Ventifact

Wind erosion in the design process

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Preface

With my background as creative craftsman, I have a great interest in production processes and materials. My inspiration comes from my direct surroundings, particularly nature as maker and designer.

This project brings me back to my youth and the place where I grew up. Near the shore in the Zeeland province, I did spend a lot of time on the beach, surrounded by wind and sand. I can remember vividly the intense winds and how they would almost painfully blast the sands onto my bare legs. The power of the wind in combination with sand showed itself in miniature “Grand Canyons” on piles of sand or dunes. In this project I want to share my interest in the wind as maker and designer.

I went out looking for a way to find and establish as co-workship with the wind hoping to develop a new way of making and shaping. I want to visualize the unseen shapes of the wind and record the unpredictability of it. Using the wind to create unique objects and sculptures as seen in nature, but with the ability to make choices and have limited influence on the production process. Showing the power and beauty of a natural entity in the form of an object.

Emiel Gilijamse
Rotterdam, 30 januari 2019

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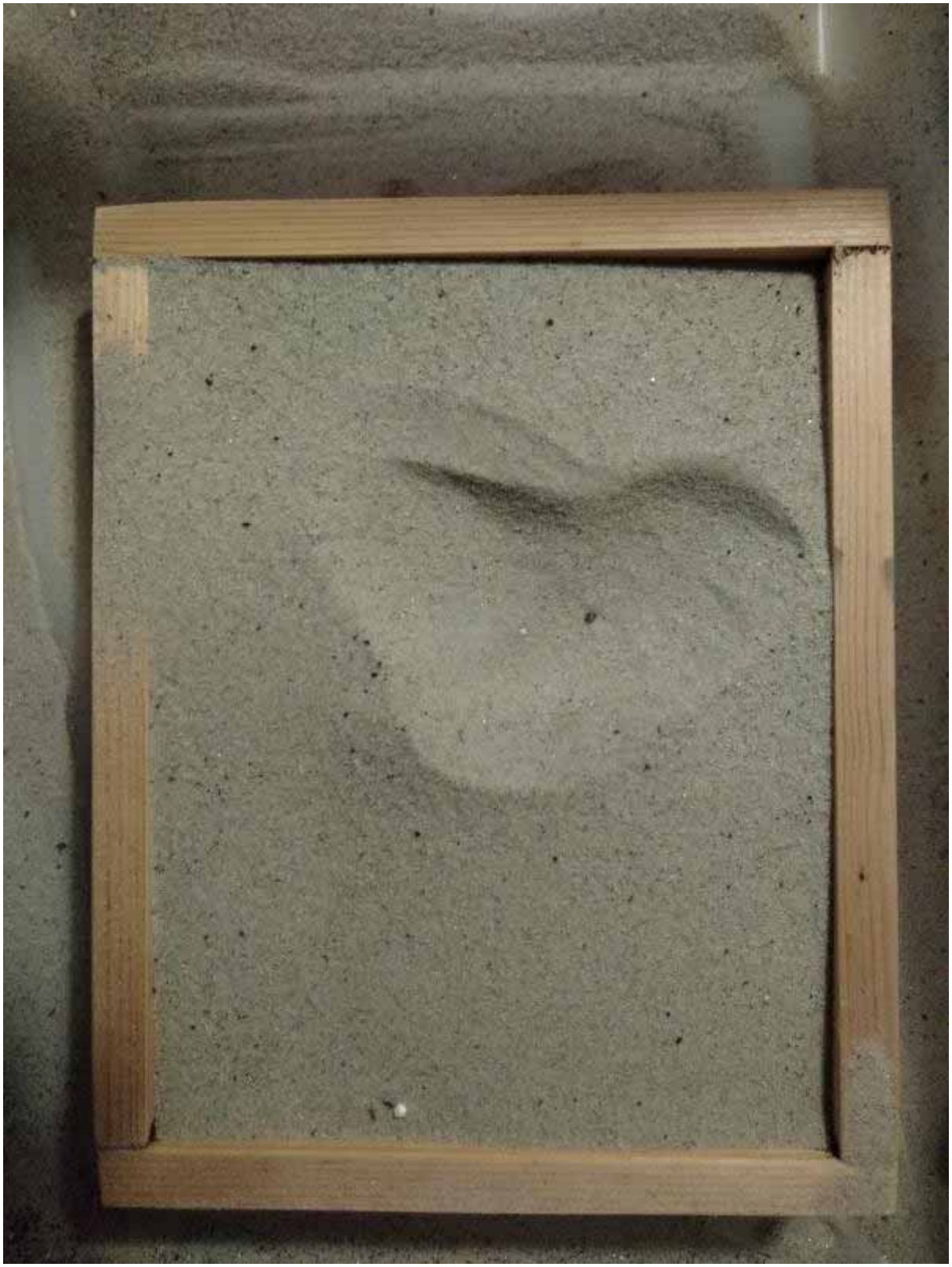
Bijlage 1: Fotodocumentatie onderzoek



1 Introduction

The main reason for this is the interest in the wind as an invisible natural force which forms the surface of our planet. The interest to visualize this natural force and to use this in the realisation of a physical object, form the basis of this project.

