

Modules for Kids

A Prefabricated Building System for Preschools



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Modules for Kids -
A Prefabricated Building System for Preschools
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Thanks to

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Thanks also to Madeleine Nordenknekt who arranged the workshop for me and gave me critical review of my work.

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Abstract

In this thesis a new preschool building at Kullegatan in Gothenburg is designed. The new building will be designed as a prefabricated modular building system. In the process these questions are explored:

How can ideas of the learning environment be guiding in the design of the modular building system?

How can the modular building system express individuality and wholeness within different contexts?

Hopefully the process and findings will be able to give input to the ongoing development of a concept preschool building driven by LF in Gothenburg. It is a standardized solution meant to be used repeatedly for future development and thereby ensure quality, as well as save time and investment cost.

Meetings with preschool teachers as well as professional designers have been made to understand the learning environment. A visit

at Flexators factory in Gråbo was made to better understand the construction process. The proposal for Kullegatan has been developing throughout the process by sketching, modeling and evaluation.

The result questions the norm of using cuboid volume elements as modules and instead uses the parallelogram as its basic shape. This results in a common denominator that tie the building together while at the same time gives identity to each part. It also proposes a hybrid building system with parts of flat prefab elements which make it more flexible to different organizations.

Even though the proposal needs a set of design rules, and needs to be tested on different sites, the thesis shows a potential for how a prefabricated modular system can be produced in factory by repeating the same basic elements, but still be able to handle different contexts and express individuality.

Contents

Introduction	1
Project background	2
Project aim	3
Method	4
Research	7
Modular construction in Sweden	8
Pattern architecture	10
The learning environment	12
Visit Äppelgården	14
Visit Engelbrektsgatan	16
Kullegatan	18
Design Process	21
Volume studies	22
Facade studies	28
Organizational studies	30
Workshop	32
Building system & Assembly	38
Design Proposal	41
Discussion	59
Discussion	60
Conclusions	61
Bibliography	

Introduction

Project background

Sweden's urban areas are growing and with an increased population there is also an increased need for preschools. At the same time many existing preschool buildings need to be replaced in the near future. Gothenburg is developing a concept building for preschools to address the problem. This is meant to provide new buildings as well as replace outdated buildings in a rapid pace. The hopes with the concept building are to reduce planning time, construction time as well as cost through standardization.

In 2015 I worked as an intern at Liljewall arkitekteter on a similar project for Stockholm. The idea was three different sizes of buildings 4, 6, and 8 children units with the same developed and thought through inside and an adaptable facade that could fit its surroundings. There were some problems with designing without a specific site in mind though. The delivery access to the kitchen didn't always fit the plot and the whole rectangular shape of the building didn't always play well with its surroundings. When this method has been very common for single housing, the large preschool building proved to be more complex.

This led me to ask if not a modular system would be more flexible. Why was this method not even discussed? For me it seemed even more advantageous where even more of the building is constructed off site, making assembly on site more effective. If it was possible to organize the building differently according to needs and site, adding units according to demand, wouldn't that be more flexible?

This would of course demand more planning for each project, but considering that there is no "one-size fits all" for buildings with always unique places maybe extra thought for each project is needed anyway.

My perception was that construction with modular volume elements is associated with

temporary buildings where there is no time or funding for a higher architectural ambition, or negatively associated with the late modernism development of the suburbs and considered a thing of the past. No one seemed interested in developing a modular system into something sophisticated when considering preschool buildings. Instead it has been criticized to inheritable only produce architecture with a repetitive expression, inflexible to context and function. Production of standardized type buildings with flat elements has been promoted instead. But this system has the same kind of problems concerning both repetitive expression as well as inflexibility to change.

At the same time different housing project, mostly for student housing or small apartments are starting to appear which gives me hope that there might be a future for this method when it comes to preschool buildings as well.

I think that the possibilities with production of preschools as volume elements should be explored, and while the majority of the contractors are interested in standardized flat element solutions, this thesis can be a good arena for reflection and discussion.

Can the modular construction get a modern revival in solving the issue of producing a standardized solution that is flexible to different sites and needs? In *Prefab Prototypes* (Anderson M., Anderson P., 2007) the following reflection can be read;

"The paradox is that the more standardized the units become, the less flexible they are, and the narrower the possible applications."

This means that if the construction system is specific in its application of function, namely preschools, maybe there is a larger flexibility when it comes to other areas, such as appearance.

Project aim

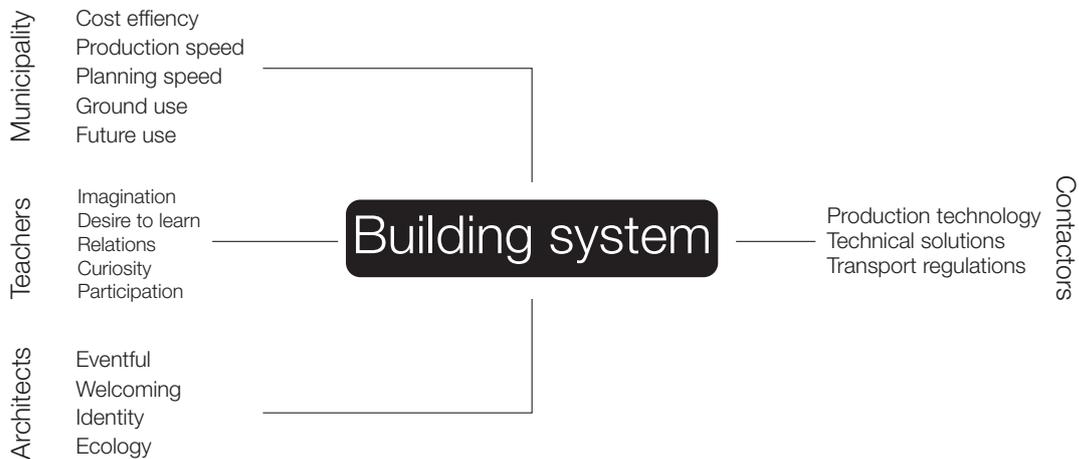
In this thesis a new preschool building for Kullegatan in Gotenburg will be designed. There is an existing preschool on the site, but the buildings is outdated and to small. The new building will be designed as a modular building system with the learning environment as the guiding design principle. The design might work as a prototype to be repeated at other sites and be a more flexible solution than the type building. In the process of designing for Kullegatan the balance between standardization and customization will be investigated, both with an economical as well as a cultural perspective. While standardization and repetition can fulfill the economical needs of the city, it does not provide a flexible enough solution

for every different situation. Aesthetically, modular construction is known to produce a monotonous appearance limited to the addition and subtraction of the same elements, but does this need to be true? Can modules be something else than the generic cuboid and thus give a new appearance? The following questions will be investigated in this thesis:

How can ideas of the learning environment be guiding in the design of the modular building system?

How can a modular building system express individuality and wholeness within different contexts?

Main focus of stakeholders



Method

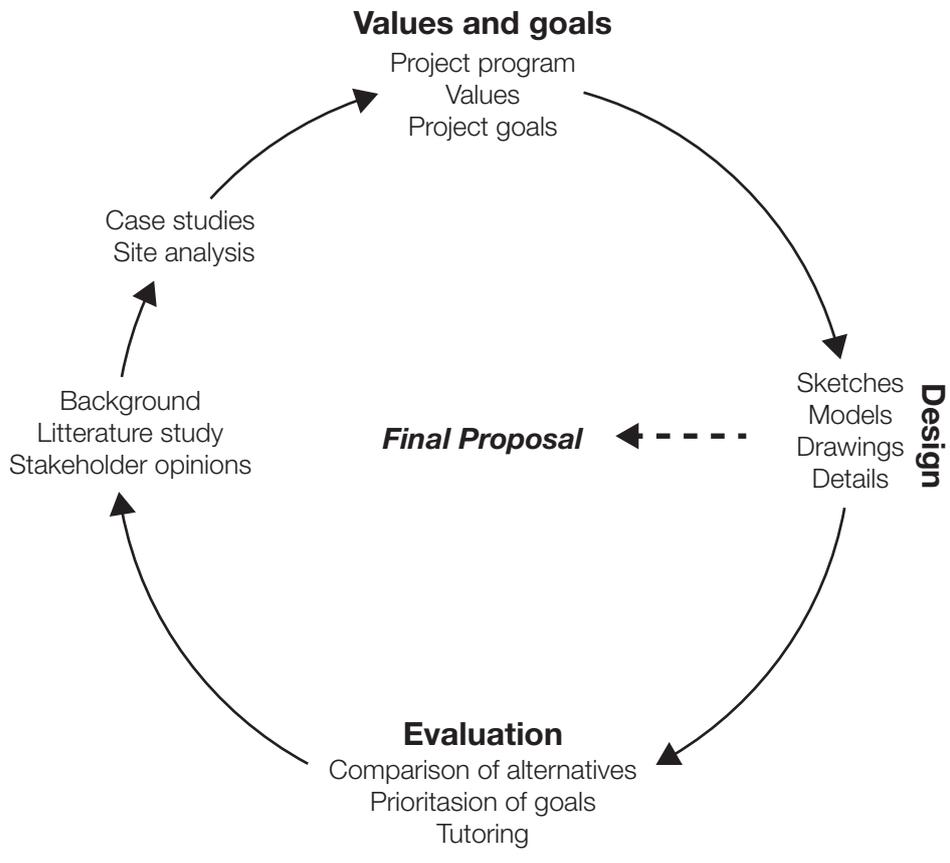
This project centers on a comprehensive design proposal. In the process of designing research has been done both in gathering necessary information through literature studies, interviews and case studies on which the design is based, but also in the evaluation process of sketches and models and the understanding earned by experimentation.

I started with meeting different stakeholders in Gothenburg to learn about and understand the issue. Early on I met with representatives from the city discussing the situation their view of it. I then visited Liljewall Arkitekter and school designers to understand what school design is about and what is important. Later I visited two preschools to see and understand the daily routine and how it can differ between preschools. I also talked to the principles of

each school about children and architecture. A visit to Flexators factory in Gråbo was made to see the construction process and talk about the challenges and possibilities of the construction method.

I also looked at reference project of both modular buildings and preschools from around the world to get inspiration for my design and learn from my predecessors.

I have worked with many aspects of the design at the same time through sketching, drawing and modeling. The results have been gathered weekly or daily in a sketchbook and evaluated through text or tutoring and presentations. This has then been guiding in refining and prioritizing the scope and goals of the project and finding what the important parts of my background research are.



Research

Modular construction in Sweden

First off, when using the term module or modular construction in this thesis, I refer to a largely completed or whole section of a building built at a factory and trucked to site for assembly. This could also be referred to as a volume element or volume module. It is not to be confused with “prefabricated” which could mean any size of element completed in a factory and used in construction.

According to Peter Adler (2005) industrialized building construction in Sweden can be divided into three phases. The first phase was in the time after the Second World War when industrialized construction had a breakthrough in Sweden. The goal was to find a solution to high cost and effectively provide housing through rationalization. Between the 70's and 80's the second generation came with focus on flexibility for the user, variation in appearance, and consciousness about the environment. The third phase started in the beginning of the 90's with focus on flexibility over time, ecological approaches, and the integration of information technology.

Bostadsbolaget was one of few that in the 60's used volume modules for larger housing buildings. They used a developed scheme for dividing the building that could be combined in different ways. It was a kind of hybrid system with both volume and flat elements. It was a kind of open system where the load bearing volume system could be combined with elements from other producers. (Boverket, 2006).

Älvsbyhus opened a factory in 1960 for production of volume modules for single housing units. In the 80's the amount of single housing produced with prefabrication was 85 percent (Boverket, 2006). Älvsbyhus is still today one of the largest producer in Sweden of prefabricated single housing.

Flexator was established in 1956 as Oresjö's Fabriker. They started with construction of temporary housing for road construction workers

but soon developed into also building school buildings and offices, also for permanent use (Flexator AB, 2016).

Advantages and disadvantages

Historically most construction systems using volume modules have been branded as a solution to functional and economical issues. Most systems do not have their own kind of expression but promises to be able to look in many different ways (Boverket, 2006). There are a lot of things in common between the different systems, and the construction method brings the same pros and cons.

Advantages

The most obvious pro is that there is a controlled process in factory. This enables the production to be energy efficient and measurable. It also brings easy access to advanced machinery. The production chain makes it easier to do a quality check of the components compared to production on site. It can also give less waste when each step is repeated many times and can be made more efficient through practice and waste can be reused.

The construction on site can be safer when there is more control and fewer steps performed with fewer tools. There is also less space needed for material during construction on site. This makes the site less vulnerable for theft as well as making a smaller impact on the surroundings during construction. The time to achieve a continuous roof over the building leads to a smaller risk for moist problems. Also the construction of the walls etc in a dry environment contributes to fewer problems with moist.

The factory has a large potential to be a healthy work environment. Lifting can be made with machines. Adequate work benches for each

labor can be set up for example. Also ventilation and controlled disposal of pollution can be made.

The cost can be reduced by standardization. There is also an experience feedback loop that can help improve the product by repetition. The standardization also leads to lower planning time, further reducing the overall cost as well as making the process more efficient.

The production in the factory gives the possibility of an overlapping process where work can be done at the site with the ground while the modules are constructed in the factory at the same time.

Disadvantages

Coming to disadvantages the dimensions is limited by the transportation. This makes sizes of different element less flexible to the real use. While transporting the modules most of the space of the trailer is taken up by air within the element which results in more transports compared to flat elements.

The floor plans suffer from the needed optimization for transportation. It has proven difficult to fit both stairwells and elevator shafts with the rest of the spaces inside which results in a difficulty to achieve high floor plan efficiency.

Another consequence of the method is the double slabs between stories. This results in unconventional relationships between stories in the facade. It is an aesthetics problem itself but it can also be difficult to match a neighboring building with window lines as well as the building getting a higher total height. On the flip side it does make for better sound insulations between stories.

