

# House in a Day

*The usage of modular architecture to aid in reducing  
the Dutch housing shortage*

***Graduation Studio***

***Research plan***

M4H Area Rotterdam

Modularity

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# 1. INTRODUCTION

In the past few years, the housing crisis has become an increasing problem globally. This issue is not as simple as it seems and is a problem that consists of political, economic and physical factors. (Lengkeek & Kuenzli, 2022)



Figure 1: Protest organised for the housing crisis. (Redactie, wonen, 2021)

Affordability has become a topic which is the focal point in the Dutch discussion about the housing crisis. The majority of the people are unable to find a place to live, the waiting lists are multiple years if you are looking for social rent, buying is out of the question unless you have 2 high earners and private rent has become too expensive and scarce. As stated earlier this issue is extremely complex and has multiple actors. There is simply too much demand and too little supply (in the areas that are desired). On top of that material prices are rising incredibly fast due to supply chain shortages which were amplified by the COVID pandemic.

The target group that is being hit the hardest during this housing crisis are starters and single-person households. These groups which overlap, are in dire need of affordable and qualitative living spaces but due to financial constraints (high land price, high entry barriers), they are unable to find good homes that fit their living need. According to Hoppesteijn (2012) the elderly, a group of people with the age of 65+, will have an increase of almost 30% from 2012 until 2035, this means the increase in elder homes and 1 person-households are important.

# 2. PROBLEM STATEMENT

The **housing market** is **under pressure** as it has become unable for the majority of starters and single-person households to acquire a home. This is due to **political**, **economical** and **practical factor**. This paper will research the long-term and short-term solutions to this problem but also with a design aspect.

Almost every industry has had automation become a part of its supplychain, automotive industries produce their vehicles in a factory, and the electronic industries produce their products in a factory. Architecture/housing has lacked this innovation of automation on a large scale.

The modular architecture is a kind of architecture that utilizes modules which are built off-site and put together on-site to speed up the building process. Although this kind of building is being used on smaller scales it could be a possible way to have an impact on how fast we can build and help in reducing housing shortage on the short term.

So with this paper, we want to research how modular homes can be used as a way to make affordable and housing that is sustainable not only for environmental standards but also for an ageing society. Modularity brings more advantages besides building faster or cheaper it also makes the building process more efficient as there is 60% less construction waste (Jaillon et al, 2009)

The research question that emerges from the problem statement and the relevance is:

***How can modular homes help in solving the housing crisis in the Netherlands in terms of affordability, scalability, and sustainability?***

### 3. METHODOLOGY

To answer this question a literature review will be conducted to find the answers to a set of research questions. These questions are described at the end of this chapter.

Chapter 1 begins with the definition of the housing crisis that the Netherlands is facing at the moment. Furthermore the chapter will explain how this housing crisis can occur and which factors play a role in this housing crisis. The factors will be divided in 3 types: political, economical and physical. These will be explained by performing a literature review which will give an overview of the main problem and what the reasons are for this problem.

Chapter 2 focusses on modular architecture. This research wants to explore how modular architecture can help in reducing the housing shortage. This means it is important to know the definition of modular architecture. The chapter will discuss a brief historical analysis about modular architecture. Afterwards it will give an insight in what different types of modular architecture there is and what the positive/negative outcome is for using this type of architecture. The questions that will be answered in this chapter are: What are the pros and cons of modular architecture? How can modular homes be built in an affordable, scalable, and sustainable way? This is done by literature review but also by interviewing existing companies who deal with this type of architecture.

Chapter 3 is divided into 2 parts, part 1 deals with the housing need of starters, students and elderly. This is because the preliminary research and the studio work shows this is the target group that fits the site and also the modular typology. This chapter will be using literature reviews about the living needs of these specific target groups.

In the second part the political and spatial constraints that come with modular architecture is discussed.

The main question that this chapter will answer is **How can modular homes be used**

to fulfil living demands for starters, students, the elderly, and makers? (how can you work with the constraints modular homes bring with them?)

In Chapter 5 the research will look to real-life examples that can be used as a case study. These examples show how modular architecture is used for the desired target group in its own context.