The project focusses on the question if a co-workship could be established between wind and designer and use this co-workship to create a method to design within the design process. Looking for the right balance between control and coincidence is very important. A main focus in this project is to realize a physical outcome during the research on wind and to use it as designer. Studies of form and shape were done in a physical and digital environment to explore the possibilities of the co-workship between human and wind.
The approach is supported by a variety of theoretical sources about wind and winderosion to support the physical realisation of an object which is part of this research. The research focusses on documenting and understanding the wind to use in the design process and use it as a designtool. The personal interest in the making process lead to the focus on making 3-dimensional objects. The research pays limited attention to the use of wind as an energy source and will not react to the use of wind in transportation of humans an vehicles. .

This Project reacts to digital design processes which mimic natural processes. Known as generative design there are several digital design tools available which use algorithms to visualize characteristics of natural processes, for example like erosion. These processes are therefore controllable and predictable, I would like to use the wind in his natural form and the uncontrollability that comes with it. The differences in pressure in our atmosphere and the flows of air which are caused by these differences, are hereby the uncontrollable aspects.
The interest in integrating this aspect is finding both a new design language and design methodology. The intended outcome of this project offers the designer a method to have limited influence in the design process and can therefore be surprised by a phenomenon that can not be fully controlled. As a result, the physical outcome is not only a result that the designer can never fully realize, it changes the relationship between man and nature.

Various scientific sources have been consulted for this study, which have clarified the behavior and the working of the wind in order to be able to work with this in practice. Articles from meteorological institutes and educational institutions contributed to this. The term ‘geo-engineering’ has been researched to get a better picture of the relationship between man and natural forces. Articles about how we are currently working on putting the forces of nature into our own hands, but also about the human vision of controlling the environment in the future for different purposes. Various software programmes have been used to investigate the relationship between digital and natural wind.

This project aims to present an alternative design tool where the wind plays an important role in certain design choices that are made.

The degree of control by the designer is essential, which distinguishes a naturally formed object between a consciously produced object. The degree of control, however, is what is investigated during this project. The time factor proved to be important.
This project asks the following questions:

- How can I use the uncontrollable power of the wind in the design process?

- Which examples can be found in nature which have been designed by the wind?
- How do humans try to control the power of weather and wind?
- What digital weather tools are available and where are they used for?
- In what degree do I have to control the wind to design with it?
- Can I apply my findings in the natural environment?
- How can I create my own Human-Wind design methodology?

To answer my main and sub questions, I choose for a "research through design" approach. This means that I want to be able to produce a physical object at the earliest possible stage in order to get an idea of what my possibilities are to cooperate with the wind. A test setup in the form of a wind tunnel to do form studies is of great importance here. The outcome of my physical tests then leads me to new questions and results. This method is supported by a theoretical research that runs alongside the physical research.

In chapter 1, I look at examples of the wind as a designer that occur in nature. The forms, the beauty of it and the process of making are explained. The fascination with wind erosion comes to the fore. Chapter 2 will deal with how man uses the wind, tries to understand and influence the forces of nature. The concept of geo-engineering is discussed here. The use of digital design programs and their results are discussed. It is examined whether these can be of value for the physical examination.
The process is discussed in the third chapter. The setup that I used to do tests is presented. The ways to form with wind used in this study will be explained. Choices that have been made regarding control and coincidence take shape in this chapter. The search for the right material is also discussed. The chapter will conclude with a vision of how this project can have a future application.

2 Research

Chapter 1 *Wind as Designer in Nature*

The surface of our earth has been shaped by nature elements since the beginning of its creation. The shifts of matter, known as erosion, by wind, water and ice on the earth's crust have a major influence on the appearance of the earth's crust. I have chosen the wind to work together as a maker and designer.(Wind Erosion, sd)

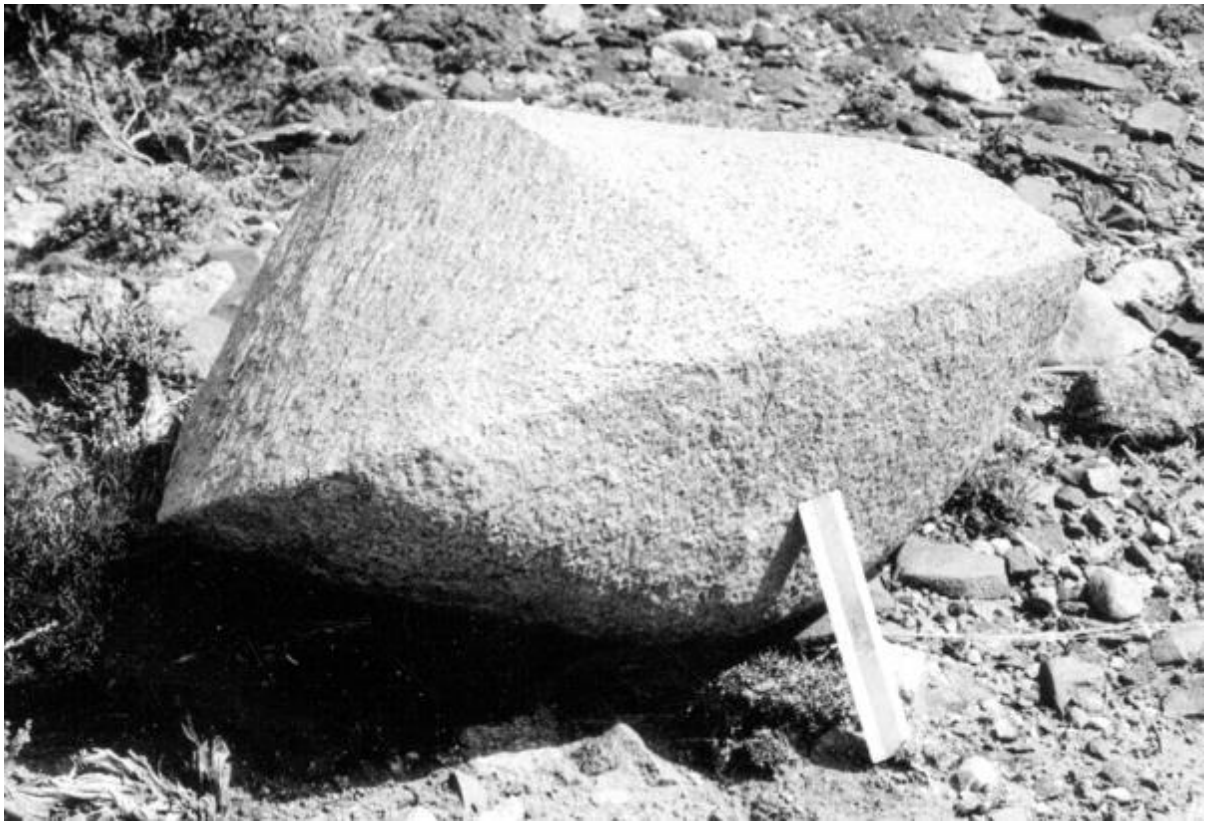
Wind is able to transport matter from high to low pressure during its journey. In most cases this is in the form of sand. Wind and sand together form a powerful duo which is capable of making rocks or mountains or breaking them down. By scouring rocks for long periods, sometimes millions of years, and removing material from its solid form.
The most common, and also most changeable forms that the wind leaves behind can be seen in loose matter, such as sand. The influence of wind on the surface of the earth can be clearly seen on sandy plains such as beaches and deserts.