Continuing on the facade there is a repetition of external joints between elements. This creates a pattern that needs to be treated in some manner. Technically it might create heat bridges but this is usually treated in most modern system and is not a problem. The joint appear also on

the inside and becomes an aesthetic problem. The common solution is a metal rail covering the connection.

While the transport and lifting of the modules demands them to be a lightweight construction this result in problems with sound insulation. The modern standards are tough to achieve with this kind of constructions.

Lastly, even though standardization brings with it a lot of good things it also makes the whole method inflexible for changes. In a rapidly changing society with unforeseen leaps in technology flexibility is highly desirable.



The production chain of the Flexator factory in Gråbo. I met with Lars Rydberg, Deputy CEO and Peter Sandgren, Regional Director to talk about the possibilities and challenges of modular construction as well as see the production and understand it better.

Pattern architecture

The principles of modular construction, whenever its volume elements or flat elements, results in repetition. This creates a strong expression, a pattern that has been handled more or less consciously in the past. Alejandro Zaera-Polo (2009) of Foreign Office Architects makes a connection between the patterns of mainly the urban fabrics and the building envelope, and political and cultural views of the era. He writes:

“As the articulations of the building envelope, such as cornices, corners and fenestration patterns, become technically redundant, the envelope’s own physicality, its fabrication and materiality, its geometry and tessellation have taken over the representational roles that were previously trusted to architectural language and iconographies.”

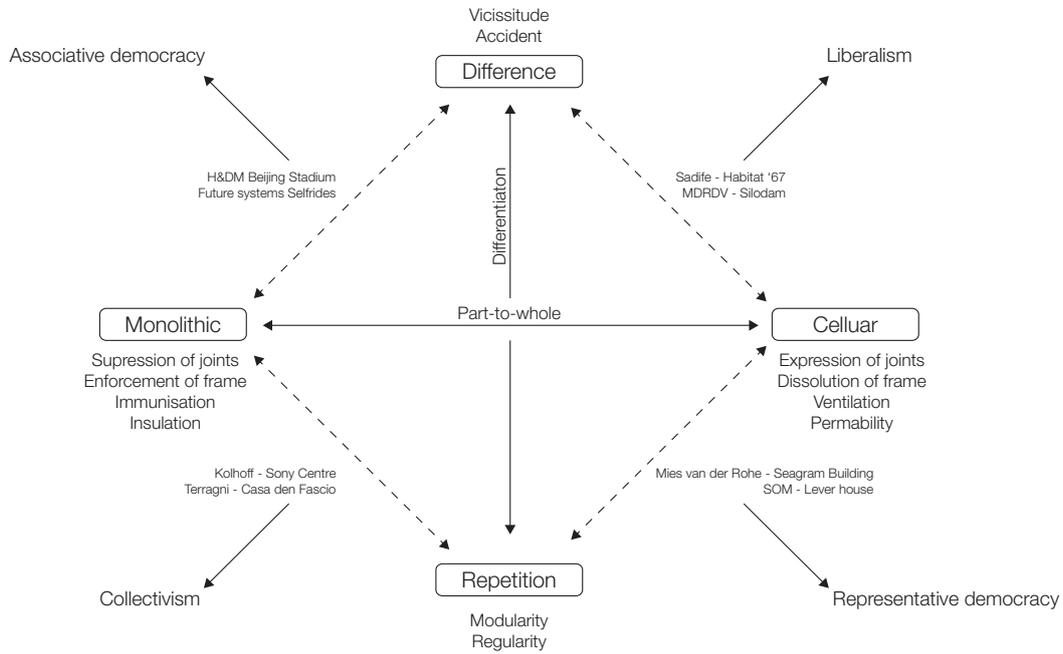
Zaera-Polo means that the structuralists promoted serial, modular construction to enable flexibility and thus representing a democratic bottom-up approach, in opposition of the modernist focus on the building as an object. But this led to a restricted ability to produce an image of the whole.

This led to the emerge of post-modernism that explored the architectural language, material

consistency and part-to-whole relationship. They used techniques of collage and montage to produce a composition in contrary to the modular patterns of the structuralism. Depending of how the parts are treated within the frame the structure becomes either monolithic or cellular.

Contemporary architecture has treated patterns when it comes to the building envelope. Zaera-Polo summarizes this in a balance between difference and repetition. Instead of the regular modular patterns that was a quality for the society that prioritized the part over the whole the new kind of tessellations searches for expressing new kinds of political forms in a globalized and heterogenic society.

I’m not sure about how consciously Zaera-Polo means that these choices are made. But I am certain of that the message that our design sends out is a crucial part when we evaluate our design choices. This is something that I need to be conscious about when designing my preschool. What message do I want to send out? Is modular construction limited to the structuralist approach? Can it only represent a uniform society or are there other possibilities?



The building envelope tessellations and its connection to political views according to Alejandro Zaero-Polo.

The learning environment

In 2015 the book *Buildings Schools: Key issues for contemporary design* (Care) was released. Focusing on secondary schools, with examples of such from around the world, the reflections and ideas listed can be applied for any kind of school. It has case studies of some widely acknowledged buildings and state the lessons learned from the studies and what the common denominators of success are. The first thing is to have education guidelines that is connect to architectural goals. In Sweden we have the Curriculum for the Preschool given by The National Agency for Education. It states a lot of fundamental values and goals to be met by the education. It can be summarized in a task to encourage and promote curiosity, imagination, relations, participation, independence and a desire to learn. This is of course no easy task and there are no national guidelines for the architecture and how it can help. This makes designing a school a difficult task where each stakeholder has its own view of what is good and not. In the end it is usually the municipalities that are the clients and they usually set up their own architectural goals. This is often a subject of conflict among stakeholders though.

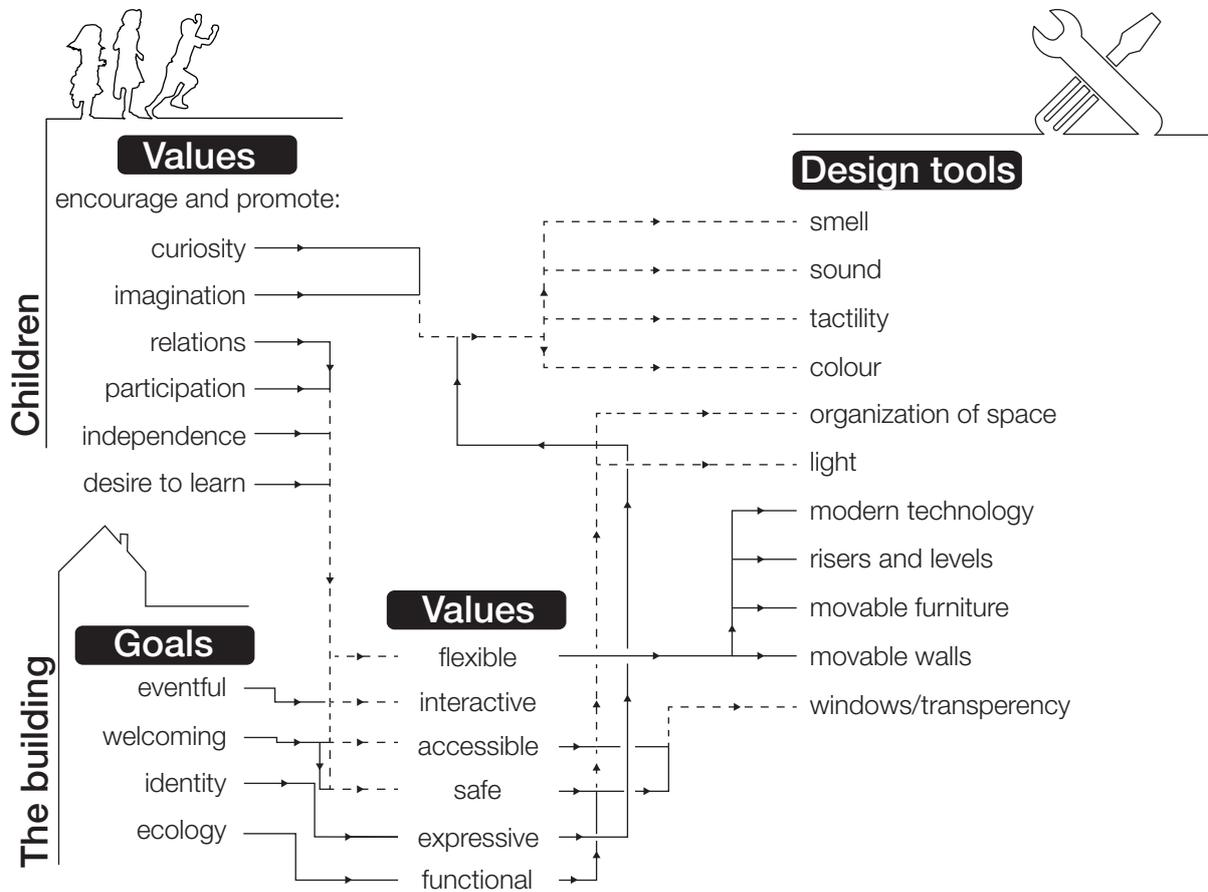
Participation in the building process is the next bullet point which means that every stakeholder should be involved early in the process. Since there are so many ideas of what is right and wrong to do, dialogue is important. It is also stated that it is up to the architects to be able to make a comprehensive presentation of the design ideas for every stakeholder.

To integrate the schools in the community is another point that is made. It exemplifies with buildings with a functional mix, for example library and school in the same building. The school building as the centre of the community is a popular idea, with relations to countryside villages where the school was the largest and central building. This can help making children feel connected to the rest of society.

Environmental design is important for all buildings but in the school building it can have a special function of a teaching architecture. It can have a central focus and be naturally integrated as an identity for the school.

Flexible learning spaces on all levels are something that must be addressed. This can mean a central multi-functional space where children can meet and build relations, or movable furniture and walls. Here a focus on the acoustic environment is important. Also the long term flexibility of the facilities is important. In ten years the need for a preschool might be obsolete and the building might need rebuilding as a primary school. Creating different special qualities is important to be able to accommodate different activities.

I have summarized the different goals and values and connected them to design tools in the diagram to the right.



Visit Äppelgården

Äppelgården was designed by Liljewall arkitekter and was ready for use in 2010. The building was designed in deep discussion with the principal and teachers of the school. The principal is named Agneta Lindfors. The school uses The Reggio Emilia approach and was designed thereafter.

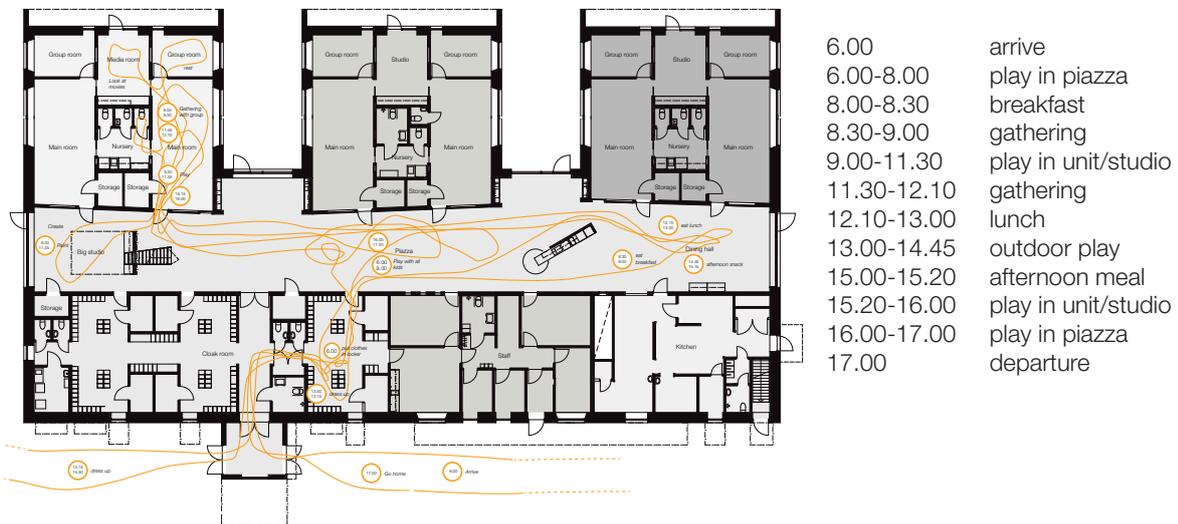
I met with Agneta at the school and she showed me around. She told me about a typical day for the children as well as mapped where they are during different times of the day. The first children arrive at 6.00 and the last around 8.00. During this time they all play together in the central piazza. There are only 3 teachers in the whole school during the beginning of the day. At 8.00 they eat breakfast in the dining hall. At 8.30 there is the morning gathering where they divide in their different age groups and units. Here they go through what will happen during the day and who wants to do what. After that they go on and play in groups or work in the studios with projects. At 11.30 there is a gathering again before lunch break. After lunch there is usually outdoor play in the school yard. This is until 15.00 when they eat afternoon meal, again in the dining hall. After this there is play in the units or studios again until 16.00 when all the remaining children move to the piazza and the staff can be

reduced again.

We also discussed what is important for me to consider when designing a new school. Her main point was to consider children in the design. Low sill heights in the windows so all children can see out. Work with transparency in and between the units to create a safe and independent environment. There should be flexible furniture and space for documentation is crucial. I noticed some things on my visit. For example her office was situated in the entrance with a large window where she could wave goodbye to everyone in the afternoon. The walls of the central piazza were used as exhibition space, with little boxes in the wall where everyone could see each other's work. The shared and open studio space in the end of the central space work very well where the children needed to clean up after them and be organized. There was only one entrance to the building where all children of every age entered. They then divide into different cloakrooms adjacent to the entrance. This was functioning very well and there seemed to be no confusion among the children. There are a lot of pros as well where the children get to know all the teachers, all parents know where to enter and get to meet each other in the parents square.



