REFLECTION

Architectural Engineering Graduation

Studio

Personal information	4447387
Tutors	
Research title	An evaluation method to assess user-friendly Design for Assembly and Disassembly of modular infill systems
Project title	½ Footprint 2/1 Comfort

The relationship between research and design

The graduation project started with the search for a way to increase the support for circular building methods and by this accelerate the switch towards a sustainable and circular built environment. Since in practice this is a process that encounter a lot of obstacles, caused by law, new production methods and scoring methods, increasing costs and so on. As it was noticed, in previous research mainly manufacturers and companies are addressed to increase knowledge around circular solutions and process integration. To take another perspective on this issue, the graduation project focuses itself on the end-users of a building, the important and large group that is now overlooked.

The first step to address this problem was to find a way how future residents could be involved and be made aware about circular building methods just as was seen with sustainable solutions like solar panels. A circular solution that was already be found beneficial for the end-users of a building in the research of Geldermans et al. (2019), consisted of flexible infill systems. The research that was done in the first semester of the graduation year continued this research by seeing how the end-user could be involved in the assembling and disassembling process of such systems, just like the Ikea-packages. The result was the formulation of an evaluation method for user-friendly assembly and disassembly of modular infill systems. The method could help to test and improve existing systems or find the design principles to compose new systems in the design phase.

In relationship with the overall design objective, the research touched upon a possible solution to promote circularity from a user-perspective within the social, stuff and space plan (adapted from Loughborough University (2012) and Brand (1994)). The two subjects of circularity and user-friendliness that form the basis of the research, are in the design process further explored on all building levels (figure I). This concerns the program, access and circulation, configuration of spaces, the balance between private and shared spaces, the load bearing structure, climate design, detailing, façade design, public space and so on.

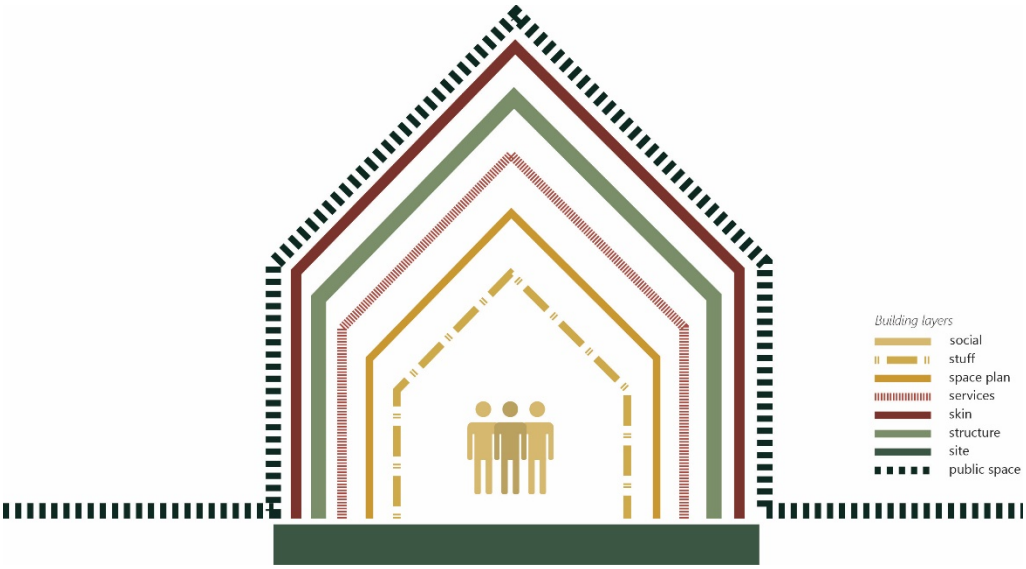

Figure 1 Building layers (adapted from Loughborough University, UK, 2012 and Brand, 1994).

From the P2 towards the P4: integration of the research results into the design

Proceeding from the research towards the design, before going on with practical studies to design the infill system that fits the resulted requirements, the first question that I asked myself was:

What should the infill system be?