(fig. 1 "Bognold Dunes" on Mars)

The interesting thing about the forms that the wind blows in sandy plains is the changeable aspect. The landscape and its intriguing forms are constantly changing. This also inspired Ralph Alger Bagnold during his military service in the deserts of Egypt in the early 1940's. So much that he devoted his life to it and wrote the book 'The physics of blown sand and dunes'. (Ralph Aldger Bagnold, sd) A book that is still relevant and used by NASA to analyse the sand dunes of Mars. NASA named a type of sand dune to Bagnold, the "Bagnold dunes" *(fig. 1)*. (Bashir, 2015)

In solid matter, such as rock formations, the role of wind erosion is also clearly visible. Both on the surface of the earth and more hidden in ravines, the work of wind as a designer is unmistakably present. In order to wear forms in rock formations, however, thousands of times millions of years are considered before the influence of wind and sand becomes visible on a large scale. *(fig.2)*. (Walrond, 2004)

(fig. 2 “Antelope Canyon”)



(fig. 3 “Ventifact”)

In 1869 an expedition was set up following the discovery of a strange-looking stone in Lyall Bay, Wellington, New Zealand. Captain William Travers, Dr. James Hector and Mr. Walter Mantell previously concluded that it was a man-made object. But the local Maori’s did not recognize it and the researchers traveled to the site. Here more of these objects appeared to be found and they discovered that these were not formed by man, but by prolonged exposure to wind and sand. They had found 'ventifacts', of Latin 'made by the wind'
(fig.3). (Walrond, 2004)

These ventifacts are often collected and searched in places where this is permitted. There are protected areas where it is forbidden to move these ventifacts to take with you. They are fossils that provide a lot of information about the weather over a long period of time. The reason for collecting these objects is usually the form.(Walrond, 2004)

Chapter 2 *Humans and Wind*

2.1 *Measuring and Understanding Wind*

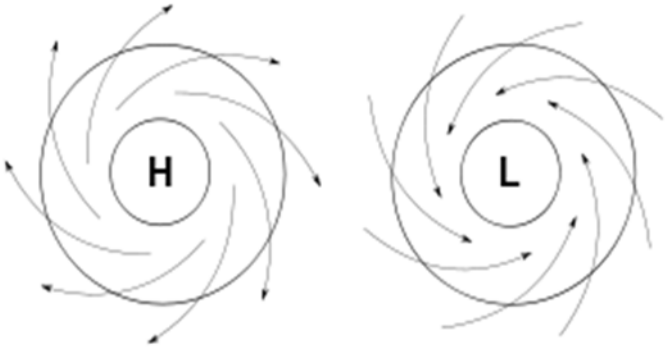
In order to work with the wind, one must be able to measure the wind. The wind is generally measured on the basis of the Beaufort scale *(fig.4)* 1805. (Windschaal van Beaufort, sd)

Kracht*	Benaming	Windgemiddelde snelheid over 10 minuten (km/u)	Windgemiddelde snelheid over 10 minuten (m/sec)	Uitwerking boven land en bij mens
0	stil	0-1	0-0,2	rook stijgt recht of bijna recht omhoog
1	zwak	1-5	0,3-1,5	windrichting goed af te leiden uit rookpluimen
2	zwak	6-11	1,6-3,3	wind merkbaar in gezicht
3	matig	12-19	3,4-5,4	stof waait op
4	matig	20-28	5,5-7,9	haar in de war, kleding flappert
5	vrij krachtig	29-38	8,0-10,7	opwaaiend stof hinderlijk voor de ogen, gekuifde golven op meren en kanalen en vuilcontainers waaien om
6	krachtig	39-49	10,8-13,8	paraplu's met moeite vast te houden
7	hard	50-61	13,9-17,1	lastig tegen de wind in te lopen of fietsen
8	stormachtig	62-74	17,2-20,7	voortbewegen zeer moeilijk
9	storm	75-88	20,8-24,4	schoorsteenkappen en dakpannen waaien weg, kinderen waaien om
10	zware storm	89-102	24,5-28,4	grote schade aan gebouwen, volwassenen waaien om
11	zeer zware storm	103-117	28,5-32,6	enorme schade aan bossen
12	orkaan	>117	>32,6	verwoestingen

(fig. 4 de schaal van Beaufort, door Sir Francis Beaufort)

Based on the amount of sail required to move a large ship at different wind forces. This wind scale applies to the pressure of the wind and expresses the wind pressure in kilograms per square meter.