Äppelgården Förskola. Photo: Liljewall arkitekter.



Visit Engelbrektsgatan

I met with Josephine Stenberg, headmaster for a couple of preschools in Gothenburg centre to talk about the education and the buildings. We met at Engelbrektsgatans förskola, a temporary solution with rented modular facilities that was established in 2012 and will stay until 2017.

We talked about what Josephine thinks is the most important to consider as an architect designing preschools. Alike Agneta, she highlighted transparency - the teachers shall be able to have an overview all the time but the children needs privacy and a feel of belonging to their unit. This could be achieved with windows of different height, halfway walls, or movable walls.

Flexibility - the indoor space should be adjustable and flexible. Movable walls are not a problem with acoustics, rather the risk of pinching if not designed correctly.

Sound - She raised the question about what is problematic sound. The sound of children playing is maybe a nice sound even in the office space. But the noise of traffic or fans is disturbing.

The yard - From study visits to England she saw what a truly gated playground and yard could evolve to. Today the play outdoors needs to be regulated because of the risk of children getting lost and that people get in and disturb the yard

when the preschool is closed. In England they had cultivation boxes and cozy hideouts in the yard.

To have plenty of entrances for different units is a good thing. There is more control and less noise when dressing and undressing. But it also brings more places to look over for the teacher, which is a bad thing.

Greenery - in the urban school yard there is not enough greenery. Trees and bushes has proven to have a positive effect on health, and it is also important for children to get in contact with nature.

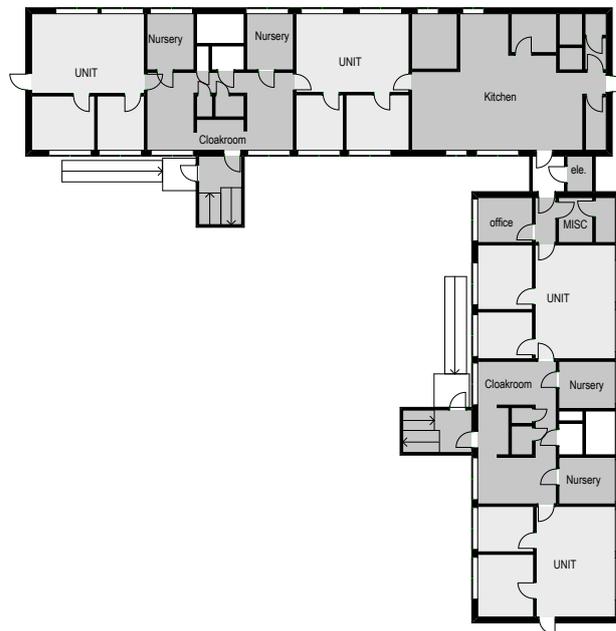
The play is the most important activity. Challenging play is the most fun. Building huts and dressing up for example.

Children play in groups of 5-6 people. 2 teachers and 10 children are better than 3 teachers and 15 children. The group is the most important to be a constant. Here age is most important.

Something that I thought about in the building was that all vertical communication was in external shafts, integrated in the shape. Also the communication inside the building forced you to walk through rooms. This seems to be a problem with the sizes of the modules consider different functions.



Engelbrektsgatans förskola, Göteborg.
Source: <http://www.t-d.se/sv/TD2/Bilder/?image-id=163825>



Ground floor plan sketch

Kullegatan

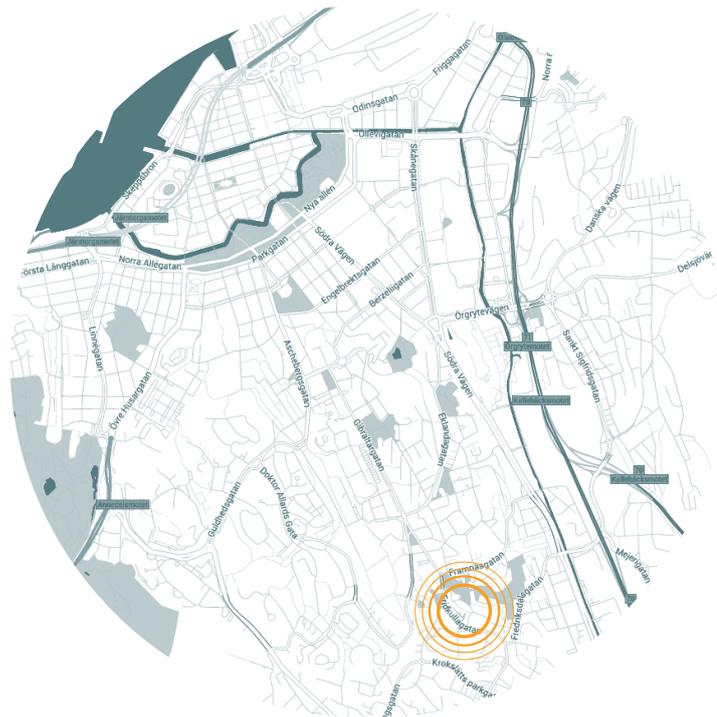
Kullegatan is situated in Krokslätt in Gothenburg. The preschool lies on top of a hill next to Buråskyrkan and a small area of greenery. The surrounding houses are a mixture of multistory slab blocks and single family housing.

The city wants to develop a preschool of 7 units with 18 children in each, for a total of 126

children, as well as a school kitchen. This requires a two story building with food delivery access. The school yard provides both natural hills with large trees as well as hard ground for ball play and running about. The original program given by Lokalförvaltningen is stated below.

Program given by LF

	Area
7 Units	
Cloakroom	20
Nursery	8
2 WC	3
Common room	40
Resting/play	20
Play room	15
Storage	5
Common	
Entrance	28
4 RWC	20
Studio/activity	70
Staff	
Work space + copy	19
Staff space/kitchenette	30
Office	10
Principal office	10
Meeting	8
Dressing room	5
RWC/Shower	5
Misc.	



Kullegatan in Krokslätt, Göteborg.



The place in front of Buråskyrkan.



The existing preschool to be demolished.



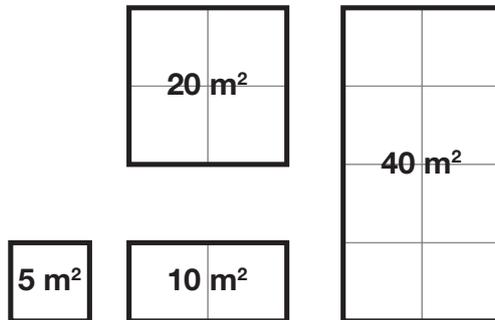
View over the neighboring park.



Buråskyrkan built in 1971.

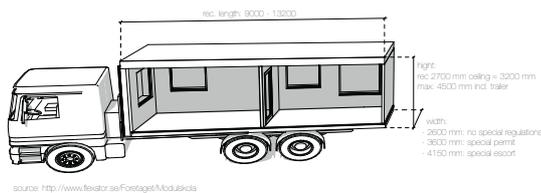
Design Process

Volume studies



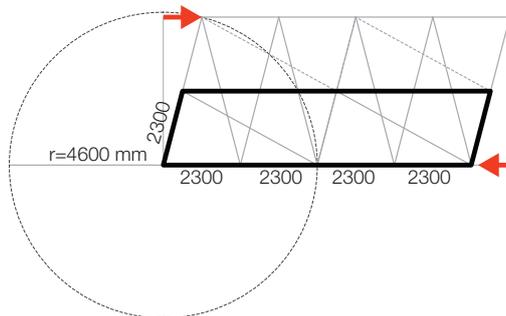
Main program areas

The studies started with looking at the program and understanding the different sizes of rooms. The program from LF primary demands room sizes of 40,20,10 and 5 m². I choose the base dimension of 2300 mm which creates 5 m² squared.



Transport regulations

The transport is the limiting factor for how big the modules can be. In Sweden the max width is 4150 mm but that requires special transport permit and escort. If the width is less than 2600 mm no special permit is needed.



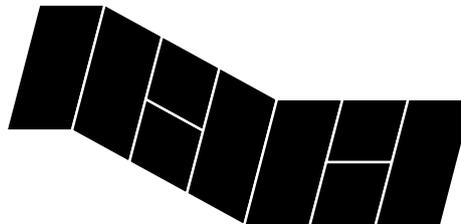
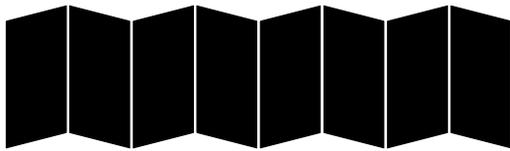
Module symmetries

Instead of working with a rectangular module I choose to tilt the sides to create a parallelogram, thus opening up for different possible assemblies with mirrored and flipped units. Two base modules of 2300 x 9200 mm creates the home unit space of 40 m².



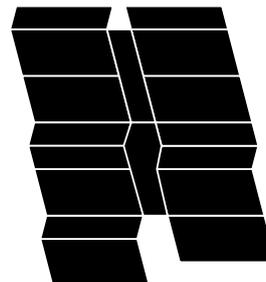
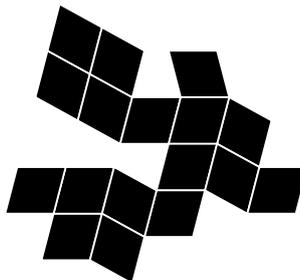
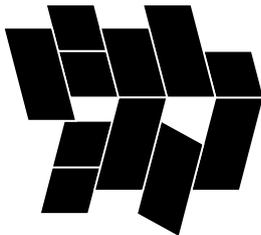
With the parallelogram as a base unit I found that many different kinds of appearances can be made. The part-to-whole relationship is not obvious as with a strictly rectangular module.

It also offers the possibility of a facade with different directions without having to break the continuous walls. This is technically beneficial as well as it gives a strong expression.



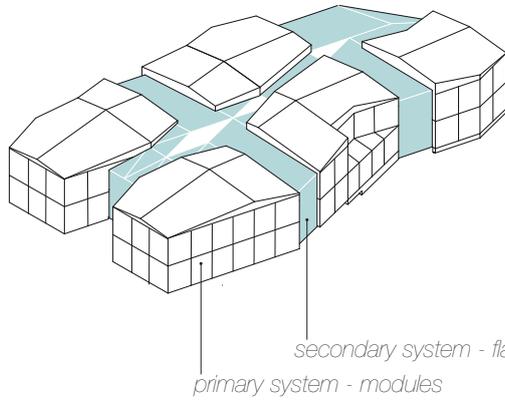
I started to sketch with different assemblies of the parallelogram. First with a symmetrical bending of the facade but I realized that the shift

of an angle can empathize a change of function or show importance as for example the position of an entrance.



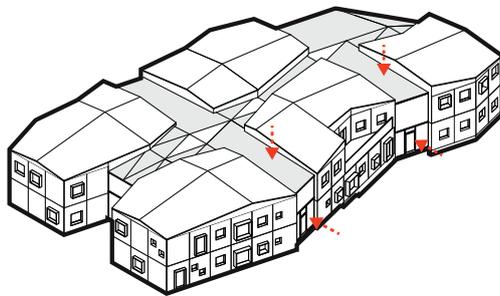
The space that is created in between the units is also interesting. By using a non-rectangular tessellation I can create different breaks of sight lines and framing of spaces with slanted

walls as well as directions in the space by angles. The space between units was something that I brought with me to further testing.



Hybrid system

The construction consists of two main parts. The primary system is the modules, which makes all the classroom and kitchen spaces. Secondly there is the communication areas that is attached to the modules and built by prefabricated slabs and walls.



Volumetric differentiation

I choose to differentiate the communication system and emphasize home units, making them into houses in themselves. I did this by pushing the roof down and the exterior wall in.



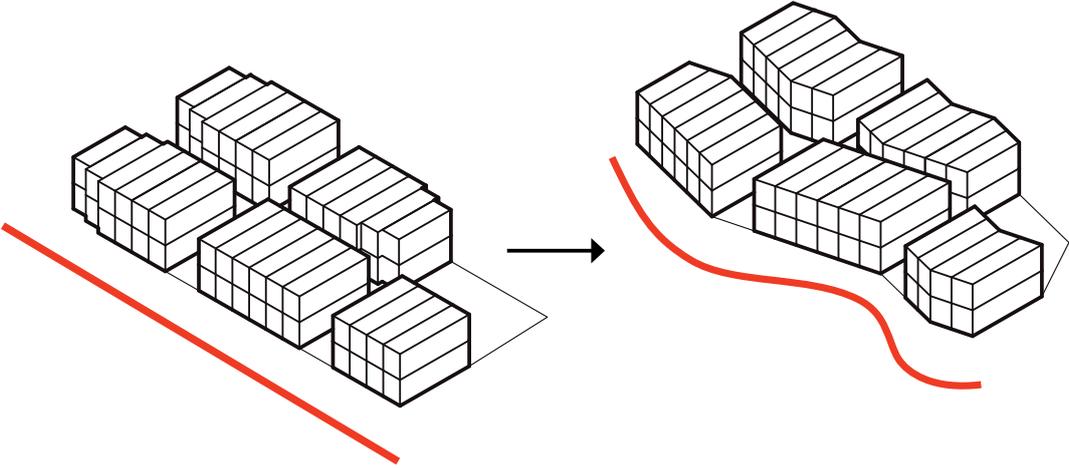
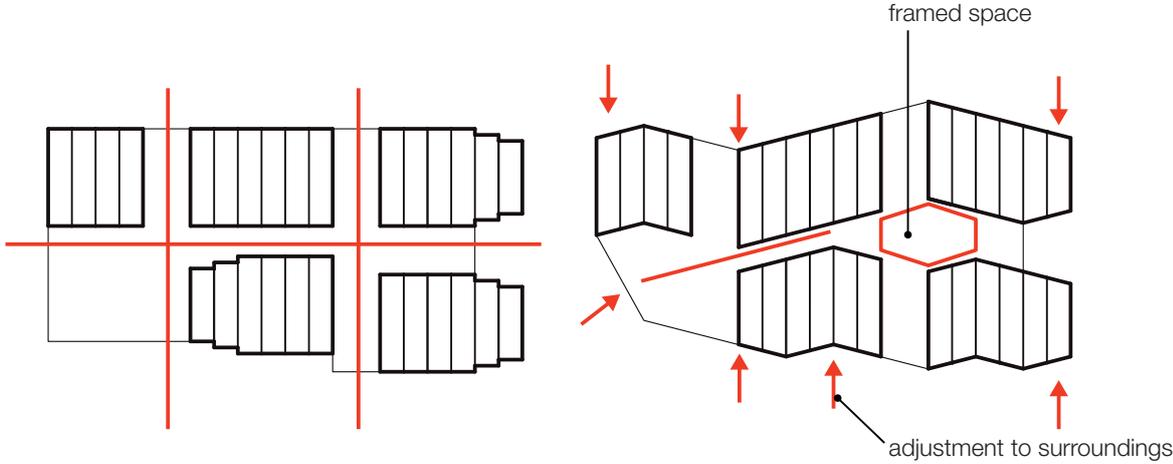
I cut out block of 2 by 2 units to try and assemble in different ways to understand the relationship between the outside and the space in the central space. What I found was that each “house” got its own overall shape, each unique giving it an special appearance while still connected by a contentious line in the facade and built by the same shape.

