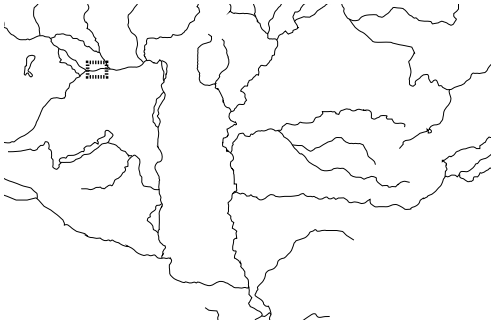






Context

Kóny, Hungary

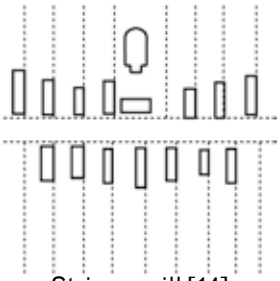


Kóny - location in Hungary

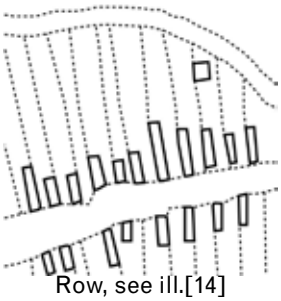
The village "Kóny" is a small village in Hungary with app. 2700 inhabitants.

It is a good spot for the project, because we can still find the traces of hungarian vernacular architecture . But on the other hand, the location is interesting in an urban point of view, because it is not far from major hungarian economical centers such as Györ.

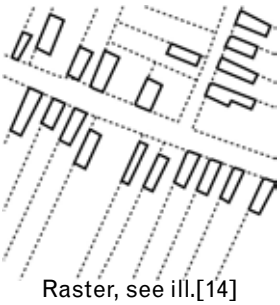
Thanks to the good infrastructure (motorway - bus lines - train), the footprint of the village is still growing. As the village is self grown, we can find the different village typologies in the same place. There are traces of "strip", "row", "raster" and "conglomerate village.



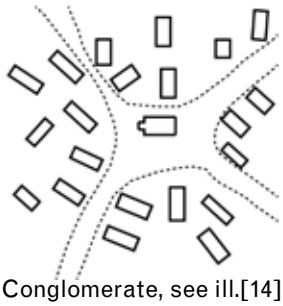
Strip, see ill.[14]



Row, see ill.[14]



Raster, see ill.[14]



Conglomerate, see ill.[14]

Atmosphere - long, wide straight streets

The front facade gives identity for the street

In the newly developed part of the village the wide streets are still present

The atmosphere is given by the rhythm of the buildings and voids

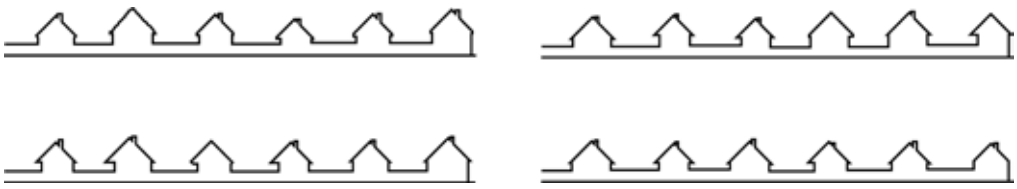
Street analyze

The rhythm of the volumes and chimney

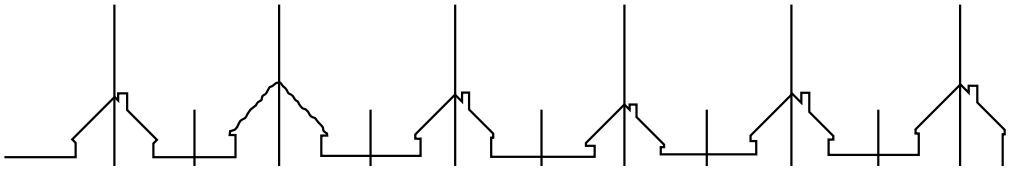
As the research showed, there is a strict rigid system between void (garden) and solid (house). The pattern always stays the same. This means: Building - Fence - Building - Fence ect. If we look closer we can realize, that the pattern is the same, but the width, rhythm and articulation of the elements varies.

Basically the structure is not a-b-a-b-a-b... but a-b-a'-b'-a''-b''...

In my opinion during the design it is important to react to the urban requirements, which was developed during the centuries.



The silhouette of the general “skylines”, see ill.[16]



Rhythm comes from the facace and voids, see ill.[16]

Site

Edge of the village

The main roads a clear definition for the site

As we can see from the images and axonometry, the village has mostly one storey buildings. It difines a “skyline” from short but long buildings, which also comes from the vernacular structures and typologies.

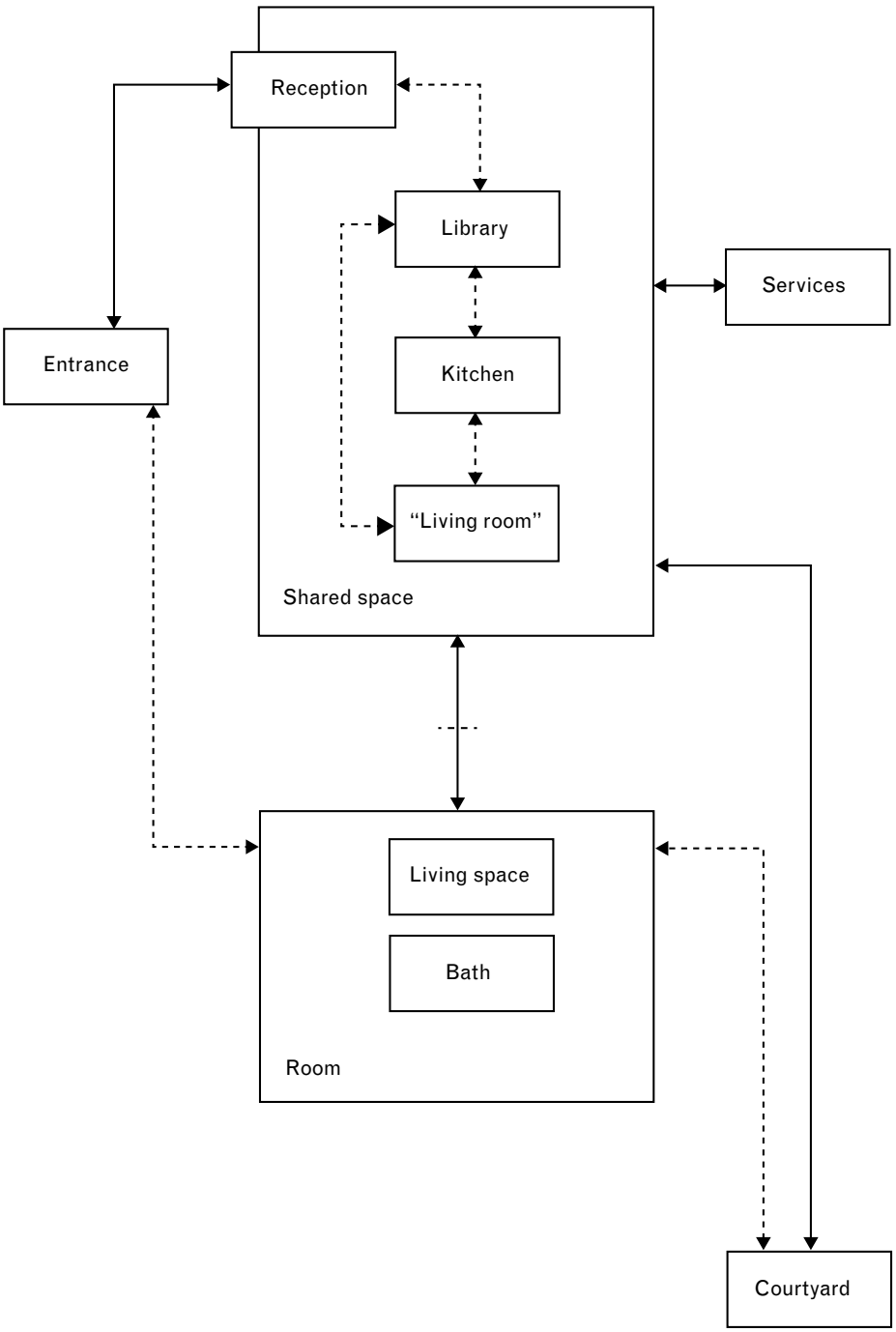
The site is located at the edge of the village and nature

Development

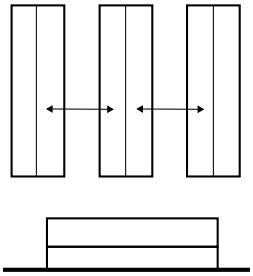
Site plan

Concept

Schemate + Variations

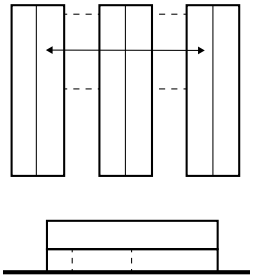


Relation of the living spaces



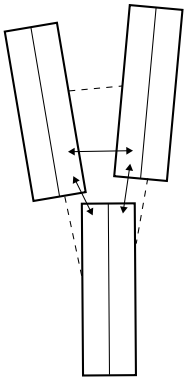
study 01

- weak connection between the “modules”
- there is almost no direct communication between each module and functions. Such as private and public



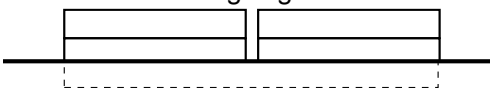
study 02

- the connection is through a logitudinal space
- it connects the different segments of the building

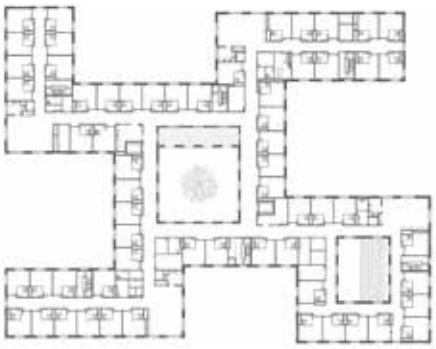


study 03

- the communication between the modules through a centered space
- the center space brings all wings of the building together



Sergison Bates - Care Home, Huise Zingem ill.[91]



Sergison Bates - Care Home, Wingene ill.[92]

The reference buildings from Sergison Bates sharing a similar concept in terms of efficiency and circulation. The floor plans can be read as a centralized floor plan layout. The efficiency comes the open public gearhering space in the heart of the building. All the human flow dive into the space, meet and spread to the individual, private room.

In my opinion the strength of the project comes not just from the physical architectural elements like material, volume, space or the in-between space, but also from the layering of the private, semi-private spaces.

The references give an answer to an efficient elderly home. The building that is optimized for the everyday life of the older generation.

Concept

Variations - Site Study

Study for the geometry

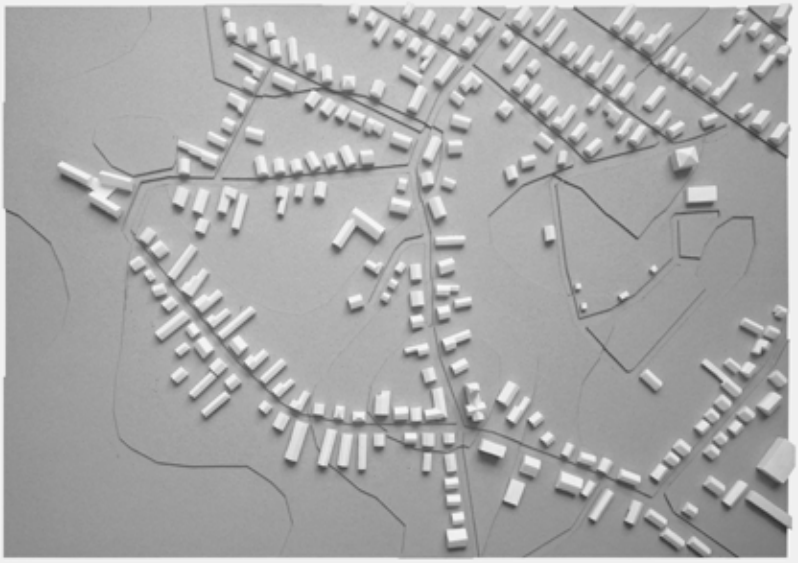
The topic of the design is an old pepole's home. A place where they can live, and spend time with others.

The site has its special feature that it is located at the edge of the village and the nature. Moreover, two roads are running into each other provoking a diagonal shaped volume. The challenge is to fit the building volume in this interesting situation. More studies were done during the concept development. The site has been tested with 3 – 4 – 5 individual volumes and with one merged volume fragmented in 5 sub elements. As we can see, the study with 4 individual volumes fits the best in the site, as in this case there is a loose space in-between the volumes, but the spatial arrangement ties the geometry together.