One of the pioneers in measuring and predicting the wind and weather, was Christophorus Buys Ballot. He found out that the wind and air pressure in the atmosphere are closely linked. In 1857, this resulted in the Law of Buys Ballot, named after him. This law states that the wind is the movement of air from a high pressure to a low pressure area in our atmosphere. The basis for this is temperature differences that take place on our planet. The greater the temperature difference, the greater the pressure difference the more intense the air displacement, in other words the harder the wind.
(Buys Ballot, sd)



(fig. 5 Illustration of the Buys Ballot Law)

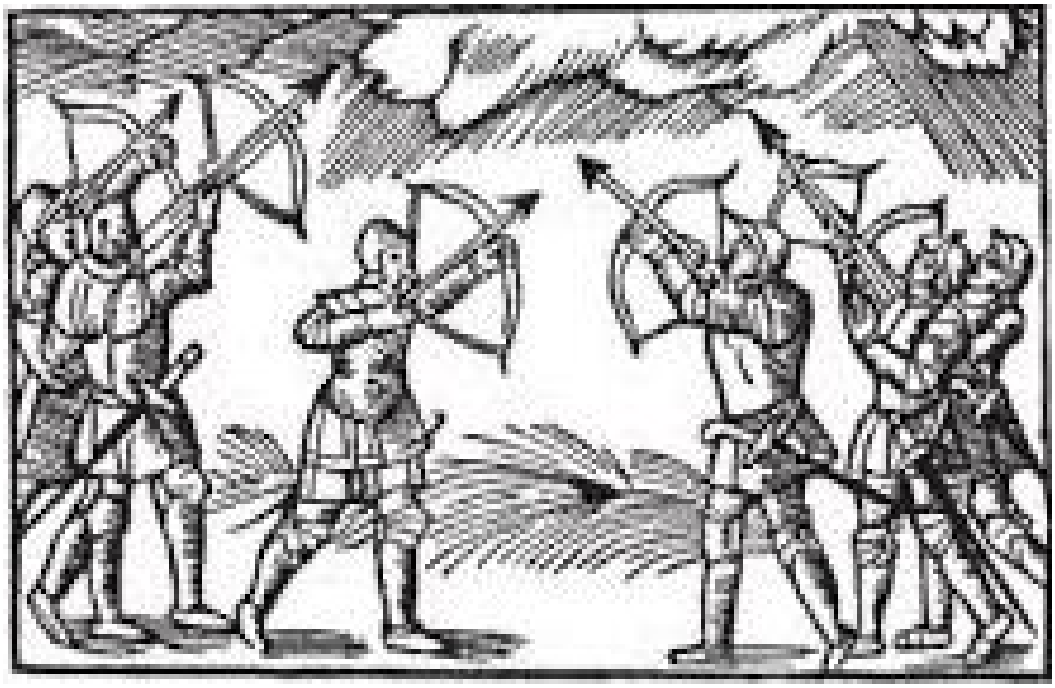
v

I have divided the relationship between man and wind into two categories. The relationship in using the wind in its natural form and trying to control the wind itself. We can see the use in its natural form in the form of the use of windmills to, for example, process food or generate energy. The urge to absolutely control the wind can be placed under the term geo-engineering.

2.2 *Weather and Wind Control*

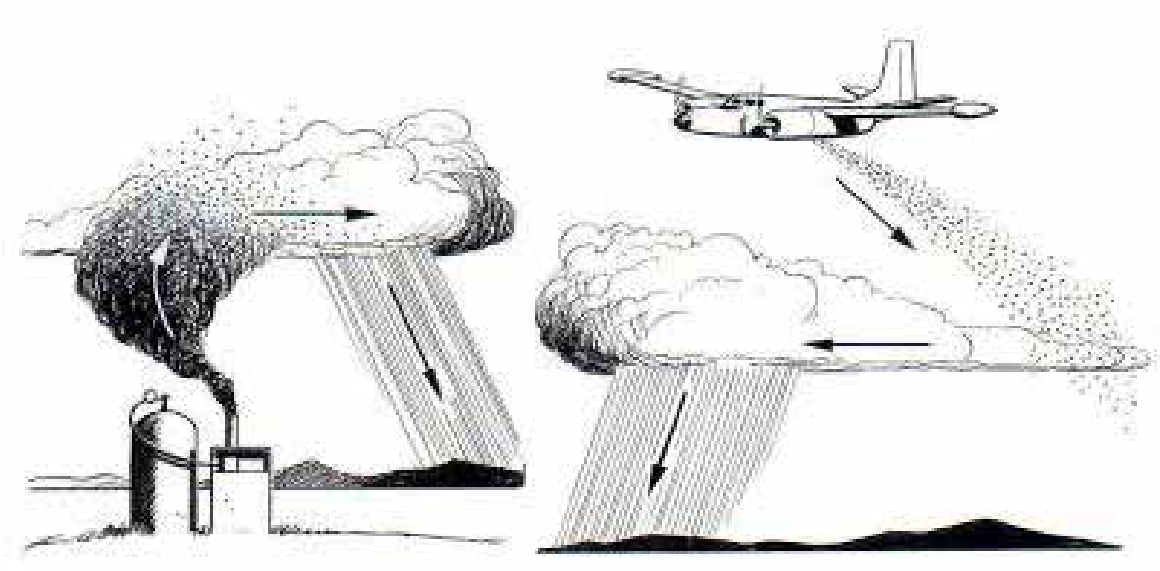
During my research I came across the term geo-engineering. With the use of technology, humans are trying to control the weather and its forces. Although this sounds like science fiction, the urge of people to have control over the weather is not new and certain forms are already being applied in practice.
(Benestad, 2011)