Comparison - straight and angled modules



No distinction of units. No feeling of wholeness.

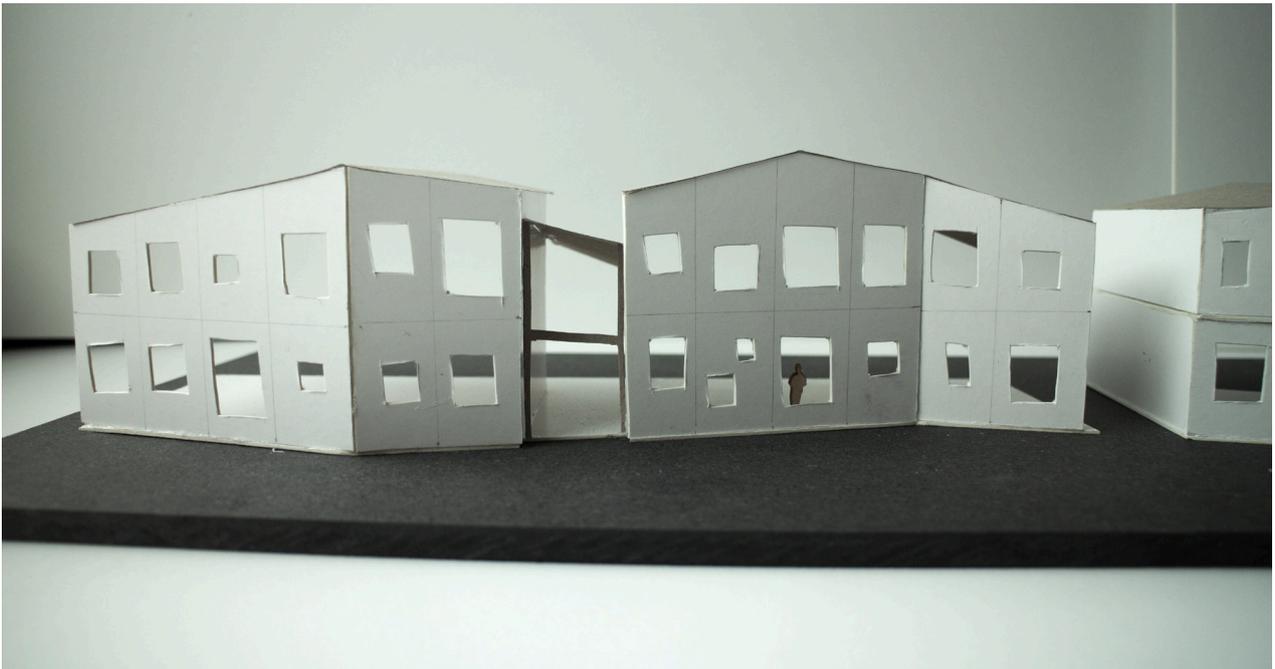
Continuity of the facade. Feeling of parts in a whole. Unique shapes for each unit.





I built some simple models to study the space between the units and its appearance as well as the windowing on

the facade. I liked the windowing best when it appeared random or placed at will.



So I decided to let the windows be controlled by the function on the inside and not follow any other rules. This

would generate a limited amount of functions but placed at a seemingly random pattern.



I also tested with different placement of the top modules, cantilevering over or being pushed backward to create either an overhang or a balcony. This resulted

in interesting spaces and relations but a break of the continuous facade.

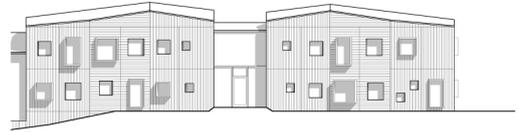


Facade studies

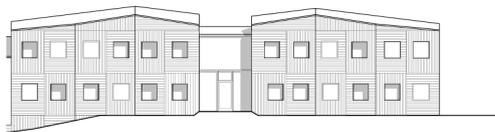
uniform windows

mixed windows

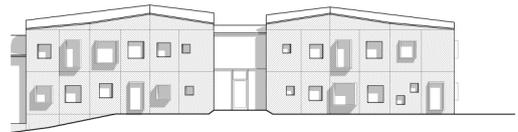
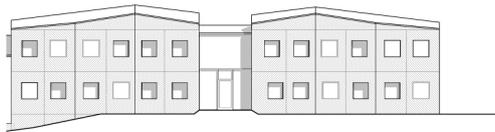
Striped fields



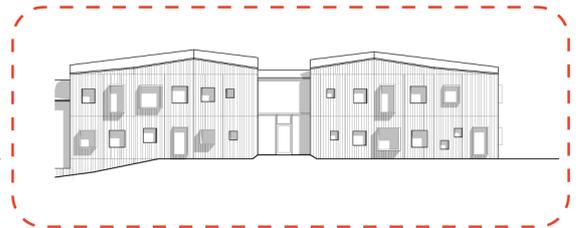
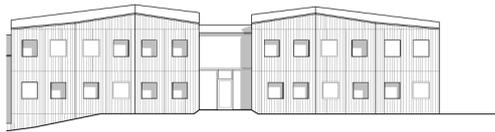
Patches



diagonals



non-uniform vertical panels

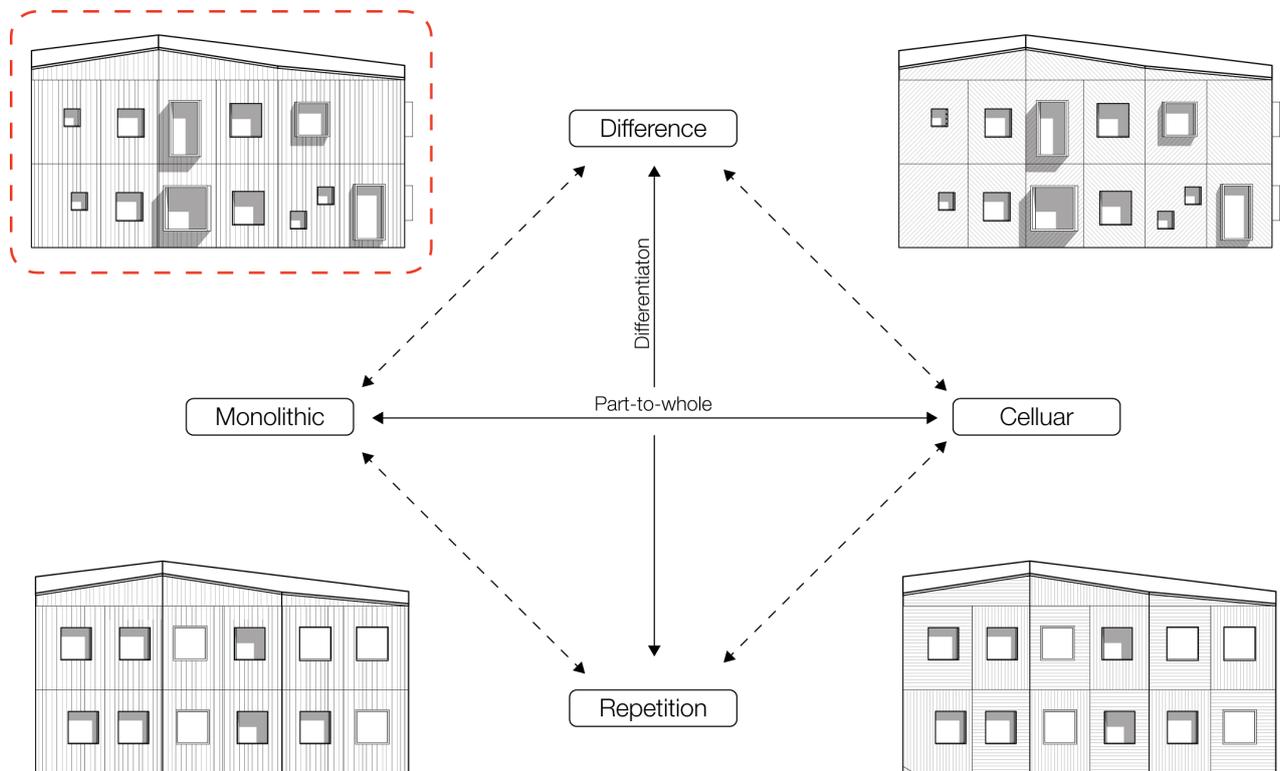


horizontal bottom

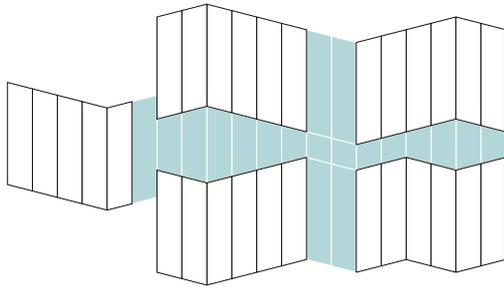


The chosen design expresses wholeness and unity through the volume that its uniform paneling, making the vertical lines blurred by incorporating it in the pattern. It expresses individuality and uniqueness through the sizes and placement of

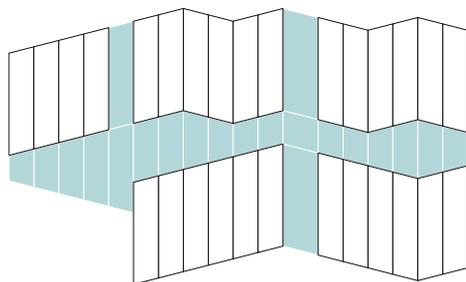
windows that results in a playful inside as well as outside. I found it suitable for the preschool that should encourage both independence and relations among the children.



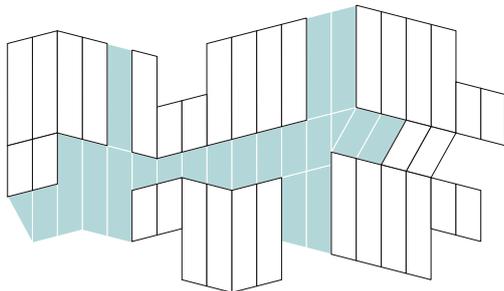
Organizational studies



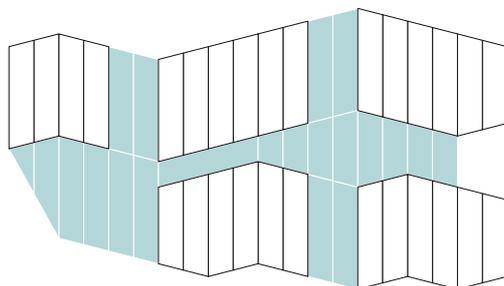
In the first iteration I organized the children home units two by two with a central space in between. The kitchen is too the side on level with the delivery area.



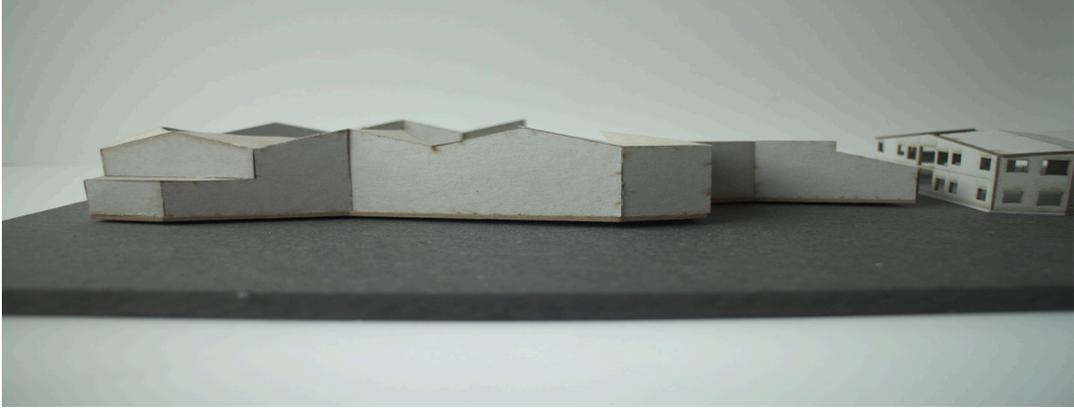
In second iteration I reorganized the central space to give it more daylight possibilities.



Later I worked with creating a more dynamic facade and creating spaces directly outside of the building. I also experimented different kinds of lengths on the modules.



