ZERO-WASTE

in lifestyle and building design

Reflection report

Mandy Ham - 4634225

REFLECTION REPORT

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PREFACE

During the Dwelling Dutch Housing Graduation Studio, I've been working on a zero-waste residential tower. During the eight months of researching and designing, I've applied different ways of doing research, which all had influence on my design (and design process). This report I will reflect on the different research methods that have been used and what the relation is between research and design in my own design process.

CONTENT

INTRODUCTION

During the last phase of the master Architecture at the Faculty of Architecture and the Built Environment, I've chosen to do my graduation project in the Chair of Dwelling, Dutch Housing. The Dutch Housing graduation studio focuses on the question *'how do we want to live in the future, and what kind of buildings do we need, to make that possible?'* Knowledge about how we dwell and how we occupy are for that reason very important in the Dutch Housing graduation studio.

> "*Architecture is an ever-developing body of knowledge concerned with how we use space: how we dwell and occupy, establishing meaningful places and giving form to the world around us. How we build is informed by how we understand the world, and how we understand the world is framed by what we have built there."*[1]

In the architectural design process and design practice doing methodological research is an important role of the architect as well, as decisions that are made during the design process will make the final result defensible. In other words, the result will be based on 'Evidence Based Design' in which the question 'based on which research methods have certain design questions been answered and how have design choices been made?' plays an important role during the design process. This is also the question which I will answer in this reflection report.

[1] (Lucas, 2015)

In order to answer the question, it is first important to have a clear idea of my own design process. The design process should be made explicit in order to understand which research has been done and how certain design decisions have been made. To do so, I would like to adopt some principles of a conceptual framework in which the design process is described on the basis of five generic elements. The article ‘Making explicit in design education: generic elements in the design process’ published in the International Journal of Technology and Design Education written by Elise van Dooren et al. will be the basis to give insight in my own design process and to reflect on it.

METHODS AND APPROACHES

Elaboration on research method and approach chosen in relation to the graduation studio methodical line of inquiry, reflecting thereby upon the scientific relevance of the work.

The Dutch Housing graduation studio can be split up in five phases. Each phase ends with a presentation (P1-P5) as shown in the figure below. This reflection report must be submitted before the P4, for that reason the 'before P5' period has been excluded from this reflection report.

Start of the studio (introduction)

The studio started in Amsterdam with a presentation given by a member of the municipality of Amsterdam. After the presentation, a visit to the location was planned. Minervahaven (situated in future Haven-Stad Amsterdam) is the place of the urban context of the graduation studio. This research, called field research, is in my point of view strongly related to the frame of reference explained in the past chapter. By visiting the site, first ideas about the area are being formed. The goal of the site visit was to make a 'stijlfiguur' wich shows how I felt by the first visit of Minevahaven. During the visit I made pictures, sound records, video's and experienced the place by walking through it. There is one interesting photo I took, not knowing that my inspiring direction for this project would be exactly what is shown in the photo I took the first time visiting the harbor area.

WHAT A WASTE…

Phase 1 (start – P1)

During the first phase of the graduation studio, the main goal was finding a topic of interest. I started investigating three topics of my interest; elderly, Alzheimer and loneliness.

Although these topics interested me very much in the first place, it took me a while to realize that this wasn't the graduation subject that made me happy. During the MSc1 studio I visited the Maldives in order to design a waste center, as collecting waste is a huge problem at the islands. During the visit it became clear that collecting the waste wasn't the problem. The waste being produced by human was the problem. And in the Netherlands this isn't any different. We have a huge problem, our world has a huge problem and if we don't do anything about it, waste will cause serious damage to our environmental health. So, my topic was born: ZERO-WASTE

During phase one also the masterplan had to be designed in groups of four students. Every group would get a specific masterplan; Manhattan, Barcelona, Campus and De Lamellen. The design of the masterplan was mainly based on typological research. The different masterplans were superimposed in the area and adjusted only where needed. The adjustments made were based on historical aspects which should be kept in the masterplan. Together with the typological research of the different masterplans, desk research about the history of the harbor area was done as well.

Phase 2 (P1 – P2)

After the P1 presentation, the research report was written about the topic of interest relating to the city of Amsterdam. Another important part of phase two, was forming a building mass (conceptual design).

Research report

The research report I wrote was split up into three different topics; a zero-waste lifestyle, a zero-waste building design and case-studies.