Since thousands of years stories of the will of man to control the weather are known. For example the Indian rainmakers and mythological stories about extreme heat due to the gods. Stories that serve as a source of inspiration for physical applications in changing and controlling the weather, as well as the wind.
(Fixing the Sky 'the checkered history of weather and climate control', 2010)



(fig. 6 Prent uit 1555, boogschutters verzwakken een storm met pijl en boog)

In attempting to come up with a solution for the disastrous tropical storms on the American coast, a solution for these storms was made in 1954. With subsidy from the US government and the U.S. Navy during this project, certain amounts of silver iodide (a chemical that adheres moisture particles so they fall down by gravity) shot above the storms in the atmosphere *(fig.7)*. Although it is claimed that the storm Esther in 1961 in power decreased by the use of this method, there were questions about the effect and the ecological impact of the project which operated under the name Stormfury until 1983.
(Fixing the Sky 'the checkered history of weather and climate control', 2010)

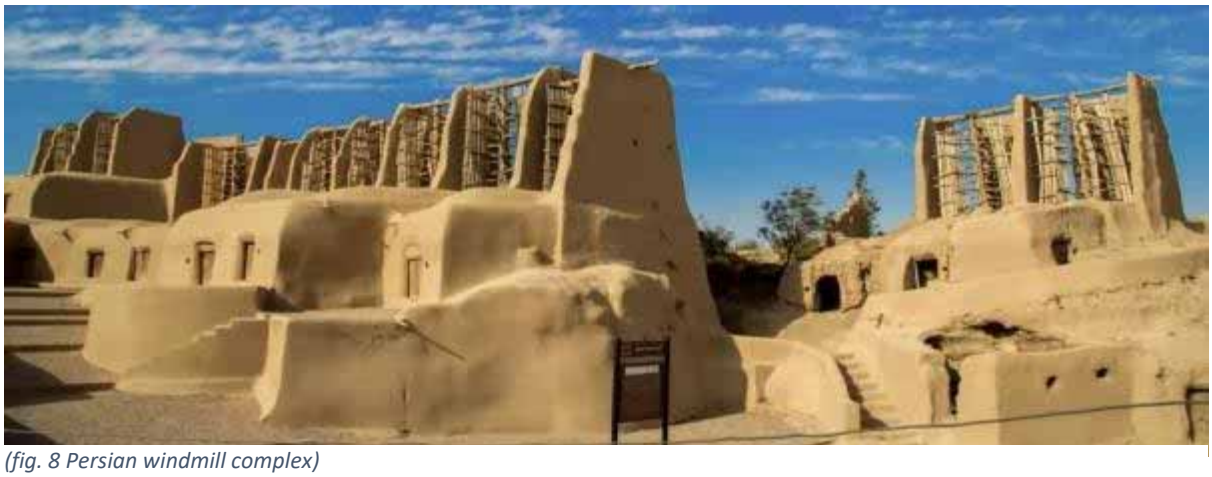


(fig. 7 inserting silve iodide in the sky from ground or air)

Despite the doubts about the effect of the use of silver iodide in controlling the wind, it is still being used today. China is currently trying to control the rainfall in the Himalayas by evaporating silver iodide into the atmosphere using large stoves *(fig.7).* At the moment there are about 500 stoves in Tibet to allow the monsoon clouds from India to rain over Chinese territory in order to be able to keep the land supplied with fresh water. This technique is not new to China, the opening of the Olympic games in 2008 was kept dry using this technology. The silver iodide could let the potential rain cloud rain earlier by making the raindrops heavier. Both the application of this method in the past and the application now in the Himalayas are widely criticized.
(China is building a huge weather control machine, 2018)

2.3 *Using Natural Wind*

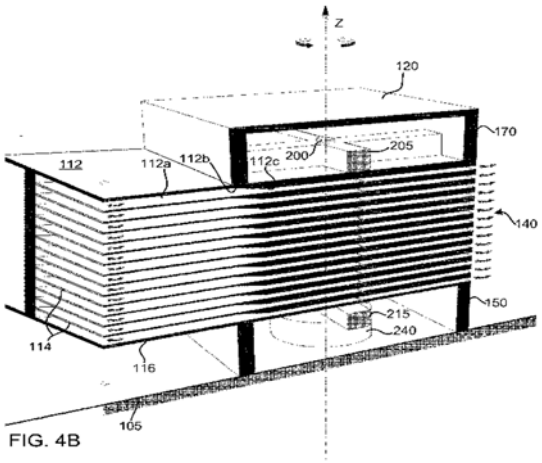
In the use of the natural wind without wanting to control it, can be seen in designs of different devices and machines. The best known is perhaps the windmill. The physical transmission of wind energy to mechanical energy, the turning of parts, was first applied by the Persians *(fig.8)*. In the sixth century AD they built large-scale structures that could convert wind energy into moving millstones for making flour.(Howard, 2017)