In the last iteration I reduced the number of different sizes but kept 3 kinds to create more harmonic shapes from the outside and interesting spaces between the units.



1:250 model test 1.



1:250 model test 2.



1:250 model test 3.

Workshop

To understand the possibilities and limitations outside of my own imagination I took my shape pieces down to Liljewall arkitekter and held a small workshop with architects as well as planners from the City. The task was to find different typologies and try to analyze the system. We summarized with a round table discussion about children and architecture and what is important for me to think of.

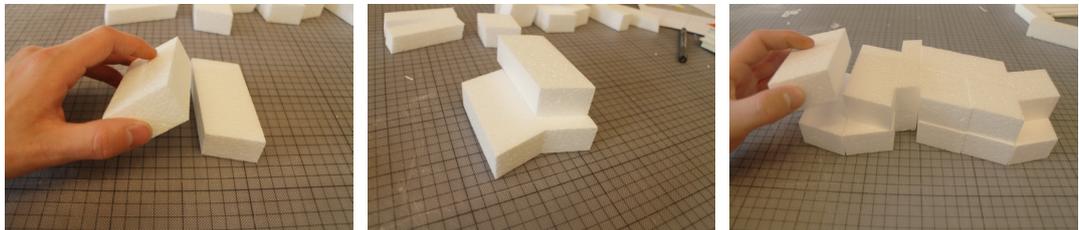
Group 1 focused on the unit and the relationship between rooms. They came up with the idea to create a modular interior wall system with standardized measurements. By having a number of standard wall elements the system for the interior space can be rational but flexible. Different spaces have different needs and by using suitable blocks different characters can be given to different rooms. This system can be flexible for the future as well where segments can be replaced.

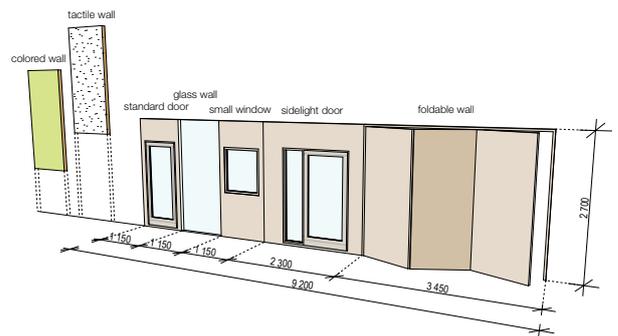
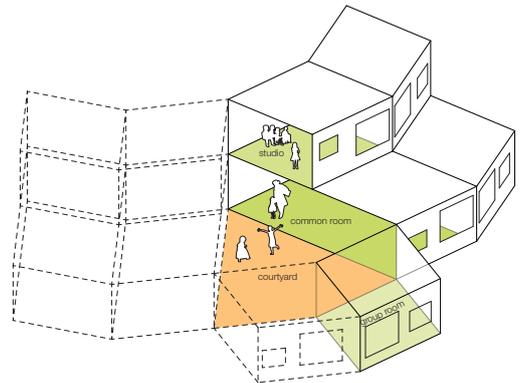
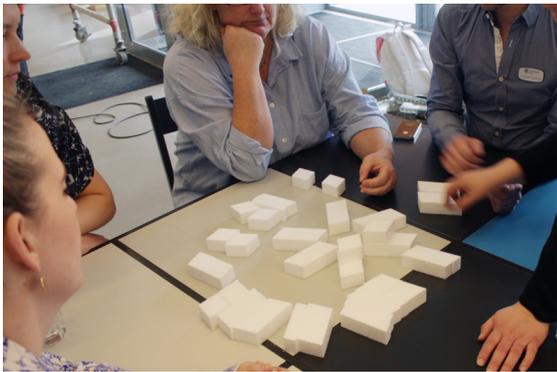
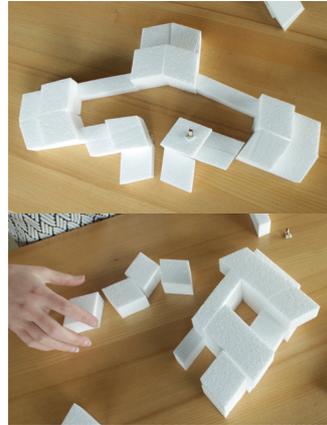
Group 2 focused on the assembly of modules for creating spaces. Courtyards and daylight

where considered as well as centralizing spaces for sharing between units. Cantilevering volumes were used to create balconies and dynamic shapes.

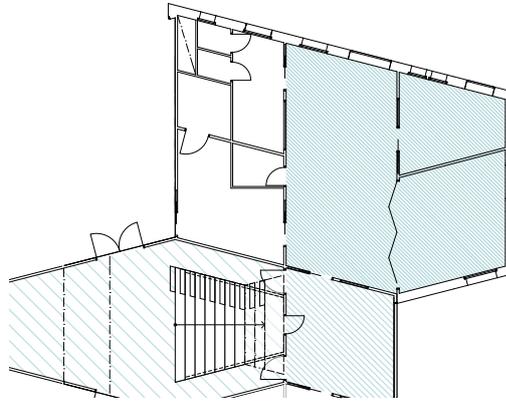
Group 3 focused on the relationships between units. Shifting units in correlation to each other creates commonly shared courtyards between units. They also thought about units in vertical space. That way everyone has a home unit at ground level as well as second level.

Looking at the results from the workshop and the sketchy typologies that were built I understood that I need to set up some design rules for how the modules can be assembled. The program of the school is one kind of rule but following the program and using the angles modules does not ensure that the possible qualities are achieved. In contrary, the unconventional shape might just cause trouble instead.





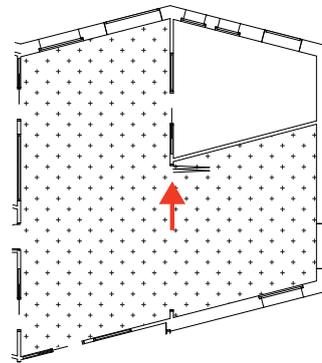
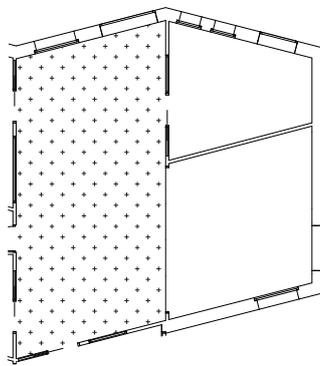
Designing for a learning environment



Identity - gradient of privacy

The organization of the building consists of more or less private spaces. The home units are the natural place for the children where they start and end their days. This is organized by age groups. The home unit is private for group.

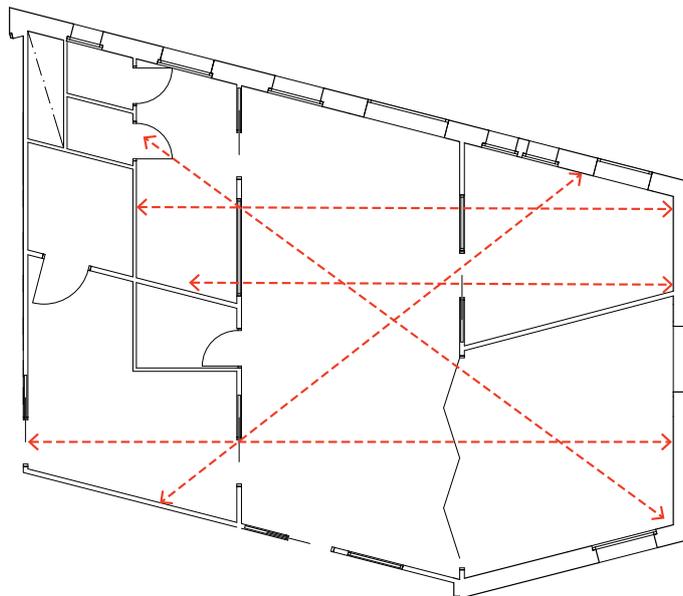
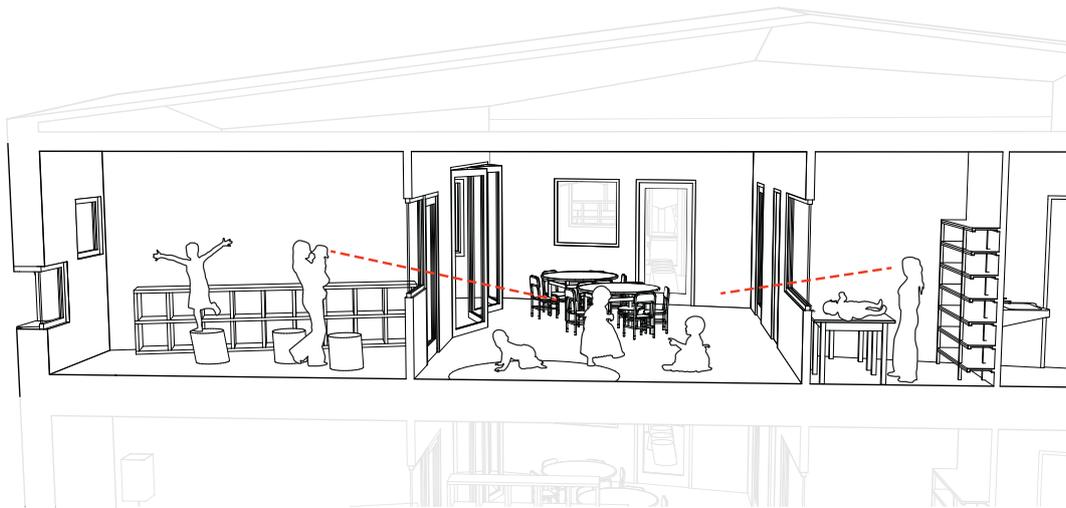
There is studio spaces between the units that is shared with one other unit. The central spaces is shared with the whole school and here the children don't move freely but can meet with each other and have large activities.



Flexible spaces - movable walls

All units consists of three main rooms. The first is the common room where they have gatherings or group activities. There is one small room for building huts or playing in smaller groups. Last

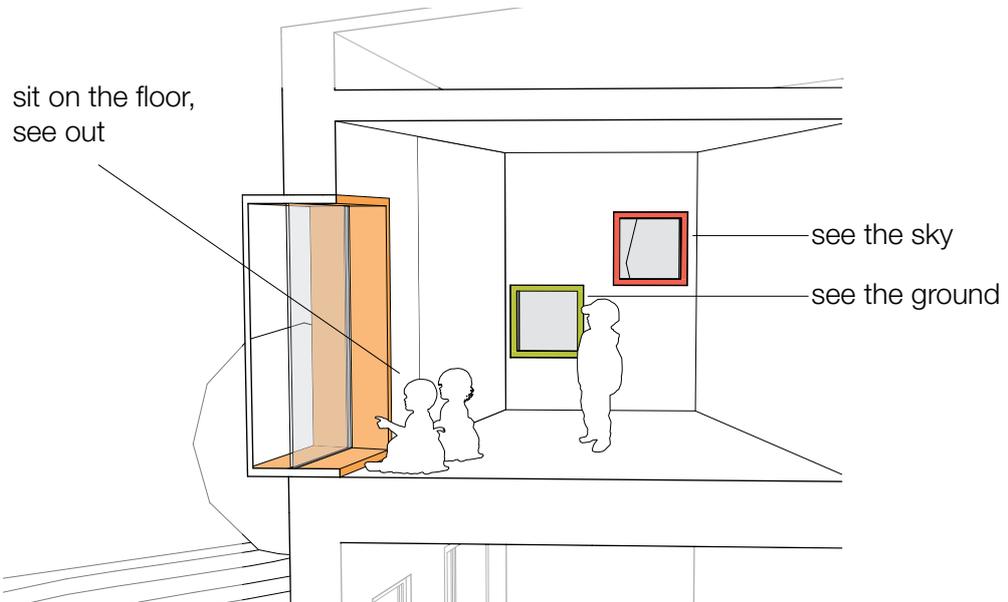
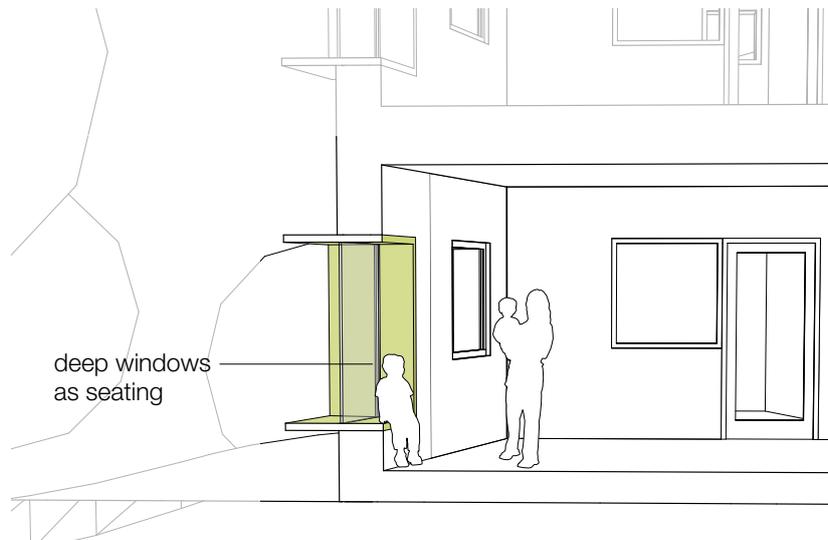
there is the sleep room where they can rest or play. This is connected by a movable wall so that the space can be connected with the common room if an even larger space is needed.