Infill systems that already exist, focus for example on one part of the infill such as walls, that were addressed within the research, or the circular kitchen. Also systems are already designed were all functions come together that require technical installations and exhaust and supply of resources. After finding all those systems, I thought okay what if it is already there? What is my addition to the system then? Are these only the improvement of the joints and components?

However, when I was looking together with my boyfriend for a home ourselves, I noticed that not only the housing shortage was a problem, but also the way these houses are spatially configurated in relation to its total square meters. The homes that were within our budget felt oppressive, because the small square meters were all filled with boxes, all meeting the exact requirements of the building regulations in the Netherlands.
So then I came to the conclusion that the goal of the infill system was not only to be a system that is flexible in terms of assembly and disassembly at different places and responds to different preferences of residents, but that it should and could be a system that is also flexible during its time in use. Meaning that, next to the permanent establishment, the infill system should also include furniture. For example a place in the house could be during night-time a bedroom and during daytime an office. Compact homes would then not feel oppressive, but could be as spacious as one wishes. These findings formed the principles to start designing the infill system based on the research.

As was described in the research plan, sketching was the first method to try and find all different configurations of the infill system. The different options were filtered on the basis of practicality during the in-use phase. After that, the options were analysed, based on the need of as less as possible non-renewable materials and its ability to use the space optimally flexible. With this, the design process got back to the scale of that was addressed in the research.

Although I was excited to start with prototyping and modelling the components and joints, I got stuck on the fact that I thought of designing something new. However, everything that the infill system needed on this level could already be found in the earlier discussed circular systems when assessing them with the evaluation method developed in the research. So then I decided to look into these joints and components and prototype them in physical models first, to get a grip on them and see how they work. The second step consisted of trial and error of quick physical models to see how they work together and if they could be combined.
The found joints that fitted the evaluation method very well could all be compared to actions we do in everyday life, like closing a box, pulling/pushing a drawer or unscrewing/ tightening of a cap. As a result, in the design process assumptions were done for now that these joints could be handled by an (unskilled) resident. However, I think that this is not the right approach to end with and the preconditions set at the P2 to test scale models among (unskilled) end-users should be carried out. Towards the P4 the plan is to optimize the infill system together with all inventive techniques that are already there to fit in the storyline of the project. From the P4 to the P5 it would be a excited goal to test the system in a prototype scale model.

Secondly, I thought of finding the preferred configurations of the homes for starters by doing a sketch exercise among the studio's students and friends (future starters). However, during the design this idea changed. Reading documents of research about the preferences of starters when looking for a home, concluded in 70m2 homes, 3-rooms and garden-preferred. All preferences that are the result of residential architecture according to the minimal building regulations, regulations I want to partially let go. People do not know differently and get no other option, so then it is harder to come to new ideas of configurations of floorplans. However in this is of course is the dilemma and question at the same time: *'When you design for such an important target group, should you translate their living preferences literally into a design? or are we as architects the ones that should interpreted these preferences, together with the resources, the boundaries and spatial qualities and fit this all together in one comfortable building?*
Next to this it also known that most people do not like rigorous changes in the way they live, only if they make life easier. At least, the city does not have the capacity to fit all 70-90m2 preferred homes in the amount that these are demanded. So where I initially thought of choosing the first direction to start with, I changed my strategy and chose the second approach. Looking around and seeing different activities young people would like to have close to their home, now especially visible during the corona-pandemic, I could find out what the other functions of spaces are that starters would like to have in their own home or nearby.

To bring this idea of the flexible infill systems to the larger whole of a complete building, during the P2 this was formulated into 'The Building Layers of Learning'. Within the design process this approach continued to be one of the main aspects that shaped the design. In decisions it could weigh more or less in a balance with location specific aspects, user specific aspects and so on. In this, a question that was a lot repeated in this process was: *Should residents learn everything? Or: Should everything be able to be done or understanded by everyone? Are there different levels?* For example, in the circulation and traffic areas of the building, next to my own ideas I tried to find supporting research on how to stimulate informal meetings between residents and what gathering places to design to support the share of knowledge and skills. *Is a resident tempted to walk from home in the morning in the east-sun at the other side of the building or does he/she takes the quickest way to the entrance? Or if I place a collective bicycle storage on the other end of the building, do people walk via outside or via internal routes within the building?*

Because as went through the different design phases, I noticed that for me this project is about designing places. Places that can adapt to different activities during the day, the season, all different residents and so on. After the definition of the living unit and the modular infill system, the concept of having more quality and comfort with less space was continued in a design for a collective body (Illustration 1).

