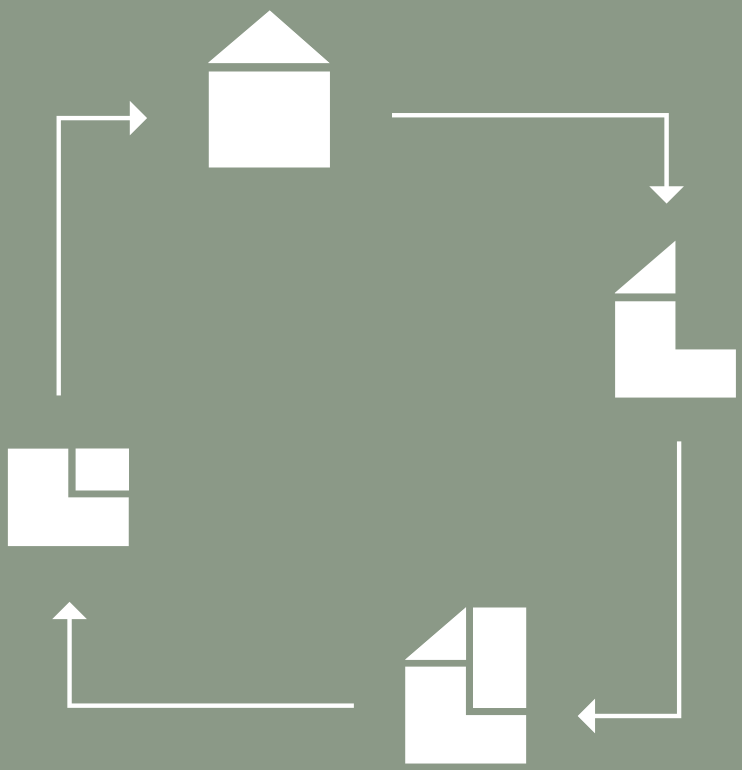
ADAPTIVE CAPABILITY

lengthen the lifespan of buildings already in the design phase



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ADAPTIVE CAPABILITY
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ABSTRACT

A large part of the built environment ends up having a much shorter life span than the buildings have potential for due to changed requirements regarding function, appearance or qualities. To demolish and replace with new, instead of using the existing structures, results in unnecessary use of energy, materials and a negative impact on the environment.

For a long-term sustainability within architecture, it is essential to consider the whole life cycle of buildings already when they are designed. The aim of this thesis is to investigate the possibility to design architecture prepared to easily be changed and transformed in the future to meet new circumstances with simple methods and as little environmental impact as possible.

Adaptable design based on analysis of the chosen context, the area Rosendal in Uppsala, and the demands of the inhabitants, is explored. Design strategies based on theory, case studies and analysis of the local context work as a theoretical framework that underlays the design concept. By mainly using a research by design approach, a design proposal of a building is developed through iterations.

In consideration of the future perspective, scenario planning is applied and a storyline for a possible development of the area is created. The impact of changed requirements causes the building to be expanded and transformed to host exchanged functions, which can be done due to preparations implemented in the initial design. The proposal consists of three steps of the building design.

The thesis challenges the way of viewing buildings as out of date and promotes the approach of treating them as units, not only of materials, but also of time. Through the design proposal, the thesis demonstrates the implementation of context-based adaptability in the initial architectural design, as a sustainable approach to lengthen the lifespan of buildings.

KEYWORDS:
Adaptability, Extensibility, Transformability, Longevity, Resilience

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01.

INTRODUCTION

The chapter presents the foundation of the thesis. It contains an explanation of the design framework and how the thesis has been conducted.

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Educational Background

Bachelor's - Architecture and Engineering, Chalmers, 2015-2018

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Internship

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Master Studios

Planning and design for sustainable development in a local context, Autumn 2019

Reality Studio, Spring 2020

Future visions for healthcare, housing and work: Healthcare architecture, Autumn 2020

PROBLEM STATEMENT

The environmental impact of the built environment is large. The construction sector is responsible for 40 percent of the yearly resource use in the world (IVA, 2020). A large part of the use of resources takes place during the construction phase of new buildings. Further is the construction and demolition waste responsible for 25-30 percent of all waste generated in EU, which makes it one of the heaviest waste streams (European Commission, 2017).

Consequently, the largest resource efficiency improvement that can take place in the construction and real estate industry is to use the existing structures and their surroundings better and more efficiently. This would entail less demolitions and a reduced need for new construction (IVA, 2020).

A common reason behind the decision to demolish a building is that there is no longer a need for the particular function, or that there is a wish for changed appearance, attributes or qualities. To convert or transform an existing building is a sustainable option to demolish it and build a new one when the requirements are changing (Wong, 2017). But sometimes the renovation process is even more expensive and complicated than to simply exchange the building.

For a long-term sustainability within architecture, we need to consider the whole life cycle of buildings already when designing them. The requirements might change further on, and the buildings should be able to adapt. By having the future in mind when designing and maintaining the architecture, a great environmental, economic and social profit can be entailed. Buildings should be viewed as unfinished, to meet the changing functional, technological and aesthetic demands of society.

"The greenest building has already been built"

(Carl Elefante, 2016)

RESEARCH QUESTIONS

How can buildings be prepared to be adapted to future possible changes in order to meet new requirements?

How can the initial design prevent unnecessary demolition and waste of materials?

AIM

The aim of this thesis is to investigate approaches to design architecture prepared to easily be changed and transformed in the future to meet new circumstances with simple, cost-effective methods, and as little environmental impact as possible. This will be exemplified by designing a building with a function based on the requirements of one specific site and the local context. The context will be analyzed to predict a potential development in the future where the function of the building is not required anymore. Due to new expected requirements, it will be showcased how the building can be adapted and transformed with as few changes as possible.

DELIMITATIONS

Adaptability This thesis is focusing on how to simplify the alternative to transform instead of exchange buildings with considerations implemented in the original design, rather than complete flexibility.

Scenario The research is exemplified by a design proposal in a real context. A scenario of one future possible development will be created that will influence the design proposal.

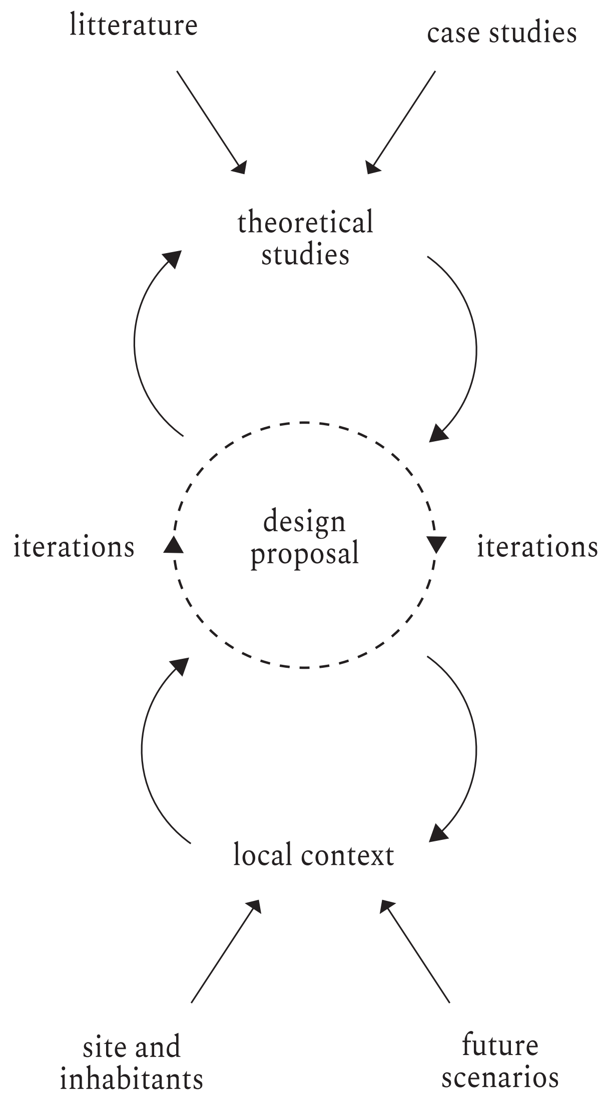
Detail Level The aim is to look at the architectural design and the general constructive system. The tectonics will be considered, but not the detailed technical solutions and service systems.

Low Tech The thesis will concentrate on relatively low cost architecture without advanced or high tech systems.

Detailed Plan The boundaries of the detailed development plan, for the area where the site is located, are not taken into consideration in the design proposal.

METHOD

The thesis is initiated with a Research for Design phase to facilitate the process of delimiting and deciding focus areas to implement in the design proposal. The choice of a site and building function suitable for the context is selected within this phase. Design strategies and a future conceptual scenario are shaped influenced by the theory, case studies and careful analysis of the site and its inhabitants, as a base for the design proposal. Thereafter the thesis will feature Research by Design where the design proposal will be developed through an iterative design process. The current appearance and the future transformations of the building will be developed in parallel. This will generate ideas of research areas to further investigate and apply in the project.



02.

ADAPTABILITY

The chapter contains a theoretical background to adaptable architecture, and why it is essential in today's context.

DEMOLITION

- why does a building get out of date? -

Indicative design working lives for various types of structures are formulated in Eurocode - basis of structural design. The category "Building structures and other common structures" where offices and residential buildings are included, is set to a lifetime of 50 years (CEN, 2001). Looking back in history we know that buildings have potential to last much longer than that. Below are reasons listed why buildings are considered out of date and demolished.

Deceptive Indications	Given numbers, indications, and recommendations from trustable sources such as those mentioned above can cause a distorted impression of what to strive for regarding the longevity of buildings.
Costly Renovations	Assumptions are made that it is more expensive to refurbish than to demolish and build new. Lots of factors need to be included to get a correct estimation of the whole picture (Norwegian Green Building Council, 2019).
Too Small	When a building is considered too small, the possibility to expand the building instead of replacing it with a bigger one, is very seldom investigated (Geraedts, 2014).
Space Efficiency	Some buildings have rigid and inelastic plans and structures, at first glance considered impossible to reorganize and therefore judged as unusable (Geraedts, 2014).
Weak Construction	Due to inadequate maintenance during the life of a building, the construction might be in such bad condition that a demolition is considered the only option, without investigating the required actions to refurbish it (Wong, 2017).
Not Green Enough	"green buildings" are usually associated with innovative technology. When measuring the climate footprint of buildings, the whole life cycle should be analyzed. As a large part of the emissions comes from materials used in the structure and foundation, a refurbished building with a higher energy consumption system can be greener (Norwegian Green Building Council, 2019).
Outdated Service	The ventilation and cooling solutions in old buildings, can be judged as too poor to meet the current requirements for indoor air quality, without considering techniques to improve the air quality (Norwegian Green Building Council, 2019).
Not Contemporary	A wish for changed appearance, attributes, or qualities might influence the decision to replace buildings, while the identity and charm of old or transformed buildings is ignored.
Lack of thinking Outside the Box	Sometimes buildings can no longer be used for their indented purpose and other suitable purposes are not considered (Norwegian Green Building Council, 2019).

ADAPTABLE ARCHITECTURE

- meaning of adaptability in architecture -

The fully understand the impact of implementing adaptability in the initial design, a proper definition is essential. In the book *Adaptable Architecture, theory and practice*, it is stated that "every building is adaptable – but to what end and at what cost?" (Schmidt, 2016). It is explained that the methods used in adaptable design are often well-established systems rather than new inventions, and many successful transformations of old buildings have been done. But we do also see examples where adaptation is required but the characteristics or the capacity of the building is limiting, and a transformation would be too extensive or expensive. Those buildings are in risk of falling out of use. It is here the approach of viewing buildings as units of time is essential. To already in the design phase try to extend the life of a building by consider not only the current requirements is a way to explain the concept of adaptable architecture (Schmidt, 2016). Adaptability can be defined as "The ability of a space to be modified for uses beyond the one originally designed for" (Melton, 2020).

In the report *what is the meaning of adaptability in the building industry?* various definitions of adaptability related terms are collected, and a division is made between six adaptability categories (Schmid et al, 2010). The thesis will in particular treat convertible and scalable.

Adjustable	change equipment or furnishing within building to respond to different users/tasks
Flexible	modify internal spaces and enable shifts in space planning for various users
Refitable	possibilities to easily replace, change, upgrade or renovate components
Convertible	allowing for changes in use within building; economically, legally and/or technically
Scalable	increasing or decreasing the building volume, horizontally or vertically.
Movable	changing configuration or location of the building

A limiting factor for the possibility of applying adaptability preparations in the further life of a building is the regulations set in the detailed development plan. To change an already established detailed plan is a complicated process and might not be considered for transformations to an already existing building even though the context constantly is developing and new requirements can occur (Kalbro et al, 2012). Furthermore, there is a risk for changed building regulations where the prepared transformation does not meet the new regulations. Another challenge is the possible extra cost entailed by applying adaptability. To succeed with adaptable building design, it is therefore important to analyze each individual project. All adaptable methods do not need to be implemented in every building (Schmidt, 2016).

"Architecture is not about space but about time."

(Vito Acconci)

BENEFITS

- advantages of designing for adaptability -

Environmental benefits

When buildings are demolished, replaced, or extensively refurbished, resources are waisted and environmental pollution is generated. Following the supply chain, this is not only caused by raw materials used in the building, but also from manufacturing, construction and installation related recourses. (Minnery, 2015). By designing for adaptability, the resources can be conserved for longer which result in a reduced climate footprint of the building.

Social benefits

Adaptable buildings allow to satisfy the continuously changing needs of individuals and provide them with a more expressive frame, able to evolve through time. (Brand, 1994). This enables to stay in the same neighborhood with a comfortable standard of living maintained. To adopt or renovate existing buildings cause less disruption to the surrounding area than to demolish and build new, which is beneficial for the neighborhood (Melton, 2020).

Cultural benefits

The character and soul of buildings are shaped by their history; with the changes, aging of material and marks left by inhabitants (Melton, 2020). Long-lasting buildings generate local identity and orientation in both space and time for people. Adaptability is a way to avoid demolitions and abandoned buildings, instead the buildings continue to be a well-preserved and valuable contribution to the community which helps to create a character for the area.

Resilience benefits

When designing for adaptability and a long lifespan, the system and material choices are significant. Robust structures with durable, low-maintenance materials and easy to repair or replace systems make the building resilient to different kind of unpredictable incidents, both social and environmental (Minnery, 2015).

Economic benefits

Preparing buildings for future adaptation can entail a great financial value due to easily made transformations and exchange or repair systems (Melton, 2020). Some approaches used in adaptable design might lead to higher initial costs. The benefits and drawbacks of applying them must be investigated for the unique circumstances of each project.

"

> *" The primary goal of design for adaptability is to lengthen a building's lifespan by making it possible to adapt the space with minimal disruption."*
>
> (Paula Melton, 2020)

LAYERS

- buildings as a set of shearing layers-

In the book *How buildings learn: what happens after they are built,* the author refers to, and further develops, the architect Frank Duffys definition of a building as a set of shearing layers with different longevity (Brand, 1994). It is argued that a well-conceived building should have a clear division between the different layers as their longevity and need for exchange or service is diverse. The layers and their respective approximate longevity according to Brand are presented in figure 1.

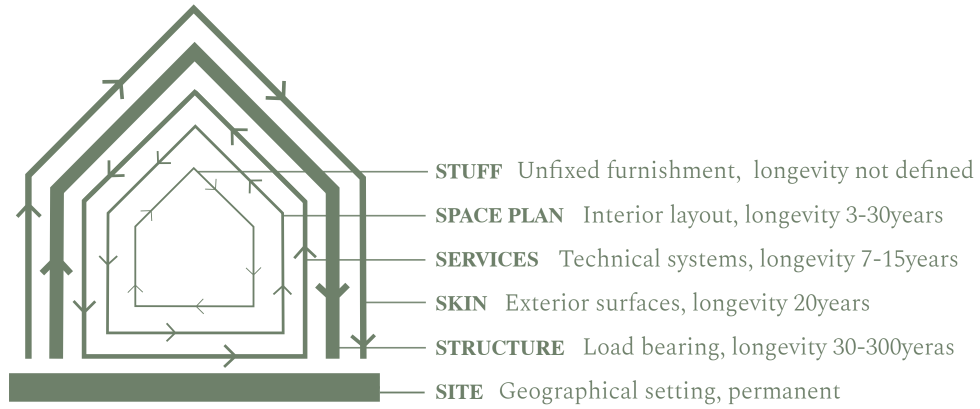


Figure 1. Shearing Layers, redesigned diagram (Brand, 1994)

The theory of shearing layers has been widely used as a method to organize and deeper understand buildings as not only depending on the current context but also the time, a useful approach when designing for adaptability. But definitions of specific longevity time spans for the layers can be problematic. The attitude to rather strive for as long longevity as possible for each layer is desirable.

In the report *what is the meaning of adaptability in the building industry?* a summary is made, see figure 2, of how the six earlier listed adaptability categories relate to other dimensions including Brands layers. A proposal of a reasonable time scale for the different kind of adaptability, as well as the effected building layers, are displayed (Schmid et al, 2010). The time scale should be treated with caution, but is remarkable that the suggested cycle speed is relatively short, indicating that with appropriate prerequisites, adaption can be accomplished without extensive or expensive operations and can be considered frequently.

ABLE	TYPE OF CHANGE	CYCLE SPEED	LAYERS EFFECTED					
			stuff	space	service	skin	structure	site
adjustable	of task	daily/monthly	●					
flexible	of space	daily/monthly	●	●				
refitable	of performance	7 years		●	●	●		
convertable	of fucntion	15 years		●	●	●		
scalable	of size	15 years		●	●	●	●	
movable	of location	30 years					●	●

Figure 2. Adaptability categories in relation to other dimensions, redesigned diagram. (Schmid et al, 2010)

LIFE-CYCLE

- buildings in terms of time -

Buildings go through stages in their life, with various length for different buildings. A division between five different stages has been developed as a tool for making life cycle analys and to further understand the complex environmental impact of buildings (Gervasio & Dimova, 2018).

1. Product stage The life cycle of a building starts already with the extraction of natural resources that are used to manufacture construction products for the building. In this phase is the transportation of the materials and distribution of building products included.

2. Construction stage The second phase covers the activities related to the construction of the building, such as the transportation and the assembling process. The product and construction stage can be presented as one united stage, as they are both part of the building process, but they are here presented separately.