While investigating the zero-waste lifestyle of people, I joined different Facebook groups for people that were starting to live zero-waste or were living zero-waste already for a while. In the groups mainly tips and tricks on how to live the zero-waste lifestyle were shared with each other. I also started to live zero-waste myself, in order to exactly understand the difficulties, it brings in my own environment while I was trying to change my lifestyle to a zero-waste lifestyle. The zero-waste lifestyle movement is very new, especially while looking at zero-waste lifestyle in dwellings. Most of the information relating to the topic I could research by doing literature study in which the book 'Zero Waste Home' from Bea Johnson (seen as the mother of zero-waste) was my main inspiration and main resource. However, it was difficult to research the needs from people that really live zero-waste only by reading the book. For that reason, I send out a questionnaire to the Facebook-group of Zero Waste Amsterdam. A big part of my target group research is based on this questionnaire which is part of descriptive research. With the help of a good friend studying psychology, I was able to form a questionnaire that is valid and reliable.

Based on the results of the questionnaire, different design aspects were formed in the design brief which I tested with the results from the book written by Bea Johnson.

Another way to test the results and idea's I formed based on the questionnaire was by using Virtual Ethnography, which is a part of the ethnographical research method. Virtual Ethnography, is a research approach in which the researcher looks at the online setting. As ethnography is mostly related to fieldwork, bringing in the Virtual Ethnographical research method into practice, the researcher focusses on the virtual community. Kozinets describes Virtual Ethnograpy as *"a qualitative, interpretive research methodology that adapts the traditional, in-person ethnographic research techniques of anthropology to the study of online cultures and communities formed through computer-mediated communications".*[2]

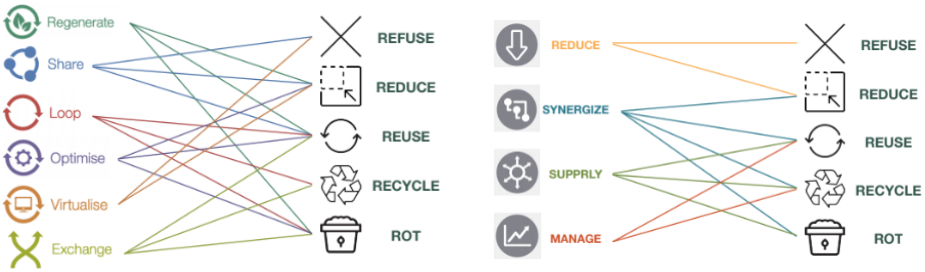
However, disadvantages of this method can be that people wear an 'online-mask', which will make that they want to occur differently to impress others for example. However, the Virtual Ethnographical research has not been the main research method, it has been a way to test the results from the questionnaire. By researching the Facebook group based on ethnographical research method, I was able to test if the results from the questionnaire were more or less the same as the way people are acting in the zero-waste community. I found out that indeed most of the data I collected from the book and Facebook were corresponding to the results from the questionnaire.

[2] (Kozinets, 2006)

The second part of the research report, was about a zero-waste building design (circular building design). Research about this topic is based on literature study (desk research). The goal of this chapter of the research booklet was to form a zero-waste design matrix which will be a design tool (mainly for the building technology part, not the lifestyle part) which can be used as well to test the building in the end. The matrix is based on a scientific model, namely the Shearing Layers by Stewart Brand. Using his five layers combined with the 5 R's of zero-waste (Refuse, Reduce, Reuse, Recycle, Rot) introduced by Bea Johnson, a design matrix was formed and could be filled in.

	REFUSE	REDUCE	REUSE	RECYLE	ROT
STUFF					
SPACE PLAN					
SERVICES					
SKIN					
STRUCTURE					
SITE					

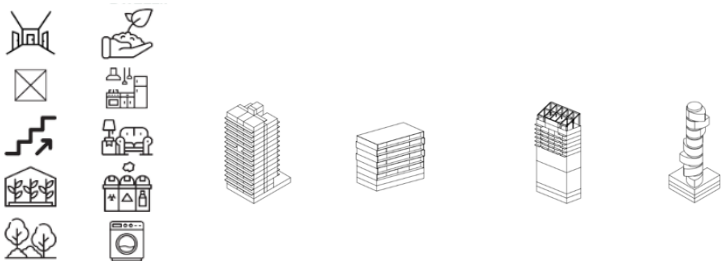
The 5 R's of zero-waste were in the research tested by the two most widely adopted circular design principles; the ReSOLVE principles and the Seven Pillars of a circular economy. The 5 R's of zero-waste were compared to the other principles in order to test the validity and reliability of the 5 R's of zero-waste.



The last part of the research is about case-study's. In the Chair of Dwelling a commonly used research methodology is investigating typologies. Doing research about case-study's is for that reason a very important part of the research report as well.

