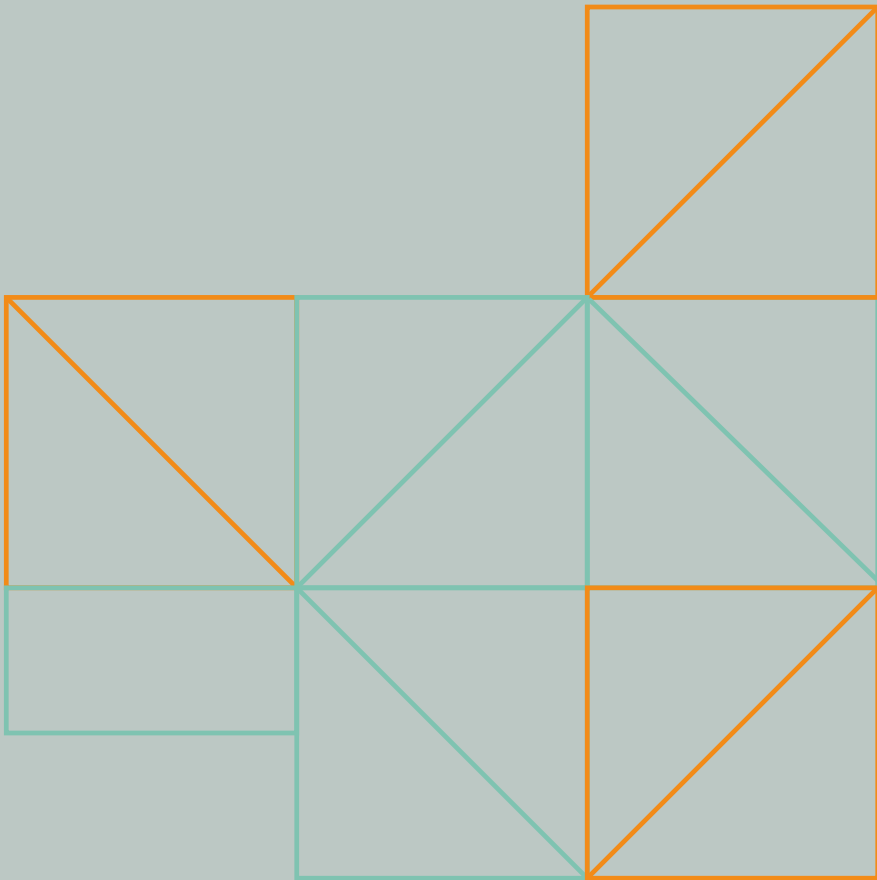


REFLECTION

GRADUATION PROCESS

MSC 3 & MSC 4



2019-2020
MAUD HOUTERMAN

Universiteitsfonds Delft

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Architectural Engineering,
EXTREME

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RESILIENT HOUSING FOR SINT MAARTEN
CREATING A LOCAL INCOME GENERATION

INTRODUCTION

For my graduation project I am designing resilient housing for Sint Maarten. These houses will have a positive effect on the local income generation and therefore give the economy a boost. My personal life goal has always been to provide housing for people in developing countries. Furthermore, I am always amazed by the amount of single waste usage of humans and in particular plastics. In my graduation project I try to combine those two worldwide problems; need for housing and plastic waste. In this paper I will reflect on the process towards my final design and discuss the effects of some research and design decisions.

STARTING OF

What had drawn me to the Architectural Engineering EXTREME studio is that it copes with the technical and architectural aspects in an extreme context. From the beginning, I wanted to make a technical but also a social effective project. I had a specific goal to combine my previous master projects; social housing in Ghana and 3D printing of a roof. These two projects symbolized the two worldwide problems I want to encounter: need for housing and plastic waste.

We planned a field trip early in the graduation year. Before going to Sint Maarten I did not have a research question, I thought the field trip would help with that. The study trip helped me to realize the local problems. However, the trip did not help me focus on my initial idea because I was overwhelmed by all the problems the island has to face after hurricane Irma. I only thought about how I could help the local people, and forgot what I wanted to achieve personally. For me, it can be hard to focus on one subject because I find everything interesting. I lost a lot of time doing multiple things. After my tutor directed me back to my initial idea I started to get a grip on my project. I started to write down a problem statement (fig.1) and then created some guidelines. Later I realized that making guidelines does not mean that they have to be fixed till the end of the project.