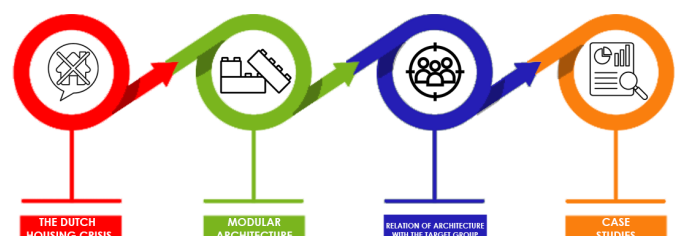
These case studies give a bigger insight in the way a design can be articulated using modular design. These case studies will be analyzed by using plan analysis and contextual analysis (how?, when?, why?).

The case studies that will be studied are: **Nakagin Capsule Towers, Raines Court, Keetwonen Amsterdam, Startblok Riekerhaven, Keramus, Nest toolkit.**

This theoretical framework will provide a better understanding of the housing crisis, modular architecture and how to create qualitative dwelling for the proposed target group. This output will be implemented in the design of the graduation studio.

Research questions:

- What are the factors that play a role in the Dutch housing crisis? Political? Financial? Physical?
- What are modular homes and what types are there? What are the pros? What are the cons?
- How do you design a modular home to be affordable, sustainable, and scalable?
- What are the challenges of using modular homes in the Netherlands and what are their solutions?
- How can modular homes be used to fulfil living demands for starters, the elderly, and makers? (how can you work with the constraints modular homes bring with them?)
- Case studies of modular homes



3 Figure 2: Diagram which shows the theoretical framework (Made by author)

## Theoretical Framework

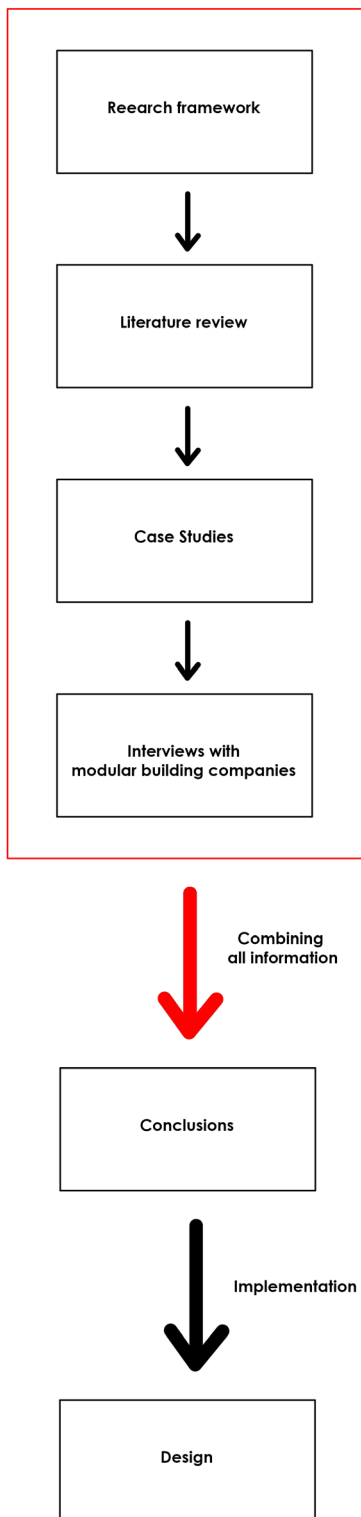


Figure 3: Diagram which shows the research framework (Made by author)

## 4. RELEVANCE

Although there are papers on the subject of modularity and creating housing quickly by using this typology, these researches tend to focus more on the technical aspects than the societal or political aspects. The housing crisis has been proven to be a problem which has factors on multiple levels. Due to this being a multiple faceted problem it is important to have research that covers modularity on all these different fronts.

It is immediately clear in this research that modular architecture obviously has economical benefit/value, but there is much more to it than only having an economical value. If used correctly and on a larger scale it can have an environmental value as well as using modularity reduces waste and creates a certain circularity in the building process.

