REFLECTION
Architectural Engineering Studio

Project: Aeolian Symbiosis; An alternative approach to coastal architecture

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INTRODUCTION

ABOUT THIS REFLECTION

For all graduating students of the Architecture Faculty of TU Delft, each student is required to write a reflection during the course of the studio. With the goal being able to look back and see how the initial methodology has performed thus far. Whether the methodology has been effective or not, is equally valuable as learning material. In the next few pages, three aspects will be discussed highlighting the progress of the methods used, the preliminary results and the connection of the project to a wider context.

In the first aspect, the link between the research and project is laid out. Important in this chapter is the results of the research and the preliminary design that followed. In the second aspect, I will go more in depth about the research and how it was conducted. I will also talk a bit about the related issues I have encountered during the making of the wind tunnel. The third aspect is about looking beyond the confines of the project and to discuss about the connections of the project and the wider social context. Lastly, I will talk about the performance of the used methodologies and how the project has progressed towards the end.
ASPECT #1
RELATIONSHIP BETWEEN RESEARCH AND DESIGN

While I had a clear fascination and own reasons for joining the Architectural Engineering Graduation Studio track, I did not and could not project how my project has turned out thus far. Whether it be for better or worse, I shall discuss within the next few chapters. Nonetheless, I have gained new knowledge while also deepening my existing ones.

As with all architectural intervention, research has to be done that runs in parallel with design. For my project, the context is the coast of the Netherlands, specifically the dunes. Understanding the mechanism at play was essential. During the initial phases, literature, articles about the wind dynamics, dune formations and building on coastal areas formed the starting point for my research and project.

Running parallel to the information gathering, I know I have to find a way to test my designs and theories. This is done in two ways, using CFD (Computational Fluid Dynamics) simulations and a physical wind tunnel for more real world testing. If the above mentioned information gathering can be considered the “soft research”, then using CFD paired with the wind tunnel is the “hard research”. In these beginning stages, it is very much research by design. The studio and the research provide me with guidance, argumentation and justification for my choices and actions.

The research was focused on how wind reacts to foreign objects (man–made structures) in the dunes. I was mainly looking into the form and how it would impact the sands on the dunes. In the very beginning I was also looking into how to manipulate the wind by playing with the form of the structures. This, however came to a dead end due to the goal of the project and the limited knowledge I have in fluid dynamics and the lack of necessary tools I will need. So I shifted all my attention towards producing a form that has as little negative impact on the sands in the dune as much as possible. As we are all aware about the issues about building on the dunes and all the debates and discussions regarding this matter.

The outcome of the research by the end of P2 period suggest an inclined form that will give more way to the wind and therefore lowering the overall influence on the sands surrounding the building. The preliminary design for P2
examination reflect directly to this outcome. Basically, the research recommends either a faceted form with angled surfaces. As this is the direct results coming from the research, the real design part has yet to happen. I have yet to take the knowledge of the research and translate that into sketches, drawings or plans.

The above image shows the visualization render of my project based on the results of the research. As said beautifully by British architect, Richard Horden in his Book Micro Architecture.

“The computer can generate any spatial object you ask it, but the architect needs to develop a rational or intuitive understanding of the form to make it buildable. Simple or complex, engineer or sculptor: beauty has to do with control.”

The research is the computer that gave me suggestions about the optimal form with the parameters I have inputted, but the translation from research to design is the task of the designer, me.
Upon learning more about the dunes and the coastal environment, I discovered the blowouts in the dunes and its intention. Blowouts are essentially depressions of sands caused by the wind.

These blowouts can be man made or formed by nature. The purpose of such blowout is to allow the sands to move and be blown to the back of the dunes, building up its volume.

Discovering this fact enabled me to further refine my design goal. The project is not only about how to build differently in the dunes, but also how to stimulate the ongoing processes in these dunes. This also means more testing and simulations with new sets of parameters in order to find an optimal configurations that would yield the most potential.
ASPECT #2

RELATIONSHIP BETWEEN THE METHODICAL LINE OF APPROACH OF THE GRADUATION LAB AND THE METHOD CHOOSEN BY THE STUDENT IN THIS FRAMEWORK

Architectural Engineering, a good mix between architecture and the engineering behind it. This chapter focuses more on the engineering part. As said in the previous chapter, preliminary literature readings and information gathering are the “soft research”. This part narrows down into the “hard research”, which is the CFD simulations and the wind tunnel testing. The field of fluid dynamics is very complex and proved to be too difficult for me. I have merely scratched the surface of it. To be able to run simulations and also able to read the data of the simulations, I have chosen to use ANSYS Fluent, a specialized part within the ANSYS software suite dealing with CFD. The reason I chose this software over other more user friendly ones, like the Autodesk Flow, is because the data I can extract from it. Autodesk Flow software does not provide me with the data that is being calculated while the simulation is running. ANSYS Fluent however give me all the data I can possibly need. These data was important for me, because I can see the performances more clearly with numerical data, rather than just the visuals provided by Autodesk Flow. Learning to use the software was difficult and time consuming, but it was well worth it in the end.