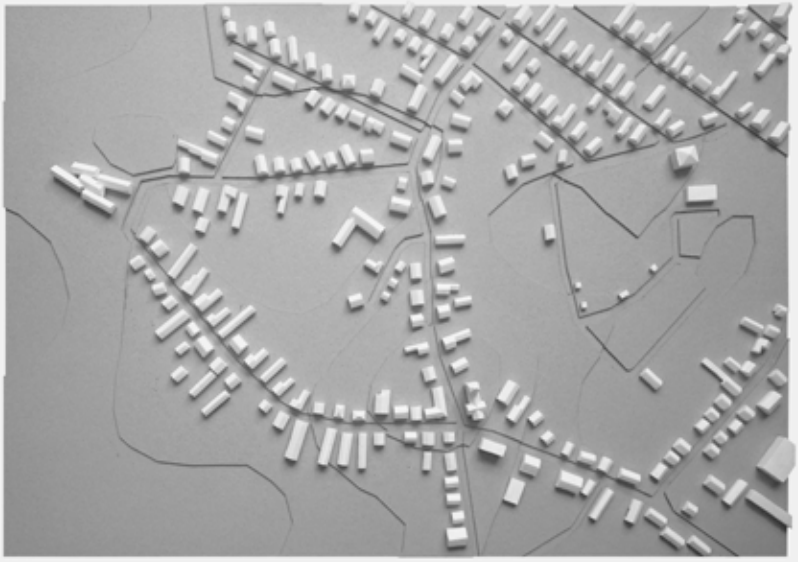
1. Loose connection of the three volumes

2. Balace between thight and loose, the footprint fits to the surroundings

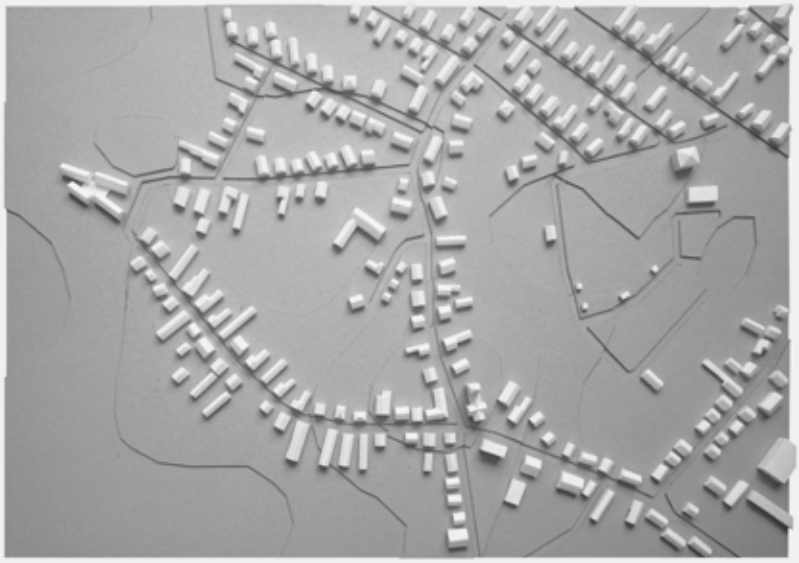
3. The five building volumes are loosing the connection from the village structure



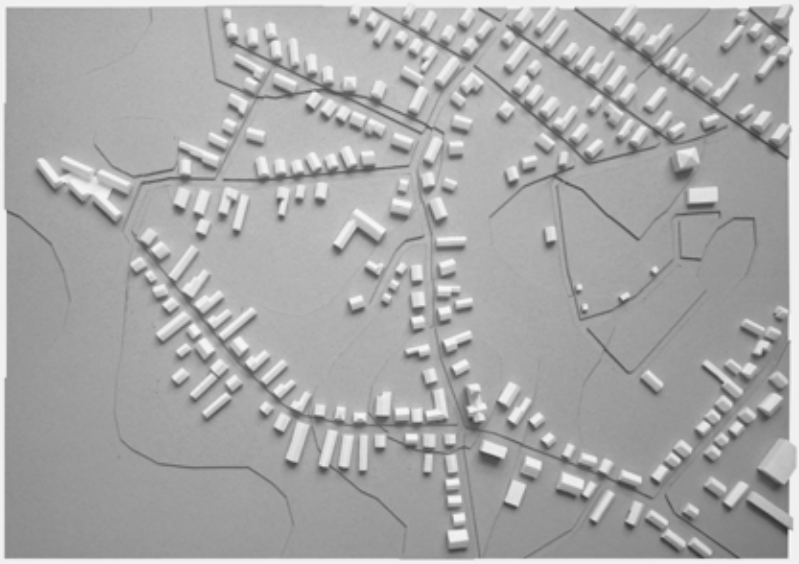
1. Loose connection of the three volumes



3. The five building volumes are loosing the connection from the village structure



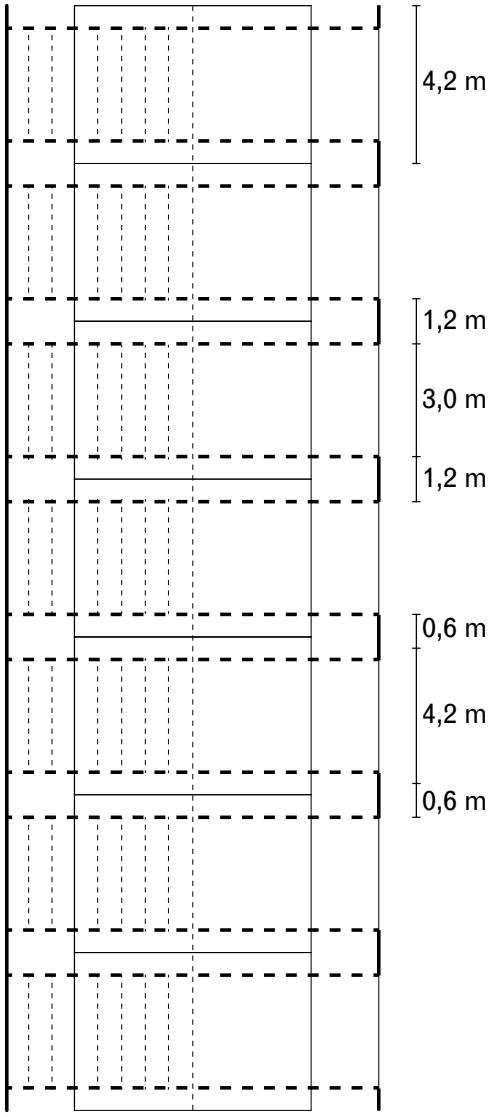
2. Balace between thight and loose, and balance between void and volume



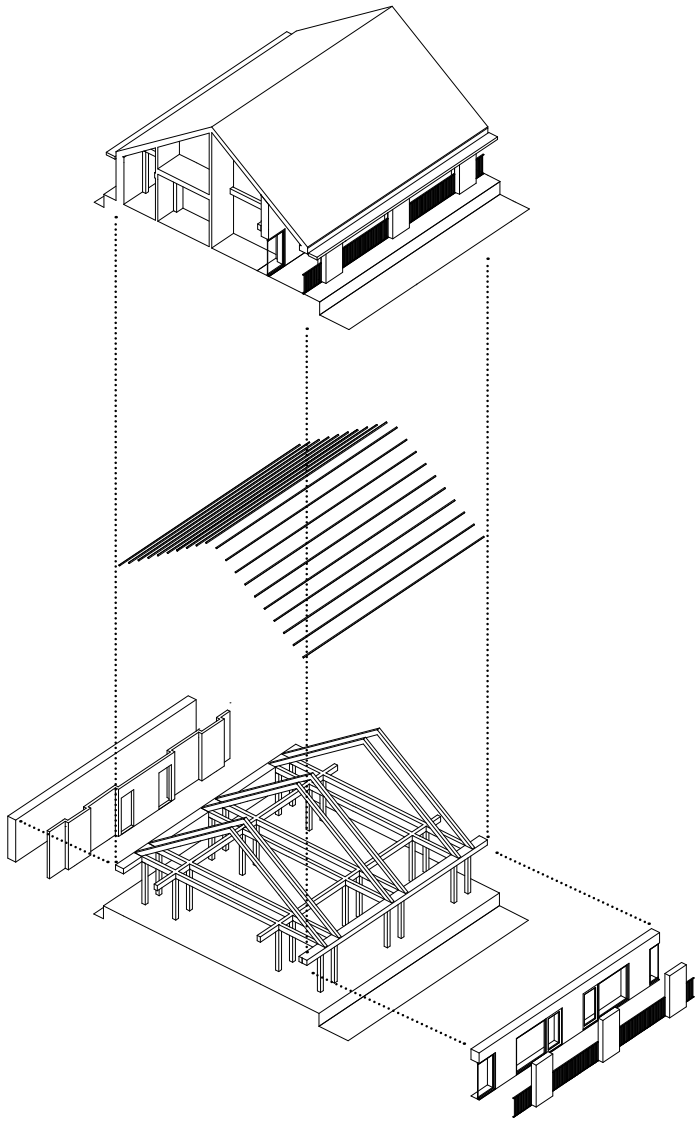
4. Balace between thight and loose, thight volume