3. Use stage The third phase is normally the longest phase. It can be defined as the operation of the building and incorporates the maintenance, water use, energy consumption, waste generation, repairs, replacements and potential transformations.

4. End of Life The fourth phase implies the operations related to the demolition of the building, including factors such as energy, waste, disposal of materials for landfill and recycling activities.

5. Beyond system boundary The final phase, defined as benefits and loads beyond system boundary, contains the potential impact of reusing and recycling construction materials and products.

Figure 3. Life-Cycle Stages according the EN 15978:2011, redesigned diagram (Gervasio & Dimova, 2018)

Life Cycle Assessment

Life cycle assessment is an emerging method for analyzing the total environmental impact of buildings including the different building components and all the stages of its life cycle (Bayer et al, 2010). The tool is utilized to make better informed decisions, compare competing alternatives, and reduce the environmental impact from the building sector. It can be useful in the decision-making of the dilemma; demolish and build new or renovate and transform existing buildings.

SCENARIO BASED DEISGN

- use of scenarios in life cycle assessment -

In the article *Integrating Scenarios into Life Cycle Assessment,* obstacles connected to the method life cycle assessment are lifted (Galle et al, 2017). It is stated that the service life of a building is impossible to model with certainly due to for instance new technical inventions, shifting lifestyles or changed functions further on. To deal with those uncertainties and avoid unnecessary costs or damage of the environment, it is proposed to integrate scenario planning into life cycle assessment. Scenario planning is a strategic method used to make flexible long term plans based on; assumptions of the future, analysis of possible realities and systems thinking. The method has been applied in diverse fields but has rarely been adopted to and used in the building and construction field.

An introduction to linking the two subjects building design and scenario-based design, was made in the book How Buildings Learn (Brand, 1994). It is there stated that by applying scenario planning into programming, a building can be treated as a strategy rather than a plan. The difference between the two terms is that a plan is based on predictions, while a strategy is designed to also involve unpredictable changing conditions. Scenario planning is therefore a tool to achieve adaptability qualities in building design. It is a way to avoid making a building such optimal to the current needs and users, that it is maladaptive to the future.

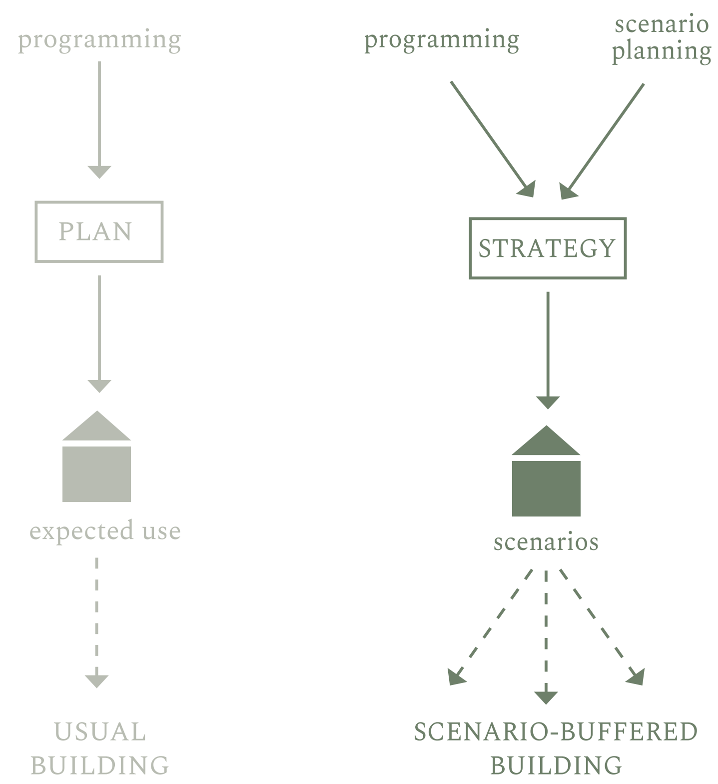


Figure 4. Scenario Planning, redesigned diagram (Brand, 1994)

SPATIAL

- adaptable considerations within volume -

The degree of spatial specialization for different building functions has increased significantly since the 50s (Larsson, 1999). This has entailed buildings that fully meet the current demands, but with less consideration about future changes. It is needed to take a step back and consider more general-purposes and adaptable solutions. A variety of guidelines and considerations for adaptability are discussed in the literature where of some commonly mentioned are described below. Though, as stated in *Toward an Adaptable Architecture, Guidelines to integrate Adaptability in the Building,* every building is unique, and guidelines should not be considered as a recipe. (Nakib, 2010).

All scales of the building design must be considered to achieve adaptability (Schmidt, 2016). Firstly, the shape and dimensions of the volume is crucial for the possible uses of the building. It regulates possible room types and movement within the building. A deep building can be limited by the lack of penetration of natural daylight in the middle area, while a long and narrow building volume can entail too long distances if the building is used for one coherent function (Warner, 2006).

The spatial planning guidelines for adaptability on a detailed level should be studied with critical consideration. Both the approach to rationalize room sizes and the approach to provide a variety of spatial sizes have been promoted in the body of literature. One adaptable method suggests the use of a modular system and a planning grid in relatively small dimensions, being an even division of the structural grid where the rooms consist of a different number of modules. (Schmidt, 2016). To group similar types of spaces into clusters within the spatial layout of the building is often beneficial. Such clusters can be plumbing or cores with vertical connection and service risers (Geraedts, 2008). The placement and amount of the clusters are important to consider.

One way to organize adaptive and flexible approaches in building design is the division between hard and soft use. Hard refers to specifically determined elements and organizations within a building, while soft includes indeterminate elements. Both approaches are used to achieve flexible buildings; hard is more related to predetermined multifunctionality, while soft demands more space but provides the users with freedom to make up their own solutions (Schneider, 2005). The Loose Fit approach is connected to the soft use. It is characterized by oversized dimensions, open undisturbed space and the addition of support space, which is the supply of extra space not defined in the brief. Obstacles related to cost and height restrictions can occur when applying loose fit/soft use approaches (Schmidt, 2016). The opposite, the tight fit approach, is related to Hard use. To succeed with adaptable design following the hard use/tight fit approach requires more planning and knowledge of expected future usages.

STRUCTURE

- adaptable considerations beyond volume -

Not only spatial qualities, but also preparations for modification of the volume, should be considered. In most cases the requested modification is an extension, either horizontally or vertically. When preparing for extensions, many factors need to be considered (Rosh, 2000).

Site Related Especially in preparation for horizontal expansions, the size and formation of the site is essential to consider. What will be taken away to give space for the new volume? Factors such as regulations in the detailed plan, accessibility, yard and parking size are possible issues related to both vertical and horizontal expansion (Schmidt, 2016). Relocation of elements can be costly.

Shape It is often easier to add volumes to a building constructed of simple shapes and modular components than organic shapes and large diversity among the building units (Schmidt, 2016).

Foundation To modify existing foundations is often an expensive process. But the cost to prepare the foundation for extra loads is marginal. Especially for buildings with a timber construction, which is a lightweight material (Rosh, 2000).

Roof For addition of floors, roof drainage should be considered in the initial design. It is generally preferable to choose a flat roof for the original building (Rosh, 2000).

Skin The facade of a building should be detached from the structure, standardized and demountable in order to maintain a coherent expression when modifying the volume (Wong, 2017). To base the exterior expression on a subdividing system and a modular rhythm can be beneficial.

Water The size and location of the plumbing services are important to take into account, to avoid costly relocations and new installations (Rosh, 2000).

Structure CLT is commonly used for additions on existing buildings because of the lightweight, short mounting time, high degree of prefab and dimensional stability (Martinsons, 2020). For buildings prepared for additions, it is preferable to have the same structural system in the initial building as the planned additional part. Furthermore CLT is a sustainable and future proof material, expected to remain on the market far ahead (Varga et al, 2017) The high load bearing and stabilizing capacity, due to the cross lamination, enables preparing for additional loads without a massively over dimensioned structure (Kolb, 2008).

03.

CASE STUDIES

Four in different ways adaptable projects have been studied and are presented in this chapter.

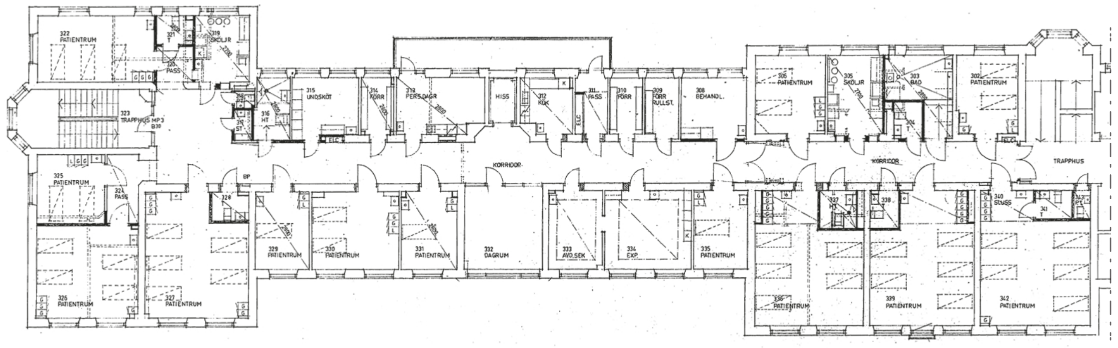
TRANSFORMED

- Renströmska Sanatorium -

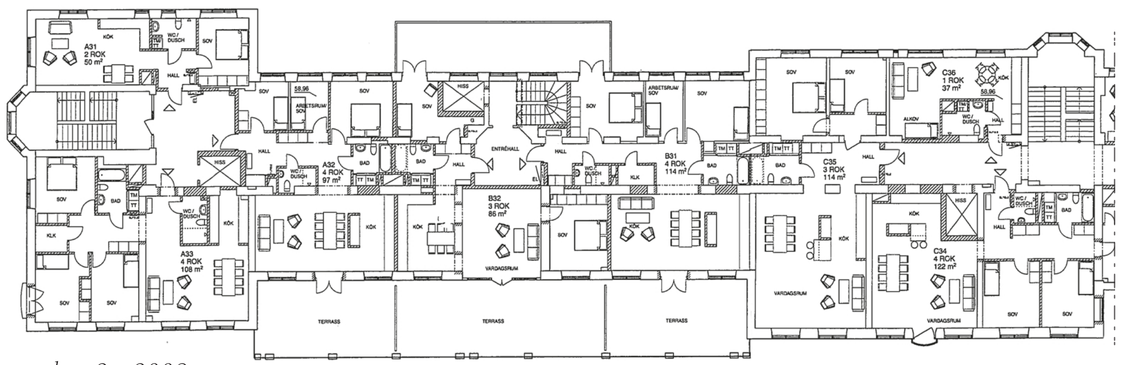
Due to demands for a tuberculosis sanatorium, Renströmska Sanatorium was constructed in 1913 with capacity for 190 patients (brf Renstromska Villan, 2011). An expansion was made in 1929 to make room for additional 72 patients. After being empty for a few years, the decision to transform the building to apartments was made in year 2008. Today the building goes under the name Renströmska Villan and consists of 57 apartments. The apartments achieved qualities that might not be prioritized in newly built housing, such as big windows, extra space, and unique but charming floor plans.

facts
location: Gothenburg, Sweden
year built: 1913
year transformed: 2008

what I bring with me
- load-bearing inner walls do not prevent transformability
- prioritize keeping walls before creating optimized rooms
- vertical communications crucial for possible transformations



plan 2 - 1980



plan 2 - 2008

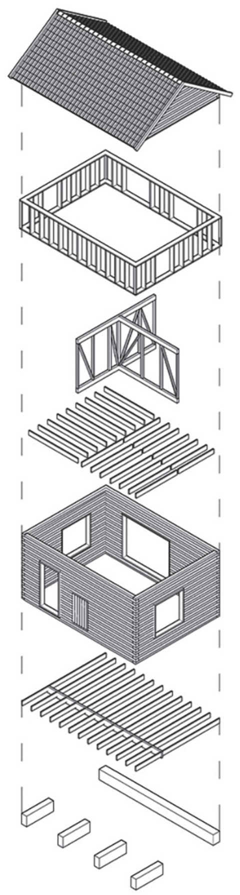
EXTENDED

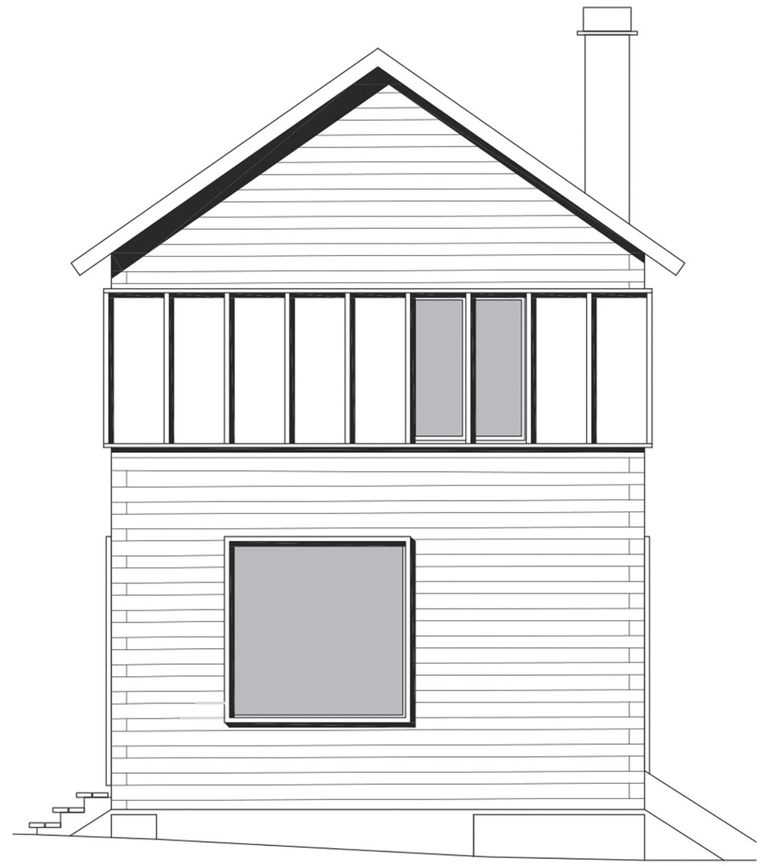
- Nannberga Summer House -

The architects at General Architecture firm bought a one-storey old timber house on the countryside in Nannberga outside of Arboga and a decision was made to expand the house with a second floor (General Architectur, 2010). Due to the capacity of the horizontal log construction, it was possible to lift off the roof including the top log rows, add a load-bearing wooden stud framework, and then put the roof on place again. This creates an interesting interaction between the old and the new.

facts
location: Arboga, Sweden
year built: 19th century
year transformed: 2010

what I bring with me
- additions need to be tailor-made after the host structure
- traditional wooden buildings stable enough for extensions
- extensions can be an attribute to existing buildings





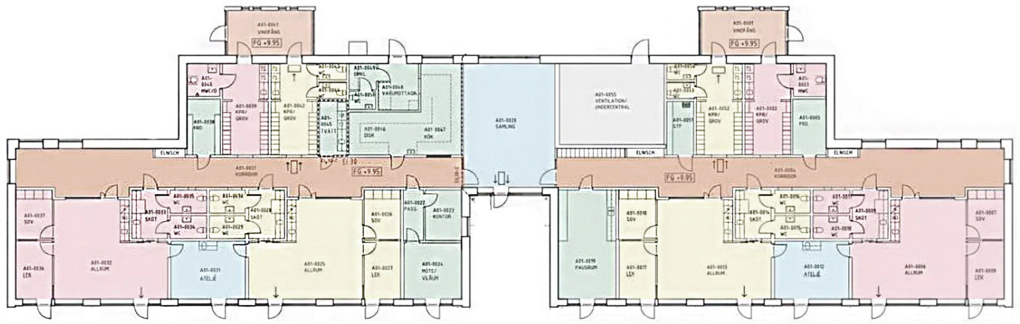
TRANSFORMABILITY

- The Flexible House in Annestad -

Located in Annestad in Malmö a preschool was designed by White architects with adaptability and flexibility in mind. The building is flexible in the way that it is prepared to, with small measures, be transformed from a preschool to a primary year school for year 0-3 or ten apartments for either elderly or students (Abrahamsson C, 2014). The idea behind the concept was to create a building that could host different functions depending on how the requirements change in the future, without expensive renovations.