This research also focuses on how a designer can think about creating spaces where students, elderly, starters and makers can work/live together. This research can have a societal impact or contribution.

Raworth (2018) brings an important point forward as she states that for a large period in time industry is focused on generative design. This means resources from earth are used to produce something and at the end we throw it away. But this system has a negative effect on the earth as it is finite. There needs to be a change in our industrial system to a regenerative design. This means you have a system that is circular where once waste is the other's resource.

This topic and research can contribute to this point, as there are modular ways of building that enforce this regenerative design but also from a programmatic standpoint where production and living can be programmed in a way that it is functioning as a circulative economy.

## 5. PROGRAM

The problem statement consists of 2 elements. One is the housing shortage and the other is the lack of efficient automatization in the field of architecture. For the design assignment that is part of the graduation project the proper program needs to be found.

If we look at the composition of the neighbourhood next to the site, only 11 % of the habitants are elderly and more than 50% is a single-person household. As stated in Rotterdams prognosis, there needs to be more living space for the elderly, especially 1 person-households.

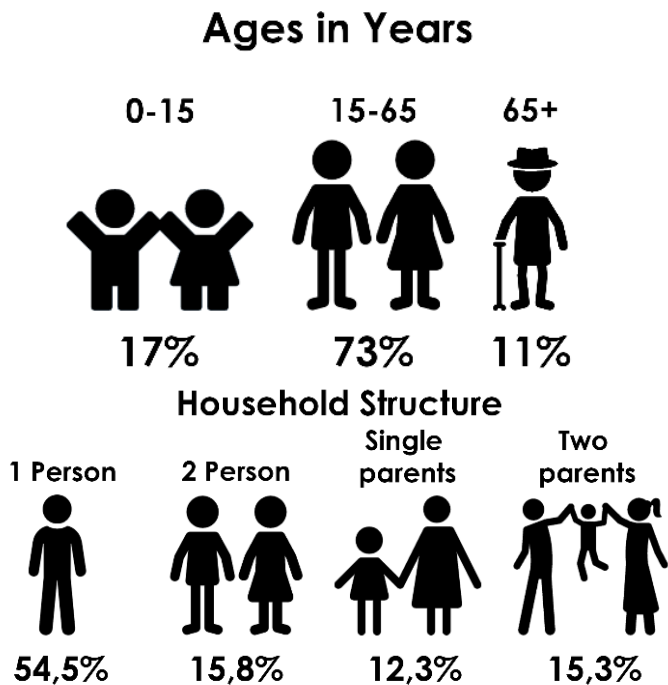


Figure 4: Diagram which shows the social demographics of Delfshaven (Made by author)

At the moment the average usage of m<sup>2</sup> per person in different households is skewed. As you can see in the diagram below the average m<sup>2</sup> per person in a single person household is 70m<sup>2</sup>. If we compare this with the other households this is 2 times larger. Creating smaller living spaces that are qualitative can help reduce this usage of space and therefore single person households become important in this design challenge.

The target groups that match Modularity and the housing shortage are mostly Students, Starters and Elderly. These are the target groups that can use compact housing and these are also the groups that are affected the hardest by the housing shortage.

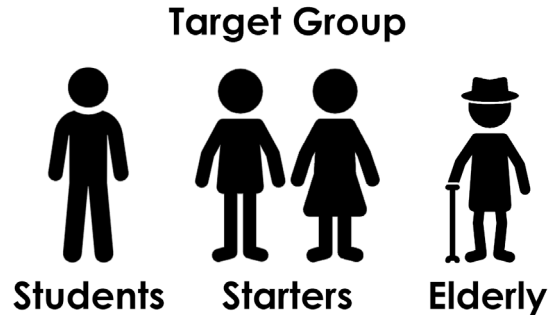


Figure 5: Diagram of the proposed target group (Made by author)

Production will be an interesting part of the program it is obvious through the mechanism of scarcity and land that production has to be combined with living. In history, production is generally placed outside of the city as it does not go well with living most of the time. In this last decade, production has evolved and a lot of types of production are easier to combine with living. Circularity has become an important subject and this is important to incorporate into the program.