Study

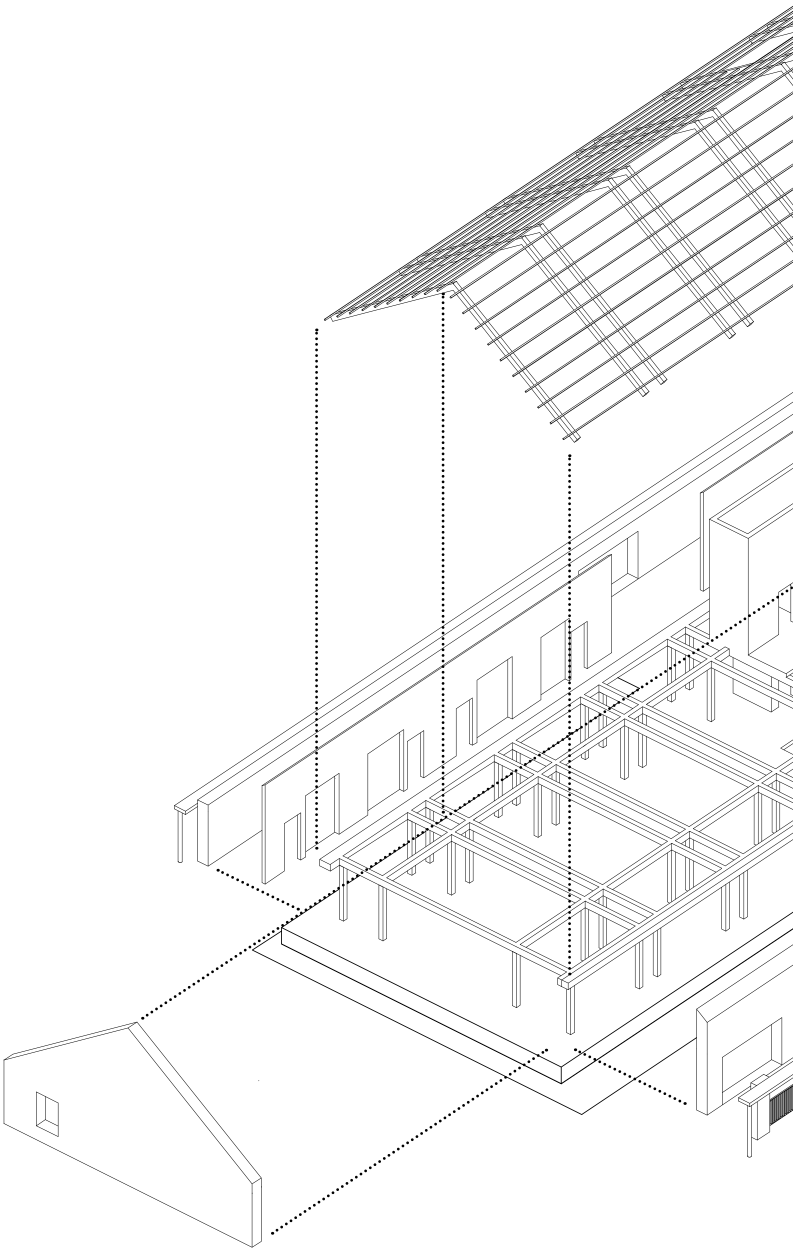
Structure



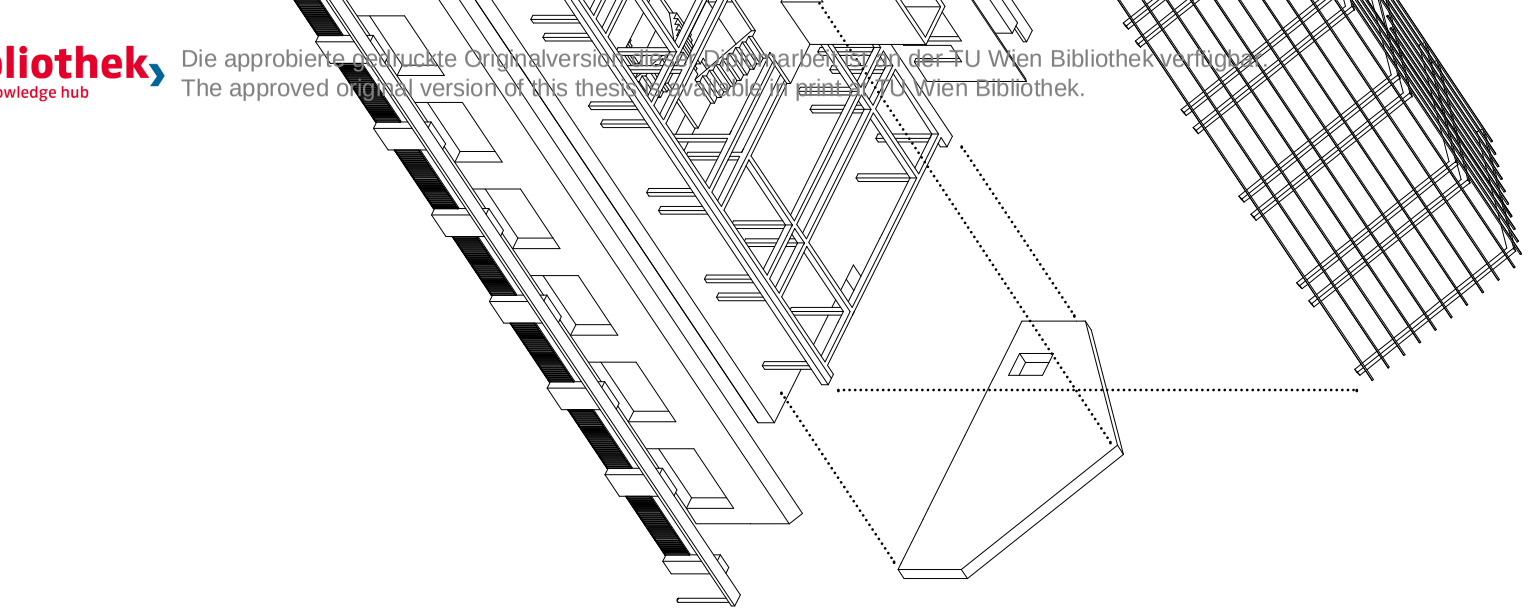
Rhythm creates the structure, and the rule

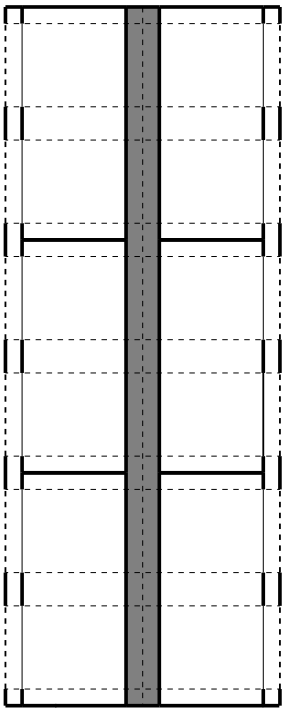


Atmoshpere through structure - the precast rammed earth wall sits in front of the columns

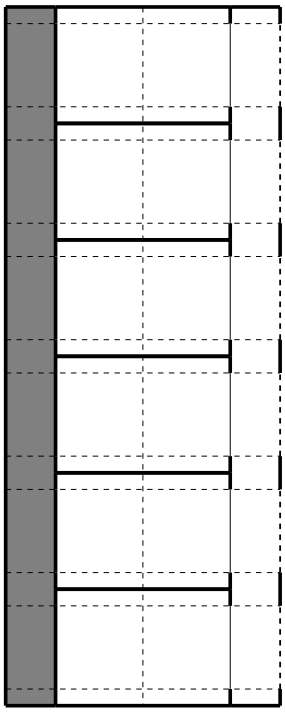


The division of the materials - layering the values and strenght of the materials



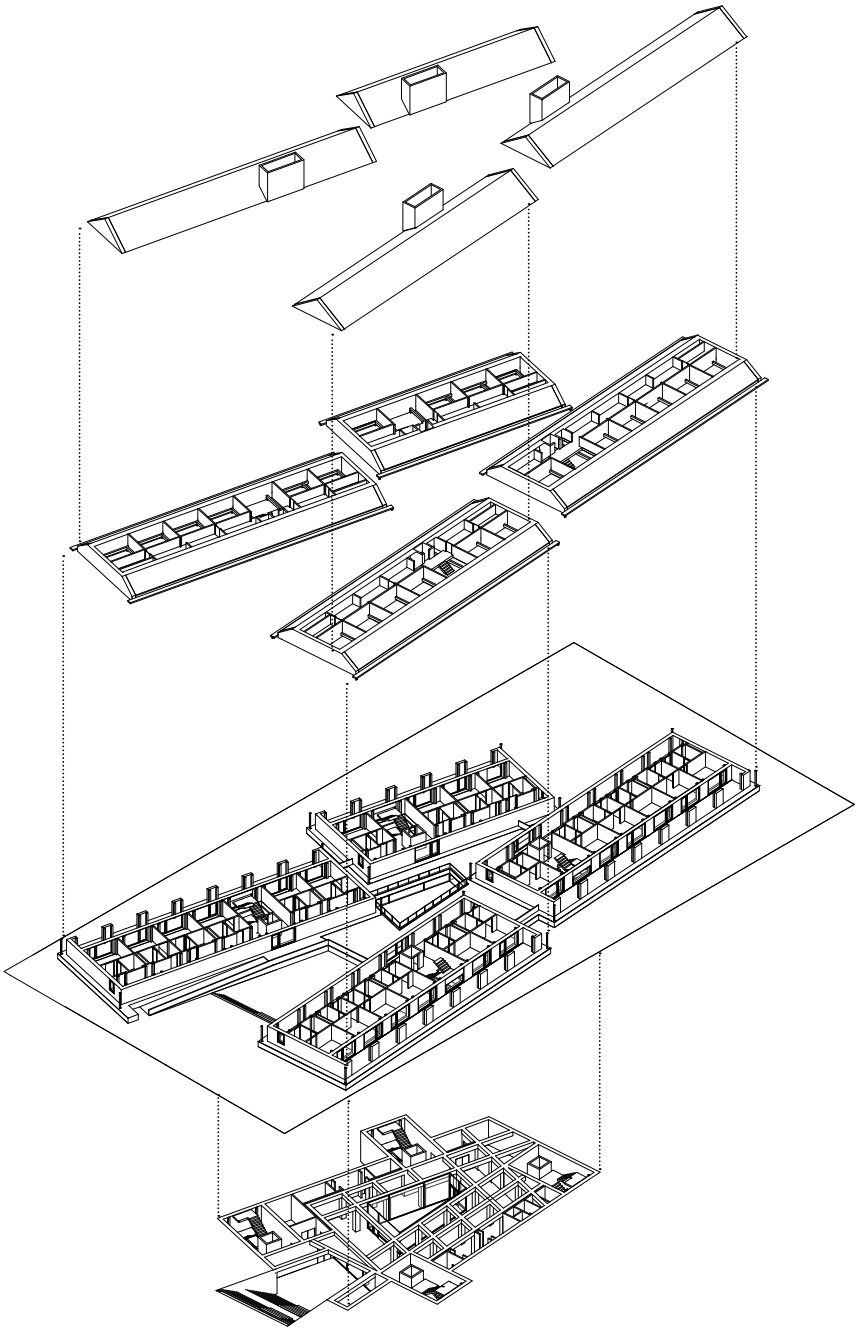


Circulation - middle



Circulation - at the side

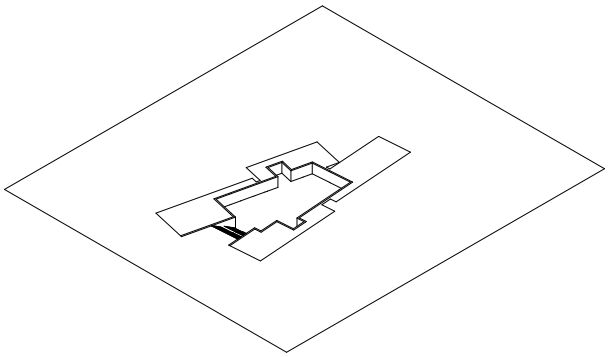
The circulation helps to bring light in the buidling and create a cosy atmosphere



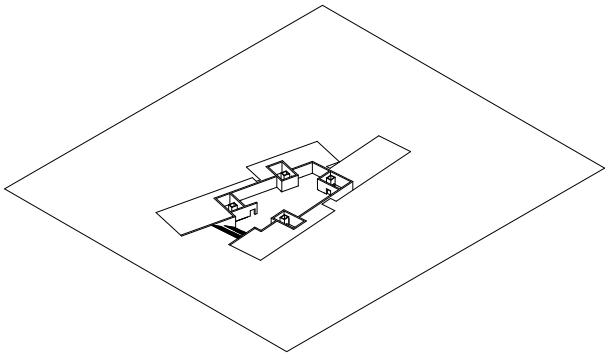
The function is layered, the connection happens in the heart of the building