Figure 1. Problem statement in diagrams. (Own work)

METHOD OF RESEARCH

Research question: What are the potentials of HDPE plastic waste as material for hurricane resilient sandwich panels that improve the insulation value on Sint Maarten?

The biggest problem for the houses on the island was that roofs were not resistant to hurricanes. I wanted to understand why roofs are vulnerable to high wind speeds. So first, I started with literature research about high wind speeds and the effects of them on roofs. I learned that making a resilient roof is mainly about the shape and connection. The problem for Sint Maarten is that most of the contractors are not well educated on building resilient housing. And when people do not have money for a contractor they ask a relative or friend to help building the house. There is a large inequality of the rich and poor. This brings me to the next problem, the community is depended on tourism to create income. However, after a hurricane tourists tend to stay away of the island and seek other destinations. This is where I started to think about a solution that combines multiple problems. What if the roof elements could be locally made of recycled plastic, be resilient and have an effect on the indoor climate.

The second half of MSC 3 consisted of physical testing. I had to see if the recycled plastic elements could be made locally. I started the experiments at home with plastic bags and an oven. It showed me I could create different textures and that it does not need much effort. I was positively surprised and wanted to see if I could get the same results with granulate from recycled plastic and different machines. I contacted company named "Unibrick" who make building blocks of recycled plastic. I could use their sheet press and recycled granulate to do more testing. I learned that using granulate in a sheet press gave much flatter surfaces. I then

tried to frame these flat sheets into a form. I used a vacuum machine on BK and I framed steel and melted the sheet on top of that in the oven. In addition I also worked on how to connect plastic sheets to each other. It was good to use different techniques to see how recycled plastic reacts to them. However, using multiple ways in testing let to results that cannot be verified because it was not tested multiple times.

Writing the research paper was more difficult and less fun than the testing. Because I used physical testing as a research method I found it hard to translate that in a paper. I tried to describe the results of the testing. However, I did not know what results I had to write down. Writing my conclusion was hard because I noticed that it did not answer my research question. During the testing I tried multiple techniques that led to the potentials of plastic as a roof element. I later learned from my tutor, that sometimes the process leads you to an answer of another question. The solution was that I had to re-formulate my research question.

There was no specific approach during the testing period. Alongside the testing I sketched some design ideas. I tried to make the ideas in plastic and learned what the limitations where. I used different machines to help me see the possibilities of each tool. There was no set up plan, the outcome of each test formed the beginning of another. I noticed that this method has some disadvantages because during the process I could have better results if I looked out for specific elements. However, my initial idea was that these tests would help me design a plastic roof panel and I succeeded.

METHOD OF DESIGN

Design question: How do we solve the need for resilient housing on Sint Maarten and create a local income source?

The design phase began with setting up the design criteria for plastic roofs. The literature research showed me that the pyramid roof was the most resilient roof shape. So I continued with this shape and started to make physical models. The idea with these models was to see how I could cluster multiple houses. But I soon realized that the pyramid roof shape was not ideal for creating clusters of housing. Because combining the units gave an irregular roof shape. The tutor helped me to look further than just this roof type. I started to make a table with different roof types to compare the possibilities (figure 7). I included architectural possibilities of façades in this list, something I did not look for in the beginning. The challenge for me was to use what I have learned about roofs in MSC3 in the final design project.

I noticed that making models helped me seeing the whole picture. I made square wooden models to see how roof shapes could be connected and thereby created different façades (figure 4-5). Making the units in small scale helped me experiment with form in urban scale, I could easily replace or remove units. In addition to the model making I used references as another tool to get inspired. I looked at information about clusters of housing and pictures of origami textures.

My overall approach during the design has been to experiment with different forms. I noticed that the models helped me a lot because I could use my creativity and explore new combinations. When the corona crisis began I started to have some difficulties with my creative process. Not being in a creative environment like the faculty of architecture, not having the tools to make models and staying

at home created a loss of efficiency in my working hours. I changed my approach to modelling on the computer and created working hours at home. Furthermore, I learned the importance of having other students around. I had no clue what other students were doing. I could not compare my own work with others which created an uncertainty about the level of my work. Did I do enough? Do I do it the right way, or could I have done it differently? I started to meet a few students from Architecture through Skype and we would review each other's projects. The feedback has helped me to look at my project in a different light and gain more confidence.