Where I first split the building in six separate blocks to comply with the scale of a neighbourhood, where anonymity between residents is prevented, the collective body connect the blocks again. By doing this, the residents of each block can easily enjoy and are encouraged to enjoy the different qualities that every other block contains. This refers to for example facilities, but also orientation of places. Where during the P1 and P2 I approached this by stimulating this circulation within the building by spreading the mixed-use functions vertically, I now concentrated these functions other than living, around this body. To do this, a balance is created between the intimacy of the residences and the dynamic-ness around the extra functions and facilities or places.

The second step was to give these places an architectural expression that fitted with their purpose. This was a big quest 'with lot of bumps on the road' as one would say in Dutch. However, with the keen feedback of all mentors I found the architecture that suited. With the design of a modular infill system that resulted from the research, a logical step was to make a fixed grid that complies with the system. However, what I disliked very much, were perfectly new designed adaptable modular living units, but in my view were not connected to the story of the location they were designed for and could be placed anywhere. Their architectural expression is in my opinion 'place-less'. Because these designs consisted of all boxes stacked together, the form of a box soon bothered me. A clash with the outcome of the research, as one mentor rightly mentioned it. *But how should then the places be architecturally expressed? What toolbox do I need?*

In one of the feedback sessions I discussed the dilemma of 'what can change over time in your project and what does this facilitate?' In this project it is the infill. However, I could not get a grip on what the architecture then should be, which direction I had to look for. In the feedback session, my main mentor mentioned a home he had lived in. This was in a neighbourhood where the infill was different in every house, fitting the family that lived there, but the houses all together still felt like one collective neighbourhood. And why was that? Because the architectural expression of the individual houses was in the same language, and timeless. Where place-less was something I definitely wanted to avoid for my project, timeless was what I needed. After this, in a new feedback moment with the mentors, I showed a façade I really liked in expression. They advised me to analyse the elements that were used to make this composition so 'calm-looking' and because of this timeless, but still has its characteristics that refer to the location it is built on. I analysed the amount of elements, the kind of elements and how these were organized. This helped me making a new big step in the design process. Now I was able to pick the right kind and right amount of elements that suited the places they belong to (illustration II).

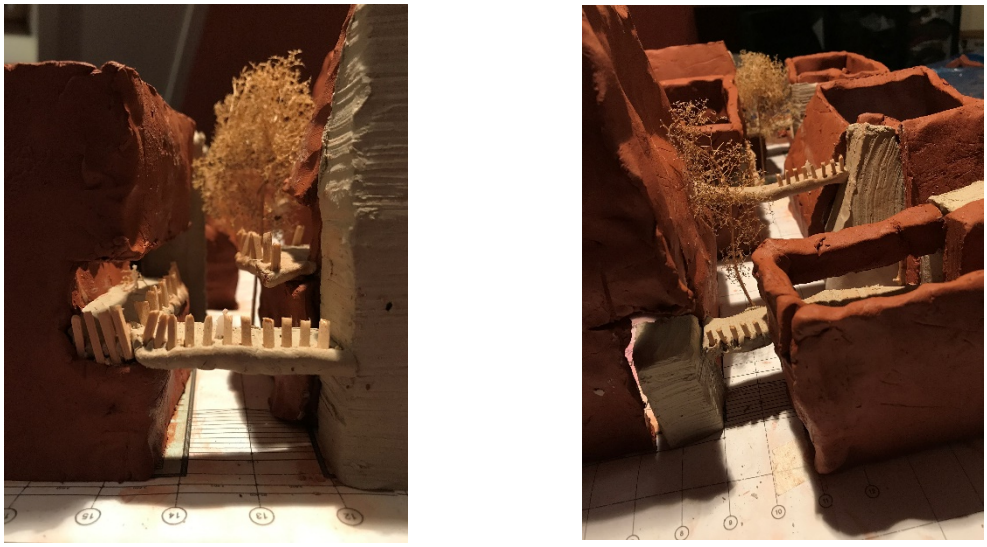

Illustration I. Studies on the flow of the collective body through the building blocks.