Constructionflow

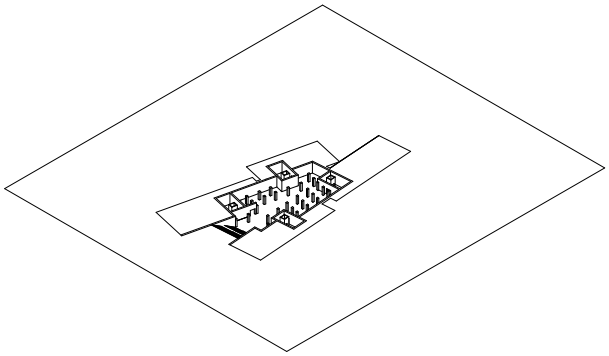
01 - Site definition



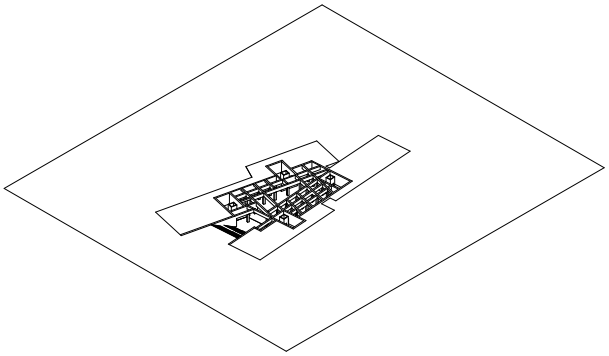
02 - Dig the construction pit



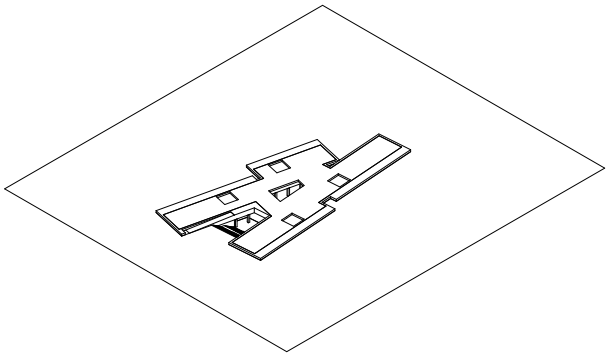
03 - Construct concrete walls and cores



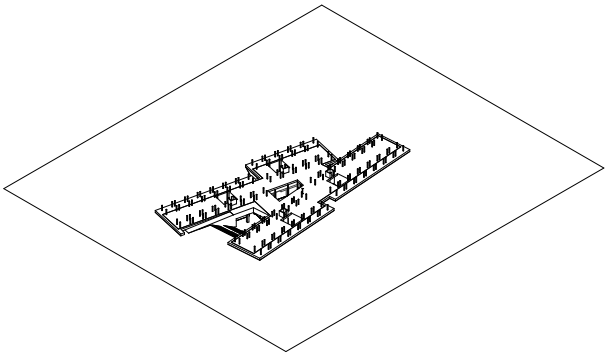
04 - Construct the columns



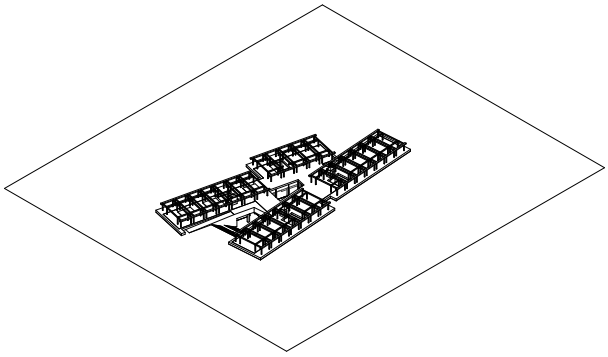
05 - Construct the beams



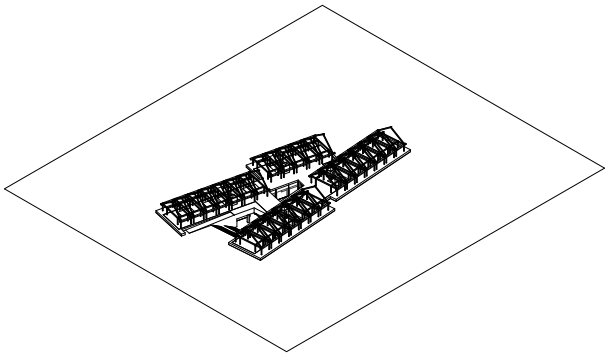
06 - Construct the ground floor slab



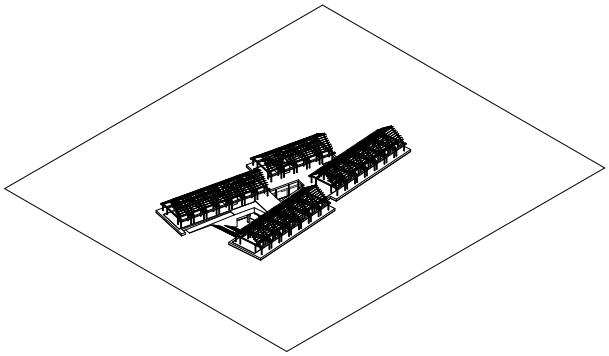
07 - Construct the concrete columns



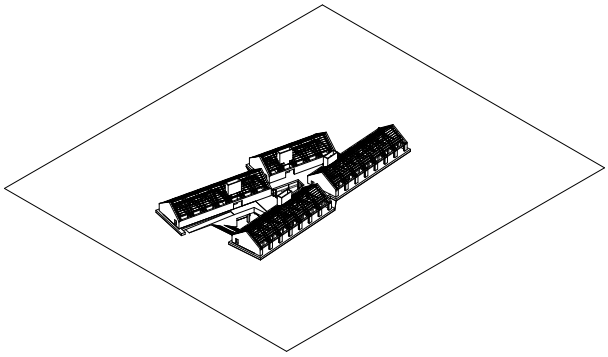
08 - Construct the wooden beams



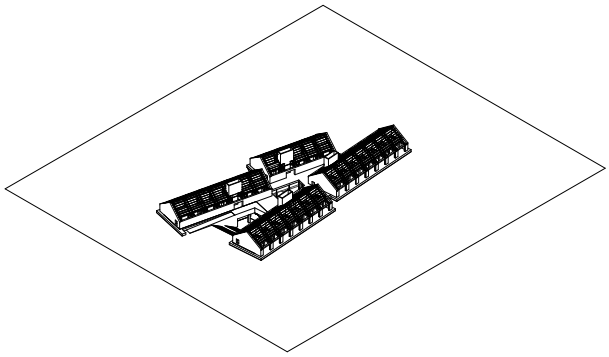
09 - Construct the wooden roof structure



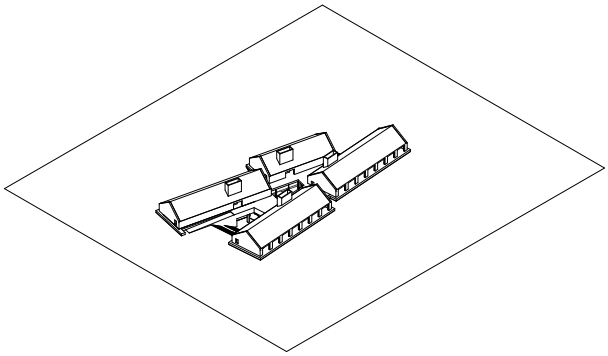
10 - Construct the wooden roof structure



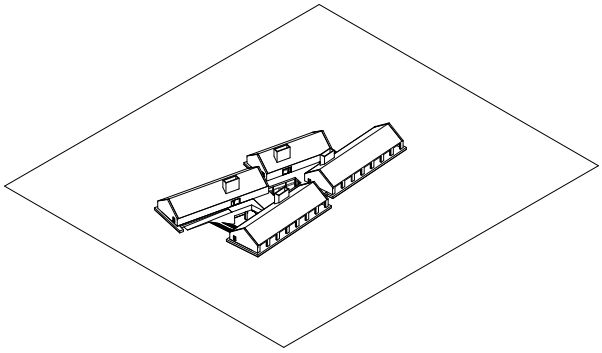
11 - Construct the rammed earth walls



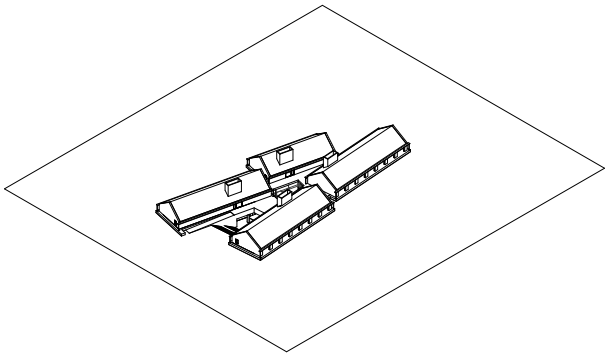
12 - Construct the interor walls



13 - Construct the roof



14 - Built in the windows and doors



15 - Finish the construction

The first step into the building - entrance - layering of the spaces

Facade

The symmetry creates a strong face

The division of the room gives a not clear identity

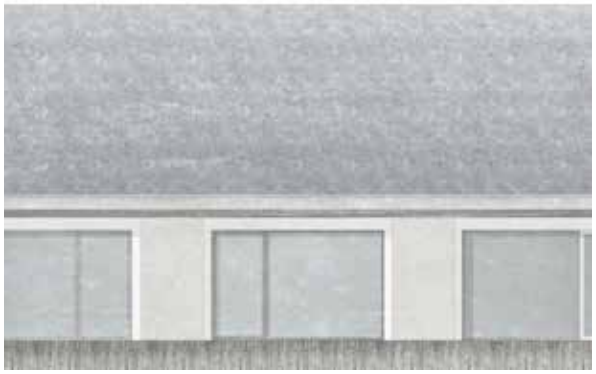
The asymetry gives space for interpreation

The merge of the window brings calm for the facade

Division

Balance between the proportion of tranparent and opaque

Strict repetition, an endless continuity



The window and door frame bring accent

Material Concept

Interior - Hungarian vernacular ill.[93]

The house reflects the materiality of the site with earthy ground and external walls clad in vernacular white lime plaster, to create a new, closely textured surface. The exposed wooden beams reflect to the master beam in the Hungarian vernacular. The master beam has been creating the space since centuries, giving rhythm and invisible division to the space.

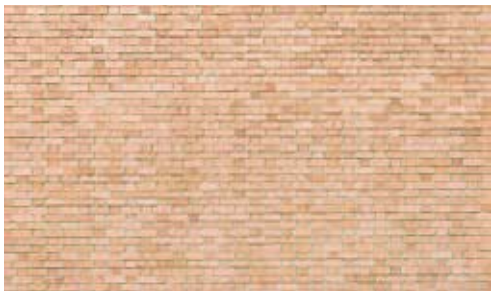
The building has architectural elements, such as the stair and elevator shaft, which were not yet part of the vernacular architecture in Hungary. To create a seamless transition from material to material, these elements are constructed with exposed concrete and brass.

The flooring had always a secondary role in vernacular, but in the project, it is very important to distinguish the social and individual spaces. The calm personal living areas are cladded with darker wood, as the social spaces cladded with brick.

White lime plaster on rammed earh - walls

Parquette - flooring

Exposed concrete -columns



Brick - flooring

Wood - beams

Messing - handrail

Zinc - roof

Aluminum - window and door frame outside

The sunken garden brings light in the space

Material and Surface

1. white plaster paint, with metal railing

2. white plaster paint, with messing railing

The study of the materials of the exterior skin deals with two totally different approaches. On one hand the one-to-one adaptation of the vernacular solution. That means that the last layer is a homogenous white lime plaster paint. It clads the structure and creates an even surface. On the other hand, the other approach would be to forget the vernacular tradition and show the structure. In the design the goal was always to learn from the vernacular, to fit in the context in all aspects (material, tradition and site ect.), but at the same time to use the latest technology to develop the architectural performance of the building.

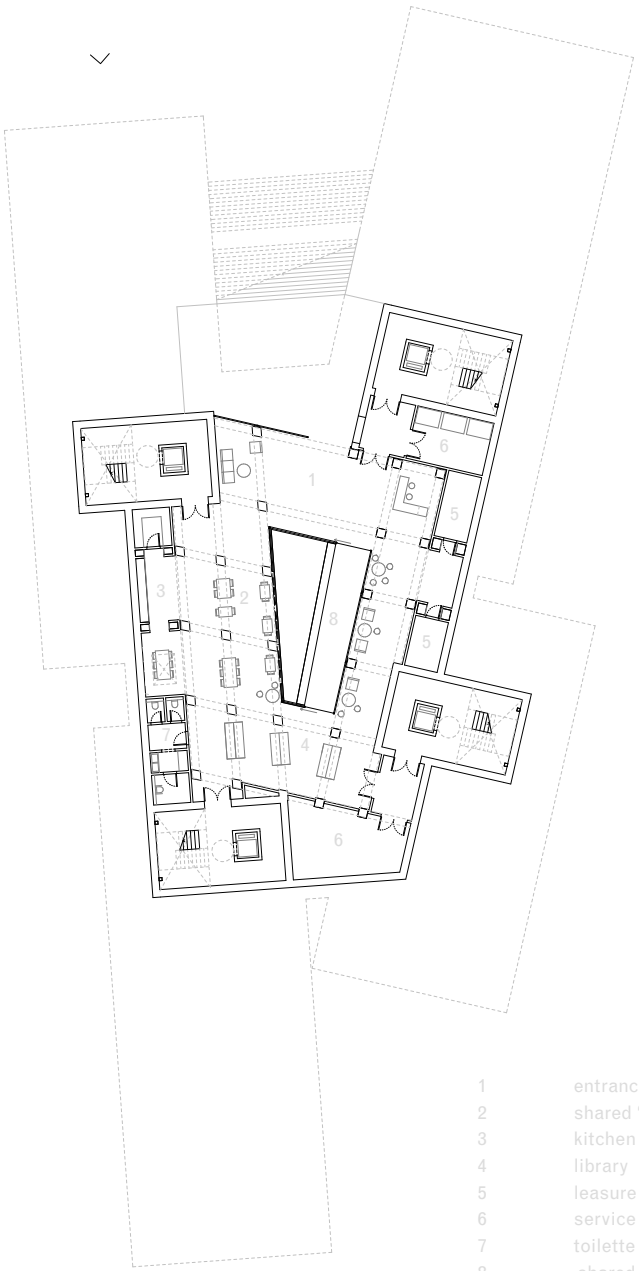
This thinking lets me to a materiality that combines the white lime plaster paint and the texture of the pure structure. A thin layer of the paint gives the opportunity to celebrate the surface and rought structure of the rammed earth walls, and to give some memories of the original material of the vernacular. In my opinion the fusion of the two basic approaches can create an atmosphere that is simple but gives answers for relevant questions of architecture.

3. visible structure - surface of rammed earth

4. claded wall - the texture is visible

The object

FL -1, 1:100



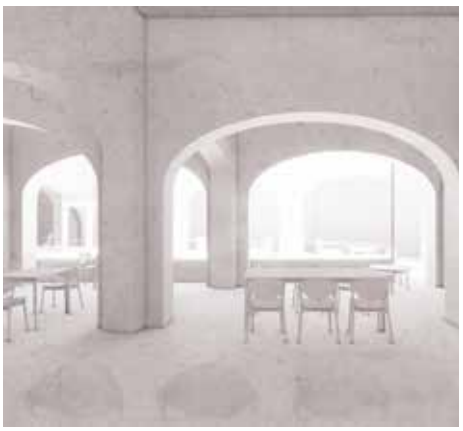
1 entrance
2 shared “living room”
3 kitchen
4 library
5 leasure / care
6 service
7 toilette
8 shared garden / atrium

FL. -1.