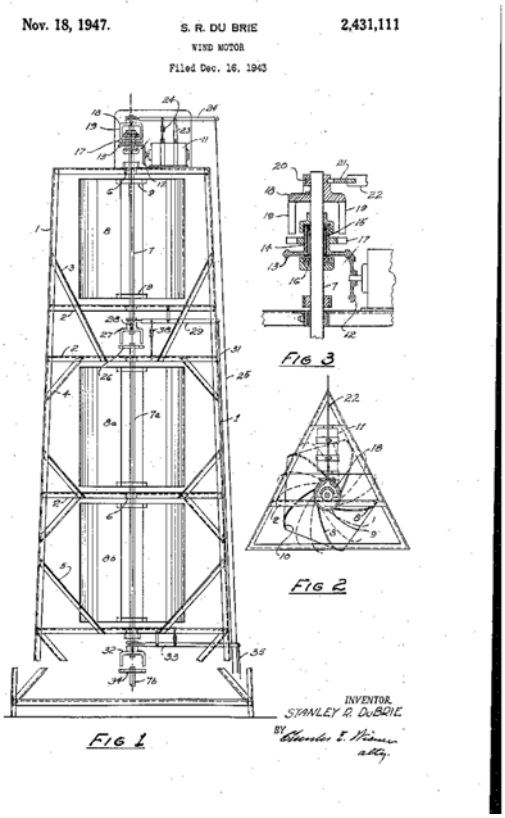
(fig. 8 Persian windmill complex)

The knowledge of the Persians and their windmills spread over the rest of the world and was used for different purposes. For example, the Dutch, who made their name in the development of the windmill, used the device for moving water to create new land.
(Howard, 2017)

Now we know the windmill especially for generating electricity. Over the centuries, different models have been developed with this as main goal. For example, there are many designs for windmills and turbines to be found in the form of patents. (patents.google.com, sd) For example, the database of google patent has a comprehensive overview of designs from the end of 1800 to the present *(fig.9) (fig.10).* This gives an interesting look at design choices that have been made in working with the wind as a source of energy.



(fig. 9 "Wind Turbine" patent uit 2017)

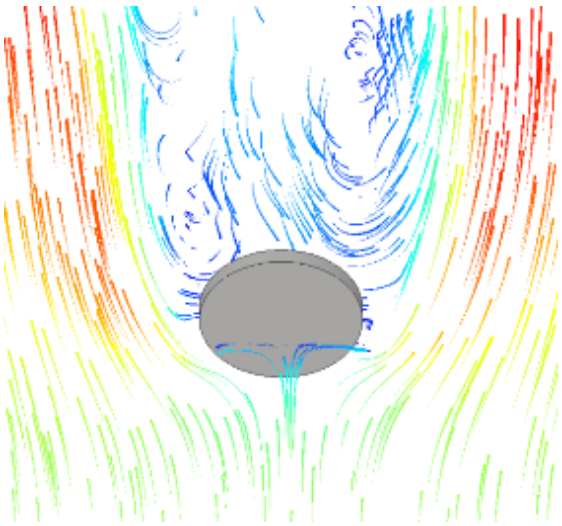


(fig. 10 "Wind Motor" patent uit 1947)

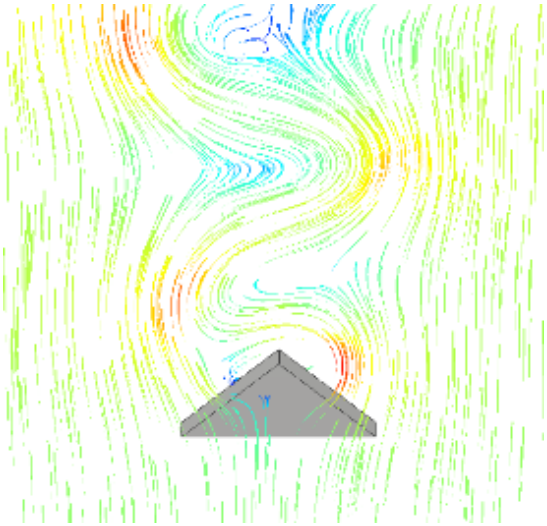
2.4 *Wind in an Digital Environment*

Today, computer programs are often used in the process of working with the wind and visualizing its behavior. By means of computer algorithms, wind and its erosive power are imitated. Both for scientific and visual purposes.

There are digital wind tunnel programs that show the behavior of the wind in relation to an object or form. The AirFlow program, part of the Inventor engineering program, can provide information about the way of the wind around an object, both 3-dimensionally and 2-dimensionally. This is often used to test aerodynamics (science that describes the movement of gases) of a form. For this project this software can be of value to be able to predict the wind directions and thus also to make a prediction how the wind can be used in forming an object.