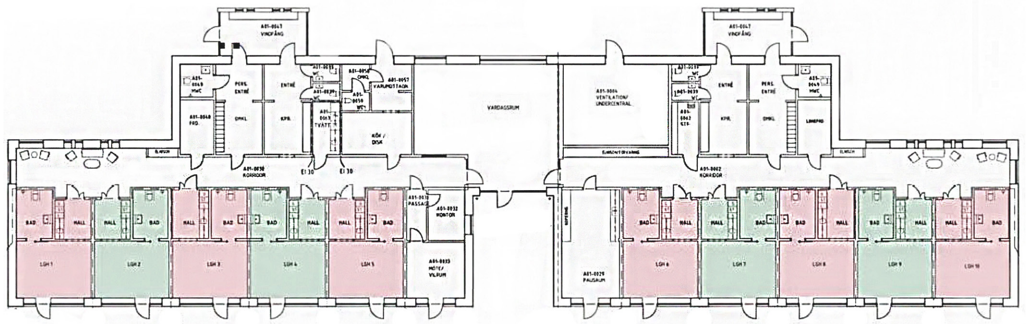
facts
Location: Annestad, Sweden
Year built: 2009
Year transformed: not yet

what I bring with me
• set communication area and flexible rooms around
• consider placement and amount of wet rooms
• separate entrance situations



current appearance - preschool

alternative layout 1 - primary school year 0-3



alternative layout 2 - retirement home

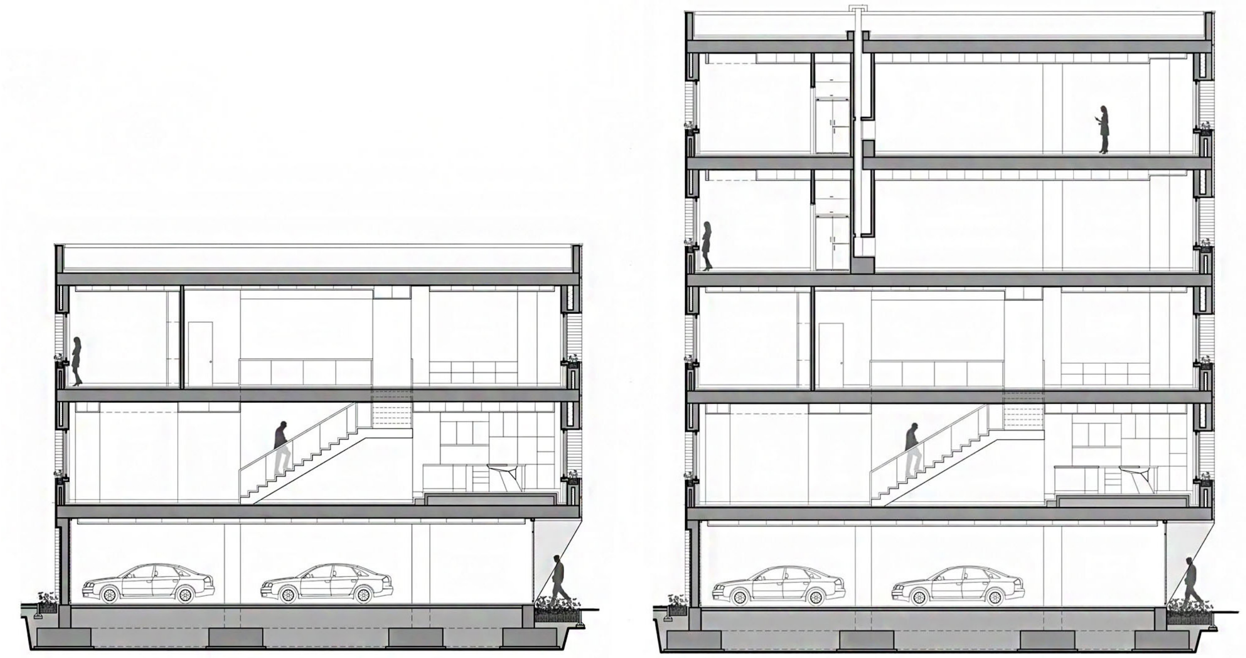
EXTENSIBILITY

- Afsharian House -

A one family house was designed in Kermanshah, Iran by the firm ReNa design studio, the customer was a family with two children (ReNa design, 2014). As the couple expressed a wish of providing the children with one apartment each when they grow up, a decision was made to prepare the building to easily be extended vertically, where two additional floors can be constructed on top later on. The apartments are possible to enter without crossing the existing house.

facts
Location: Kermanshah, Iran
Year built: 2013
Year transformed: not yet

what I bring with me
• flat roof is beneficial for extensions on top
• prepared carrying double weight without over dimensioning
• consider placement of vertical connections



04.

CONTEXT

The chosen site is presented in this chapter together with analysis of the context and its inhabitants.

ROSENDAL

- a new district in Uppsala -

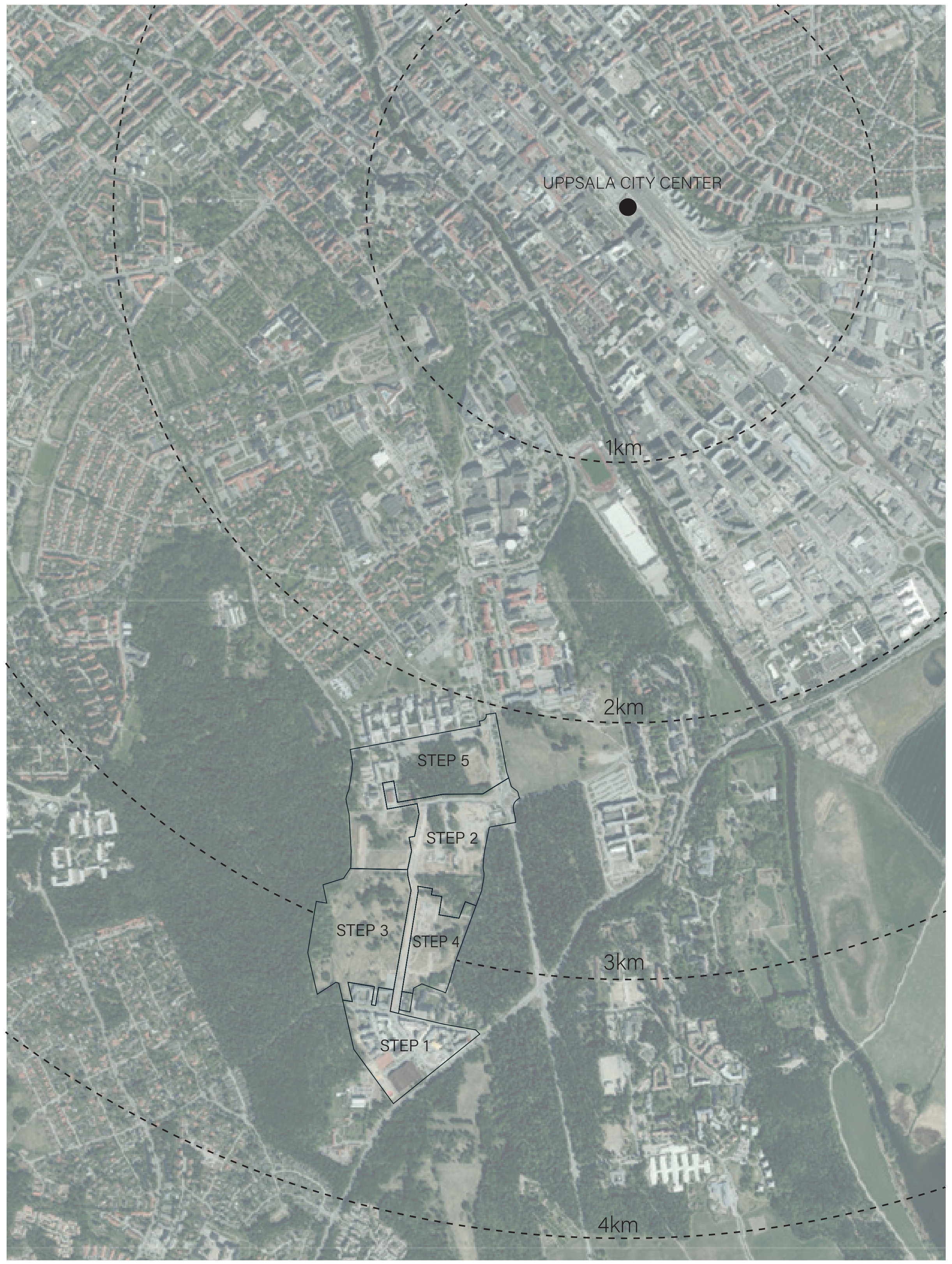
A completely new district is under construction in the city Uppsala in Sweden (Uppsala Kommun, 2019). The district is located to the south of the city center and is built on ground that earlier has been used for military training and golf courses. The area is named Rosendal and will consist of a mixture of housing, business, service and university-related activities. In total, approximately 5,500 dwellings will be built, both rental apartments and condominiums. Rosendal is built in 5 steps, the first step, called southern Rosendal, was finished in 2018 and contains 1600 dwellings. Currently step 2 and 3 are under construction. Step 4 and 5 have not been initiated yet. Sustainability and innovations have been in focus in the planning of Rosendal. The area is for instance prepared for a tram line crossing Rosendal from south to north. The line is intended to continue to the city center as a green option of transportation.

public transport

bike lanes

trade

green areas



Scale 1:20 000

SOUTHERN ROSENDAL

- chosen site and its surrounding area-

The selected site is located to the west of southern Rosendal, the first step in the construction of the district Rosendal. A mixture of condominiums and rental apartments can be found in southern Rosendal. There is also a generous supply of services and shops. The site is in close connection to the forest Stadsskogen, the most centrally located nature reserve in Uppsala. The forest mostly consists of pines, many of them are over 200 years old. Some spruces and diverse deciduous trees are to be found (Uppsala kommun, 2017). The site is located to the south of Rosendalsvägen, the only road crossing Stadsskogen. Following the road to the other side of the forest, a row house area is located. In the detail plan the area for the site is planned to be kept as a green area. But in this proposal, an optional detail plan is imagined where a building, for residential or educational purposes of up to four floors, is intended on the site.

the site viewed from south

Scale 1:4000

INHABITANTS

- the people in the area -

The dominating age group in southern Rosendal is people in their 20s, see figure 5. Compared to the division in Uppsala, the amount of young inhabitants are large, and the amount of seniors is very low. It can partly be motivated by that there is a large number of small rental apartments, of which some are even reserved as youth apartments, in the area. Furthermore, young people tend to be more open to taking risks, such as moving to an area with constantly unpredictable changes, which occurs in an area under construction. When the area is completed and settles down, the expected average age in Rosendal might increase and get a more similar distribution to Uppsala municipality. Though some differences will probably remain. As the area consists of apartments of 1-5rok and no villas or raw houses, the expected number of new families with one or two young children will be higher than the number of bigger families.

avarage age Rosendal
25 years

average age Uppsala
40 years

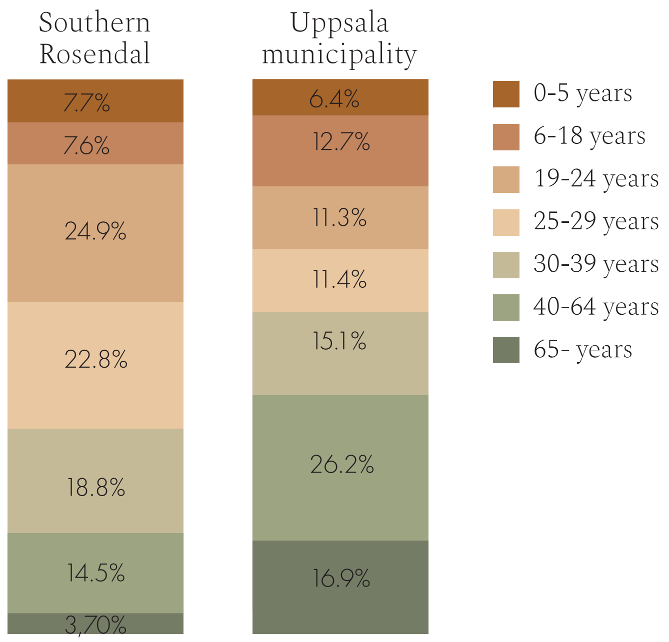


Figure 5. The age distribution in souther Rosendal compared to Uppsala (Uppsala kommun, 2019)

Population Development

As the area Rosendal is a under construction there is no statistic over the population development. Therefore, statistic over the whole municipality of Uppsala is used to predict an approximative future development in Rosendal. Uppsala has had a strong population growth the latest years, with the university, the closeness to the capital and to the largest airport mentioned as traction forces. (Uppsala kommun, 2019). In the prognosis for year 2017-2050 made by Uppsala municipality, a continuing of the strong population growth is anticipated. The population is expected to increase with more than a third until year 2050. It is not specified whether the growth is a consequence of movement, immigrations, or births. (Uppsala kommun, 2017). This entails a demand for more buildings, both housing and services. As the central areas are popular, a wish for a higher density in already established areas can be expected.

Uppsala 2021
233 900

36%

Uppsala 2050
~ 318 600

The number of births in Uppsala has gone up and down in waves during the latest years. Based on the number of fertile, an assumption is made that a similar development will continue. A possible forecast of the number of births from year 2021 until year 2051 has been added in figure 6.

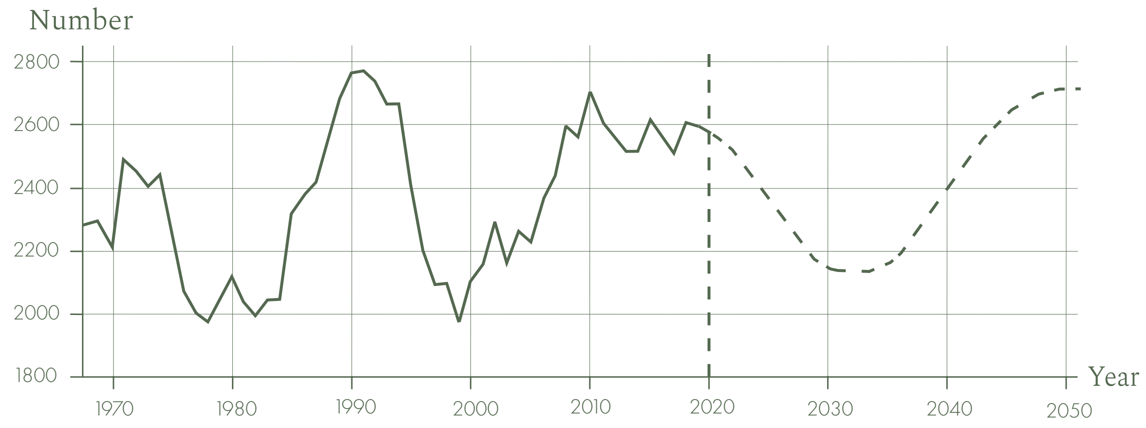


Figure 6. Number of births per year in Uppsala from 1967, redesigned diagram (SCB, 2020)

05.

CONCEPT

In this chapter the conceptual framework for the design proposal is presented, shaped through scenario based planning. One possible future development is explored, rather than many different ones.

SCENARIO

- chosen parameters -

The design proposal is developed through the earlier presented scenario based design method and a possible future scenario is formulated based on analyzes of the site, the context and the demands of its inhabitants. Two main parameters are selected: changes in age distribution and changes in density. The parameters are chosen to be typically constantly changing factors and therefore applicable in many projects.

The building in the design proposal will be displayed over a period of 30 years, from year 2021 until year 2051, to showcase how the design methods and preparations for adaptability applied in the initial design, could be utilized later on. Based on predictions of how age distribution and demands of density in the chosen context might change, two major transformations of the design proposal will be made. The relatively short time span is chosen to promote slow devlopment of the built environment step by step, rather then extensive changes where the identity of the area might get lost.

The initial building will be a preschool due to current demands. After 15 years the building will be transformed to a senior housing, an arising residential type in Sweden. To create more senior housing is a tactic to counteract the overpopulation of retirement homes, as we are currently having an aging population. After further 15 years, the building will be expanded to host both a preschool and senior housing. Collaboration houses, where co-utilization is applied for efficiency and interaction between groups, is a relatively new but arising concept in Sweden. The assumption is that it will be even more pertinent a few years from now. More than being chosen based on the demands of the site, the building functions are chosen to be common and topical functions that are assumed to not get out of date.

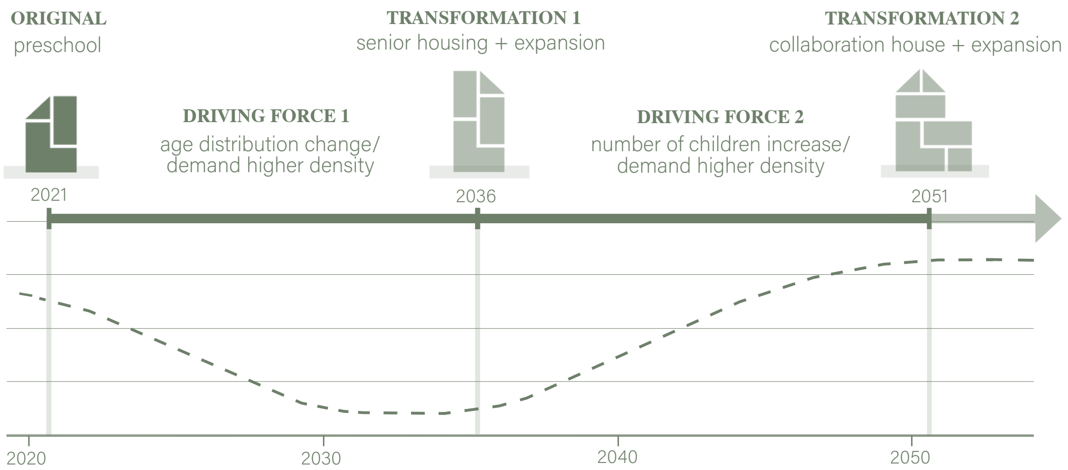


Figure 7. The development included in the design proposal, displayed connected to the assumption of number of births, taken from figure 6.

STORYLINE

- a possible future development -

year 2021

The new district Rosendal is located close to and with good connections to the city center. Diverse public functions enabling a comfortable everyday life and a well-established walking and cycling network is provided. In southern Rosendal, where the site is located, there is a variety of residential types. Many spacious condominiums with a high standard of living can be found. The green areas enclosing southern Rosendal from east, south and west, attracts couples with children as well as young seniors who just sold their villas for a more comfortable life close to town, to settle in the apartments. Furthermore, there are many smaller rental apartments, some of them youth apartments for people between 18-30 years. Of the young people who moved in year 2015, many have come to appreciate the area and decide to enter the housing market as they complete their studies, move in with partners and prepare for family additions. In 2021, many families with small children have gathered in southern Rosendal and the demand for a preschool has arisen.

year 2036

Of the younger seniors who moved to southern Rosendal when it was completed, the majority are now over 70 years old. A demand for additional convenience and support in the everyday life has arisen, but such facilities are not available nearby. At the same time, the children in the first wave of Rosendal, are now teenagers. Fewer children have been born in recent years, according to the forecast for the population curve, with a surplus of preschools in Rosendal as a consequence. The possibility to rebuild the preschool into senior housing occurs. The entire area Rosendal has now been completed and flourished for a couple of years and is very popular, the demand for housing has increased. To add a few floors without exceeding the height of the surrounding building volumes, at the same time as the preschool is being transformed, is considered a reasonable alternative.

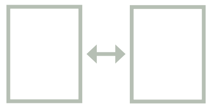
year 2051

The attributes and large supply of facilities in Rosenda has continued to attract seniors to the senior housing. At the same time is the number of newly started families with children increasing as the people born in the baby boom around 2020 are now in their 30s, according to the forecast for the population curve. Some of the children who grew up in the newly built Rosendal and went to the preschool, yearns for returning after years elsewhere. Rosendal is now an area with great diversity where both older and younger people thrive. A decision is therefore made to expand the building into a collaboration house. The preschool will be re-established and share some of the spaces with the senior housing, to create synergies, meetings between age groups and efficiency.