It is important to create a circularity/ecosystem on an architectural level to ensure production and living is working well with each other. In our masterplan the chosen part of the plot was best fit for light production. This means production that does not need heavy infrastructure to work well.

The production programming that will be combined with the dwelling programming is:

- Artist workplaces
- 3D printing facilities
- Knowledge production

Amenities are more than only showers and technical rooms, as they are also social infrastructures. Social infrastructures are important to increase liveability and to get different social groups in contact with each

other (Atkins, 2022). The social infrastructure that will be used in the project is:

- Library
- Cafe
- Daycare

The plot of choice is in total 1276 m<sup>2</sup>. The program according to the masterplan which is formed during the first 8 weeks of the graduation trajectory, is divided as can be seen in figure 6.

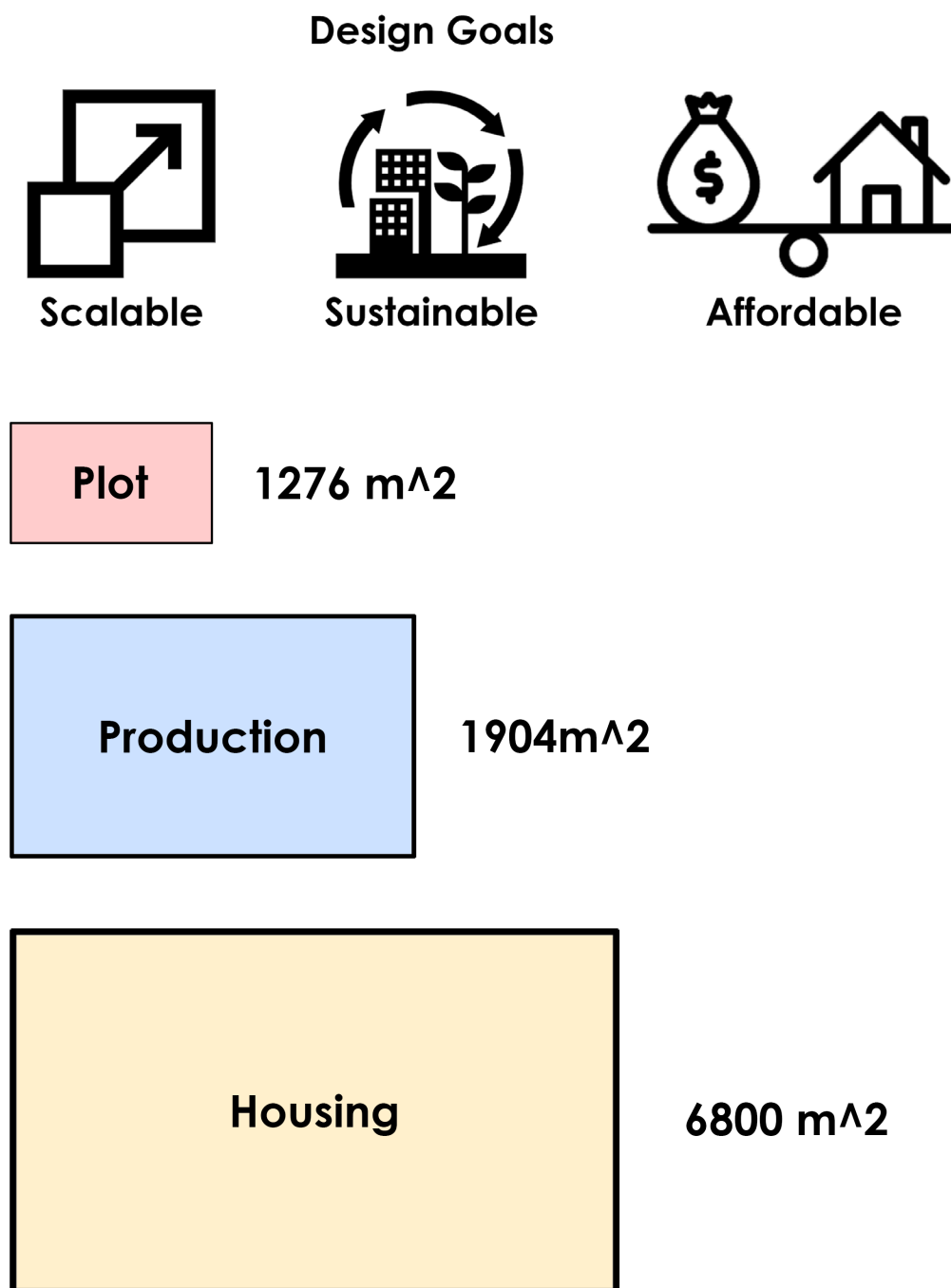


Figure 6: Diagram of the proposed program (Made by author)

## 6. CASE STUDIES

As mentioned earlier case studies will be used to analyze the usage of modular dwellings and production. This research paper will analyze these case studies by plan analysis and analyzing why and how it is built.

### **Nakagin Capsule Towers designed by Kisho Kurokawa**

Nakagin Capsule Towers is one of the first buildings that uses modules and tries to answer the question if mass-production can create liveable areas. This is a case study which could be important due to the historical significance of this building. It was one of the prototypes of sustainable architecture as the modules are detachable and interchangeable.



Figure 7: The Nakagin Capsule Tower in Japan (Sveiven & Arcspace, 2011)