Atmosphere through the structure and material in the social space

FL -1. Atmosphere through different structures

01 The round columns brings lightnes in the space, but not a character

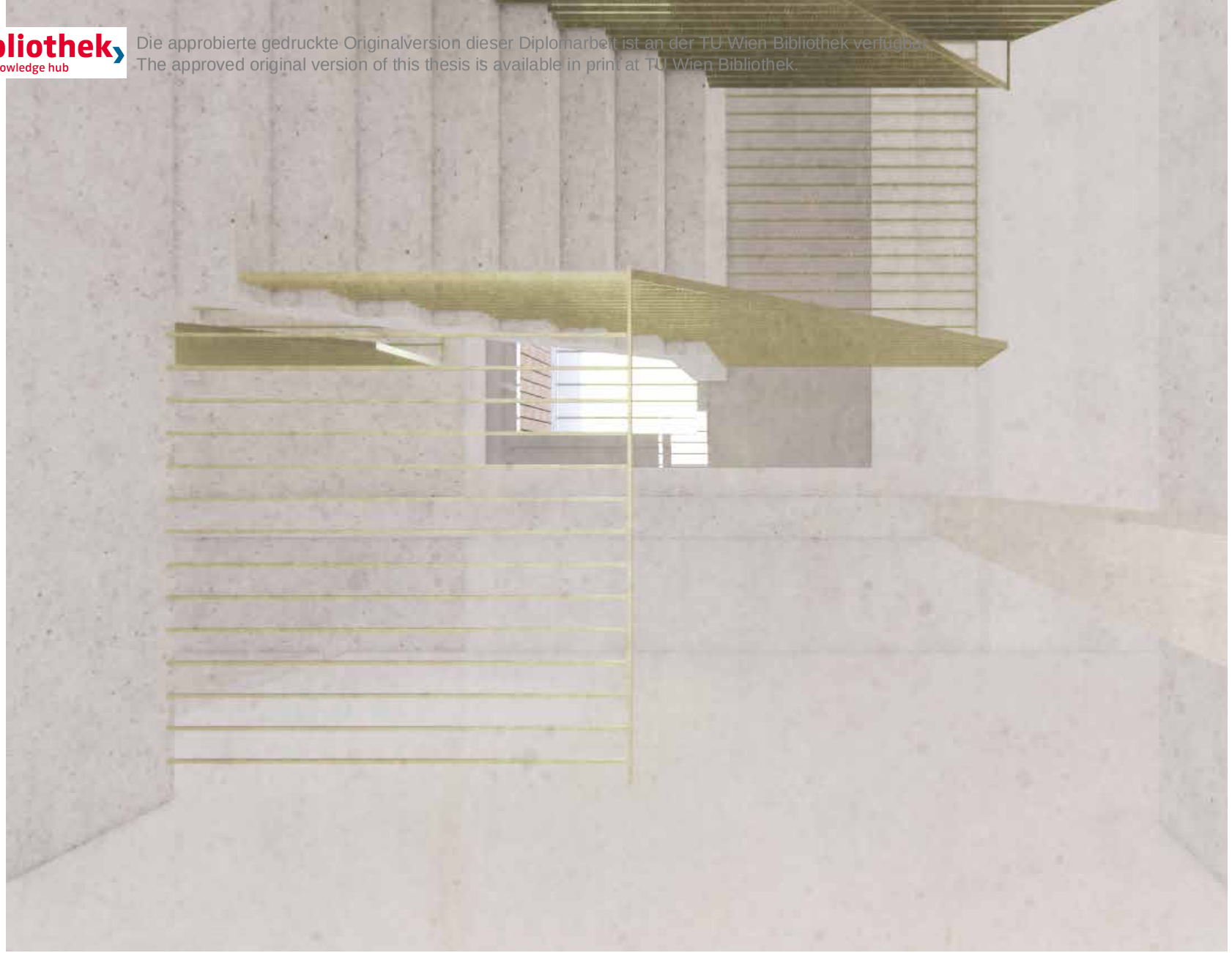


02 The arche shrink the space

03 - The rectengular columns and the beams bring a special character and identity

04 The cancelation of a raster break the rule, and lose orientation

The materiality bring character and the metal mesh ceiling the proportion



Ground floor, 1:100

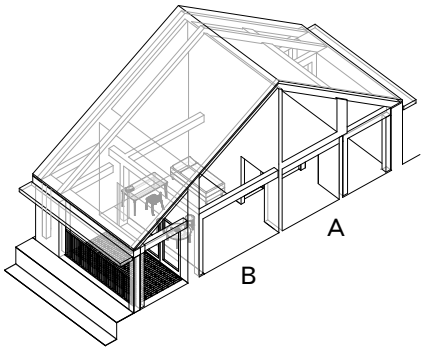
8 shared garden
9 individual living space

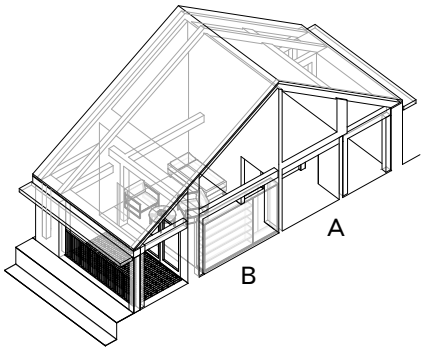
GF. +0.

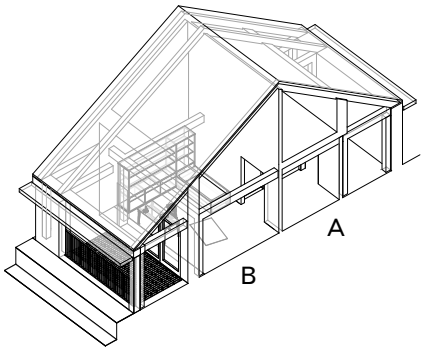
How can be a standardized space personalized?

Individual space - the freedom of self-design

As the inhabitants, elderly take most of their time in their own room of the elderly home, the design and self-reflection, personality in design plays an important role. The concept of the individual rooms is simple. The space is divided in two space. As we enter in the room, we find ourselves in area „A“, which is a predefined space with the bathroom. The whole are is following a strict design, which leads to efficiency. There is a little space for individual decisions. In contrast to that, the area „B“, or with other words, the living space gives opportunity for personalizing. For each need, the inhabitants could design their own space. The pictures above show





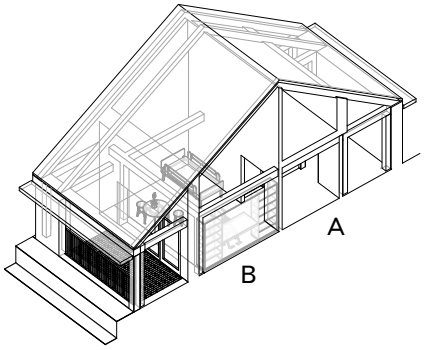


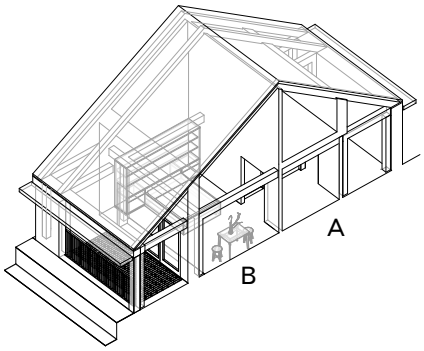
1. Furniture layout for one person - the atmosphere defined by materials and structure

2. Furniture layout for one person “2” - the accent on the furnishing and personal interaction

3. Furniture layout for one person “3” - the celebration of the outside and nature

scenes for special living conditions. It showcases possible design answers for living alone, living with the partner or living with some kind of disability. In my opinion, it is crucial in design to give place for flexibility or personalization. As reference, Herman Herzberger did similar case studies in his office building (Central Beheeren), to increase people productivity. In this case (elderly home) the well-being of the inhabitants is in the focal point.