DESIGN STRATEGIES

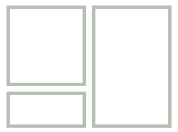
- theory used in design -

Based on theory from literature, case studies and limited by the conceptual focus, 12 adaptability design strategies are shaped. 6 of them relate to spatial qualities and the other 6 relate to structural qualities. The strategies are focusing on methods to implement adaptability into this specific design proposal and are influenced by the context.

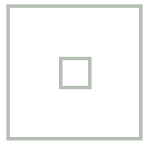


MULTIFUNCTIONAL
Create non-specific and general spaces with a large variety of functions.

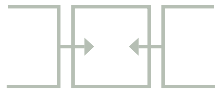
EXTRA
Provide more than the minimum spatial area and floor height to achieve the requirements for other functions as well.



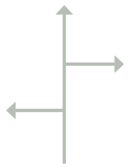
ALTERABLE SETS
Create sets of rooms that can be used for different purposes, regarding both measurements and connections.



CENTRAL COMUNICATION CORE
Create a main core of the building as a base that the other spaces are located around, both vertically and horizontally.

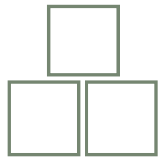


SOFT SPACE IN MIDDLE
Open spaces connecting sub spaces should be designed as buffer zones that the sub spaces can grab or give space to.

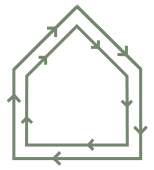


FLOWS
Organize logic and not too long-distance flows. Consider where possible separations of flows and separate entrances can be useful.

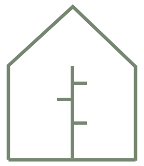
spatial qualities



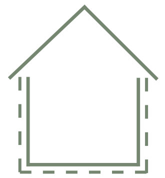
RECTANGULAR VOLUMES
Assemble the building of rectangular volumes to allow for easily additions and connections of the different bodies.



SEPARATION OF SYSTEMS
Create independent system-based layers to allow smooth upgrading and replacement of parts when needed.

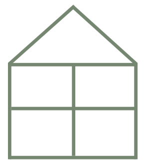


GROUPED SERVICES
Create connected service zones within the building instead of spreading them all out.



OVERDIMENSION
Design the foundation and construction of the building strong enough to be able to carry potential extra loads.

PLANNED GROWTH
Consider potential growth of the building volume in relation to the context.



MODULAR SYSTEM
Base the exterior expression on modular systems and consider the transition in case of expansions.

structural qualities

06.

DESIGN PROPOSAL

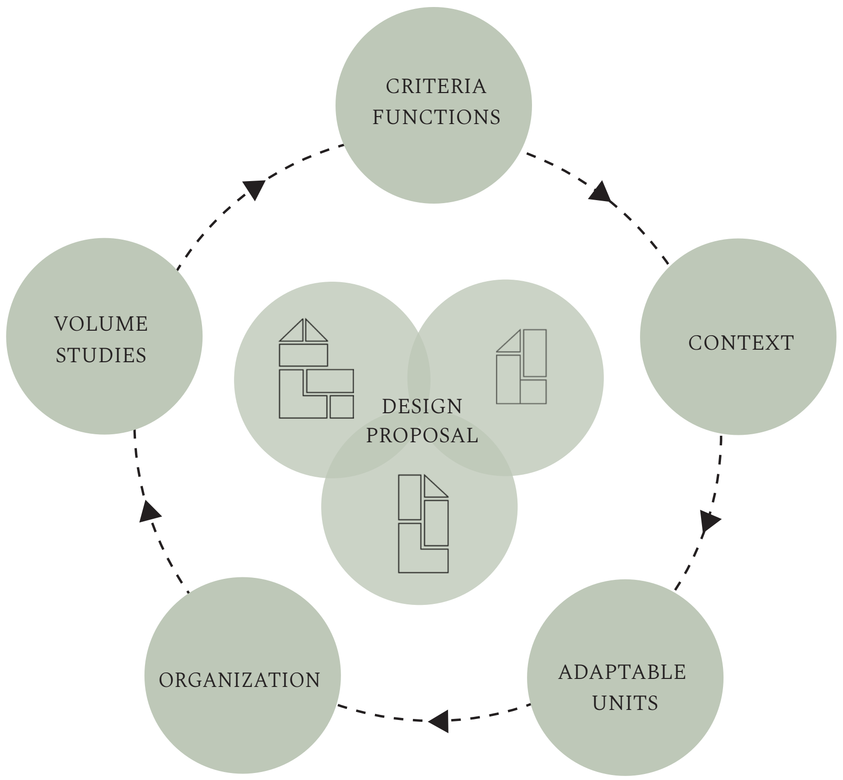
The chapter presents the design proposal developed in three steps; the preschool, the senior housing and the collaboration house.

PROCESS

- an iterative sketching process -

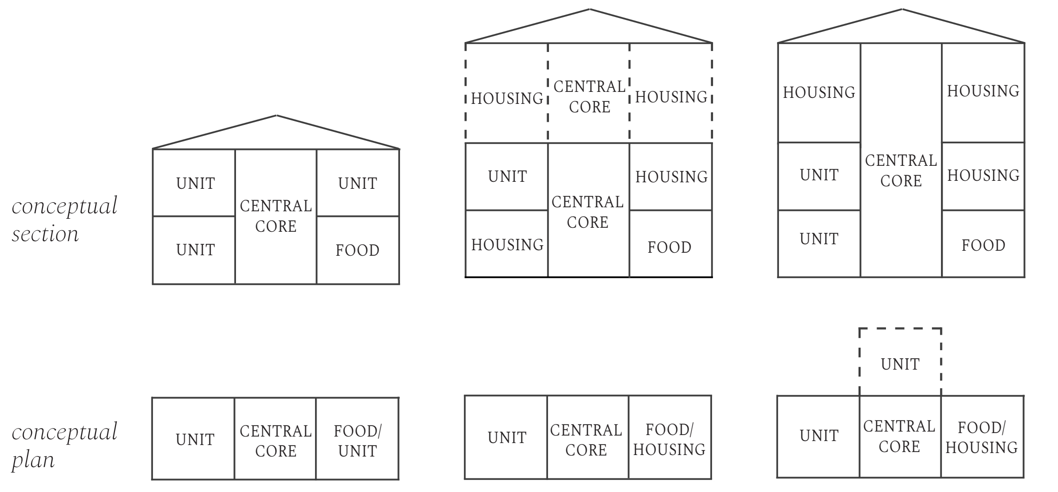
The design proposal has been developed through an iterative sketching process where the three steps, or versions of the same building, have been developed at the same time. Following aspects have been included in the process. The final iteration is presented on the following pages.

Criteria Functions	understanding the three different functions and their requirements
Context	consideration of the local context, flows and the surrounding buildings
Adaptable Units	discover multifunctionality and similarities between the three functions
Organization	trying different structures, constellations and combinations of room sets
Volume Studies	investigate volume constellations and the effect of additional volumes



Criteria Functions

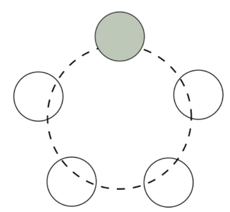
The requirements for the three functions were analyzed to find similarities in room sizes, layouts and multifunctional solutions. A preschool organization with three identical units + common space is applied. It will simplify the development of a transformational concept from preschool to senior housing where each unit can be transformed to a set of apartments. A food distribution module, necessary for both the preschool and the seniors, can be fixed and placed in vertical line with one of the units. The units need to be reached from a central communication core where additional functions can be included. With this conceptual organization the part of the building containing units, is following the hard use adaptability principles while the middle space, including the communication and entrances, is following the soft use adaptability principles. Additions of more apartments can be placed above following the same structure and spatial organization. Additional preschool units need to be placed horizontally as it is recommended to have a close connection to the ground.



STEP 1. PRESCHOOL
-3 units
-food distribution
-common space
-stuff

STEP 2. SENIOR
-apartments
-food distribution
-common space
-stuff

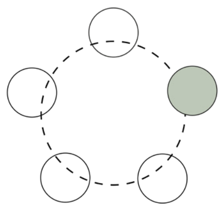
STEP 3. COLLABORATION
-3 units
-apartments
-food distribution
-shared spaces
-stuff



Context

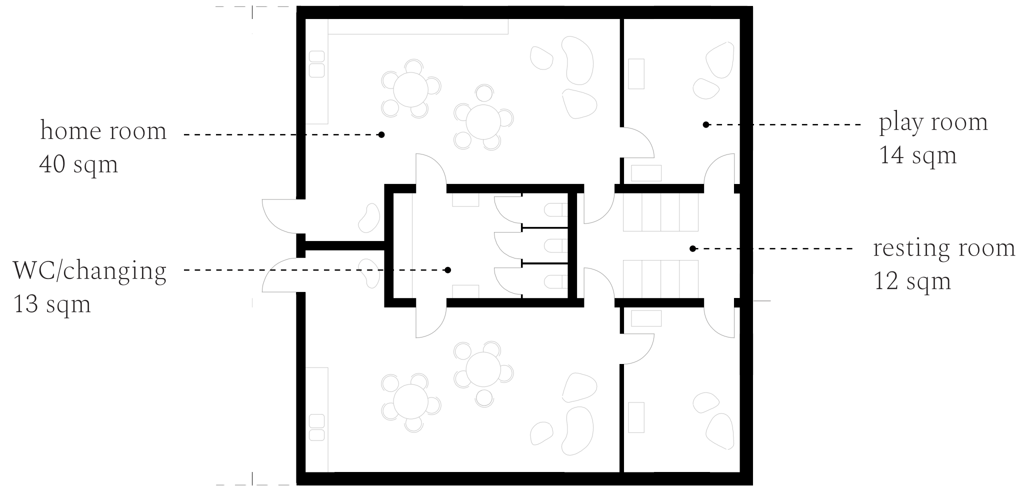
In order to create an understanding of the site, the context and the qualities of it, as well as the impact of the new building in each of the three steps, a bubble diagram was created. The important flows and constellation of the main units and fuctions are mapped out.

Scale 1:1000

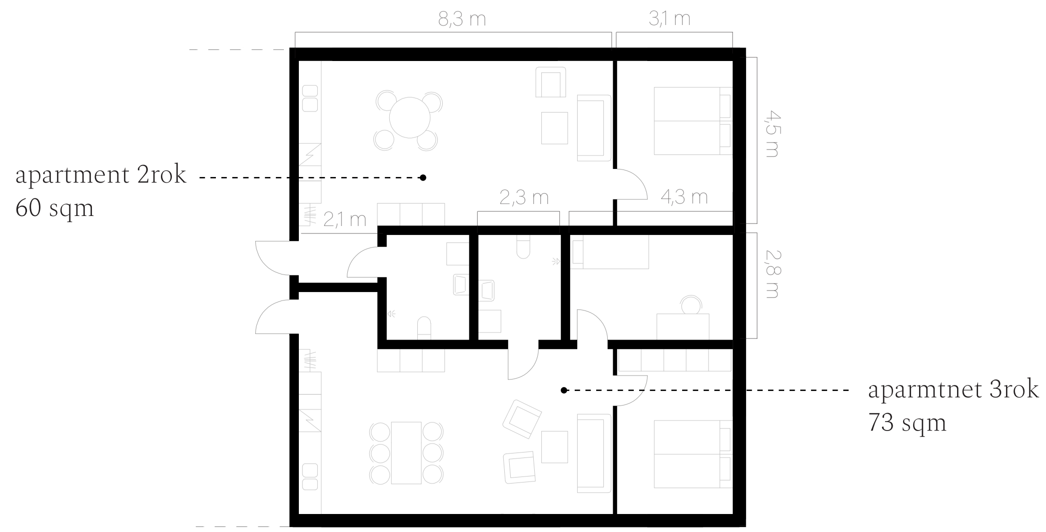


Adaptable Units

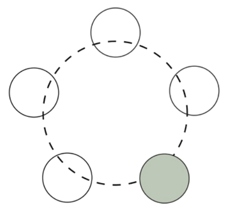
By testing different sets of rooms and unit constellations, a model was found where one preschool unit could be transformed to two senior apartments with few changes and most of the walls kept. The preschool unit has a functional layout with two child groups sharing some facilities. The senior apartments consist of one 2 rooms + kitchen, and one 3 rooms + kitchen with an identic layout but with one additional room. The apartments are spacious with good accessibility. The entrances to the units/apartments are placed close to each other to simplify the connection of the unit to the central core.



Preschool Unit, Scale 1:200



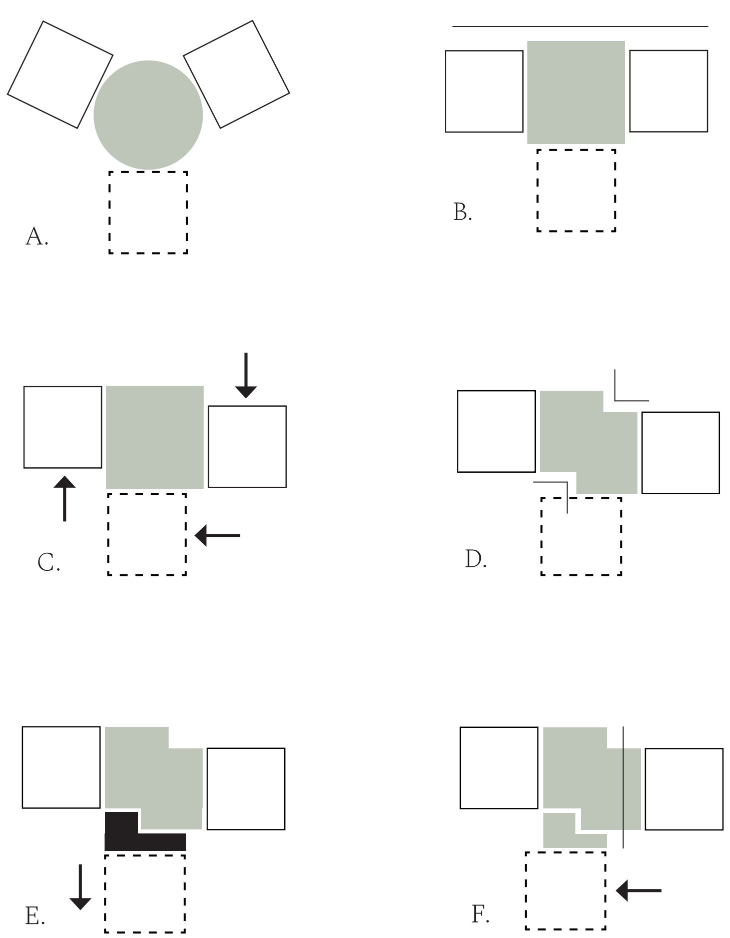
Unit of two Apartments, Scale 1:200

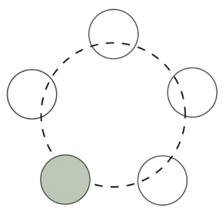


Organization

The spatial constellations of the units and the shape of the central core were developed with consideration of all the three steps of the design proposal: preschool, senior housing and collaboration house. The space needed for the necessary functions in the central core and flows, both within and around the building effected the shape.

SHAPE DEVELOPMENT A-F



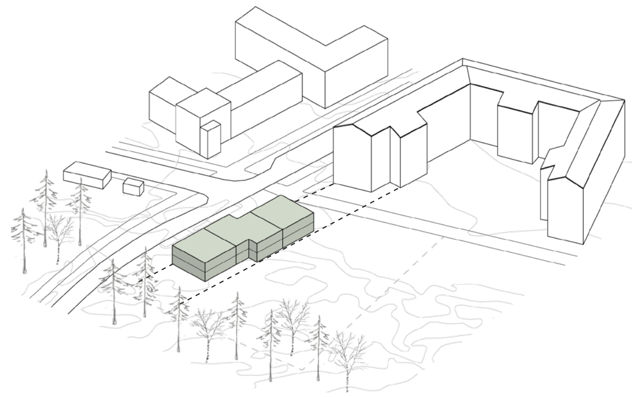


Volume Studies

The context and the relation to the surrounding buildings were also taken in consideration when developing the shape and analyzed through volume studies.

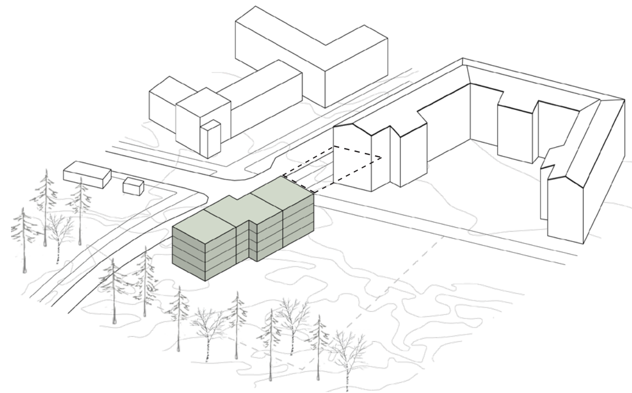
STEP 1. PRESCHOOL

The volume is placed close to the street for accessibility and is following the lines of the neighbour building to create sightlines.



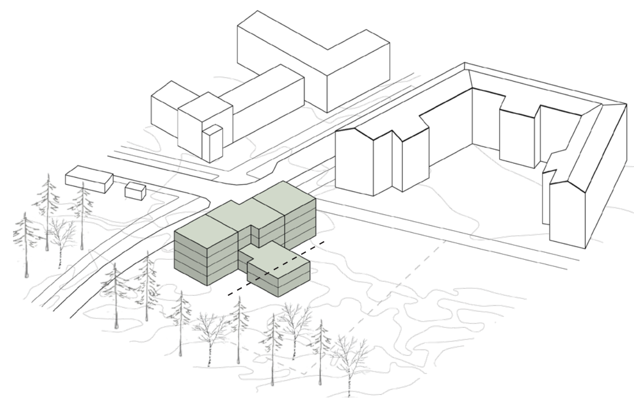
STEP 2. SENIOR

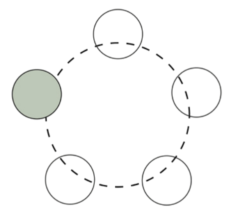
With the addition of two floors the volume is still lower than the surrounding buildings to not dominate in scale.



STEP 3. COLLABORATION

The horizontal addition is lower to avoid creating a barrier from the neighbour building in east to the forest in west.