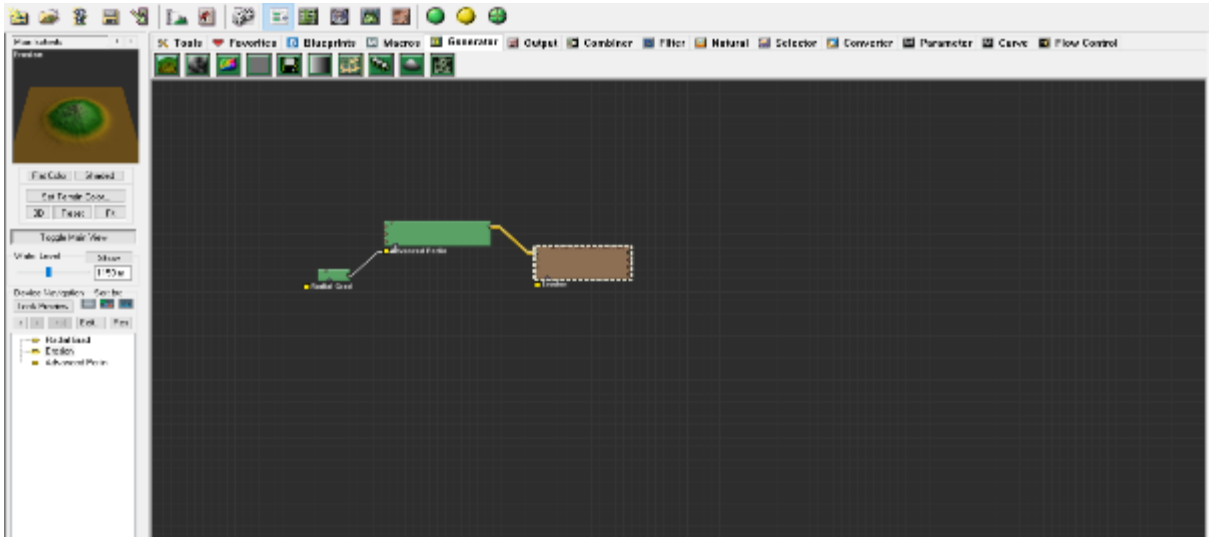


(fig. 11 Airflow result with circle)

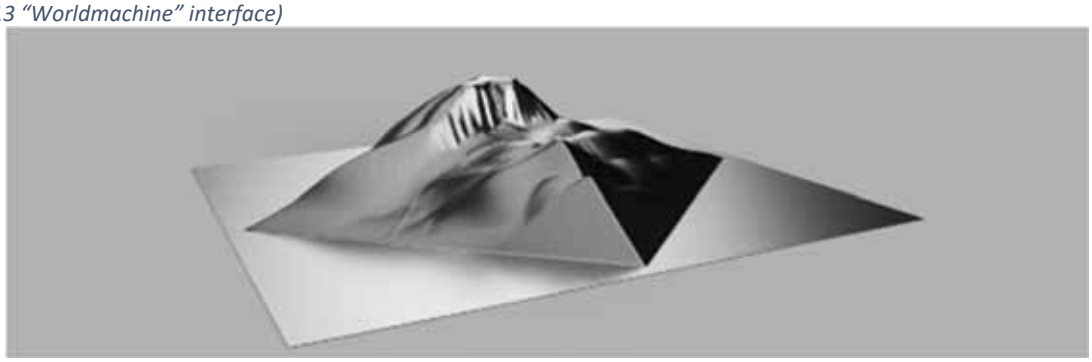


(fig. 12 Airflow result with triangle)

The WorldMachine program focuses on visualizing realistic 3-dimensional landscapes, especially for game design. This program has built in a number of erosion tools with which a realistic-looking landscape can be formed. A number of basic forms give the possibility to give a possible outcome of forming with erosive forces. In this virtual environment, the user can adjust the strength, duration and material properties to create different landscape types *(fig. 13) (fig. 14)*.