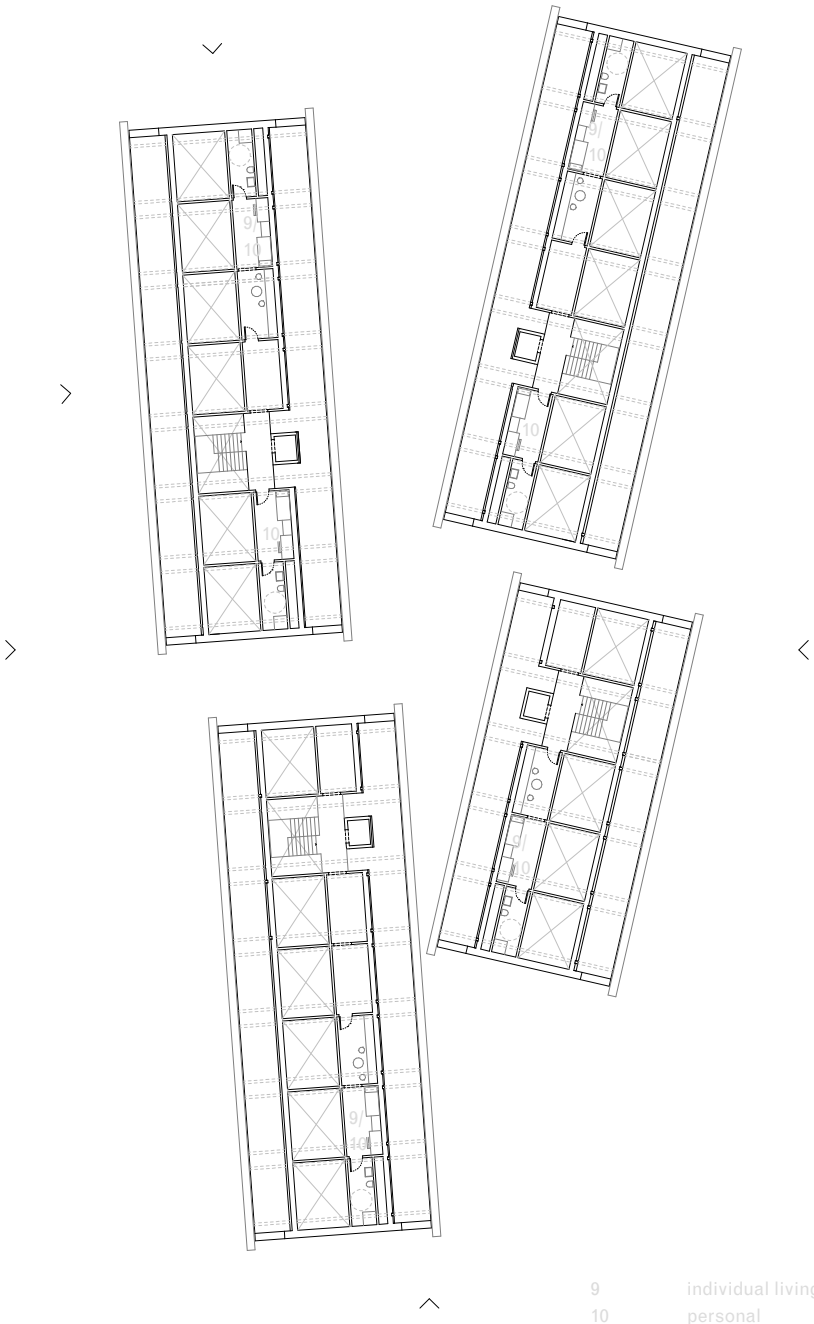




4. Furniture layout for one person - optimized for barrier-free living

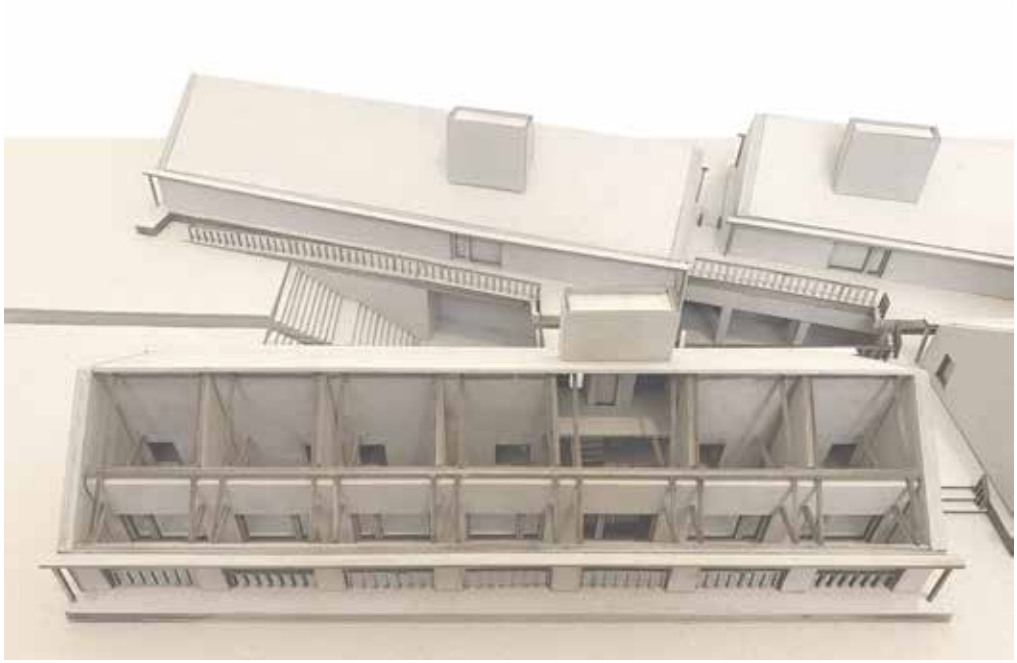
5. Furniture layout for a couple- share

FL +1, 1:100



9 individual living space
10 personal

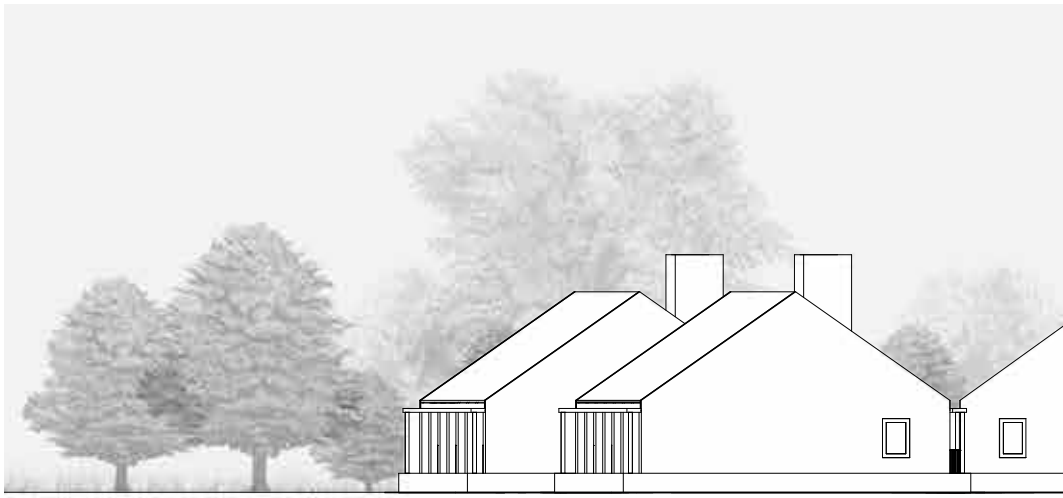
FL. +1.



Inside - outside - structure

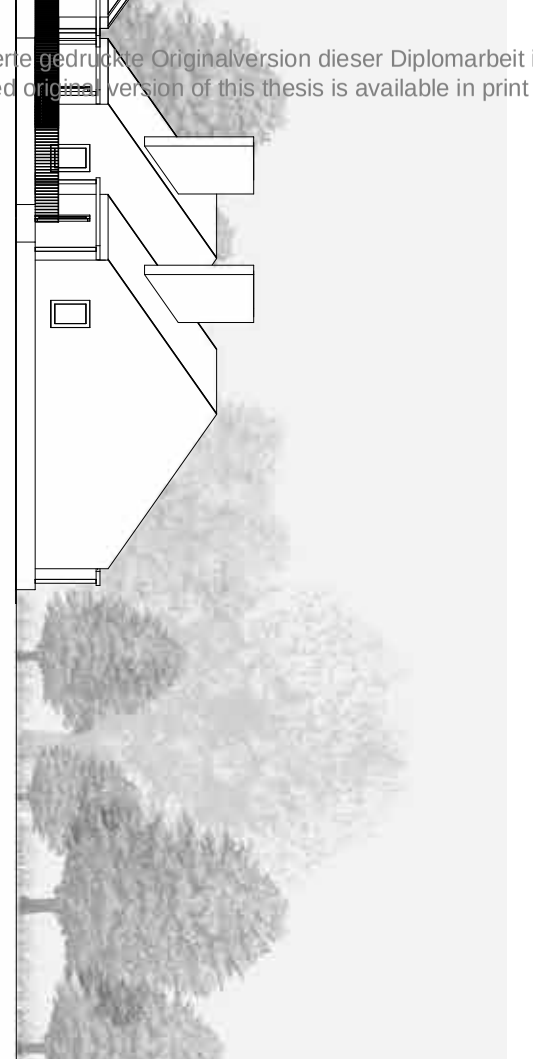
The entering and leaving the building for visitors are in the same spot