> *"To us, at the Chair of Architecture and Dwelling design, the impetus of a design assignment is an actual need, a problem in the real world that needs to be solved. […] We explicitly advocate the use of realized dwelling plans as a starting point for further design. To be able to delve into history, to analyze it and to come up with (partial) solutions to the given problem belongs to the key skills of the academically trained architect." (course g p 5)*

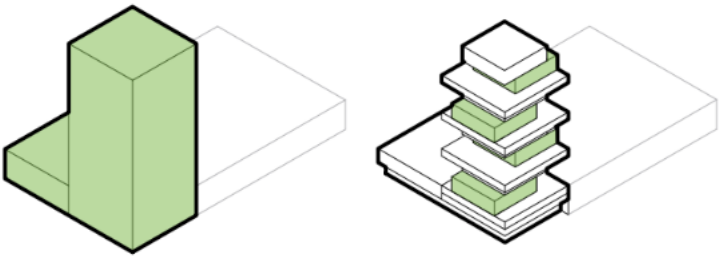
A difficulty for me was finding case-study's for typological research as no dwellings or residential buildings have been built for a zero-waste lifestyle. The case-study's I choose, for that matter, were based on the decision that I wanted to build a wooden tower. The research I did during the case-studies was mostly based on inductive reasoning. I took some design aspects from the results of the questionnaire and tried to look for these aspects in the case-studies.



Forming a building mass (conceptual design)

During the second phase, also a conceptual design had to be formed. During the quick-start the building mass, first floorplans and facades needed to be designed as a basis for the further design process.

The building mass I designed was based on the idea that I wanted to create a bit of an iconic building. The plot in which I had to work is a 60 x 30 m plot in which the tower had a maximum of 30 x 30 meters. Somehow at the end of the day my tower was born; ‘het kantelpunt’.



Squares were shifting which made that every two floors would have their own balconies on one side (the side for the bigger apartments for family’s). On the other side there were automatically place for smaller apartments that do not need balconies.

Typological research was done during the quick-start and different typologies were used to superimpose in the squares of the tower. The squares of two floors were 20 x 20 m, the minimum size based on the superimposed floorplans.

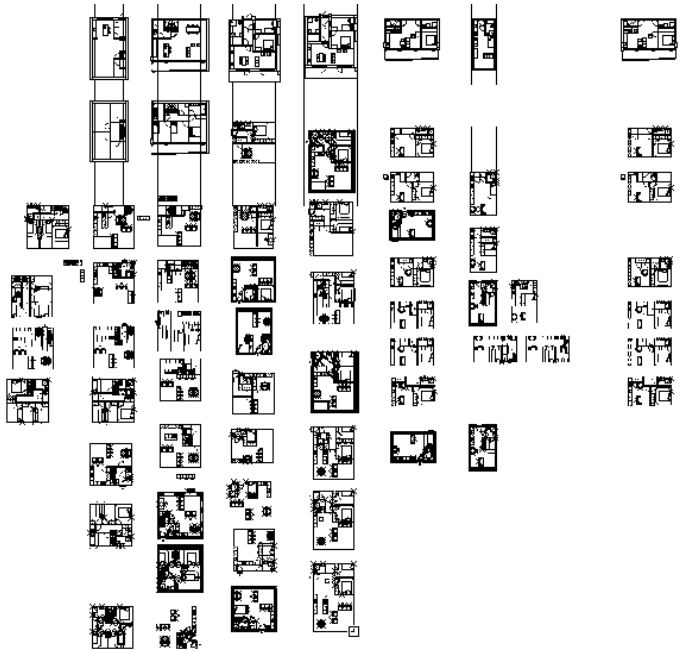
The shape of the tower was mostly based on the idea of a ‘icon’ rather than the idea of designing zero-waste. The shifting blocks made that a lot more insulation for example has to be used in order to prevent cold-bridges. As the research report was written parallel to the conceptual design phase, some aspects I didn’t think of yet, because simply no research has been done about the topic yet, made that the building mass itself might not be as zero-waste as I would have wanted it to be I the end. For example, a square tower that isn’t shifting in layers, uses way less materials for example. This was something I struggled with when the P2 was coming closer and the conceptual design had to be developed further, while my research started to show that this might not be the optimal form for a zero-waste building.

However, at some point I figured that it isn’t only the building mass that will make the design zero-waste, it is way more than that. As the zero-waste design matrix was developed, it became clear that in the different layers (shearing layers by Stewart Brand) zero-waste principles can be applied. For example, due to the shifting layers, (which might cost more insulation material) ‘natural’ balconies were formed, which makes that no extra balcony’s, attaching materials and cold-bridge blockers have to be added to the façade. And although extra materials are added to the façade, the type of materials is also important in a zero-waste building design. In the end, it isn’t about just the building mass, it is about the large scale to small scale in which a huge different can be made.