Figure 2. Experiment in oven. (Own work)

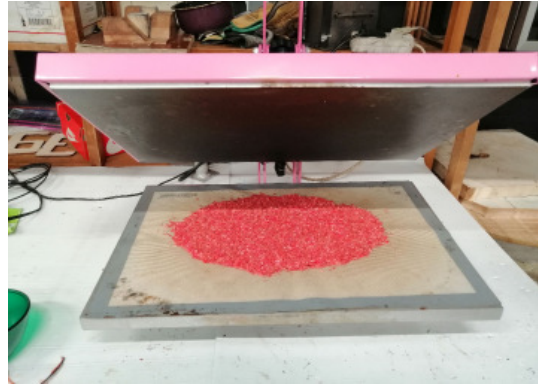


Figure 3. Experiment sheet press. (Own work)

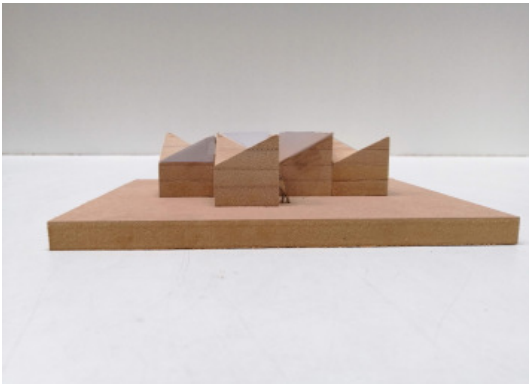


Figure 4. Model of single cluster. (Own work)

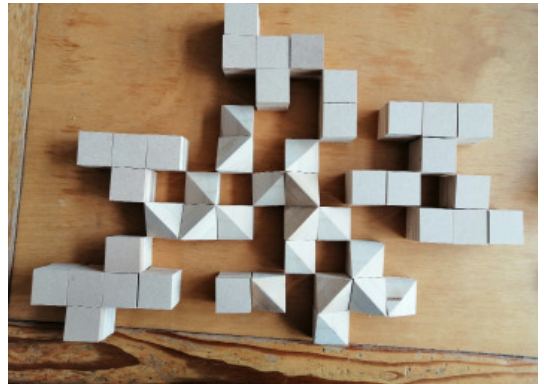


Figure 5. Model of urban cluster. (Own work)

RELATIONSHIP OF RESEARCH AND DESIGN

From the start, research was led by design. The research paper was about looking at the design potentials for recycled plastic as roof panel that effects the insulation value. I tested different shapes and structures. Although there was a tight connection between research and design it was hard to move into the creative process of MSC 3. Coming from applied science I tend to think practically. I keep asking myself how I can help these people. This thought has limited the creative process because I was designing something they would understand without any innovation. The tutors helped me understand that the challenge may lay in making something innovative understandable.

GRADUATION THEME

The graduation studio theme that fits my project is MAKE. I choose this theme because it reflects the way I work in the field of architecture. I think that my previous experiences on applied science have shaped me to think in the "making" of the building. In the research phase I worked towards a product design of recycled plastic roof elements. The knowledge I gained from this helped me to develop the design. In the design phase I used models to see how to connect modular units with different roof shapes.

TOWARDS GRADUATION

Unfortunately my final moments of the graduation process takes place in the Corona Crisis of 2020. I always looked forward to make the final model with the help of my brother or father and then graduate with the company of family and friends. I have now accepted the fact that this cannot be realized. My P4 and P5 presentations will be held online.

This consequence means that I have to focus on my digital presentation. I want to focus on using digital tools to make an attractive booklet and presentation. Knowing that I would need nice images I have to use my computer more often instead of physical modelling.