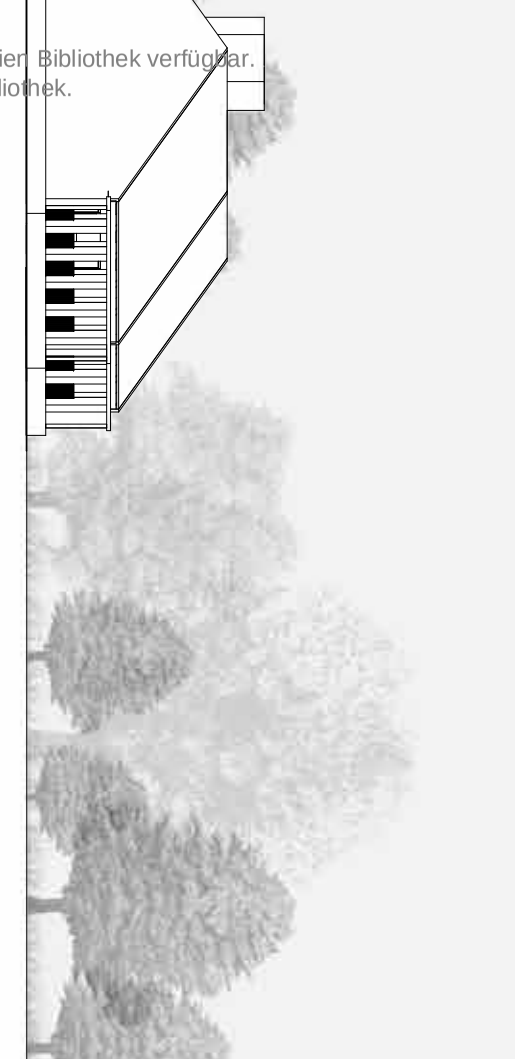
Elevations 1:100



Elevation South

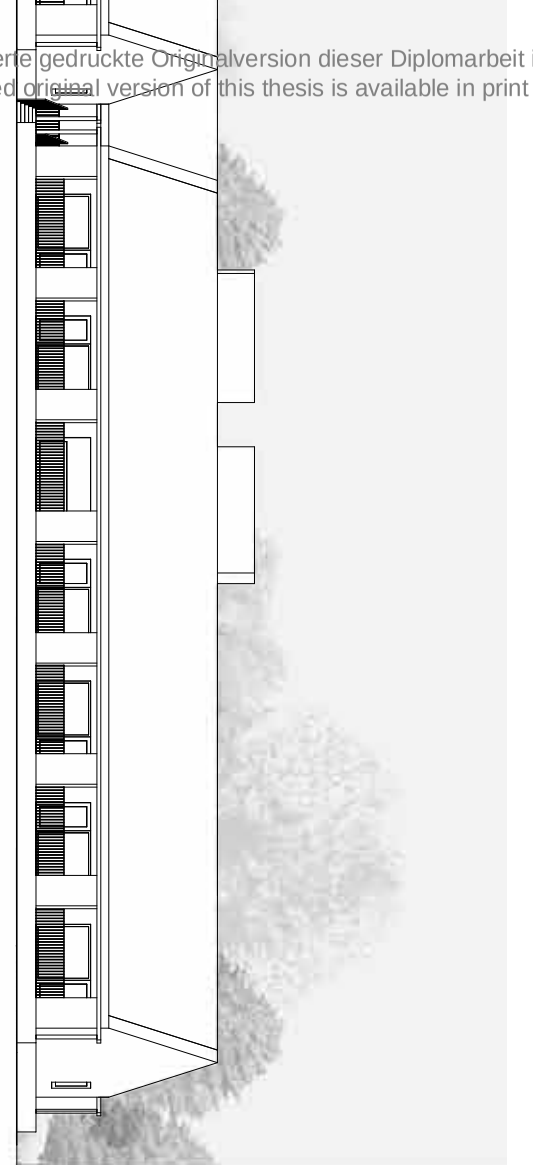
Elevation North

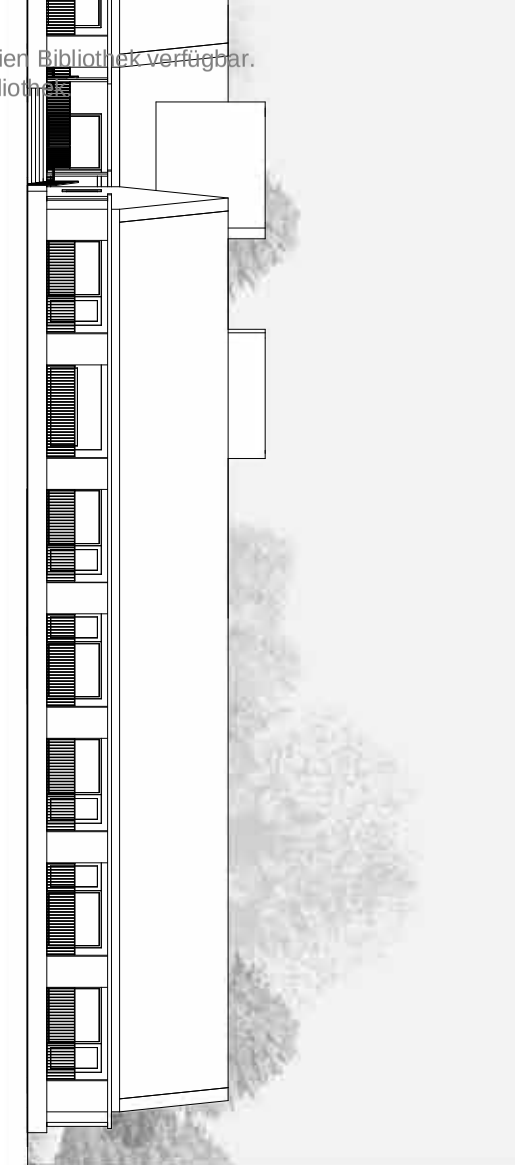




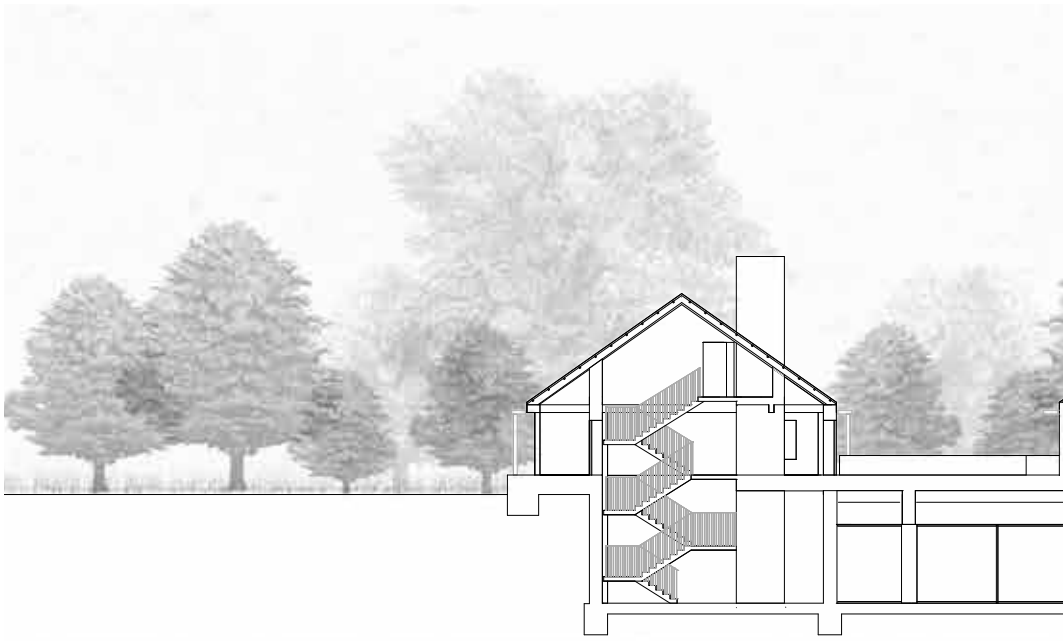
Elevation East

Elevation West

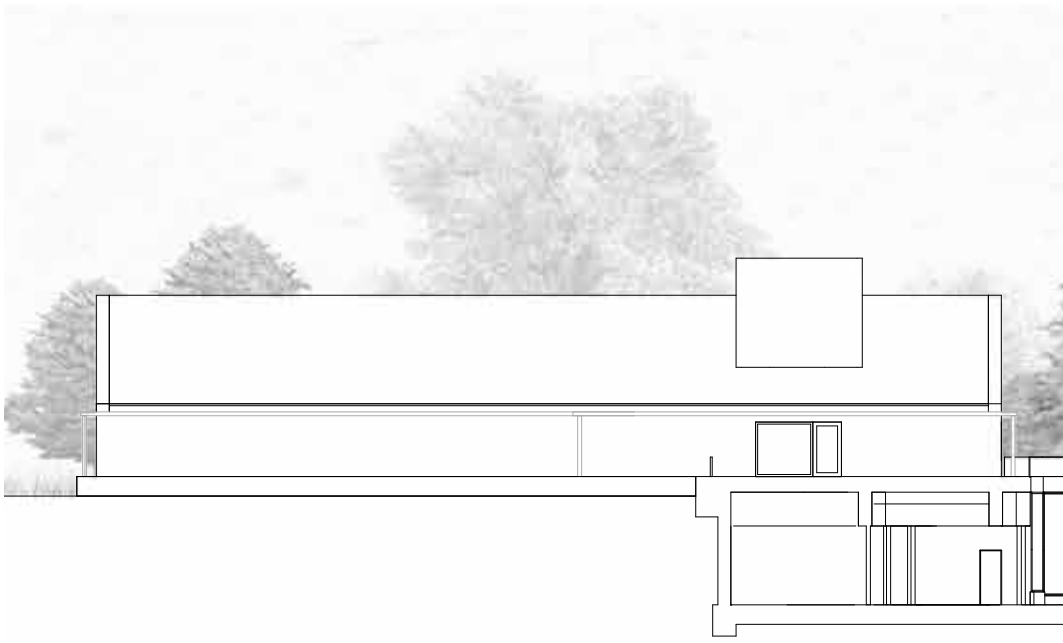




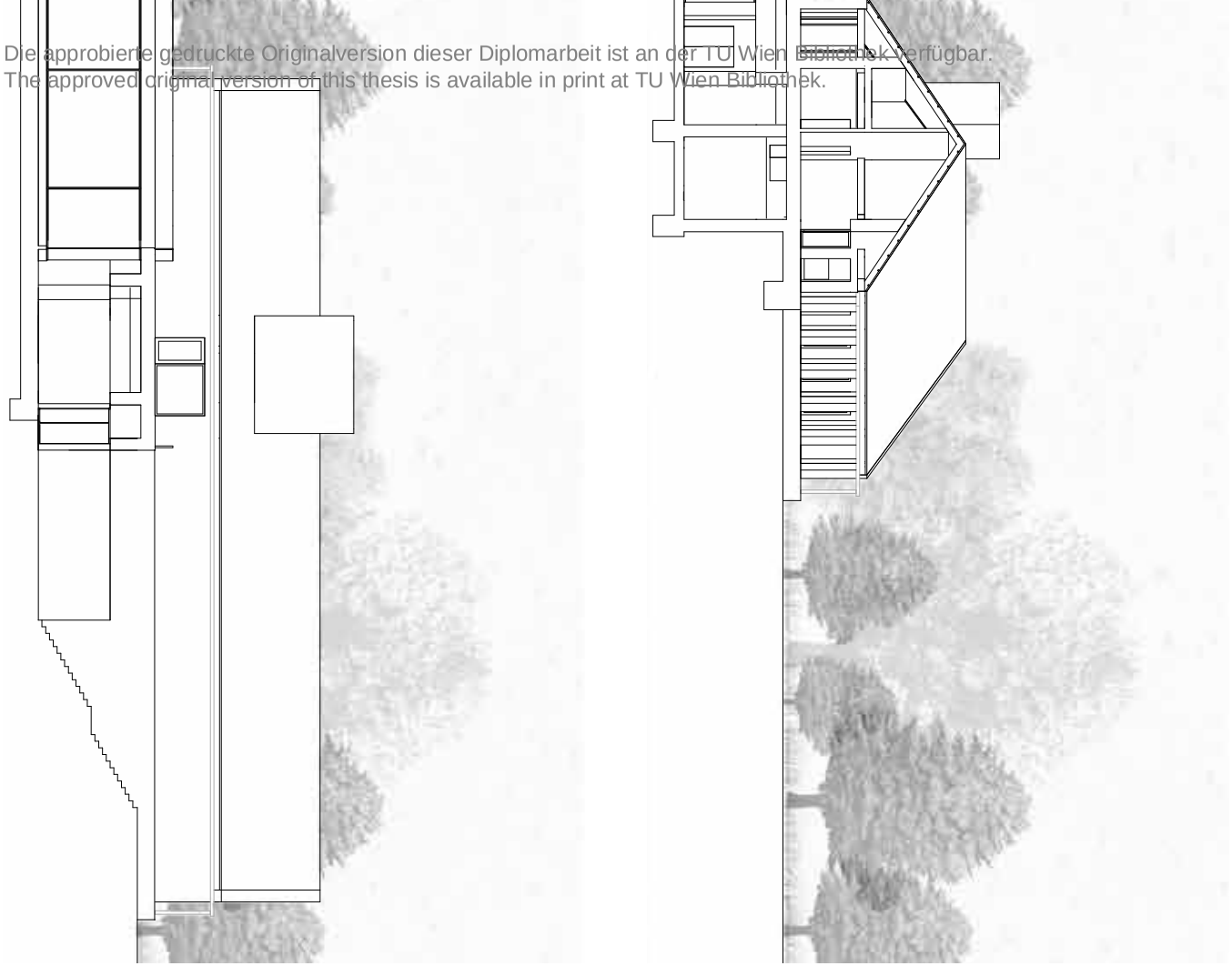
Sections 1:100



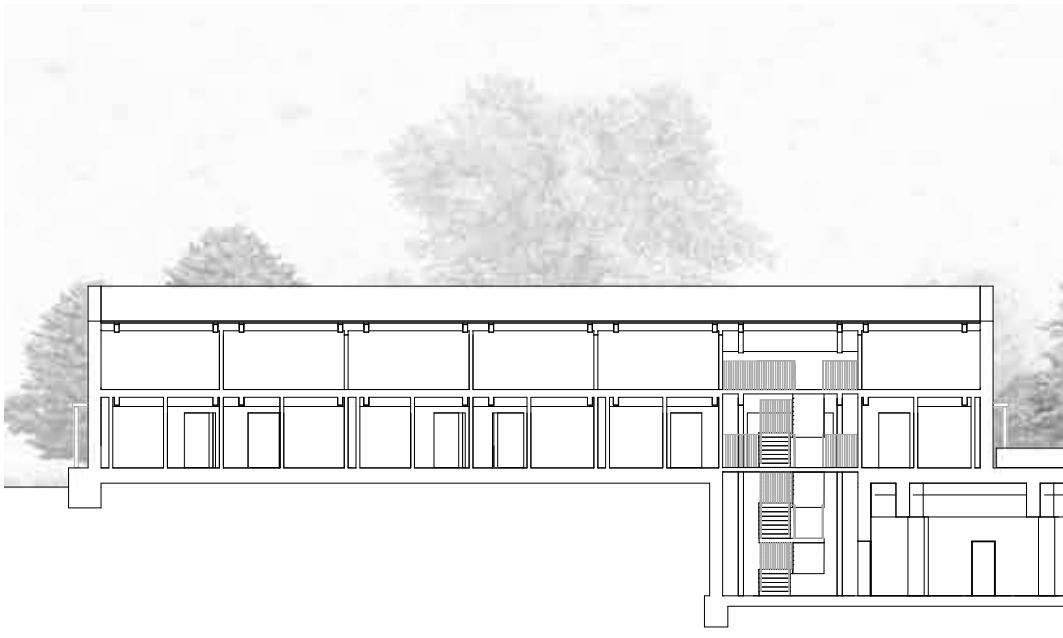
Section 1-1



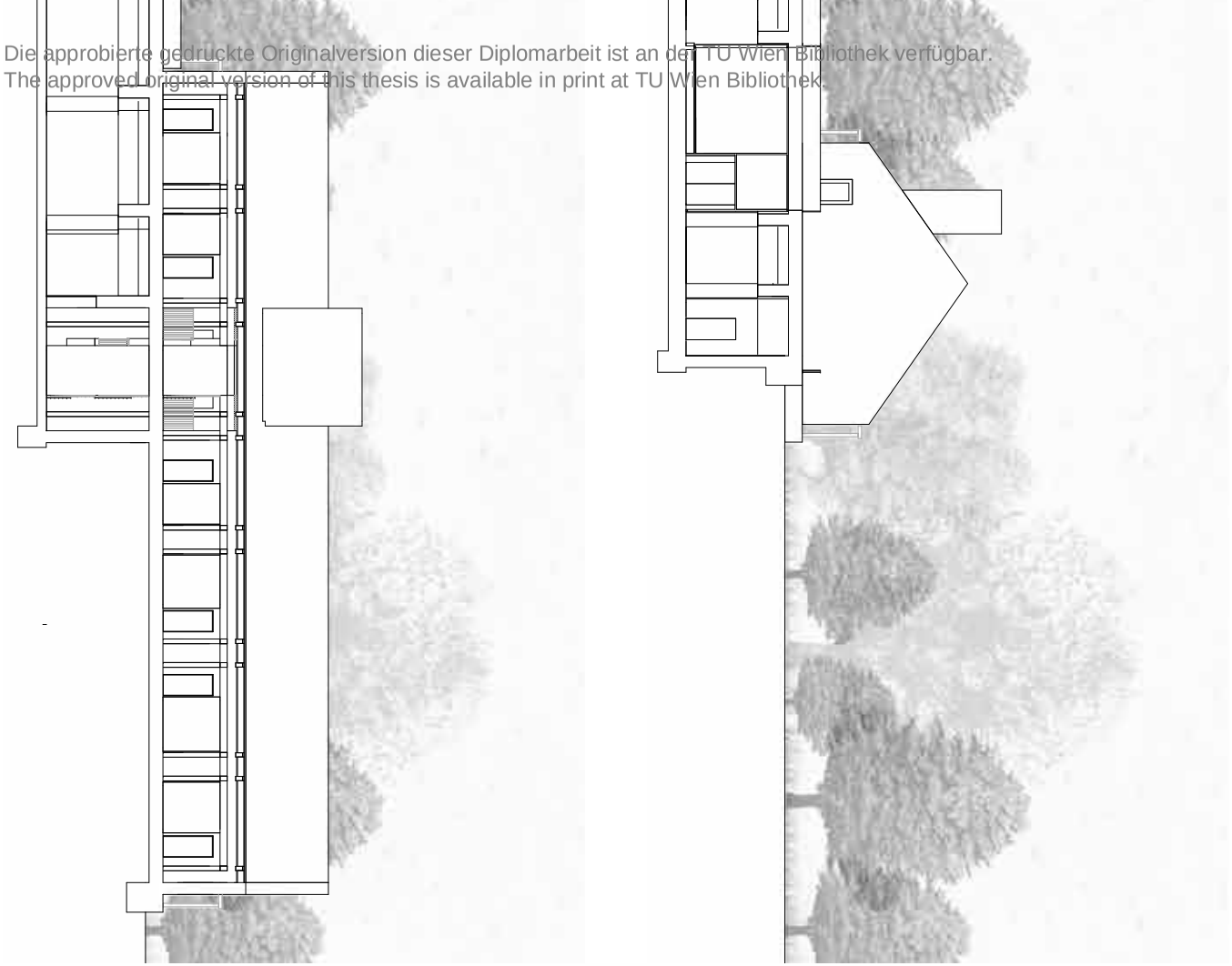
Section A-A



Section 2-2



Section B-B



Sustainable based design approach

The base material construction (rammed earth) of the building comes from the traditional building technology in Hungary.

"Our cultural achievements in architecture are closely linked to the availability of raw materials and resources, as well as to energy, climate conditions, cultural identity and social attitudes."
Paul Wallot, 1894

The design of the building layered in different focal points. One of the most important elements of the research and design is the construction technique. The construction technique is examined in multiple meanings. On one hand the tradition and vernacular approach, on the other hand the adaptation of the technology on the level of sustainability.
As the research stated, sustainability is understood in four levels.The raw material (PEI), transportation, waste reduction and flexible design. During the development of the design these aspects were considered. The traditional material with low PEI value (PEIEarth= 0-30 kWh/m3).The structure of the building is optimized for a flexible floor plan. Moreover, the concrete - wood framework structure proposed a concept for prefabrication of the elements (columns – concrete, beams – wood, wall – rammed earth) on ground floor and the elements of the roof structure.
Earthen construction structures are considered pollutant-free and therefore recommended for health-based design. [57]
All these aspects and statements were adapted from the research and placed in the discussion of the design.