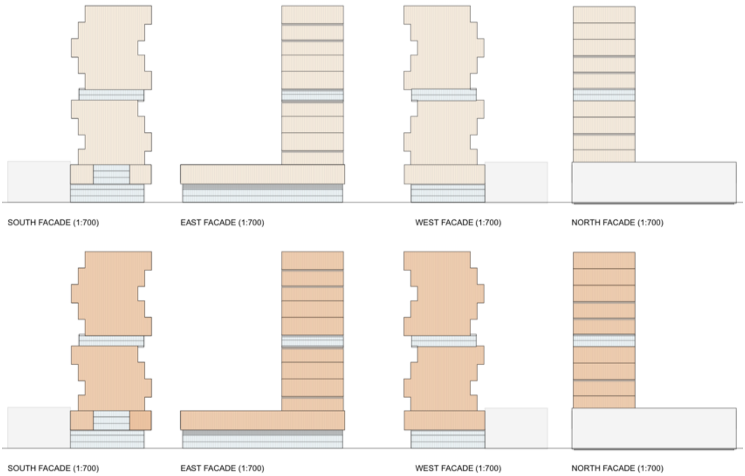
Phase 3 (P2 – P4)

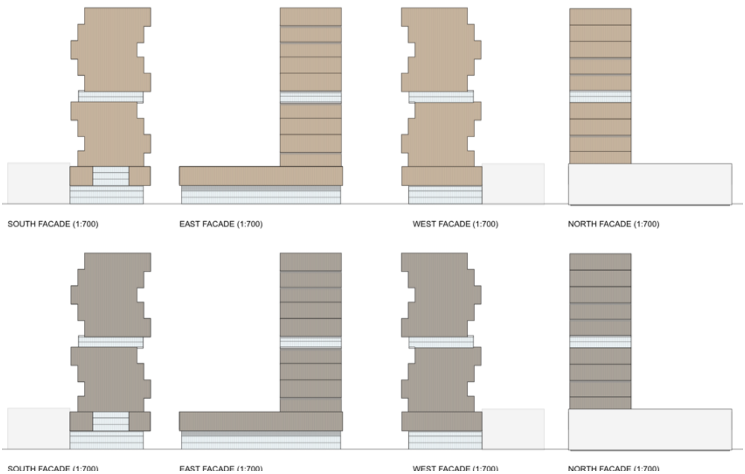
The last phase of the graduation studio mainly focusses on the design. In this phase different approaches are used.

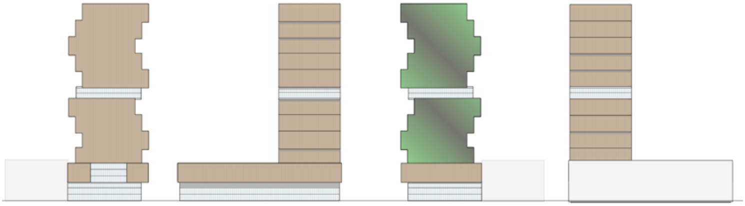
For the floorplans, typological research was done. Most of the dwelling typologies are based on the case-study's, however at some point I found out that some other dwelling types needed to be investigated as during the design process some different 'beukmaten' and dwelling types started to evolve. The typologies I found, were a basis for the design. After that, some experiments were done about dwelling typologies in order to develop a floorplan that fits the needs for my target group (based on the design brief).



Together with the floorplans, the façade was designed. Also, by designing the façade, experimental research has been used in order to form an idea of the overall picture.







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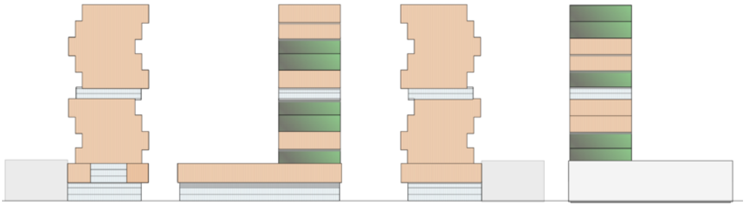

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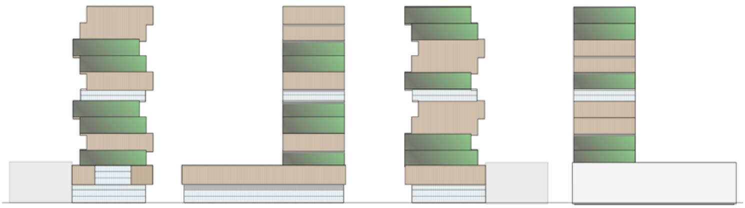

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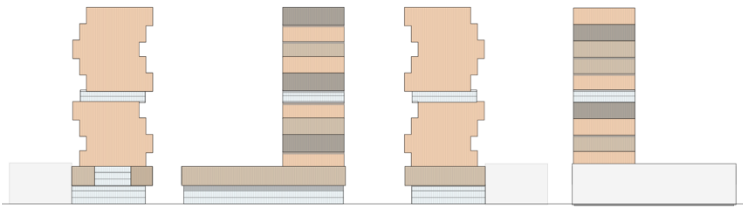

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Although experimental research is used for the design of the façade, also literature study is used as circularity in the façade design is very important as well. So the combination of on the one hand experimenting on how the façade should look like and having data about the zero-waste products and assembly-methods, make the result in the end.