PRESCHOOL

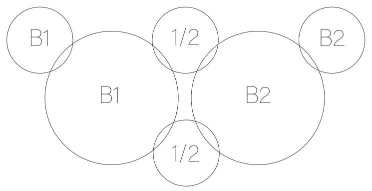
- step 1. current proposal -

To design a future proof preschool and prepare for transformations it is essential to apply a logic, repetitive organization with relatively simple spatial shapes. In a functional program produced by SKR, several conceptual standardized preschool organizations are presented (SKR, 2019). The concepts in the SKR are developed through research and are following the recommendations of the national agency for education. A decision was made to follow one of the presented concepts, concept C, and create a preschool with 3 identical units.

KONCEPT C
-2 floors
-approximately 108 children and 21 staff
-min 510 sqm educational space
-max 1400 sqm BTA
-3 units
-courtyard entrance on ground floor
-main entrance on ground floor
-cooking kitchen
-3 office spaces
-confidential chat room for 4 people

Figure 8. Specific requirements for prechool concept C (SKR, 2019)

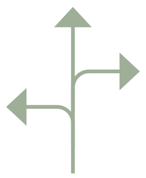
One unit is calculated for 36 children. It is recommended to divide the children in the unit in either two bases of 18 children or three bases of 12 children. The bases need some separate functions but can share some of the functions (SKR, 2019).



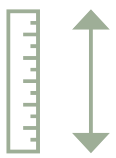
Organization of two bases, B1 and B2

IMPORTANT QUALITIES

rooms of different character for a versatile learning environment



easy orientation to create a feeling of familiarity and safety

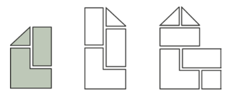


consider the hight and limitations of smal children

Program

BTA 1030 sqm

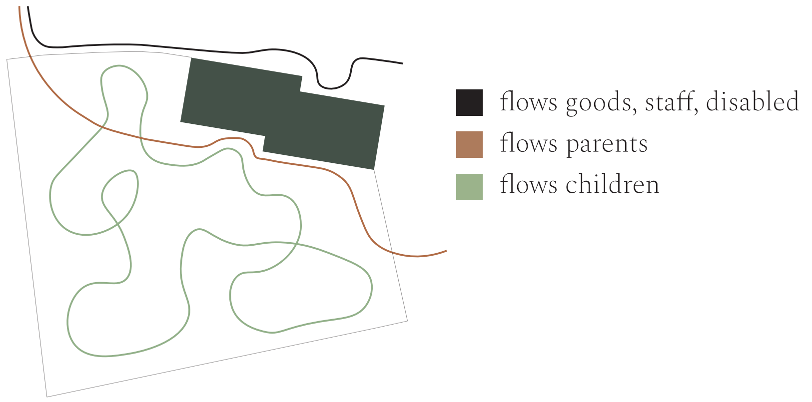
Outdoor Spaces	
yard	4000 sqm
recycling room	14 sqm
storage	6 sqm
Indoor Space	
canteen	68 sqm
kitchen	65 sqm
squere/worshop	57 sqm
staff	78 sqm
cloakroam	~ 20x3 sqm
entrance room	~ 18x2 sqm
home room	40x6 sqm
play room	14x6 sqm
resting room	12x3 sqm
washing station	13x3 sqm
storage	5sqm
play "cave"	6 sqm
cleaning room	3 sqm
technical	42 sqm



Site Plan

The preschool yard is located in connection to the forest in west. Some trees needed to be cut down for the construction of the building, but some were kept on the yard to provide the children with a natural green environment. Topography, a diversity of surface materials, attractions and zones are used to support the imagination of the children. The courtyard entrance (8) is used by the parents when picking up and dropping of the children, and by the children when moving between the indoor and outdoor space. The units on the second floor have their own entrance with an exterior staircase for easy flows. The accessible entrance (6) is used by the staff, goods and disabled people.

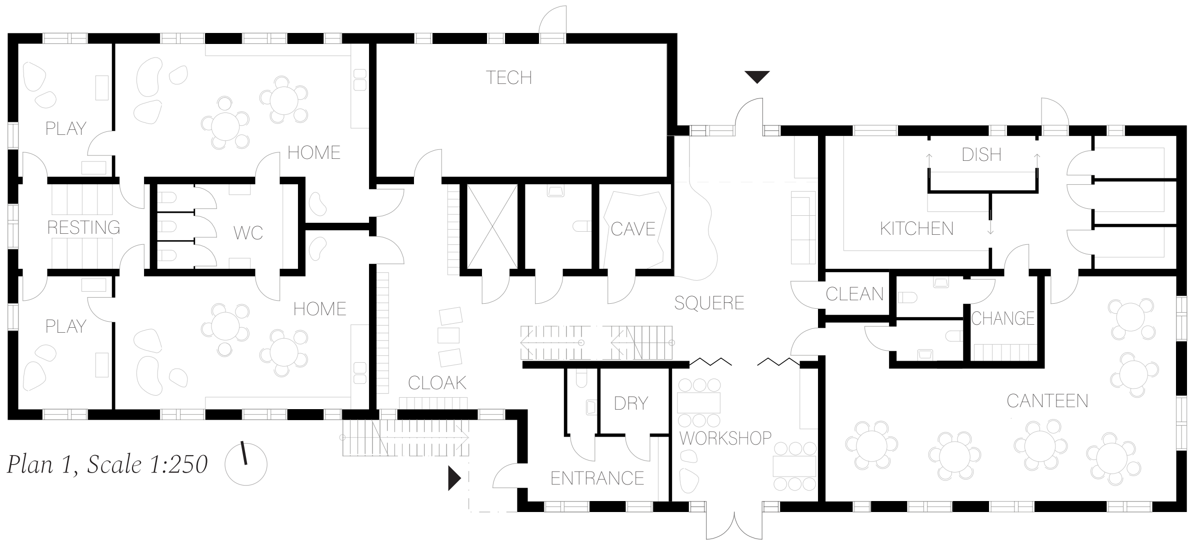
1. car parking for 14 cars
2. loading zone
3. bike parking
4. recycling room
5. storage for outdoor equipment
6. accessible entrance
7. kitchen entrance
8. courtyard entrances
9. workshop possible to open up
10. wooden deck with seating
11. nature play with logs and rocks
12. sand surface
13. barbeque
14. climbing slope
15. small hills
16. path in gradient for motor skills
17. shallow pond



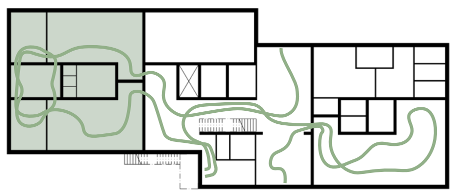
Site Plan, Scale 1:500

Ground Floor

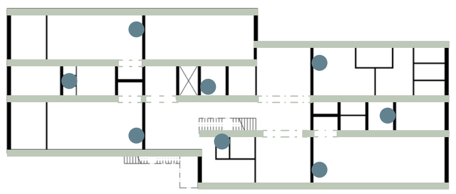
The ground floor of the preschool contains one of the three child units and some common space for all the units. The common rooms are of different character for a diversity of activities. There are possibilities for small gatherings in the cozy dark "cave", and to perform for a large audience in the spacious square, provided with an organic sitting bench which is having the additional function as a stage. The multifunctionality is extended by the possibility to open up from square to workshop to the exterior. The canteen where the children are having lunch is entered from the square, close to the staircase where children at the second floor are coming down. The placement of the staircase is providing the children with a central element in the building to orientate around.



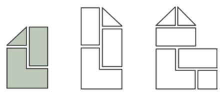
Plan 1, Scale 1:250



preschool unit and flows children



bearing walls and plumbing



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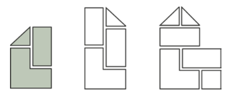
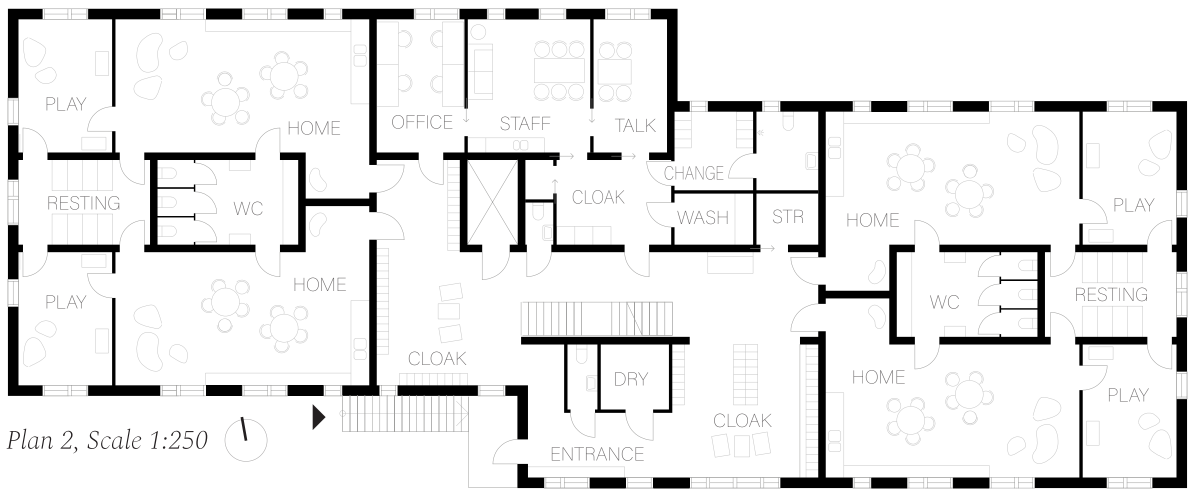
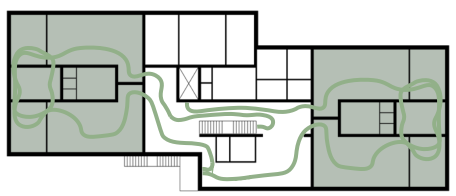


Second Floor

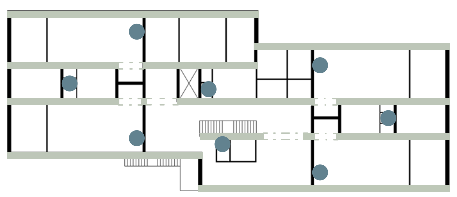
Two of the three units are located on the second floor. The units are having qualities such as a large number of windows, low enough for the children to get a good view, and circulation between the rooms. There is a limited use of dividing walls in the central part of the building, allowing for different kind of future reorganizations. The spaces are instead separated by diagonal movement, placement of furniture and the central staircase. The north part of the second floor is dedicated for the staff, separated from the area where the children move but with short distances to the units and to the vertical connection.



Plan 2, Scale 1:250

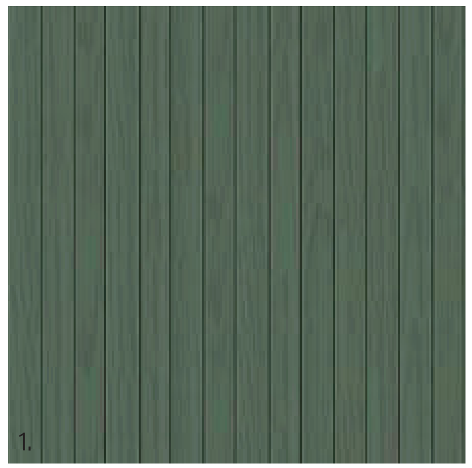


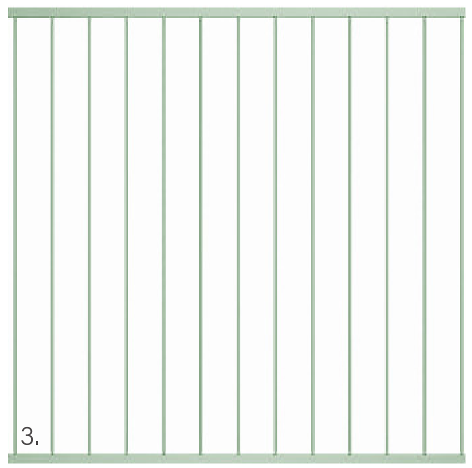
preschool units and flows children



bearing walls and plumbing

Materials





1. The dark green painted wooden facade harmonizes with the forest and relates to the exterior expression of the closest buildings.

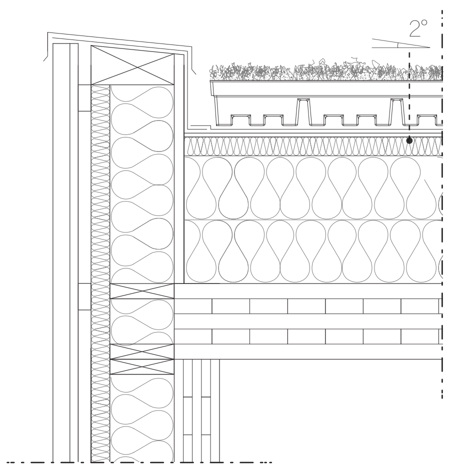
2. The sedum covered roof is providing a pleasant view for the higher surrounding buildings.

3. Exterior details such as window frames and railings are given a lighter green tone to create depth.

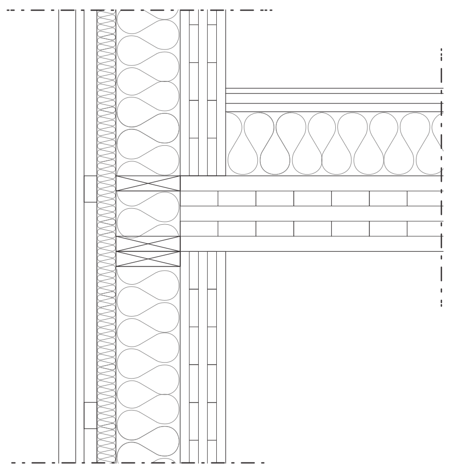
4. The CLT used in the construction is visible on some of the interior walls for a warm and soft expression.

Construction

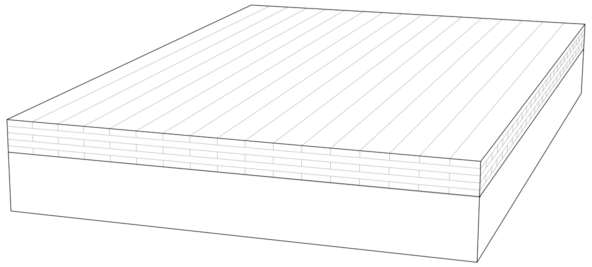
To prepare the building for future possible remodeling, the intermediate floor, roof and wall construction is built up by prefabricated plane modules possible to disassamble. The modules consist of a packet of CLT panels combined with insulation. The size of the modules varies depending on the building dimensions, with the biggest possible measurement of 3x5 meter. The thickness of the CLT layer and the isolation layer differ for the different building components as noticed in the detail drawing. On top of the roof, sedum modular roof trays are placed. Both the CLT and sedum modules are easy to disassemble and reassemble.



Wall - Roof, Scale 1:20



Wall - Int. Floor 1:20

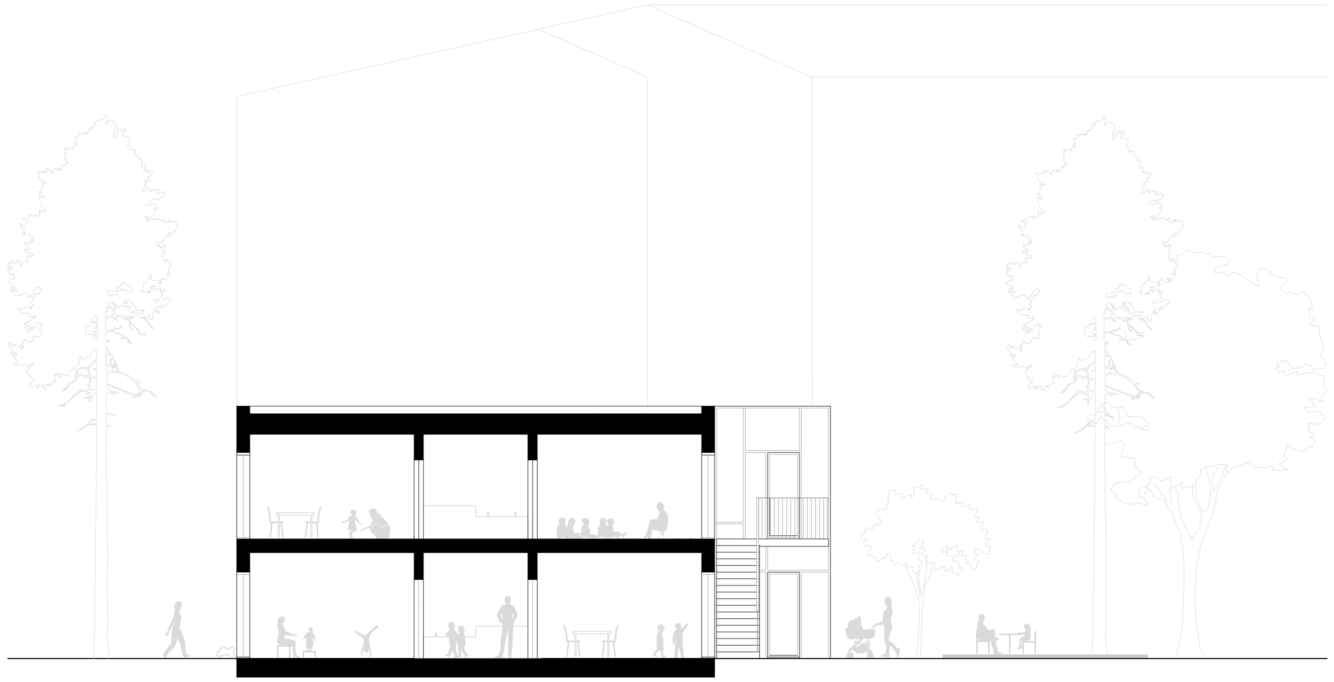


Plane Module

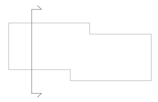
Facade and Section

The facade is based on a modular system of 0,3 meter units, where the window openings consists of either 2, 3 or 5 of the units, giving the window panes the width of 0,6 meter, 0,9 meter or 1,5 meter which is a combination of the two. The commonly used 0,9 meter windows are possible to replace with doors. The timber cladding is decorated with ribs in an irregular pattern to add playfulness. Most of the windows are placed 0,45 meter up from the floor, but the windows at positions suitable for future added balconies are going down to the floor.