During the field trip I have met people that want to know about my final project. I will create an online booklet after P4 that I would like to share with local architects and people in the local community


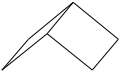




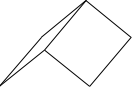
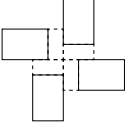



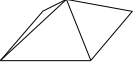
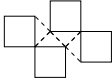

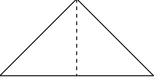

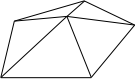



PANEL SHAPE	ROOF SHAPE	RESILIENCY	CLUSTER	FACADE	FEASIBILITY
		+ -			
		+ -			
		++			
		+++			

Figure 6. Comparing roof shapes. (Own work)

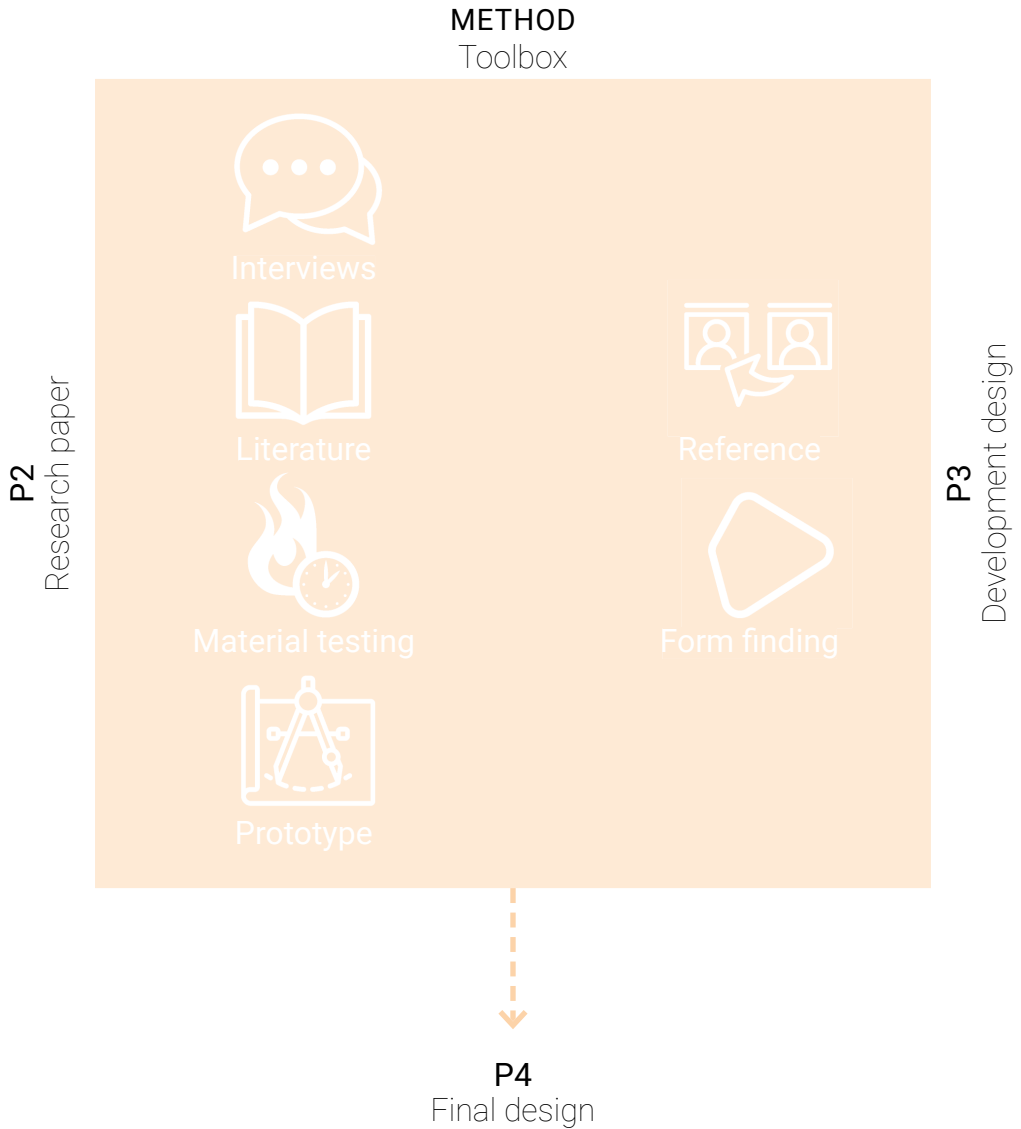


Figure 7. Used research methods. (Own work)