Independence - transparent units

As a teacher you have full overview in the units with interior windows and glass doors. When changing diapers in the nursery you can see through the common room when at the same

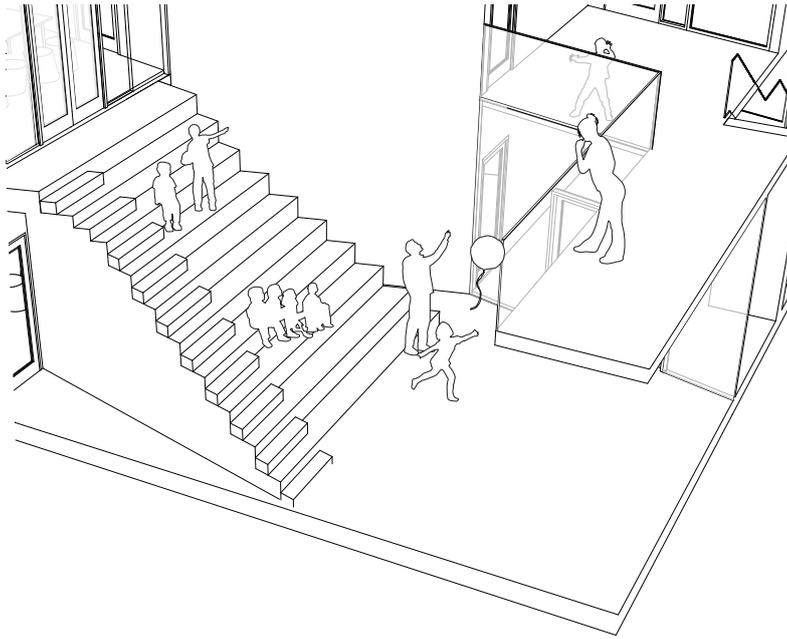
time the children can see you and feel safe. This creates an independent environment where the children can play on their own securely.



Curiosity - looking out in different ways

The windows give character to the building. By having a low sill height in the areas for children they can always see outside. Some windows goes down to the floor while some are deep forming

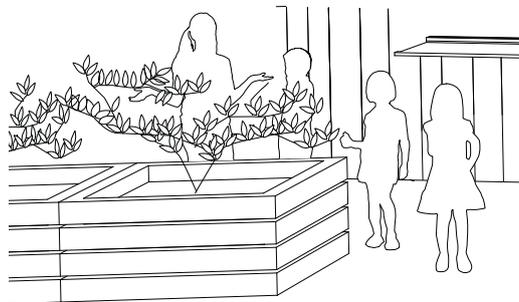
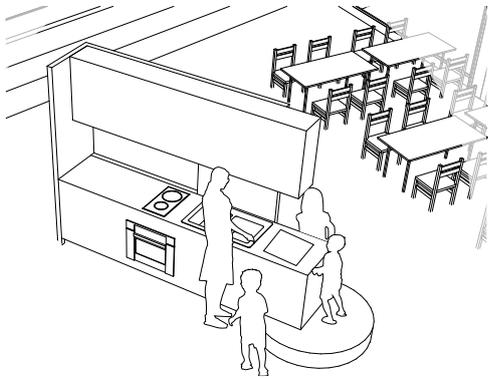
alcoves. Other smaller windows give framed views so that children can experience different view from different directions.



Relations - Levels and piazza

The central piazza is an active place for larger group activities. Here there is gallery levels that doubles as a stair between stories and seating for

performances such as a Eurovision song contest, theater or Lucia. The area has double ceiling high and visual connection to the upper story.

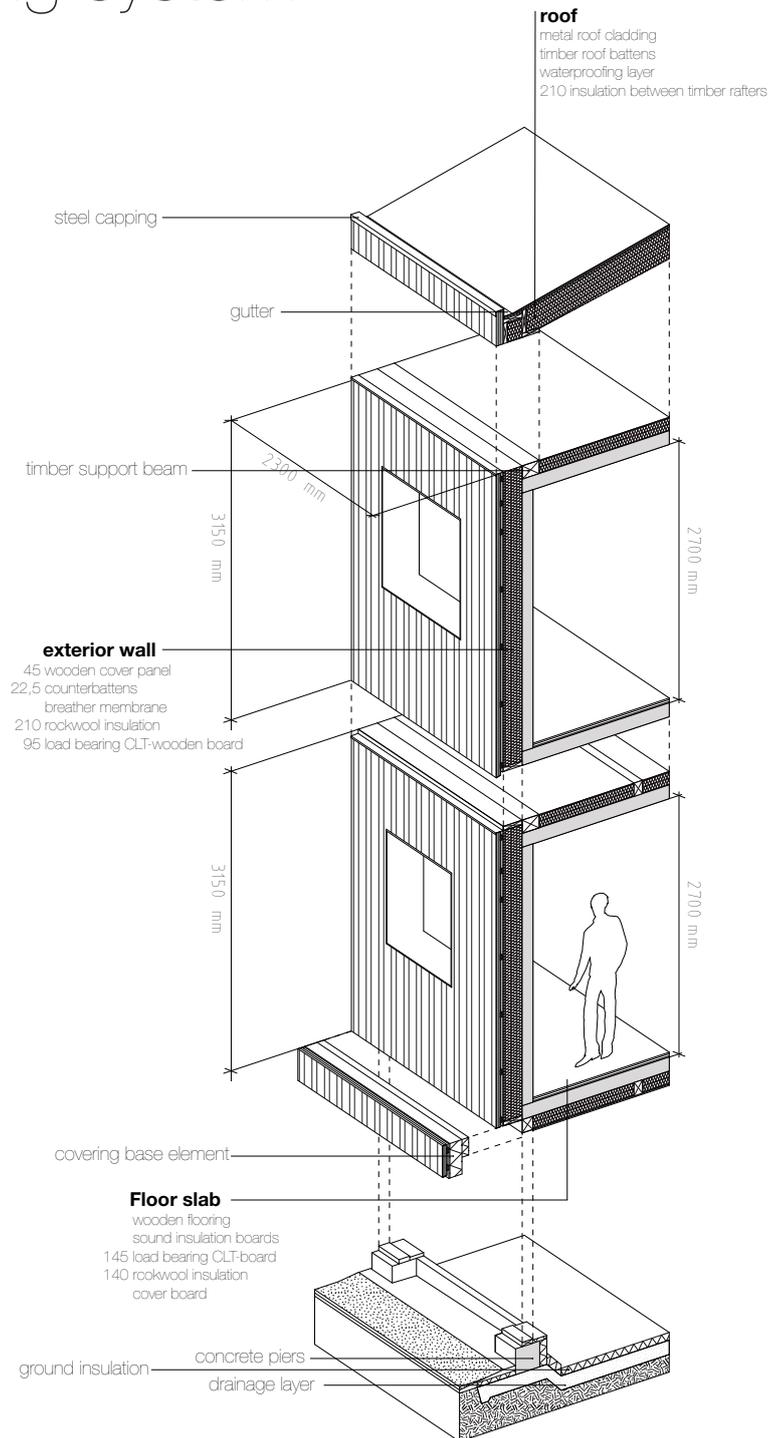


Participation - pedagogic environments

There are different environments that encourage learning by participation. In the dining hall there is an educational kitchen where the children can learn about cooking and baking. For example

making ginger bread for Christmas. In the yard there is cultivation boxes where they can plant vegetables to see grow and harvest.

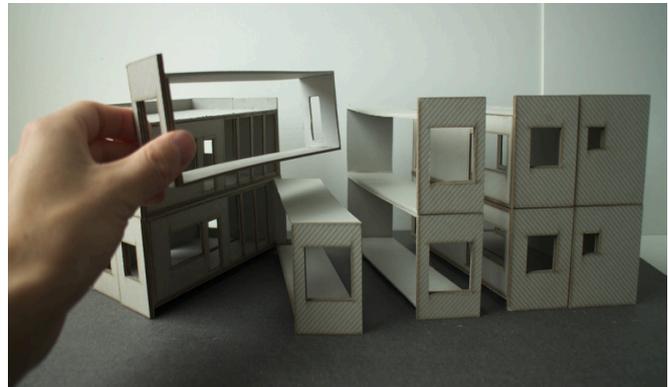
Building system



Assembly

The building is constructed with a suspended foundation with gravel drainage and ground insulation. The modules stand on concrete plinths. This is more flexible to different ground topologies than for example a concrete slab on the ground. It is cheaper and if the building is removed in the future, it is gentler to the ground.

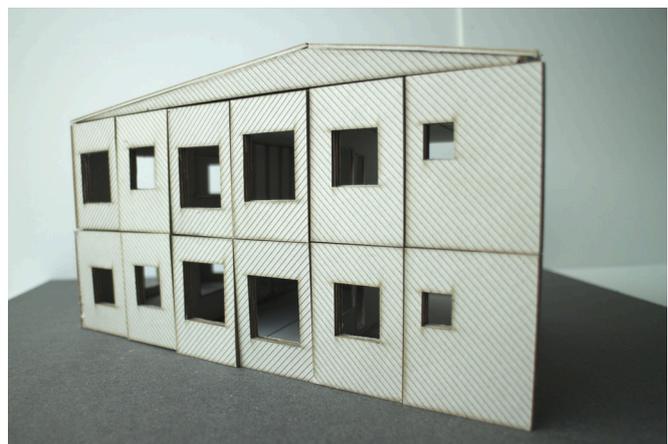
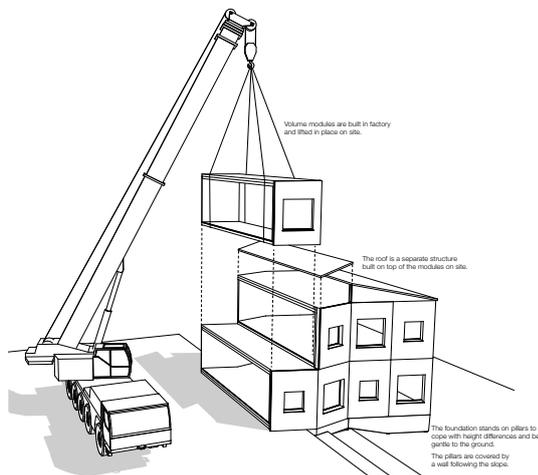
The modules consists of a CLT-timber load bearing system built as tubes in the factory with scaffolding for transport resembling the Flexator module as well as a CLT system from Stora Enso. The exterior facade is built on the modules in the factory. Then the modules are covered with a continuous metal sheet roof built on site. The secondary system is a prefabricated flat element system that is transported on trucks and connected to the modules on site.



The modules are finished to the largest extent in factory and assembled on site.

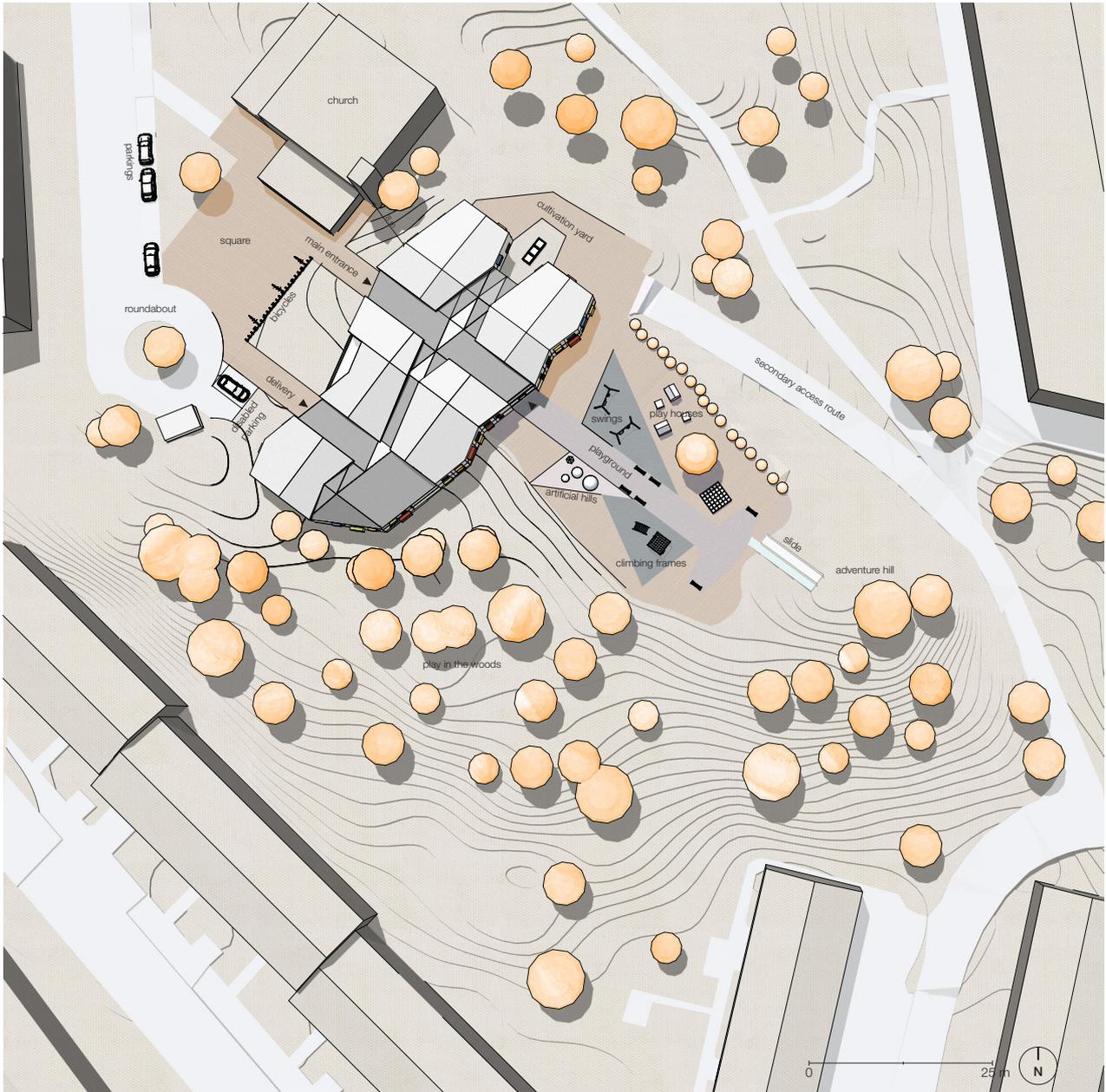


The roof is built on site.