Illustration II. One of the variations of a study model I did, to discover the architectural relationship between the different materials that define the ground floor and the collective body, as well as the possible social interactions between the residents.

Without me realizing it, I addressed with the concept I came up with during the design, the highest R's in circular design: *Rethink and Reduce*, and gave an answer to the design question I came up with in the graduation plan:

How can a mixed-use building based on the open building principle in the area of De Bossche Stadsdelta both be circular and promote circularity among starting and innovative end-users?

By:

***Reducing** space to own, **increase** the diversity of spaces to use by **rethinking** the way of living.*

Less space to own, causes a literally smaller footprint to own, but also a smaller footprint in material use. Increasing the diversity of spaces to use, increases the comfort of the residents. That is why in the end the project gets the title: **½ Footprint 2/1 Comfort.**

The role of me as an architect

Finally, in the graduation plan that was written about four months ago, I mentioned the role of the architect. A topic of discussion that is nowadays highly relevant. With so much knowledge and possibilities, do you want to be an all-round architect, knowing a little bit from all, but most of all having a broad network of specialized people who could help with specific topics? Or do you want to specialize yourself on for example one topic or one material? In my project I had this question, but then regarding the role of the architect in the design process of the building when residents are involved in the design process of their home. A new discussion about the role of the architect that is highly relevant for the studio as well as in the work field with the strategy of Open Building, originated from the ideas of J. Habraken. With this concept in mind and the reference project Molenvliet (1974) by architect Frans van

der Werf, I defined the role of the architect as a supporter. To translate this approach to circular design, the architect would give input and provide design solutions instead of spending a lot of time finding the right people that could help realize the circular design.

With only the modularity of the infill system in mind and the ability for residents to assemble and disassemble it themselves, I first could think of the role of the architect as the designer of the components. The architect would change into a product developer. With the new concept of living that I defined, where the infill is designed to be able to adapt to different activities by for example folding tables and sliding beds, the toolbox of the system's elements became more specific and limited. Now, the architect could be in one of its expertise's again: solving the puzzle. Helping the residents to design the most smart composition of elements relating to the resident's way of living.

Secondly, from out the research I was first focused on the infill system and with this the private dwelling that I as an architect had to design. However, after this I discovered that the infill system did not only require from the building a framework, but most of all the system and the residents it was made for, needed the right *in between* spaces. The spaces that make the neighbourhood a neighbourhood and ensures residents living comfortable within and around the building. So next to the design of the individual home, the task for me as the architect of this project, is to design carefully the spaces in between and shape the conditions that support and encourage various activities of residents alone or together. *The journey I made during this process of discovering and designing is summarized in the diagram on the last page.*

Personal growth

During the graduation project I bumped into some difficulties I already experienced in previous study projects. By asking the feedback of the mentors and co-students when reflecting together on these difficulties, I obtained a different perspective. Together with trying different design tools, I could convert the difficulties in a process of personal development and growth that at the same time had a positive outcome on the project.

A first difficulty I experienced, is the broaden view I sometimes got stuck in during the design process of some aspects. When this happened, I forgot to limit my view and had the feeling of wanting to research every component and detail of the project too much. Feedback of students or mentors help me then to make decisions based on the story of the project and move on with other topics.

Secondly, what I find back in my work is that even though having this clear storyline, I sometimes get stuck when studying on a topic, thinking how is this ever related to my story. A moment later I find the argumentation, just forget that the location De Bossche Stadsdelta and its characteristics and history, the target group starters and the search for a definition of a circular building are also integrated themes of the storyline.