Conclusion

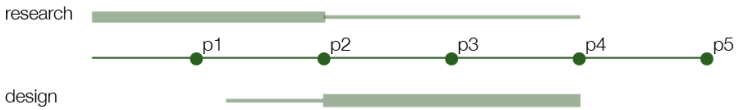
During the different phases in the graduation studio, different approaches of research have been done. In the figure below, the different research methods, which have been explained in the past paragraphs have been organized. A clear structure can be seen as the starting phase is mostly based on explorative research, the second phase is mostly based on research into design, while the last phase (which I will reflect on in the next chapter) is mostly based on research through design.

RESEARCH AND DESIGN

The relationship between research and design

In the past chapter an overview has been given about the different methods and approaches in the different phases of the graduation studio. In this chapter I would like to go deeper in the relationship between research and design based on the five generic elements of Elise van Dooren.

In the image below a schematic idea of the relation between research and design in my own design process. The image is based on the past chapter, in which the methods and approaches have been described. As you can see, till the P2, mostly research has been done. While after the P2 designing has been



"In general designing is conceived as a complex, personal, creative and open-ended skill." [3] van Dooren writes. She tries to make this explicit by introducing a conceptual framework consisting out of five elements: experimenting, guiding theme, five domains, frame of reference and laboratory. It is important to mention that although the different elements are distinguished in the framework, designing is an interwoven process so the generic elements will never be separated. In the figure below the conceptual framework is shown and on the next page the generic elements are explained.

[3] (Van Dooren, 2013, p. 1).

Experimenting

The process of experimenting or exploring and deciding is a dialectical process of being open and alert, analyzing and associating, coming up with alternatives on the one hand and finding criteria, testing and evaluating on the other hand. It is a process of diverging and converging.

Guiding theme

In the process of experimenting, one has to come up with an inspiring direction: a guiding theme or qualities as something to hold on to during the design process and to help create a coherent and consistent result.

Five domains

The process of experimenting and coming up with a guiding theme takes place in different domains, or work fields. A designer has to make statements in all these domains. For architectural design these are: space, material, site, function and socio-cultural context.

Frame of reference

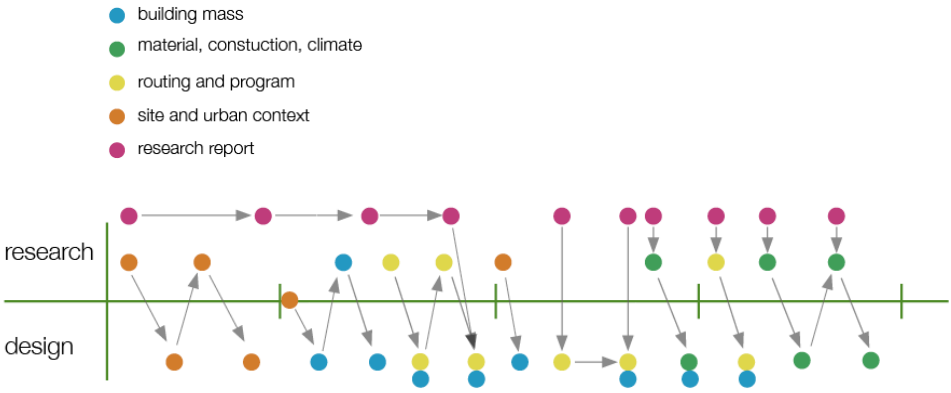
The design process is inseparably embedded in a broader context: a frame of reference or library. All knowledge is stored in the environment, in books and, often implicitly, in the designer's mind. The references provide patterns, diagrams, rules of thumb and solutions to be used in the experiments.

Laboratory

The design process has its own laboratory. For architectural design the laboratory consists of a visual language of sketching and modelling. The physical counterpart of the mental process is an external, extended memory and tool for reflection.

Cited from E. van Dooren

I tried to develop a schematically scheme for my graduation project in order to show the relation between research and design. The scheme shows that there is a clear relation between research and design in my own design process. Sometimes there is research first, while other times there is design first.

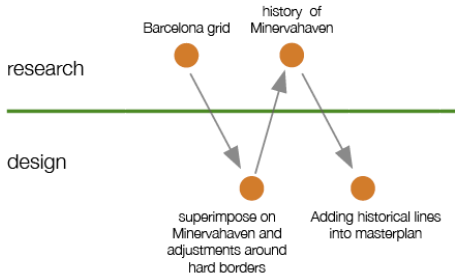


It is interesting to see, that during the conceptual design phase (between P1 and P2) no information from the research report has been added till the end. Although this was a parallel process, I can conclude that before the P2, most decisions I've made were based on experimenting. The tower I've designed is an iconic tower, not necessarily a zero-waste tower if you look at it in the first place. However, and although I think the design of the tower is based in intuitive decisions only, the end result does have its advantages regarding to zero-waste. As I mentioned in the past chapter, natural balconies evolved as well as different communal rooms spaces all contributing to live a zero-waste lifestyle.