West Facade, Scale 1:200



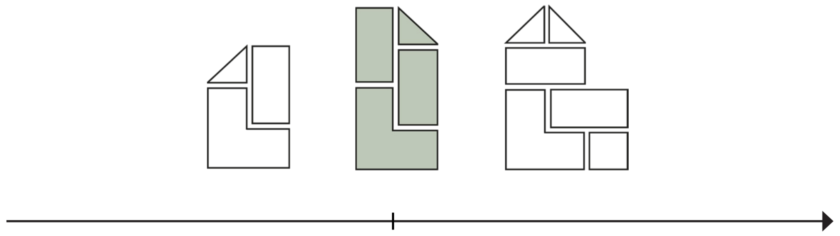
Section, Scale 1:200



The generous floor to ceiling hight of 2,85 meter is selected to ensure that the building can remain usable and possible to transform to host other functions in case of changed height regulations further on.

SENIOR HOUSING

- step 2. first transformation -

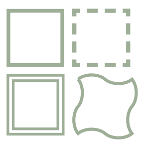


In the first transformation after 15 years, the preschool is transformed into a senior housing. Some rooms will be kept the same, but some will be given a new function. Floors will be added above the existing construction to provide more apartments, in total 19 apartments, which make the use of the common space more efficient.

The amount of elderly in currently increasing which entails a rising need for housing that meets the demands of the elderly. In Sweden, a division of three different kind of housing for elderly has been made; called "seniorboende", "trygghetsboende" and "äldreboende" (SKL, 2016). The difference between them is the level of service offered. The service required for the "trygghetsboende" is in-between the other two. It is the selected type for this design proposal and will here be entitled "senior housing". A senior housing consists of ordinary apartments without round-the-clock care. The focus is on security and community with access to common areas and activities for the inhabitants. It is preferable to provide possibilities for interaction and social spaces of different character and spread out in the building. On site, during certain hours, is a scheme manager who arranges activities and offers support with practical tasks in the property. It is recommended to provide the senior housing with extended accessibility.

IMPORTANT QUALITIES

communication area used for functions rather than corridors



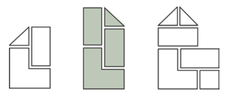
social spaces with diverse characters and levels of privacy

consider accessibility and limitations of disabled people

Program

BTA 2060 sqm

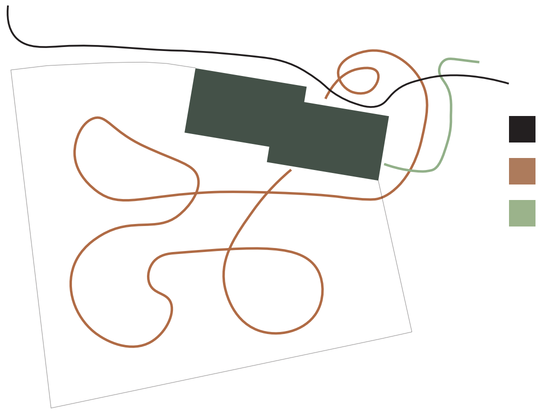
Outdoor Spaces	
yard	4000 sqm
recycling room	14 sqm
storage	6 sqm
Indoor Space:	
restaurant	68 sqm
kitchen	65 sqm
communication	~40x3 sqm
foyer	65 sqm
staff	48 sqm
rentable office space	30 sqm
common living room	42 sqm
rentable room	42 sqm
apartment 3rok	73x7 sqm
apartment 2rok	60x7 sqm
apartment 1rok	42x4 sqm
studio apartment	35x1 sqm
storage	60sqm
cleaning room	3 sqm
technical	42 sqm



Site Plan

The size of the preschool yard is kept which implies a generous yard for the seniors. The entrance i north (6) is used as the main entrance by the senior while the previous courtyard entrance is closed off and the outdoor staircase is taken away. The seniors are instead using the previous workshop connection to the exterior as a courtyard entrance (8). Many of the attractions from the preschool yard are unchanged and can be used by the seniors as well. For instance, is the path in gradient (10) useful for the seniors to practice monitoring of walkers and wheelchairs. A few new attractions are added such as boulodromes (11) and farming boxes (12). The former preschool canteen is turned into a restaurant welcoming not only the inhabitants but also seniors from the neighborhood. A new entrance with direct connection to the restaurant is created in east and a wooden deck for outdoor seating is built (9).

1. car parking for 14 cars
2. loading zone
3. bike parking
4. recycling room
5. storage equipment
6. main entrance
7. kitchen entrance
8. courtyard entrance
9. outdoor seating restaurant
10. path in gradient
11. boulodromes
12. farming boxes

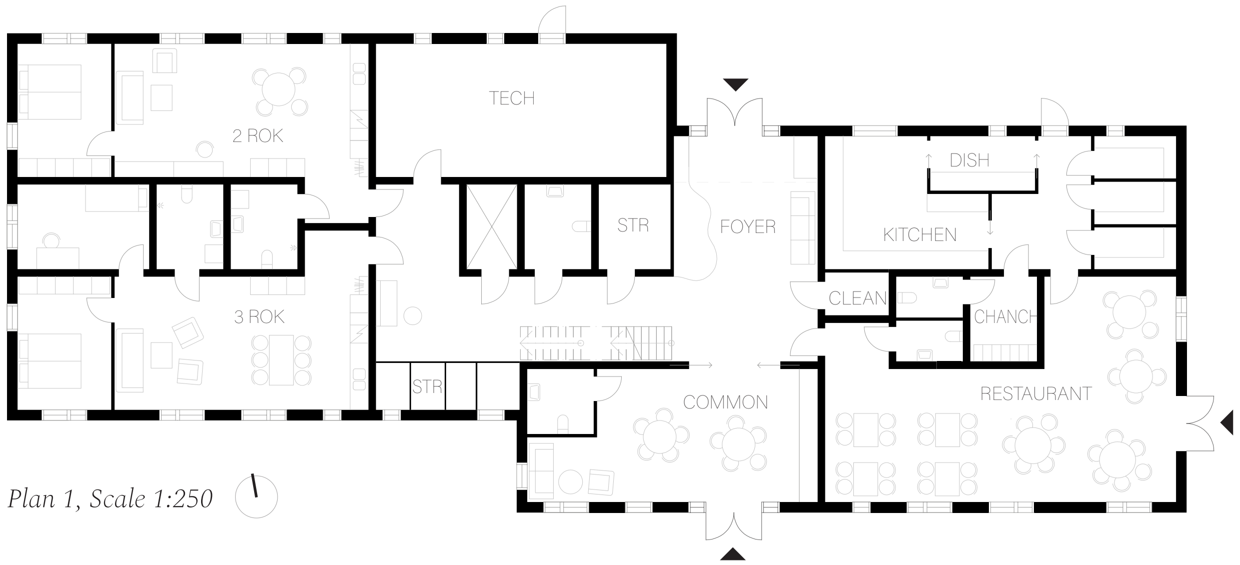


flows goods, staff, disabled
flows seniors
flows restaurant guests

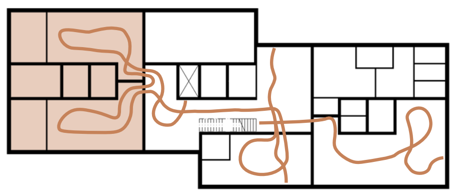
Site Plan, Scale 1:500

Ground Floor

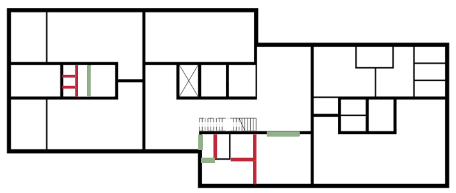
When entering the building the seniors are met by a generous foyer. The foyer offers opportunities for spontaneous meetings and a nice place to sit down when waiting for transportation service or recuperate after taking the stairs. The staircase is placed in focus and closer to the entrance then the elevator to encourage the seniors to choose the staircase and achieve daily exercise. The organic shaped sitting bench is kept in the foyer which entails a large amount of seating. The foyer is in close connection to the common living room with the possibility to leave the sliding doors open. This is to lower the threshold to join social activities. The restaurant located in the building is open for the public but is primarily focusing on seniors. The inhabitants of the senior housing have advantages in the restaurant and a direct entrance from the foyer.



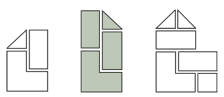
Plan 1, Scale 1:250



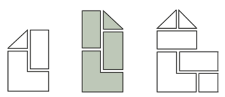
apartments and flows seniors



removed and added walls

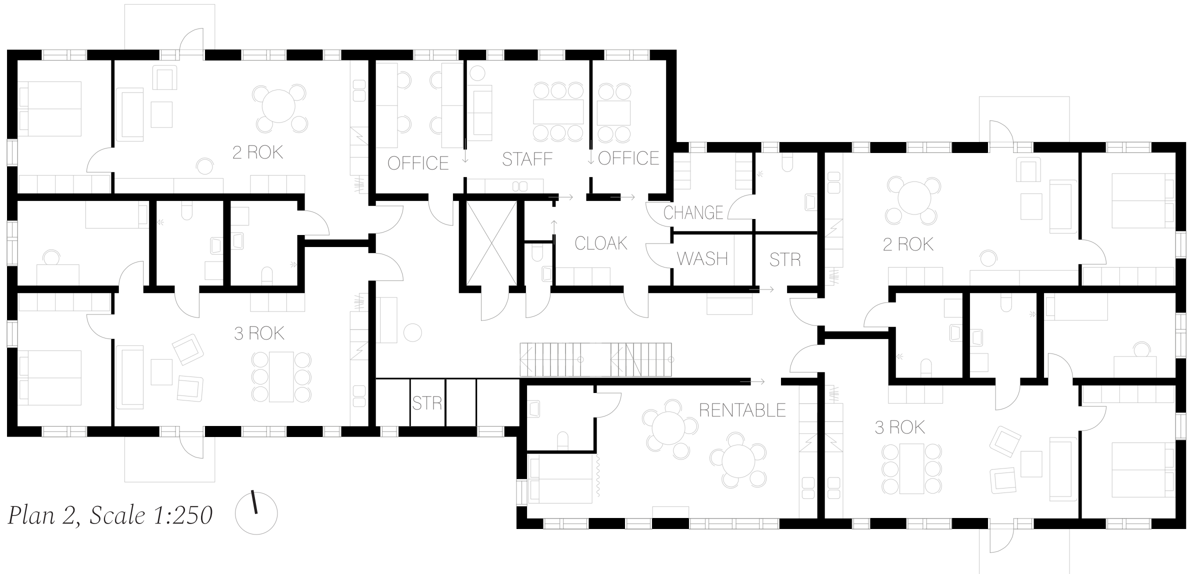


The Foyer

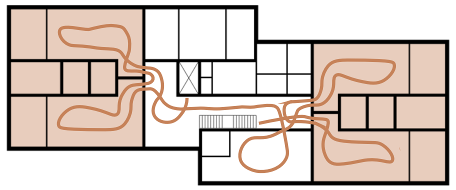


Second Floor

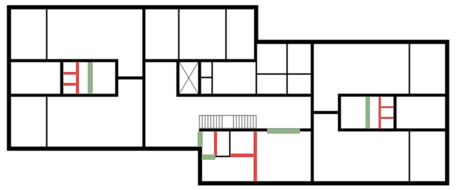
The communication space, where the vertical connection is located and the other functions are reached from, is provided with generous measurements to be used for more than as a corridor. Here is spontaneous socialization encouraged where the neighbors can sit down together. The room facing the yard is used as a combined rentable local, where the inhabitants can host events, and overnight apartment where friends and family of the inhabitants can stay over. The layout of the staff area is kept from the preschool and used by the scheme manager, but one of the offices can be rented out.



Plan 2, Scale 1:250



apartments and flows seniors

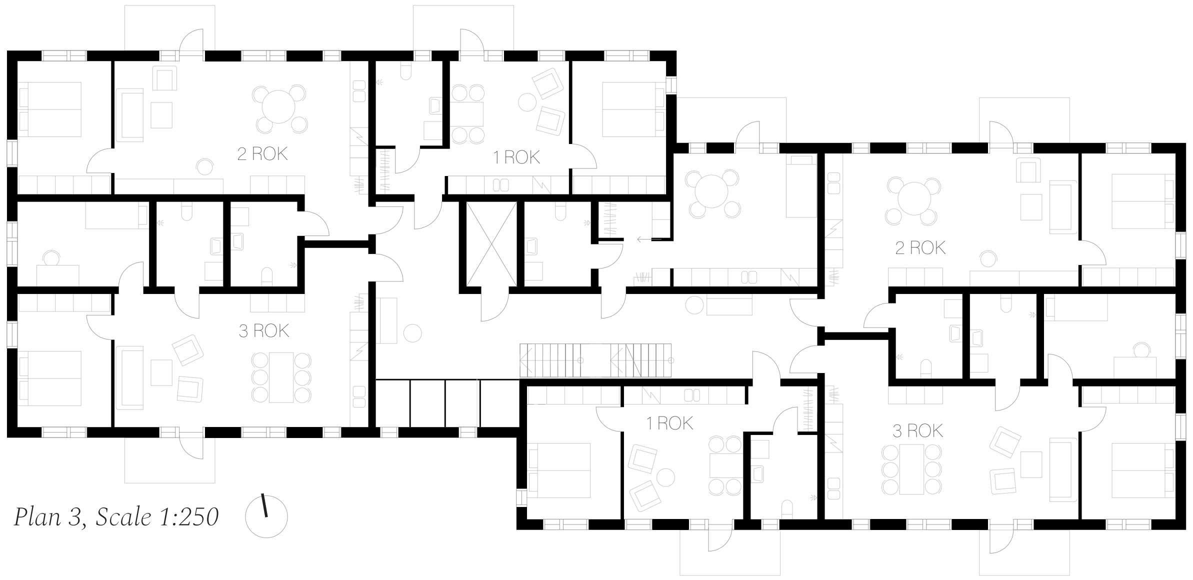


removed and added walls

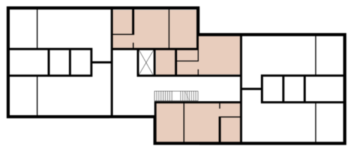
Third Floor

The senior housing is offering four different sizes of apartments where extended accessibility is applied in all of them. The two smaller apartments are mainly for single households. The “studio” apartment is based on one room while the slightly bigger apartment contains a separated bedroom. The two bigger apartments are primarily for couples, the difference between the two apartments is the additional bedroom/office in the larger one. Generous measurements and open plan between kitchen and living room is applied to allow for convenient accessibility and various furnishment options. The possibility to divide rooms to crate separated kitchen and living room or two smaller bedrooms is considered in the placement of the windows.

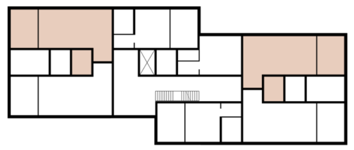
The fourth floor has a similar layout as the third floor except from the addition of apartment storage placed above the studio apartment.



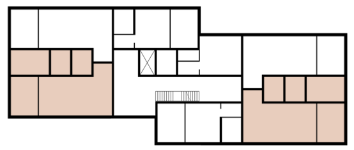
Plan 3, Scale 1:250



apartments 1 rok - 35/42sqm



apartments 2 rok - 60sqm

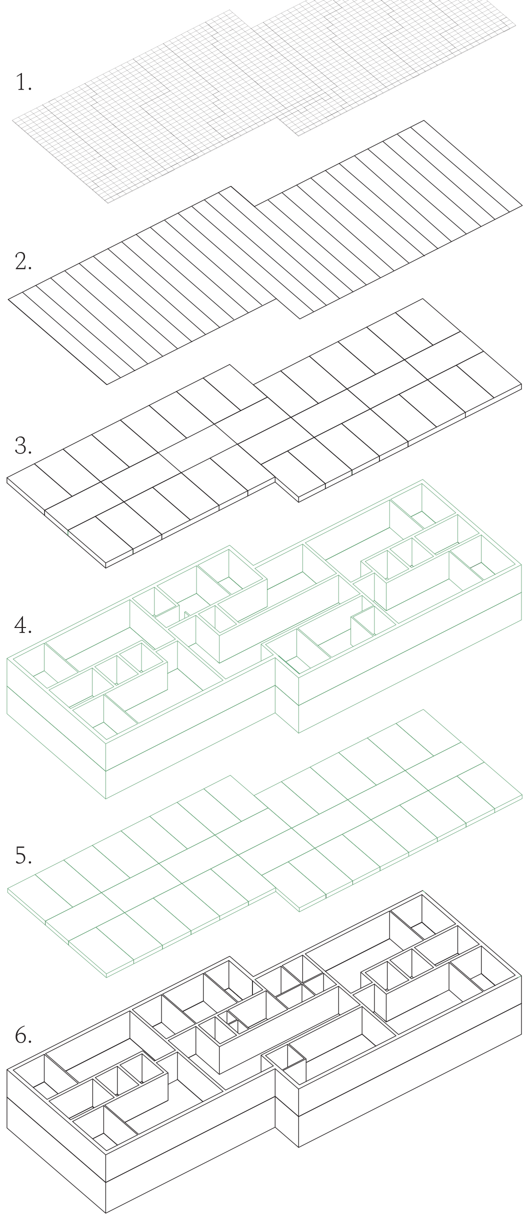


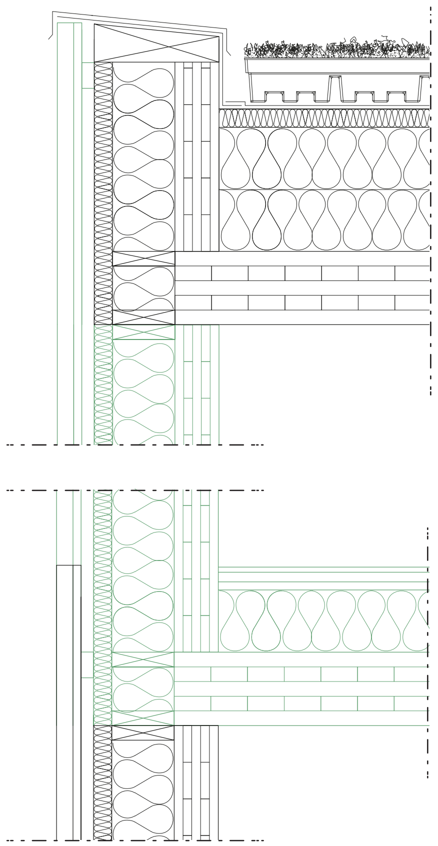
apartments 3 rok - 73sqm

Structural Strategy

Due to the modular structural system, it is possible to disassemble and reassemble the roof. The method is applied when two additional floors are added to the former two-story building. The roof is taken down piece by piece and replaced by an intermediate floor of prefabricated modules, similar to the one used in the preschool to separate the first and second floor. Then two more floors are added following the same wall and floor structural principle. Finally, the roof pieces are reassembled on top of the four-story building. It might be necessary to exchange the tar paper and some of the sedum trays depending on circumstances such as weather conditions.