While the CFD simulations provided me with numerous data, but to model and accurately simulate a real world situation would be impossible. Trying to accurately simulate how sands would react in the presence of a building blown by wind on the coast would be extremely difficult and certainly out of the scope of this project. This is where the use of the wind tunnel come into play. During wind tunnel testing, all the particles, all the variables within the realm of fluid dynamics and all the laws of physic are calculated in real time. The only downside of this is the data gathering. My only tool of documenting the tests was a camera, markers in the sands and my own eyes. The idea was to have the CFD and the wind tunnel compensate for each other’s downfall. Data gathering using lasers or infrared sensors like the one in the Xbox Kinect is also considered. After doing a trial run and some experimentation, I concluded that the data from these sensors are far too coarse to be usable to me due to the accuracy of the sensors.

The methodology of research by design is very clear with the wind tunnel tests. Starting
first with a very basic rectangular beach house, I observe the results and came up with the next sets of form to test. What form to test next is partly guided by the literary and information gathering I did in the beginning. This helped me reduce the amount of possible testing forms to a small but potential and manageable number.

Making the wind tunnel took more time than I had anticipated. Firstly, the size of the wind tunnel was not easy to construct. It took 4 people, myself included, one full day to fabricate the hollow box only. The next part was designing the electronics so the motors can be controlled via an intuitive control panel. As I am an architecture student and not an electrical engineering one, I need to teach myself about circuitry, the Arduino micro controllers, brush less DC motors and other electrical components. After getting the basics down, I needed to write the code that will eventually tell the motors what to do and how fast to turn. While this may sound simple, it is very far from just hooking up a few wires. Each motor needed some electrical signal to turn and getting all the motors to turn at the same speed was particularly difficult. The calibration process of the motors were further hindered by the

Figure 4. The four parameters used in the wind tunnel (own ill.)
fact that each motor is not identical. Each require a slightly difference signal and also draws slightly different current to power them. I had to stop somewhere before I turn this architectural project into an engineering one. While I admit, that I do like to dwell into

the electronics of the wind tunnel, but to get it properly working took more time than I had originally allocated.

Figure 5. New sets of parameters for the final design (own ill.)

2, 5, 10, 15, 20m  
1°, 5°, 10°, 15°, 20°
ASPECT #3
RELATIONSHIP BETWEEN THE PROJECT AND THE WIDER SOCIAL CONTEXT

Around December 2015 and January 2016, there has been a lot of tension regarding the Minister Schultz of Infrastructure and the Environment wanting to loosen the building regulations on the coast near Kijkduin. The coast of the Netherlands is both culturally and environmentally very important to the Dutch and the country as a whole. It protects the people from the battering North Sea and also offer a unique retreat to nature. Unlike the Belgium coast or the famous Miami coast, the Dutch coastline is for the most part not contaminated with buildings close to the beach. Loosening the building regulations obviously sparked a lot of debates and discussions among the people in the nearby areas of Kijkduin. While Minister Schultz eventually withdrew her plans, the questions remain. If we were to build on the dunes, how should we go about doing it? This is directly linked to my first design goal.

My goal for the project is to propose a different way of coastal building that can contribute or stimulate to the ongoing aeolian processes while providing public and private spaces that allows other activities to take place in the units. I want to show the municipalities/government and the people whom are very concerned with the area, that building on the dunes without ruining it, is possible. Of course we are not talking about populating the whole dune with my dune houses/pavilions, but only in areas where the dune units can contribute to the health of the dune by acting as the blowouts and stimulate sand blown to the old dunes or as native beach grass which stimulates sand accumulation. The project is first adding resilience to the dunes and accommodating people second.

This project is aimed to take both parties’ interests at heart. The people do not want the natural beauty of the dunes to be ruined and the municipalities want to build on the dunes to explore possibilities of bringing more economic value and opportunity for growth to the area.
The correlation between research and preliminary design was a bit dis-satisfactory to a small extent. The reason being that the outcome of the research still suggest many potential forms that qualifies all the parameters I have set in the research phase. The angle of attack, angle of repose, location on the dune and the distance between objects. While the P2 design did meet the first design goal, but did not quite hit the second design goal as I had intended, which is the landscape integration. That was the goal after the P2, to look into the deeper integration into the landscape.

As I progressed through the months, I managed to narrow down and refine the direction I want to go. The result is that of the P4 presentation. Due to the nature of this project and the fact that the workings of the dunes are not fully known from the beginning, I was still doing a lot of researching after P2. The consequence is the loss of time trying to find the proper anchor point for the project.

Time spent on learning the necessary softwares to do the simulations were unavoidable, but making the electronic part and calibration of the wind tunnel took a lot more time. Time I could have used on actually testing my shapes and fueling my research. I opted to use several small motors due to cheap costs and mobility instead of one big fan. This decision cost me a lot of time. Ideally, a big fan with proper speed control would be the best as it is the same configuration used in all traditional wind tunnels. The unknown problem however is the time finding the big fan or even if found, the price tag tied to it.