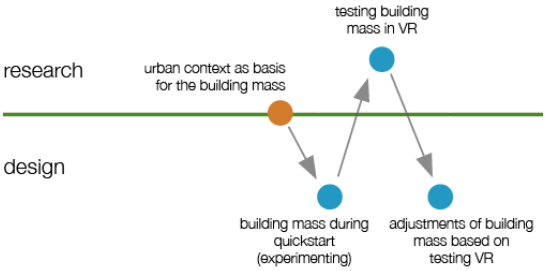
On the next pages I would like to reflect deeper on the relation between research and design.

Before P2

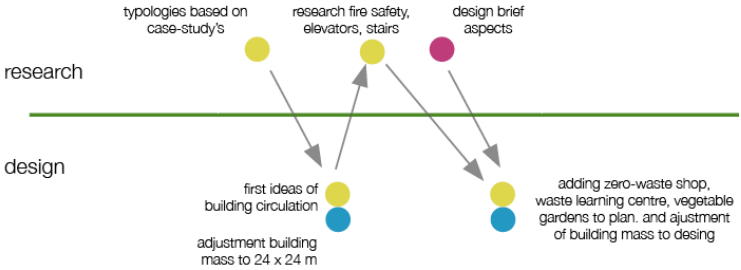
By designing the masterplan, research has been done first. First the Barcelona-grid itself has been researched before it was superimposed onto Minervahaven and some changes (design) have been made. After the changes had been made, some research was done again about Minvervahaven (mainly the history) and again the results have been used and the design changed.



The same happened during designing the building mass. During the quick-start I developed the building mass by using a model. I made different foam blocks (from 30 x 30 x 3 m; scale 1:200) and tried out some different shapes, with as an end result a tower with shifting square layers. The next step was researching the shape in its context. A sun study was done by using a 3D computer model and in virtual reality the shape could be tested in the urban environment, in the city at eye level. The output of the research (mainly based on experimenting) were used to change the design a bit again.



After the building mass was formed, the next step was to superimpose floorplans into the building mass. Based on floorplans from my case study's, the tower was adjusted from 30 x 30 meters to 24 x 24 meters, which changed the building mass again. Together with this, a first idea for the building circulation was formed, which had to be researched in terms of fire-safety and use. Together with this, some aspects from the research report were added to the design as well and again the design had to be adjusted a bit. The end result was presented during the P2 presentation.

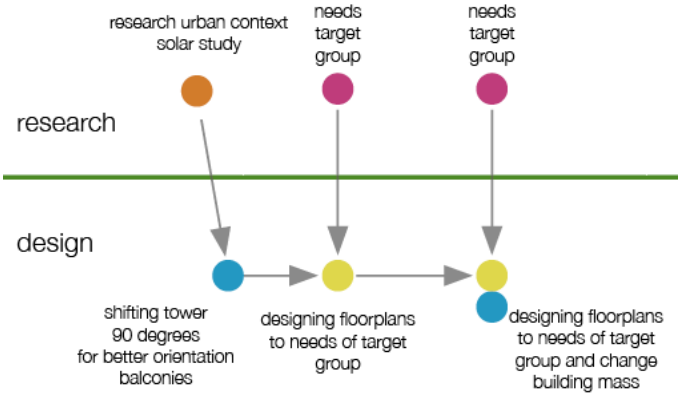


After P2

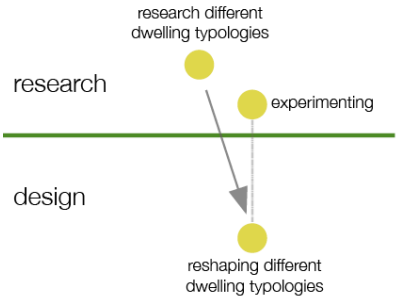
After the P2 presentation, the design process really started. The conceptual design has to be developed further in order to make a coherent, good working and buildable building. It is interesting to see that during this phase, the building mass started to change minimal by every different design decision I made. So, the building mass wasn't researched, but it changed a bit every time. Another interesting aspect of this phase, is that the guiding theme 'zero-waste' is strongly used for most design decisions made.

The design process after P2 started for me reflecting on the building mass in its urban context and found out that it would be better to shift the block 90 degrees in order to make sure that all the balconies were face east and west, instead of north and south.