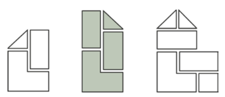
Green = Existing
Black = Added



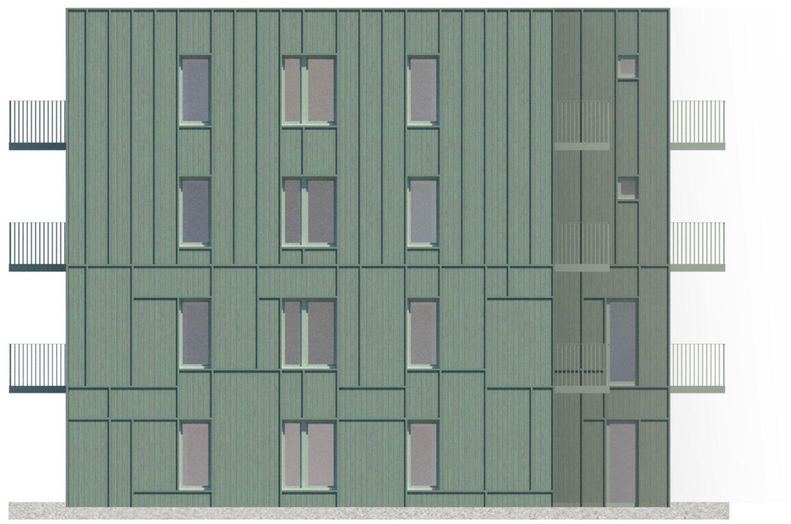


Black = Existing *Green = Added*
Scale 1:20

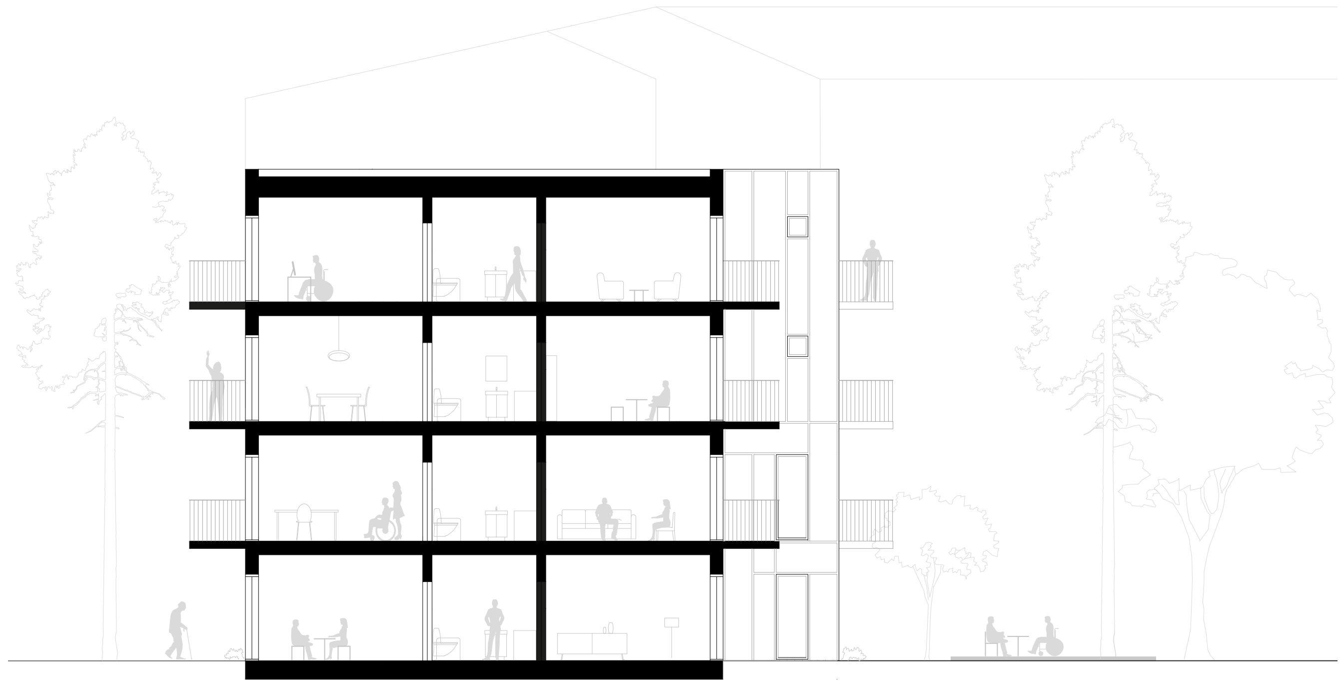
1. sedum roof trays 0,37x0,57 m
2. tar paper 1,5 x12 m
3. prefabricated roof modules
   structural roof + insulation ~ 3x5 m
4. two additional floors
5. prefabricated int. floor modules
   CLT + insulation ~ 3x5 m
6. two existing floors



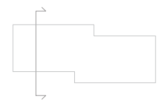
Facade and Section

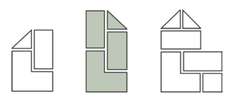


West Facade, Scale 1:200



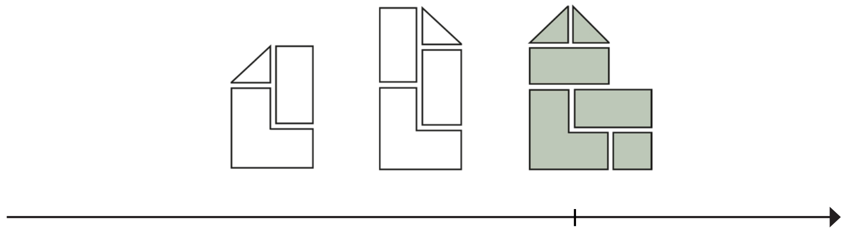
Section, Scale 1:200





COLLABORATION HOUSE

- step 3. second transformation -

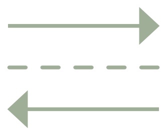


In the second transformation after 30 years, the senior housing is transformed into a collaboration house. An extension horizontally is added to allow keeping almost all the apartments, except from two, when reestablishing a preschool of the same size as the original one. The collaboration house will consist of 17 apartments and 3 preschool units.

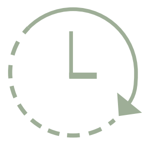
To combine locals for elderly and children is an upcoming concept in Sweden. The first collaboration house opened in year 2017, and five new houses have been established during year 2020-2021 (Elg & Lundin, 2020). Preschool and senior housing have been considered appropriate to combine as the requirements for the two functions have similarities. Both the functions require food distribution, space for staff and gathering spaces of different character, both outdoor and indoor. Furthermore, similarities have been noticed in child-friendly and elderly-friendly architectural design, such as easy orientation, natural light, clear color scheme and low windows. Low windows are beneficial for children and seniors in wheelchair, but also for those spending a lot of time sitting and laying down. There are sustainability related benefits of combining the functions. The local efficiency is linked to both economic and environmental sustainability advantages and the interaction between different age groups is promoting social sustainability. The hope is that the interaction will imply that the children gain knowledge from the seniors at the same time as the playfulness and movement of the children inspire the elderly.

IMPORTANT QUALITIES

interaction and exchange between seniors and children



separable flows and possibilities to disconnect functions from each other

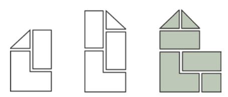


efficient use of common space in different ways on different hours

Program

BTA 2460 sqm

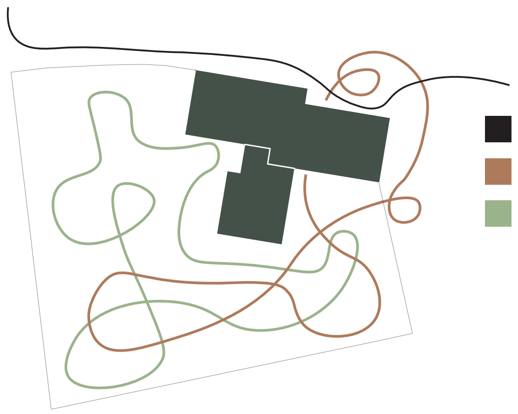
Outdoor Spaces	
yard	4000 sqm
roof terrace	200sqm
recycling room	14 sqm
storage	6 sqm
Shared Space	
restaurant/canteen	68 sqm
kitchen	65 sqm
foyer/squere	58 sqm
staff	78 sqm
common room/workshop	40 sqm
rentable room	37 sqm
cleaning room	3 sqm
Seniors	
apartment 3rok	73x6 sqm
apartment 2rok	60x6 sqm
apartment 1rok	42x4 sqm
studio apartment	35x1 sqm
communication	~ 40x3 sqm
storage	55 sqm
technical	50 sqm
Children	
cloakroom	~ 20x3 sqm
entrance room	~ 18x2 sqm
home room	40x6 sqm
play room	14x6 sqm
resting room	12x3 sqm
washing station	13x3 sqm



Site Plan

The yard is now shared between the seniors and children. The children are allowed on the whole yard, but for special occasions it is possible to divide the yard to screen off a small peace for the seniors (14). The seniors are supposed to yield to the children when spending time on the yard during daytime, during the evenings and weekends they have the whole yard at their disposal. A tiny hang out area outside of the fence is added for only the seniors to use. Above the new extension is a roof terrace established, the roof terrace is mainly used by the seniors, but can occasionally be borrowed by the preschool. The entrance in west is back in use for children and parents to use (9). The main entrance for the seniors (7) is also utilized by staff, goods and disabled people related to the preschool.

1. car parking for 14 cars
2. additional parking for 5 cars
3. loading zone
4. bike parking
5. recycling room
6. storage equipment
7. main entrance seniors
8. kitchen entrance
9. entrances children
10. courtyard entrance senior
11. outdoor seating restaurant
12. hangout seniors
13. roof terrace
14. possibility to divide yard

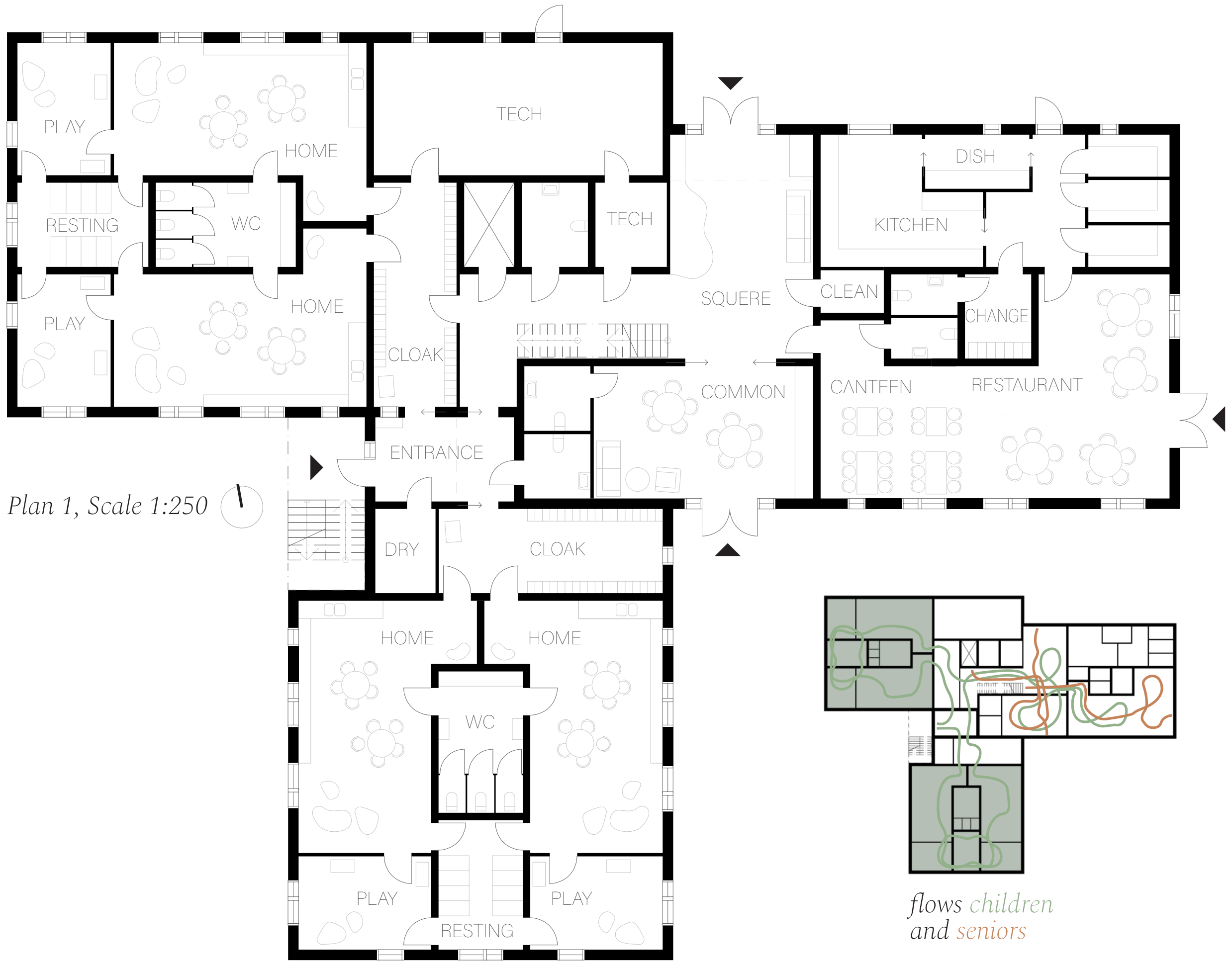


flows goods, staff, disabled
flows seniors
flows children

Site Plan, Scale 1:500

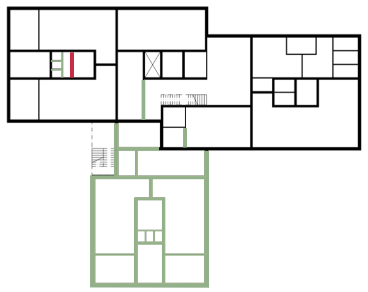
First Floor

It is essential to find a balance between shared and separated spaces in a collaboration house. Separate entrances are provided, and the most frequently used flows are not crossing. The common room/workshop and the combined canteen and restaurant can be scheduled. The squere/foyer is mainly used by the seniors but is also a place for interactions and performances. As a shoe free interior zone is required for the children, the seniors are expected to take their outdoor shoes of when entering the building. The shoes can be placed in a storage next the main entrance or brought to the apartments. This will strengthen the function of the communication area as an outer living room.



Plan 1, Scale 1:250

flows children and seniors

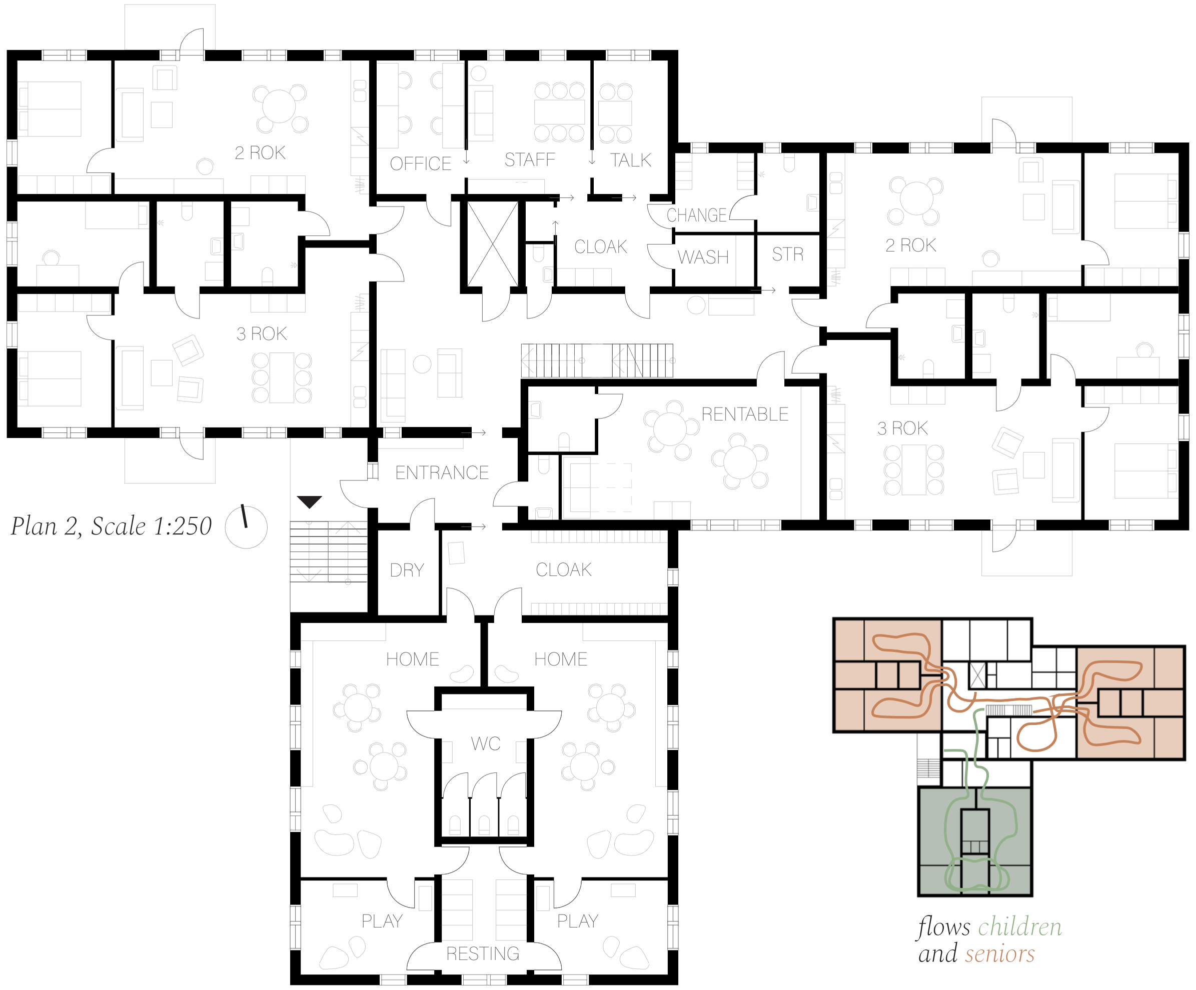


removed and added walls

The Squere/Foyer

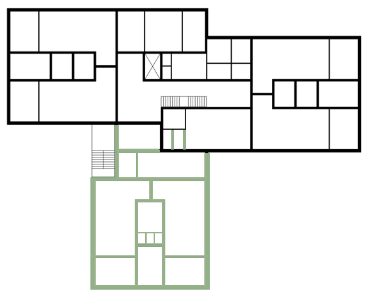
Second Floor

The communication space outside of the senior apartments is dedicated primarily for the seniors and the staff. As the preschool unit has a direct entrance with an exterior staircase it is possible to screen off the area where the children spend their time on daily bases completely. The preschool is only occasionally borrowing the rentable room. The staff area is shared between the preschool staff and the scheme manager for social and functional interaction.