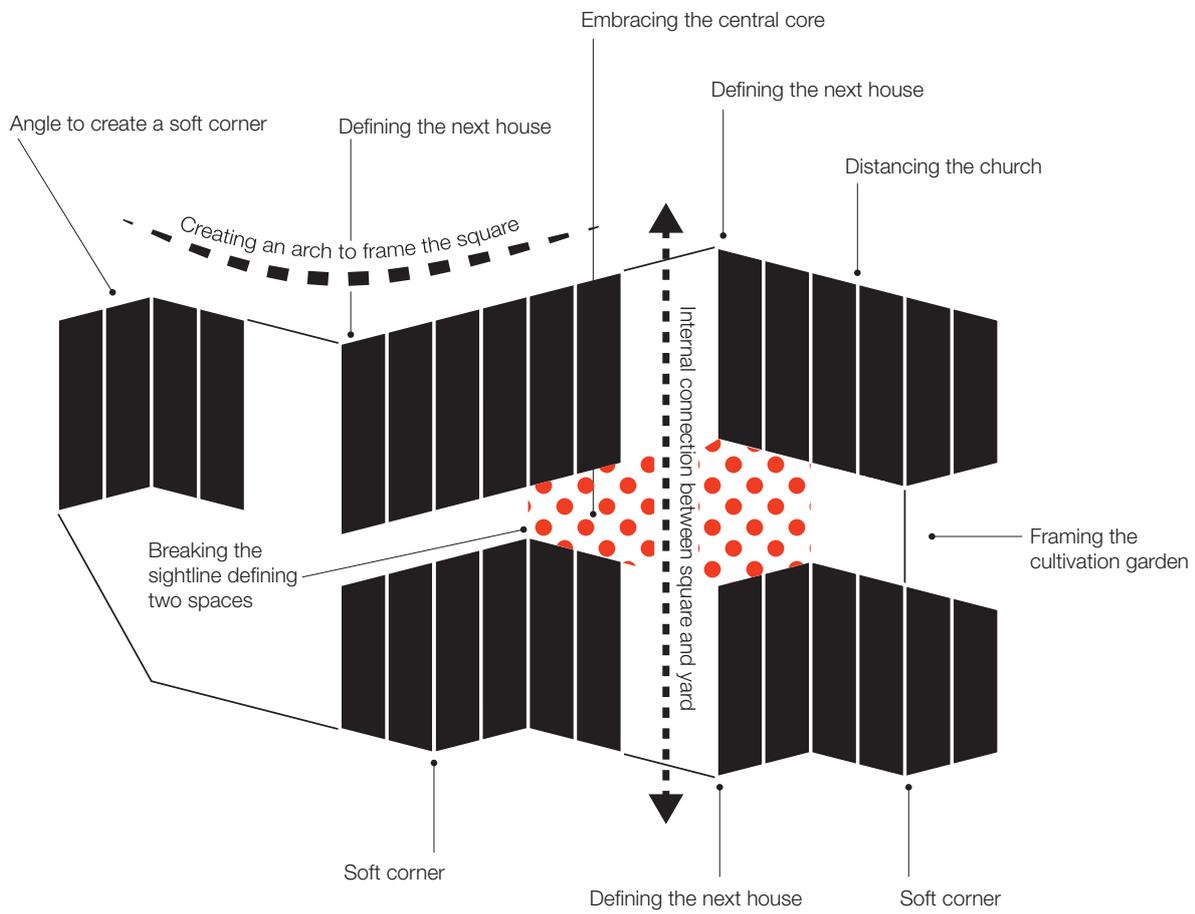


The finished building.

Design Proposal



Site plan



The layout is organized in five “houses”, each with a unique shape but tied together with a contentious line in the facade. They contain the home units as well as the kitchen. The angles of the facade frame the adjacent square and create

soft corners of the building giving it a friendly appearance. The space in between consists of parents squares as entrances, a central meeting and exhibition space and a dining hall.