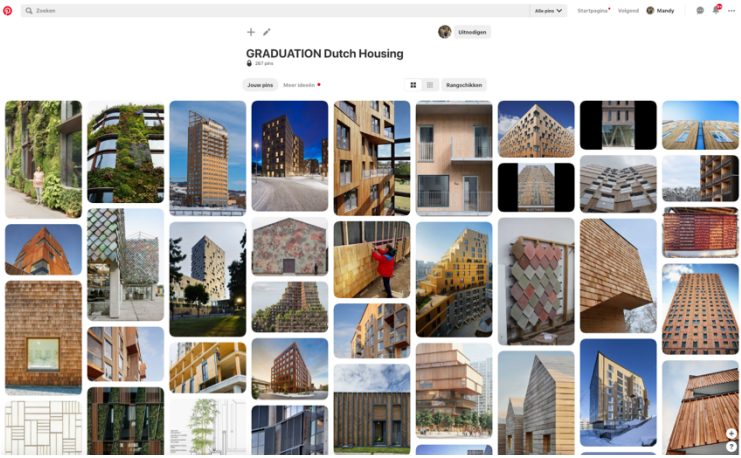
After that, is started designing by changing the floorplans to the needs for my target group. The input for the new plans were mostly based on the design brief in the research report. The main idea is to make the floorplans as compact as possible for the different people (singe-person households, two-person households and families) that are going to live in it. The decision to make compact dwellings is based on the zero-waste lifestyle principle, in which people try to live with less stuff as well. ‘Sharing is caring’ is for that reason an important outline in the life of someone that lives zero-waste. I started designing, changing, experimenting and more needs were added. In the end this resulted in some very strange floorplans with long corridors, while the floorplans are very compact. What was presented during the P3, was for that reason not good enough.



If I look back on this moment, I can understand the reason why this happened. I completely let go off the typologies I researched and I just started to change floorplans in order to make them work based on the needs of the people. So, after the P3, an important shift in designing the floorplans occurred, because I first started to research some other typologies before I continued designing mine.



Together with designing the different types of dwellings, ideas for the façade were formed. The ideas for the façade were mainly based on the ‘frame of reference’ and decisions were made based on the guiding theme. The frame of reference in my project were my Instagram account in which a have a special ‘collection’, namely the ‘Dwelling collection’. The other frame of reference was based on my Pinterest account in which I have a ‘Graduation Dutch Housing’ board. Using Instagram and Pinterest as a source for inspiration is something, I did during my masters all the time. It not only shows some projects, but it shows you projects related to the projects I saved. So, the more same project I’ve saved, the more projects it shows which will bring even more inspiration.



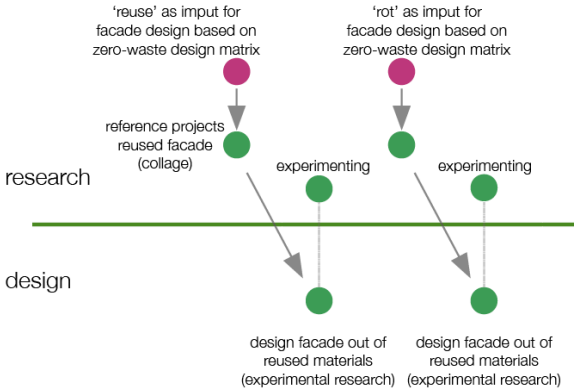
Designing the façade was a big search for me. On the one hand I wanted to try to reuse as much materials as possible, while on the other hand I tried to design a coherent and iconic building.

First, I tried to design a building made out of only reused materials. One of the reference projects I found, is a project in The Hague called ‘Hoge Vrijheid’. This was exactly what I was afraid of that would happen to my project as well as I would choose for reusing materials. By reusing materials for such a large tower, it is almost impossible to find all kind of the same materials, which will make the building look like a collage.

It took me a while before I realized I was looking for a material that fits to the iconic language of the tower, and a material that is zero-waste. ‘I want to design a tower in wood’ was the first thing I said after the quick-start, and so also the façade should be from wood.

I did some research again, looking into wood as a façade material. Wood as a façade material had a lot of disadvantages according to zero-waste. The wood should be treated for example, otherwise it will change color irregular or it will rot. Besides, the façade should be treated every X year, which will make the maintenance costs of the building rise. I knew from my MSc1 project (frame of reference) that bamboo is a very strong façade material, however, the appearance of bamboo itself isn't something I like that much. After some more online research I finally found the material perfectly for my building. The material is bamboo, only it is made out of bamboo strips. So, in its appearance it will look like a wooden façade, while in its durability it has the strong characteristics of bamboo. Also, the claddings can have different dimensions in width and on a detailed scale they can be flat or structured.