Thirdly, during the design process I have learned from my own work that I find it still hard to position myself in the range of 'designing so that it can be built tomorrow or designing with a futuristic view'. I know that I am a person of the first position, very practical and wanting to know now how things work exactly. Although I would really like to develop the skills to think out of the box and look a step further. In the end, I think for me is the aim to deliver a project in which a balance exists of components that are correctly detailed and fixed regarding to what is important now and components relating to future assumptions that are still open for different interpretations.

All these thinking processes were and are supported by the feedback of all mentors. They ask the questions to keep me sharp, but also get me 'out of my tunnel' when I am to deeply researching an aspect. The feedback helps me to broaden my view on different aspects, but also helps me to narrow it down so that it fits into the story I want to design. This gives me the feeling that I have researched the most important alternatives before making a decision.

Next to this, I think I have been assigned with the perfect balance of mentors. They each provide me in different knowledge and with different tools to support the design process on points I as a designer experience difficulty or would like to develop myself. Roel with his inspiration to think more with an out-of-the-box perspective and to connect me to different students that overlap in themes to brainstorm with. Paddy with his broad knowledge of reference projects and experience in designing. And Pieter with his practical view, sharing his knowledge and experience on making. And applicable to all, the enthusiasm in each meeting and reassurance before deadlines.

From the P3 towards the P4

In the phase from the P3 to the P4, the balance of 80% 'research by design' and 20% 'developing the design in 3D', is shifted to 40% 'research by design' and 60% development of the design into a 3D model and output. But during this phase, there are a couple of topics that still needed some studying. First, decisions had to be made regarding the demand and supply of water and energy and the integration of it in the total strategy of the project. the exact consequences on the detailing. Next to this, the ambience of the circulation areas as traffic and collective spaces had to be studied. As the building is designed as separate blocks, these in between spaces have the potential to function as the connecting body between all blocks. Thus enhancing visual and physical relationships between residents. Questions to answer were: Should it be open in the air or closed, or a balance? And in particular; are there specific places to meet with different ambiences and dimensions, intimate or public?

At last, when designing a building that can change over time, a crucial aspect to have a view on is: 'What can change over time?' And in what time span does it change? What for consequences does this have for the residents or how it was thought of the building works on all different aspects, social, climate etc.? In this part of the project, the question remained if only the infill system is the part that will change over time or if other parts like the façade or the functions could also change. For now this question is answered by addressing it in different timeframes, short term – long term: infill, function, façade, with the load bearing structure as fixed base.

From the P4 towards the P5

In the last two weeks I experienced a lot of stress in getting all products ready. The most crucial questions I had, are all answered. Now from the P4 towards the P5 I want to conduct some last studies to get the story of the project in architectural output complete. After this, I want to mainly focus on the exciting final part of the graduation year; making the products of the project as nice as possible to communicate best the various places and their specific qualities that are present in the building ensemble. To make these places, the building is designed in layers, which can be visually distinguished by its architectural expression. For the P5 I want to make a model of these layers to show how they stand out from each other, how they are related to each other, but also how the interactions between the materials and the people on these various layers take place. Finally, a goal that was earlier mentioned was to prototype one of the variants of the flexible infill systems as a final practical result of the research into the design. This is still a dream to do, although looking at time and planning and in dialogue with the strategy of the system in the design phase, I am going to change that into a smaller scale model to see the concept: a new way of living.

Graduation Journey

P1 Goal

awareness about circularity among residents.

Approach
involving residents in the construction process (design &

USER-TESTS
test among who? difficulty of the system? what level?

P2 Tool

P2 Target group

user friendly circular infill system

PROTO-TYPING

starters who ~~quite of~~ want to roll up their sleeves ~~for climate~~ to ensure the earths health

* role of me as an architect: = a design of the system

* a supporter?

SKETCHING

P3 **Rethink** living

less space to own -> more various spaces to use

* role of me as an architect: = design in between layers

COMPOSITION OF SPACES AND MATERIALS

P4 **1/2 FOOTPRINT 2/1 COMFORT**

=

P5 what circularity is for me as an architect.