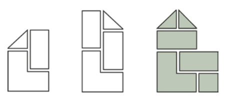


Plan 2, Scale 1:250

flows children and seniors



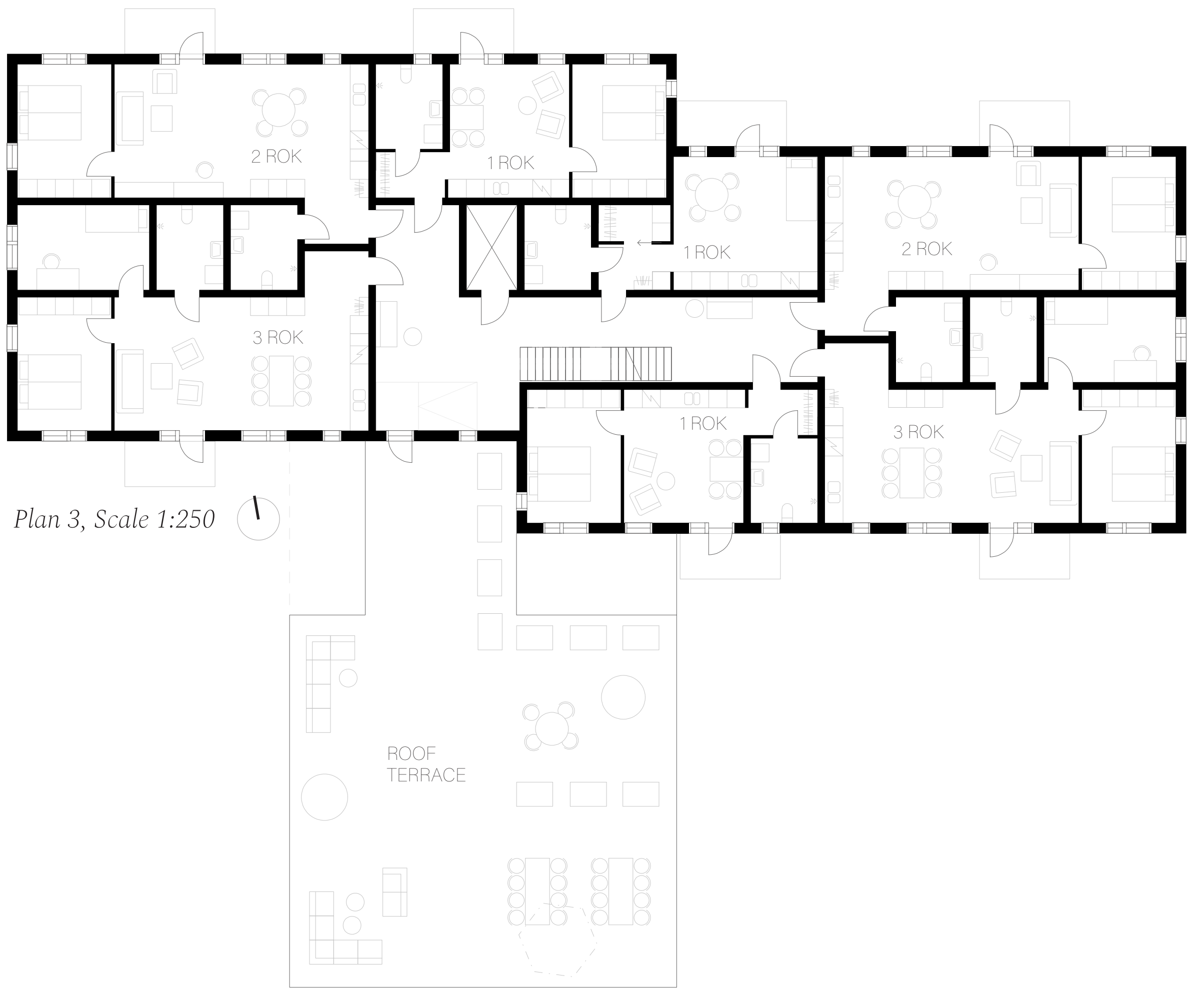
added walls



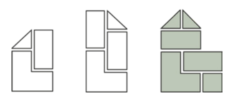
Third Floor

The third floor is unchanged since the senior housing layout except from the addition of a roof terrace on top off the two-floor high building extension. The preschool is not operating on the third floor and the big terrace is mainly used by the senior. It is working as a calm, complemental outside area to the shared yard. The terrace is offering diverse constellations of seating, green elements, farming boxes and a combination of sun and shadow. Occasionally the preschool can borrow the terrace.

The fourth floor is unchanged since the senior housing layout.

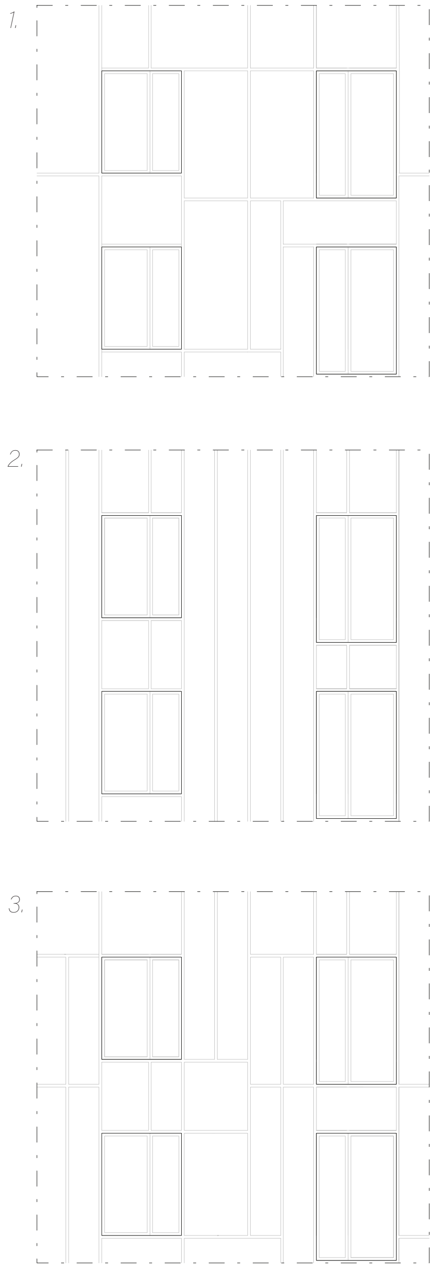


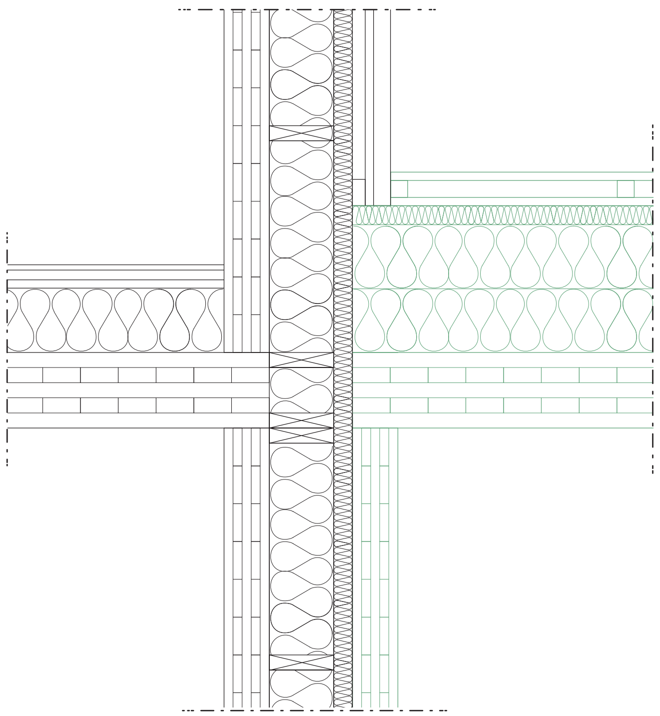
Plan 3, Scale 1:250



Exteriour

It is possible to disassemble and reuse the wooden exterior panel. The system is applied on a segment of the south facade when the extension is added. The exterior expression of the extension is chosen to have a rhythm with tighter measurements, rather than the opposite, in order to be able to reuse the disassembled panels without visible joints.

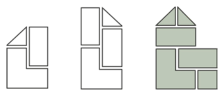




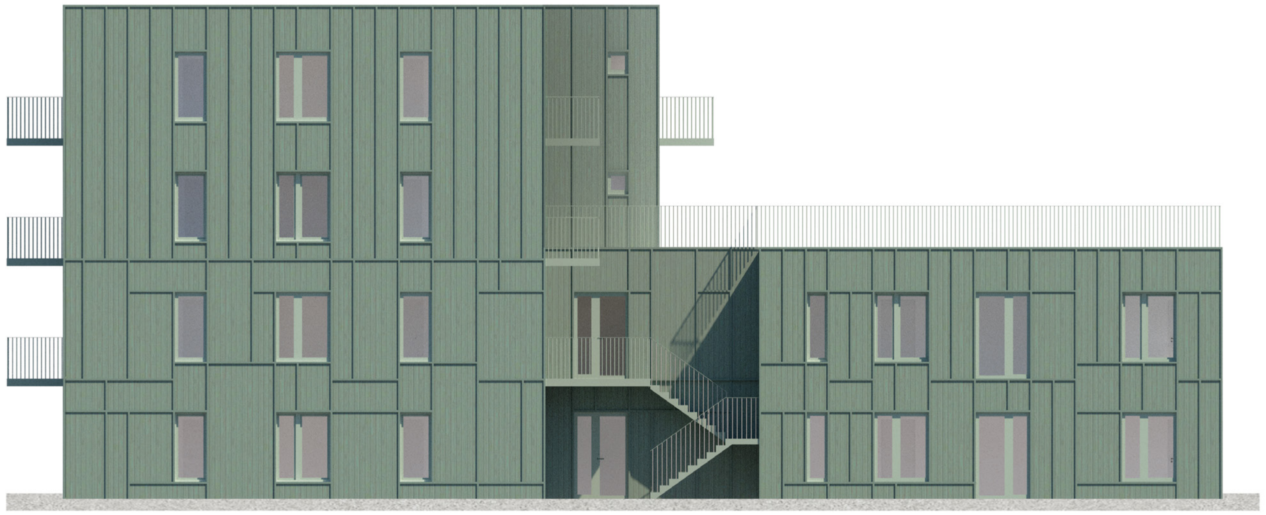
Black = Existing
Green = Added
Scale 1:20

1. rythm original building
2. rythm vertical extension
3. rythm horizontal extension

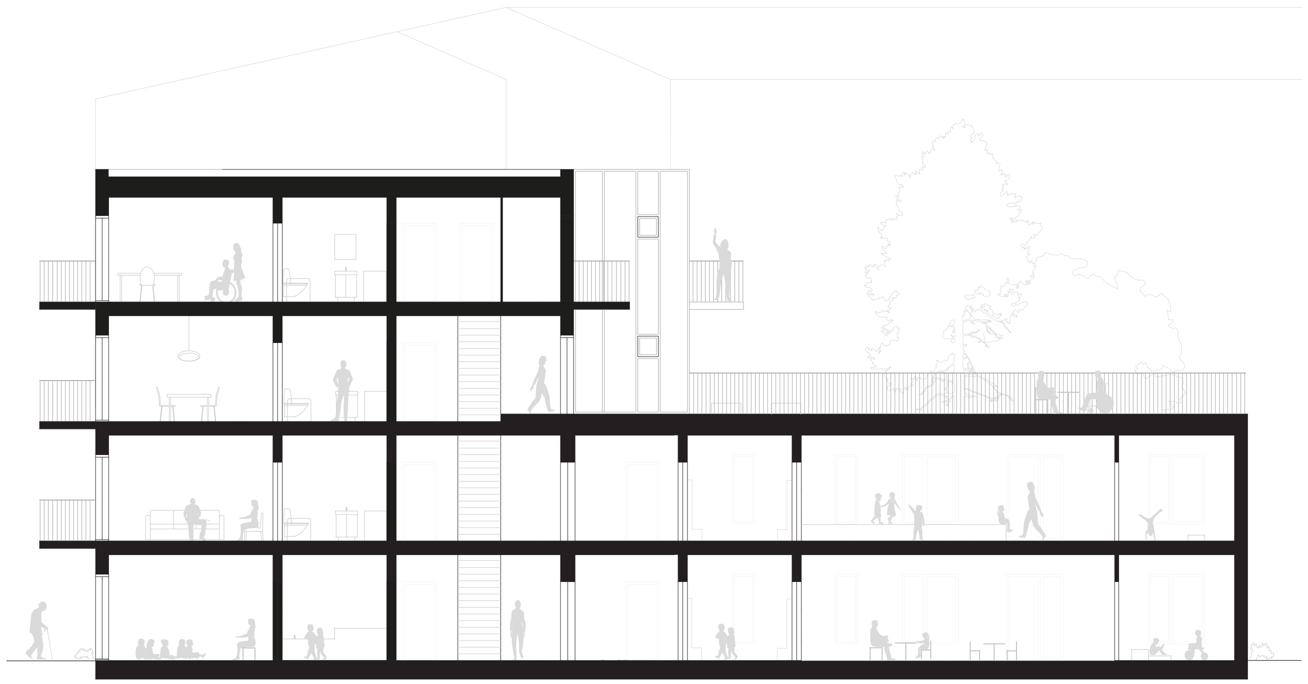
Scale 1:150



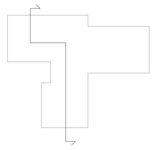
Facade and Section

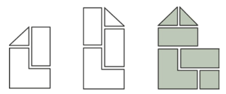


West Facade, Scale 1:200



Section, Scale 1:200





07.

CLOSURE

The findings and conclusions of the thesis are discussed in this chapter, and the references are presented.

DISCUSSION

Adaptable architecture is a broad field with lots of layers. Many of those layers are not often studied in the current architectural field. There are rarely room for or time enough to consider more than the current usage of a new building. Neither is the current planning and building permissions system developed to include the future perspective. By normalizing and spreading knowledge about adaptability strategies within architecture it will be easier to apply them, both in the design and in the planning process. Furthermore, the stigma of an adaptable building as an extra expensive building, based only on standardized modules or with advanced technology, can be removed. The thesis has been conducted through research by design where the development of the design proposal has affected the gathering of relevant adaptability related research, while the final design has the function of showcasing the findings. Scenario planning is applied to an extreme level where the future potential transformations are developed as detailed as the original design. This is not promoted as a strategy to apply in the initial design of all new projects, but it aims to encourage analysis of possible future scenarios related to the specific context and to demonstrate the sometimes short time cycles of changed requirements.

Adaptability for future changed usage, which is treated in this thesis, should not be mixed up with flexibility related adaptability. Flexibility is often considered within the same type of building, for instance changeable room layouts within housing. Optionally back and force between two functions, for instance when a building is designed to function both as an office and housing. There are recommendations regarding suitable measurements and building layouts to achieve those flexibility related adaptability qualities. Through the work with this thesis, a discovery was made that adaptability strategies for future changed usage can look very different. The strategies useful in one type of transformation can be useless for another. Standardized measurements, structural systems, and organizations suitable for all types of buildings are difficult to gather. The balance between applying a soft use design approach with loose fit characteristics or a hard use design approach with tight fit characteristics is determined by the context. If adaptability will be handed over to the users or kept as a concern for the designers and planners effects the suitable strategies too. Specific tools are therefore not presented, but the earlier displayed design strategies developed for the design proposal can act as guidelines. Following relevant aspects are collected from the design startegies and the analysis conducted within this work.

System Based Base the building structure of independent system based layers and a balanced and spread-out number of service locations.

Extra Space Overdimension and provide extra space instead of using minimum measurements. Rank where the additional space is more or less useful.

Regulations Do not only work with current regulations. Consider future possible changes and optional solutions for the users to apply.

Organization Categorize different functions within a building in more or less specific and consider the placement in relation to cores and communication.

CONCLUSION

The aim of this thesis was to investigate approaches to design adaptable architecture, prepared to easily be changed and transformed in the future to meet new circumstances. Two research questions were formulated treating adaptability issues related to unexpected changed requirements and outdated buildings. The work generated following conclusions.

How can buildings be prepared to be adapted to future possible changes in order to meet new requirements?

Adaptability in architecture is not a universal concept. This is substantiated by the studies conducted where a huge diversity of adaptable buildings and tools have been observed. How to achieve adaptability qualities vary depending on circumstances, context and building type. It should not be strived to apply as much adaptable preparation as possible in all buildings which might harm rather than gain the sustainability qualities of the building. Consequently, all architectural projects need to have their own adaptability design strategies, based on the context and the circumstances related to the specific project. The choice of hard or soft use design approach should be considered, a balanced approach with elements from both is considered preferable.

How can the initial design prevent unnecessary demolition and waste of materials?

By applying scenario planning in architectural projects, an insight into the long-term effects of the choices made in the initial design phase is created and creative adaptable solutions can be implemented. This can be a valuable tool when developing and ranking adaptable approaches to utilize. The result is a building that learn together with the surrounding. It might be transformed, recieve a changed appearance and exchanged parts. Due to the consideration in the initial design, useful material is not wasted, and the building stays functional. We cannot predict the future, but we can do careful analyzes of the context and its inhabitants; today, historically and expected development, to prevent that a building gets out of date.

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