While designing the façade, first research has been done by using Pinterest and Instagram to build a frame of reference. After creating this frame of reference, the façade was designed based on different ideas and reference projects. The ideas were researched again by experimenting, so designing and experimenting were happening at the same time during the façade design.



Conclusion

This reflection has shown that different approaches in the relation between research and design have been used. In my opinion, research and design can't be seen separately. It is an interwoven process of finding information, testing and making decisions. While sometimes there is research first and other times there is design first, in the end the relation between the two brought me further in the design process.

RELATION TOPICS

The relation between the graduation topic, the studio topic, the master track and the master programme.

BETWEEN STANDARD AND IDEALS
The future of housing in the Netherlands

> *"To us, at the Chair of Architecture and Dwelling design, the impetus of a design assignment is an actual need, a problem in the real world that needs to be solved" (course guide)*

Reflecting on the main theme of the Dutch Housing graduation studio, 'between standard and ideals' starts by answering the main question of the graduation studio *'how do we want to live in the future, and what kind of buildings do we need, to make that possible?'*.

By choosing my graduation topic, I was looking for a problem that many cities are facing and will be facing in the future if nothing changes. The stock of natural resources is shrinking, which is caused by our consumerism and throw-away society. If only we can change our lifestyle, for example by going zero-waste, a future in which resources can be used over and over again, will save our earth. I found out during the first phase of the research, that the biggest challenge, is changing the lifestyle of people in their homes, as not much residential buildings or homes focus on waste streams. So the question of the studio *'how do we want to live in the future, and what kind of buildings do we need, to make that possible?'*, in my opinion can be answered by living zero-waste in a building that supports this lifestyle.

The track architecture focusses on enabling students to *"develop creative and innovative building projects that use design as a means to deal with the technical, social and spatial challenges encountered in the built environment".* I think the end result of my graduation year, is an innovative building in which technical, social and spatial challenges have been encountered and solutions have been formed (by researching and designing) and implemented. The building is innovative in a way that it is the first residential complex ever designed for people that live zero-waste. Technical challenges were mainly about the use of ecological materials, the use of as less materials as possible and making the tower (almost) zero-energy. Social challenges were mainly about how the building is used by its residents but also its visitors. A Zero-waste Learning Centre is situated on the ground floor as well as a zero-waste shop. For the resident's different communal spaces needed to be designed.

The relation between the graduation topic and the master programme, which is about exploring *"innovative ways to create more sustainable developments"*, is recognizable in the end result of my graduation project as well. As I mentioned before, the building is innovative in a way that it is the first residential complex ever designed for people that live zero-waste. Its function is an addition to future sustainable developments, in which one of the larges problems to tackle is the exhausting of our earth. This building could change the way we design residential buildings and change the way we use them.

SOCIAL, PROFESSIONAL AND SCIENTIFIC FRAMEWORK

Elaboration on the relationship between the graduation project and the wide social, professional and scientific framework, touching upon the transferability of the project results.

The topic of my graduation project is developed based on different social issues the world faces right now. Waste production in our daily lives as well as in the way we build, is something we should reconsider in order to stop extracting resources from earth and polluting earth and our own eco-system. Together with this, the world population is growing, which also means more and more resources are needed in order to, for example, feed people, cloth them and house them. Also, world-wide globalization is a trend as more and more people are moving to cities, which means that cities will also produce more waste as well.

The scientific knowledge in the field of living zero-waste is very new and a lot of research needs to be done in order to really design dwellings differently so a zero-waste lifestyle will be supported. The research I did, which is based on a questionnaire and virtual ethnography, I hope, will be an inspiration for others to develop more houses for new ways of living.

Although the building I made, is made within an urban context of Manhattan and has an appearance fitting in this context, the results are in my opinion usable for all different kind of buildings. Different research outcomes and underlaying principles can be used for all kind of buildings as well.

ETHICAL ISSUES AND DILEMMAS

Discuss the ethical issues and dilemmas you may have encountered in the research, elaborating the design and potential applications of the results in practice.

During the design phase, I have encountered different ethical issues. For example, the façade openings. From a zero-waste design point of view, it would have been best to make the windows as small as possible, as developing glass creates more CO2 in comparison with the façade cladding, I choose, which has a negative CO2-footprint. However, for the health and well-being of the residents (especially in the one-sided oriented dwellings) a lot of daylight is important, which means large façade openings are preferred. In my point of view, as a future architect, I believe I have an ethical responsibility to make sure that the health and welfare of the users, is the most important aspect in designing residential buildings.

Another ethical dilemma I encountered is the fact that, not building at all and maybe even not having children at all, would be the best solution to save our earth. Too many resources are extracted from earth, because we are with too many people living on the planet, and this number is growing much more. However, the solution won't be to not build at all, as people will end up homeless.

So, in my opinion, future architect has *"to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs."*[4]

[4] (Brundtland, 1987)

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