### **Raines Court designed by Allford Hall Monaghan Morris**

Raines Court is built using containers as modules. The main goal of this building is to create affordable homes for target groups who can normally not afford homes. The building is owned as a cooperative so the residents have shared ownership



Figure 8: Raines Court in England ((FilmFixer Ltd, n.d.))

## Keetwonen Amsterdam designed by JMW Architekten

The biggest student project that is built using containers as modules. It is built in the Netherlands as well this means it faces the same regulatory constraints that are researched in this thesis



Figure 9: Keetwonen in Amsterdam (Livingspaces.net, n.d.)

## Startblok Riekerhaven designed by HVDN Architecten

A project built in Amsterdam which is designed to promote cohousing between refugees and Dutch youth. This project is built using containers and modularity. And tries to provide qualitative living for 2 different target groups.



Figure 10: Startblok Riekerhaven in Amsterdam (World Habitat, 2018)

## Keramus designed by Jillis Kinkel

A building with 232 modular student housing in Utrecht, Netherlands. The building has shared facilities and companies on the bottom floor and the housing units above it. This is a good example of modular housing in the Netherlands for one of the target groups.



Figure 11: Keramus in Utrecht (Knudsen, 2019)

## Nest toolkit designed by Brooks+Scarpa

The nest toolkit is a toolkit designed by Brooks+Scarpa to address the shortage of supportive housing for homeless people. This toolkit provides the flexibility to meet the demands for any site and target group. In combination with amazon's prefab company called Plant prefab.

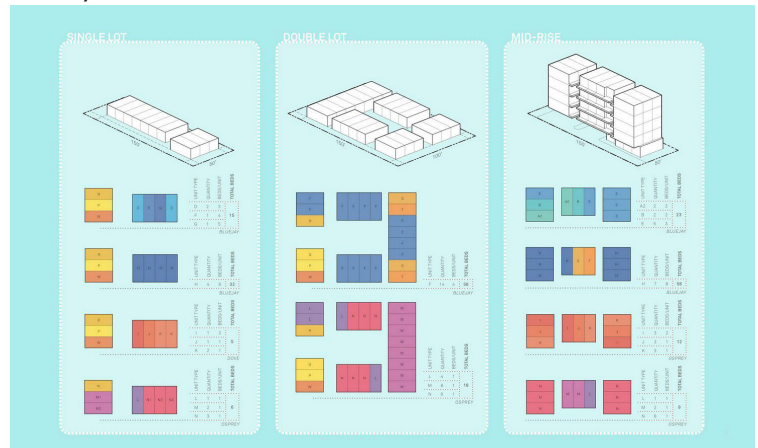


Figure 12: Nest toolkit showing multiple scale typologies. (Brooks + Scarpa, n.d.)



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## **Interviews**

Jan Snel

Skillpod

Zeecontainer woningen