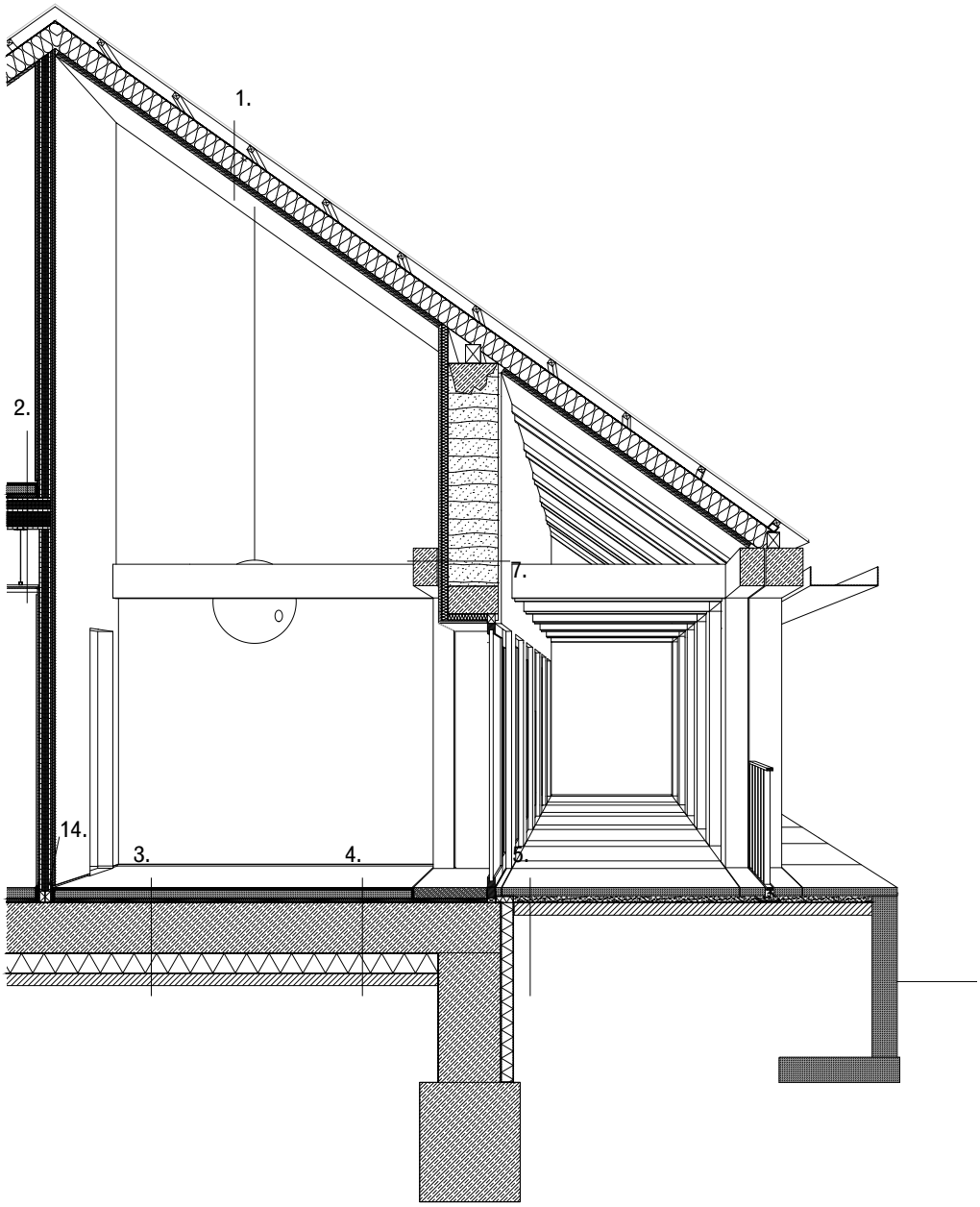
1. 2. 3. 4. 5. 6.

1. zink	2.plaster	3.wood	4. plasterb.	5. concrete	6.clay
9,50 m^3	42,00 m^3	265,40 m^3	303,23 m^3	450,20 m^3	651,80 m^3
0,75 %	2,44 %		2,44 %	26,17 %	37,80 %

Sum: 1719 m^3 / 100%

Distribution of materials (in %) excl. foundation and openings ill.[91]

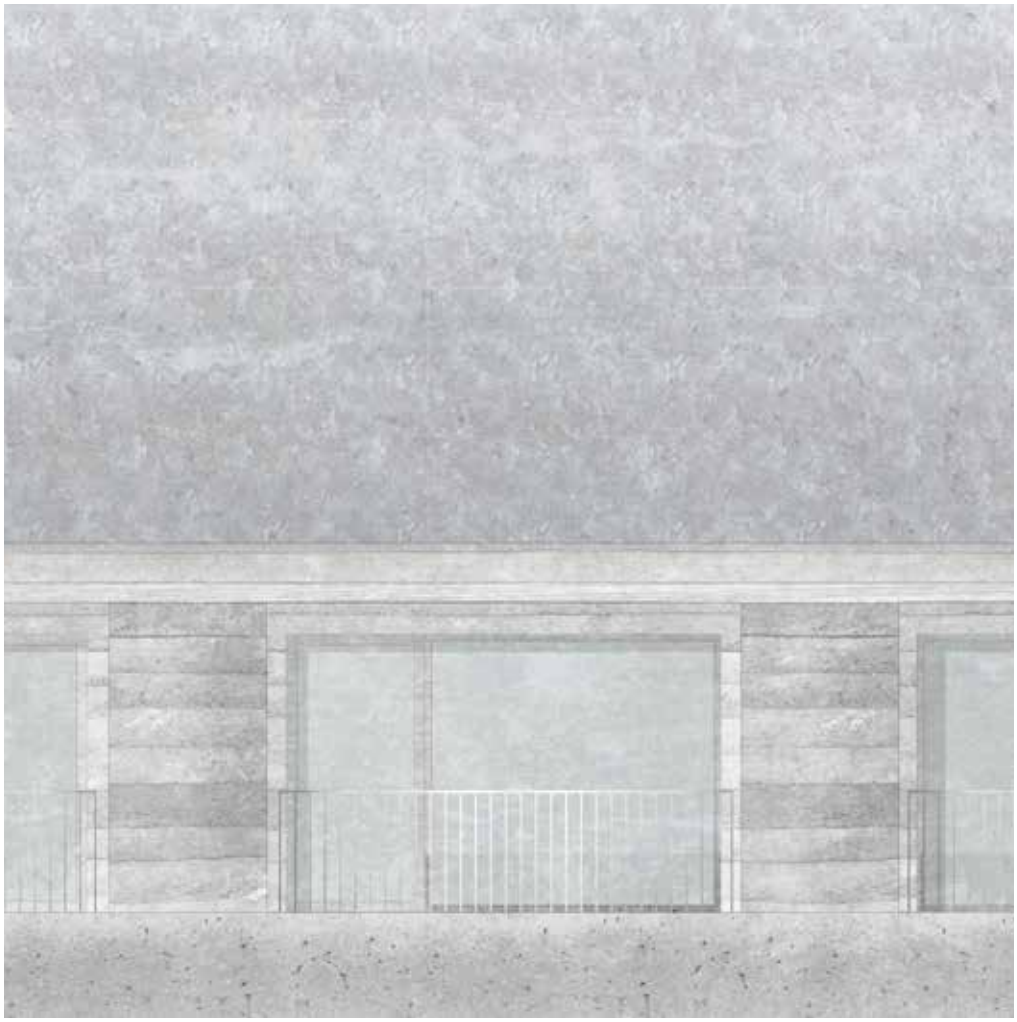
Section - Elevation 1:20



1. roof
- trapezoidal sheet 20 mm
- battens 30 x 40 mm
- counter battens 50 x 50 mm
ventilated cavity
- secondary water proofing
- thermal insulation
(mineral wool) 150 mm
- plaster board 2x12,5 mm
- white lime plaster 20 mm

2. ceiling
- parquet 20 mm
- film
- estrich 70 mm
- pe-film
- sound insulation 30 mm
- clt 300 mm
- h. ceiling – p.board 20 mm
- white lime plaster 20 mm

3. foundation
- parquet 20 mm
- estrich 70mm
- pe-film
- sound insulation 30 mm
- vapor pressure equalization
- water proof concrete 400mm
- thermal insulation 150mm
- subbase 100mm
- pe film



4. foundation
- polished concrete 20 mm
- estrich 70mm
- pe-film
- sound insulation 30 mm
- vapor pressure equalization
- water proof concrete 400mm
- thermal insulation 150mm
- subbase 100mm
- pe film

5. terracce
- clinker 65 mm
- fill 55 mm
- pe-film
- subbase 100mm
- pe film

6. wall
- white lime plaster 20 mm
- rammed earth wall (prefab.) 400 mm
- thermal insulation (mineral wool) 50 mm
- white lime plaster 20 mm
- shadow gap 20mm
- concrete beam 200 x 200 mm

Conclusion

The design was delivered after the principles learned from the research. In the discussion the main features which were translated in the design of the building were: the atmosphere, typology and construction technique

As the plan and development of the design show the Hungarian vernacular is the base for the building, that delivers the concept for a design that fit in and fits in the authentic atmosphere of Kóny.

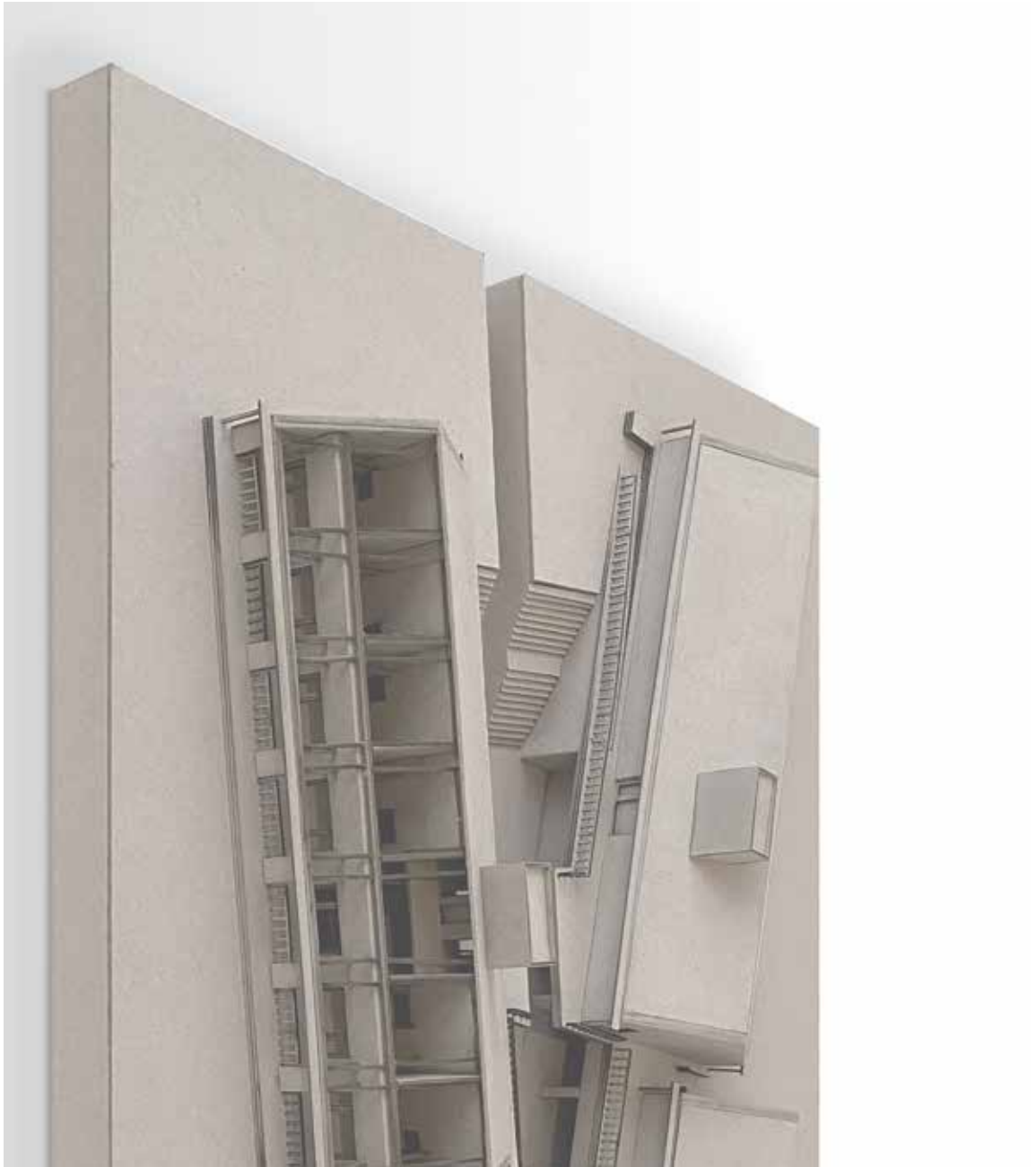
On the other hand, the building is not the one to one copy of the Hungarian vernacular architecture. It uses the codes and values of the current state of technology, needs. As a functional object, in the center is the user. The elderly, who live there, the personal, who work there, and last, but not least the visitor and family member.

The efficiency of the building comes from the fusion of vernacular typology and the general floor plan concept of elderly homes (like the references from Sergison Bates architects).

The study on the local conditions and tradition is one of the key moments in the life of the building.

The inbetween space is created by the interaction of the volumes

The interaction between the four volumes and in-between space



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