View from the yard



View from the square



View from the square



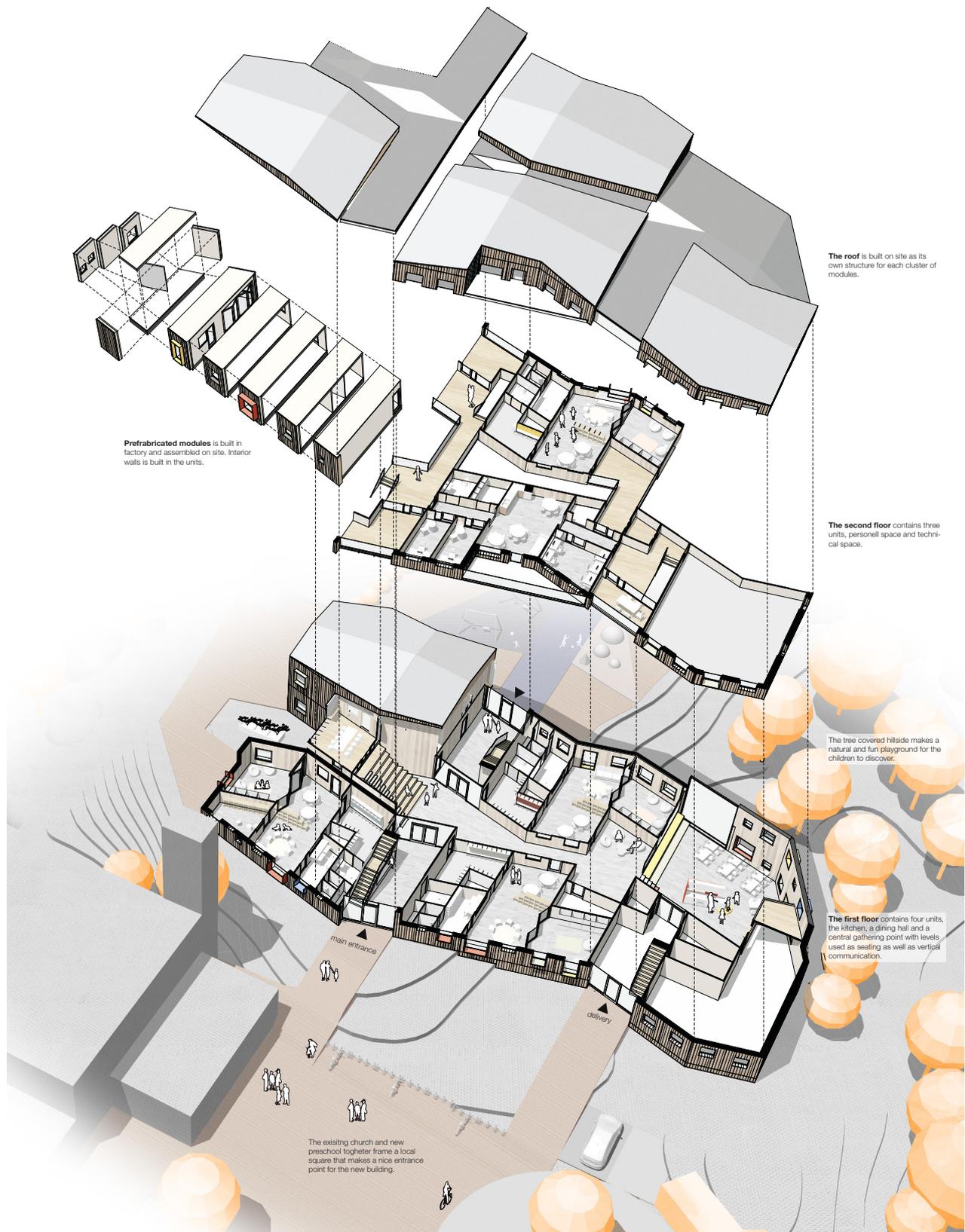
View from the yard

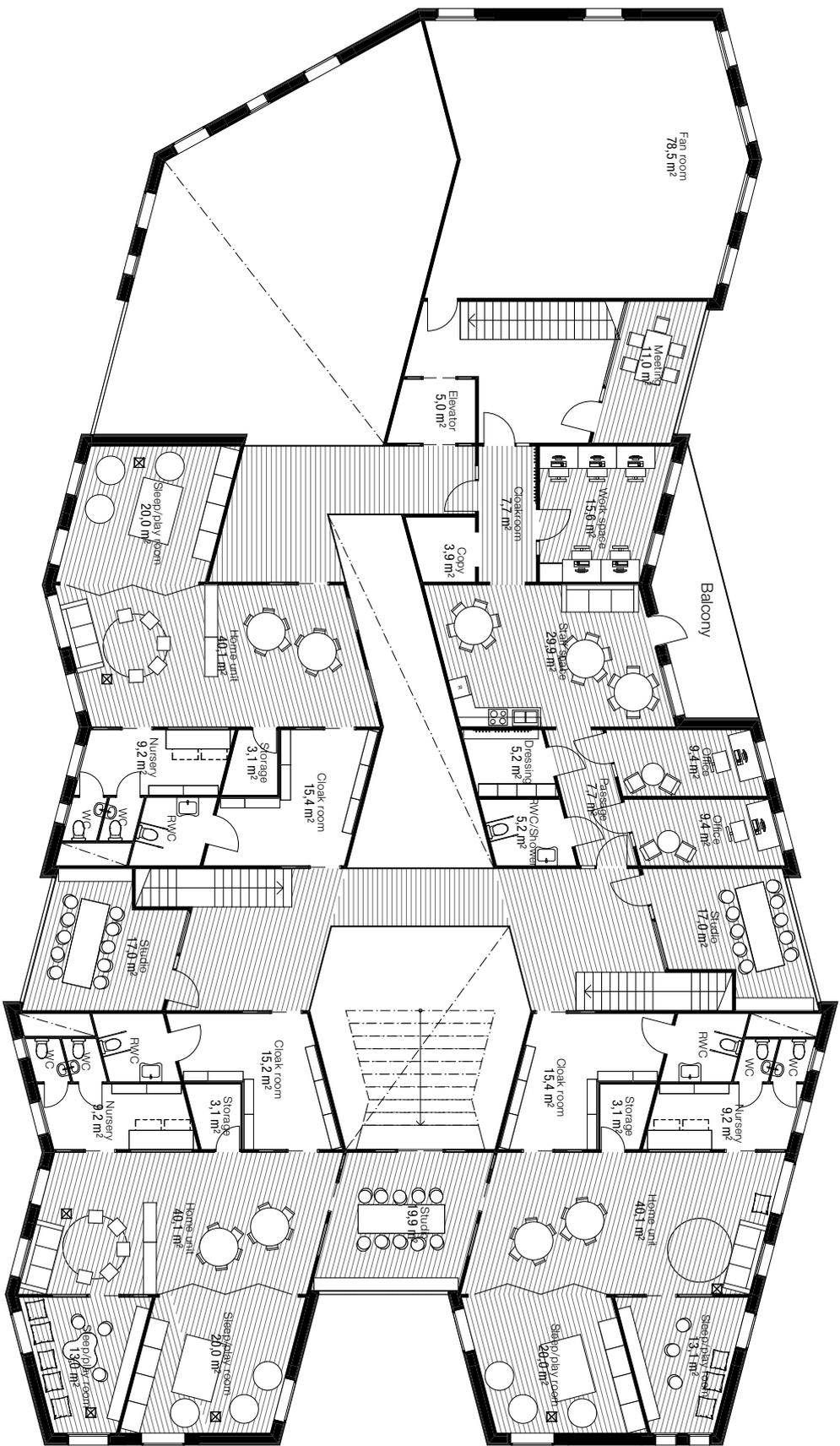


User main movements and nodes



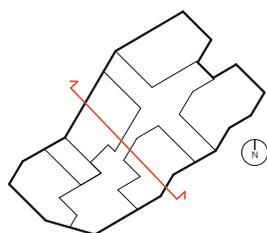
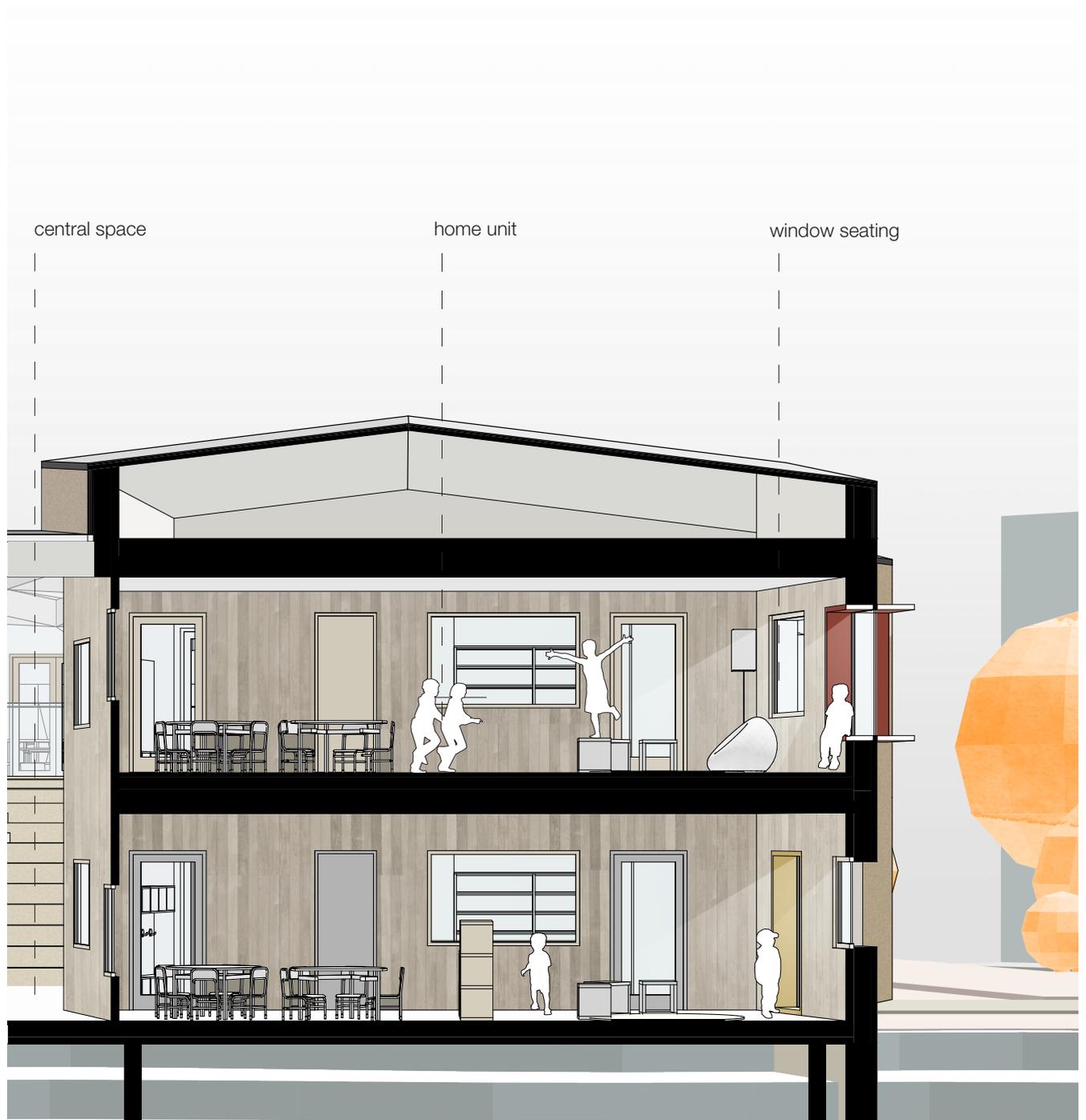
Program distribution



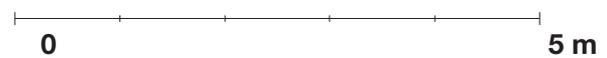


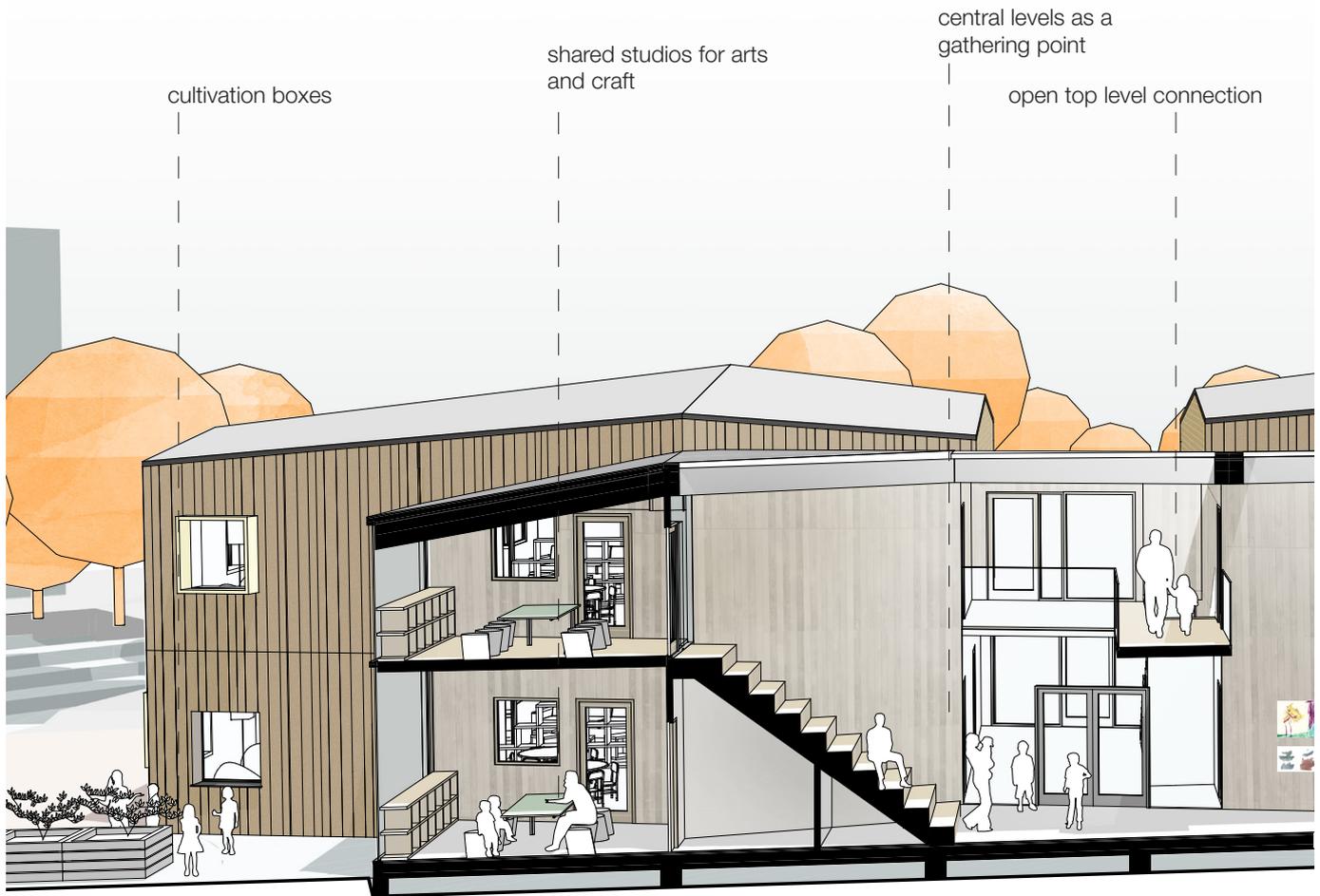
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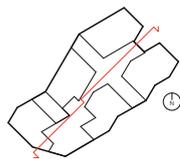
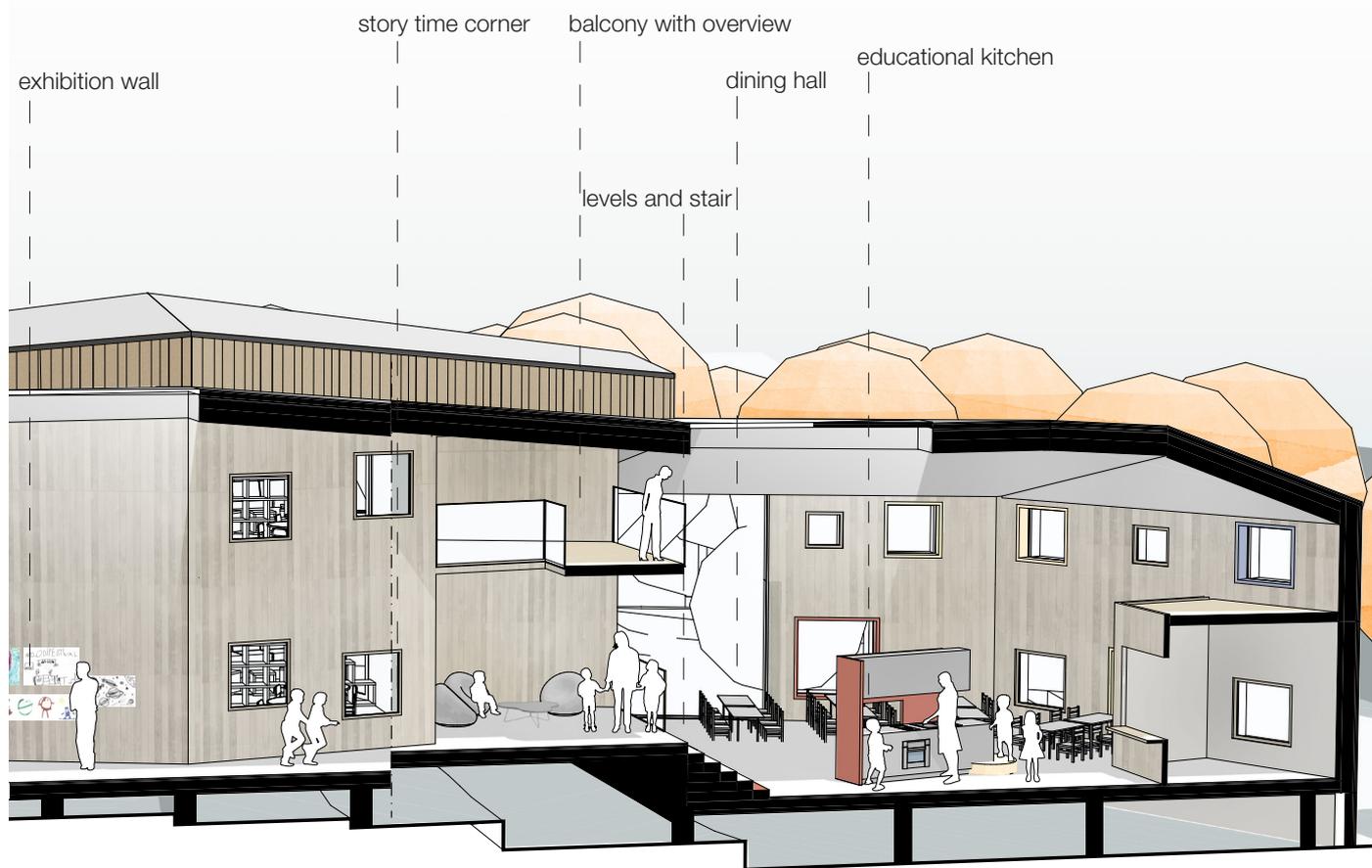




Cross section







Long section





1:50 model of northeast corner.



1:50 model of northeast corner.



Interior view of one unit.

Discussion

Discussion

This project started out with the assumption that modular construction had large potential for development and a place in architecture among buildings that have a solid program that is repeated in the country. It also assumed that preschools were such a building since many cities are now developing concept type building for preschools. Economically modular construction has proven to be a success in for example Älvsbyhus. It has also proven many times that the total construction time is reduced significantly compared to in-situ construction. That modular construction produces ugly buildings I think can be disregarded, it all depends on ambition and resources invested in the project. One initial question remains from this project which is that about the balance between standardization and customization. The proposal presented includes three main modules as well as flipped modules, three different kinds of windows, a custom roof, and a custom but prefabricated system of flat elements for the central space. It is actually quite far from a completely modular building. The reason for this was that construction with purely similar volume elements was to limiting and clumsy for a large and complex building like the one for Kullegatan. It still uses a large amount of standardized solutions and cost, planning and construction time should be greatly reduced, but to what amount remains unanswered.

The result is a proposal for Kullegatan but the system needs a set of rules to be transferable to another site without losing the initial qualities. The rules should be about what can be assembled together with what and define the central space. The reason that this is not made is that the idea for the learning environment is one that I have concluded and cannot be taken as anything else than an argument from my side. I thought that there was a cohesive idea in the city of what

kind of preschool we want to build, and that the program was simple enough to be easily manageable. After this process I no longer agree with that picture and think that questioning what our preschool should be is necessarily before we create a system for mass production. Here lies the other critique for prefabrication of houses in volume elements. For it to be economically viable a large production is needed, which in itself limits the flexibility for future changes. This might be compensated by a better working environment and a more environmental friendly process.

The result of this thesis should be tested as an extension to an existing building, when this probably would be one of the uses for a system like this. Also how an extension to already existing modules would be made should be explored.

Compared to the type building developed by Stockholm and now also Gothenburg this proposal has some advantages. One is the possibility of joining the modules in different ways and creating different floor plan for different sites. This has the downside of taking longer to plan for. But I think that this might be needed anyway, otherwise we risk for settling for passable solutions for our city instead of great. The idea of an interchangeable facade on the type building also applies to a modular building. One big argument for the type building is that the transportation from the factory to the site is much more efficient. However, this demands longer time on site with might be a problem if there is an existing preschool active on site that needs to shut down during construction. Also the work environment on site and the risk for moist problems needs to be considered. If the transportation can become green instead of gasoline the argument doesn't hold anymore.

Conclusions

The result in this thesis shows that there are many aspects of modular construction that also occur in any other type of architecture. That is the aesthetic meaning of repetition of elements and how it should be addressed. I found that it is difficult to create a multi functional building with too much standardization. Instead I choose to make a custom part and a standardized part of my building. What is a reasonable balance between these two parts needs to be investigated further considering built in qualities contra economical issues.

The design in this thesis needs to be developed into a design system with a set of rules that ensures the quality. To do this a common idea of what the learning environment should look like needs to be set. This is difficult when there are many stakeholders concerned with the raising of our children and their daily environment.

Technical issues has not been looked into in the proposal, such as ventilation, fire protection and heating. The modular construction principle should not prove a problem for this though. The construction in factory might actually help,

especially implementing intelligent technology.

Concerning the design process it started out with interviews with different stakeholders trying to find what the focus should be. I was very clear about that I wanted to investigate what a modular preschool with high ambitions could look like, but not exactly what the design focus should be. I started making models and found that working with a part that could create different wholes was fun. The idea of what I preschool should be took a lot more time to understand and settle for while I was searching for a clear answer. I didn't want to question this but instead focus on the design issues with modular construction. But this proved impossible since the idea was quite naive from the beginning. Dealing with a societal function in a project of form proved contra-productive. Personally I have learned a lot about the two subjects but at the expense of not developing any part to the extent that I would have liked. Nevertheless, the proposal shows potential for future development of modular construction and that it doesn't need to be a thing of the past.

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