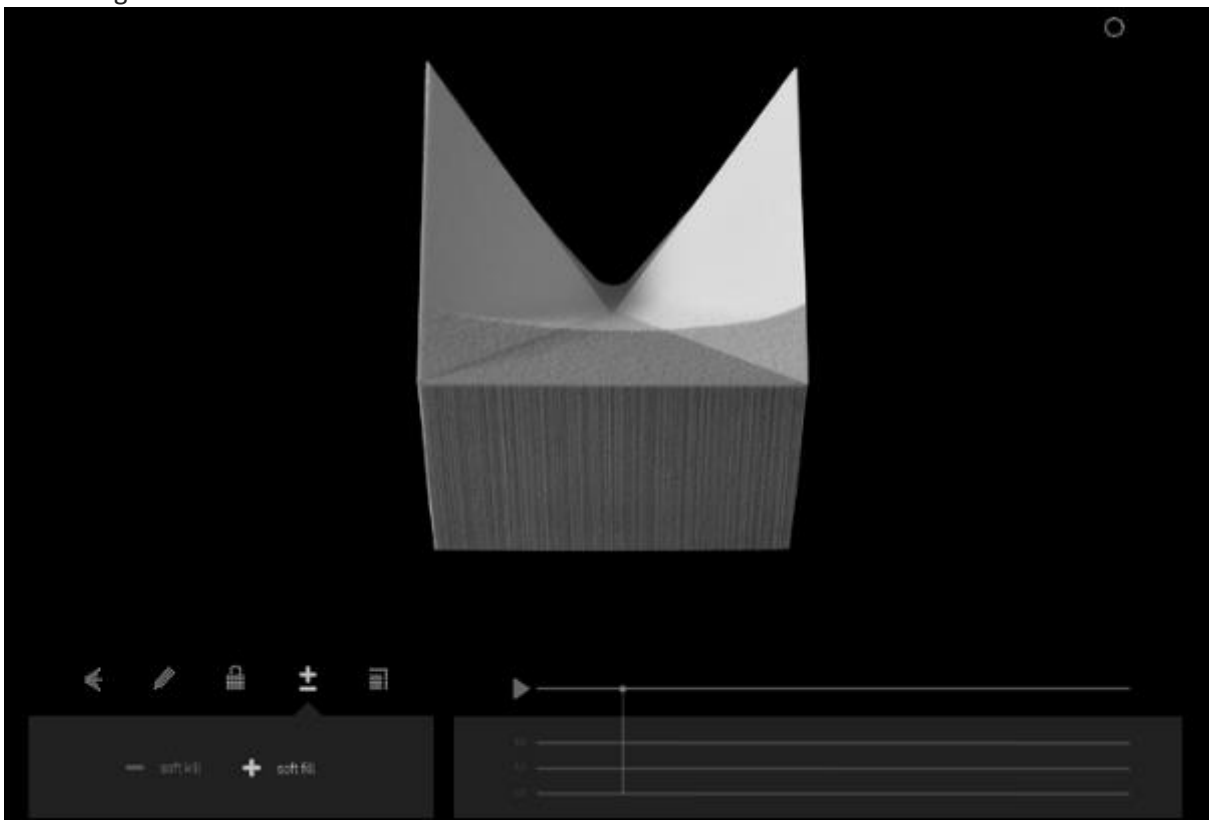


(fig. 13 "Worldmachine" interface)

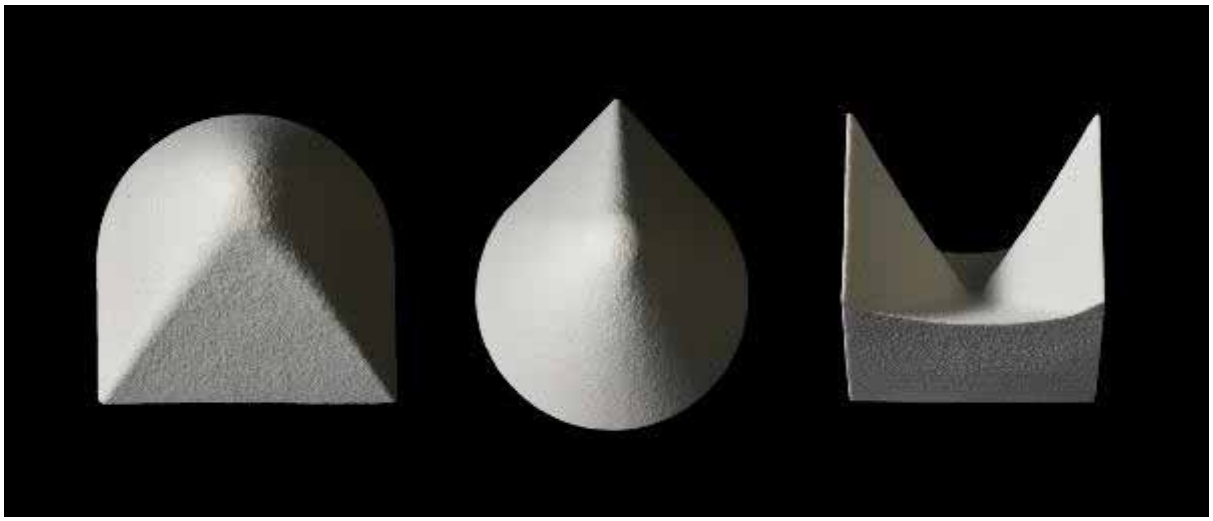


(fig. 14 piramid (de)formed using erosiontools in Worldmachine)

The Erosive Modeling program by Kirstin Dolz shows a program where erosion is used as a modeling tool. By mimicking the sandblasting in a digital environment, the user is given the opportunity to experiment with experiment with form in the 3d-modeling process *(fig. 15) (fig.16).* I have not been able to get this software, but it is a great source of inspiration for the potential of my project. Mimicking wind erosion in this software is also what I want to do in the natural environment.



(fig. 15 "Erosive Modelling" interface)



(fig. 16 "Erosive Modelling" 3d-geprinted results)

2.5 *Wind and Weather in Art and Design*

The research focused on other artists who were inspired by the wind or other natural forces in their work. Here a number of these works are described and explained which value these could have for my own project.

"We Live In An Ocean Of Air" – SALON

(fig. 17 "We live in an ocean of air" - SALON)

This work uses technology and science to make a connection between people and their environment by visualizing air movement. The viewer can see the invisible through VR glasses and thus see the relationship between himself and his environment with the air as a medium. Everything that lives in our environment needs air.
I find interesting the use of air streams to visualize wind. It is also part of my own research in predicting the wind direction around objects.

“Cumulus” – Karen LaMonte

(fig. 18 “Cumulus” – Karen LaMonte, during fabrication)

This sculpture shows a model of a cloud milled in marble where the weight is equal to a similar natural cloud. The fascination with the floating clouds above us and their actual weight have led to this work. The model of the cloud is generated with modelling software and milled out with a 5 axis robotic arm with milling router.
The use of 3-dimensional software to make models is what I want to do with direct nature in this work. The step towards digital fabrication, on the other hand, is an interesting step that can be of value for my own work.

“Wind Painting” – Bob Verschuren

(fig. 19 “Wind Paintings” – Bob Verschuren)

Work in the natural environment using direct, natural wind. By placing natural pigments on the sand and letting the wind move these work is realized. Wind force, wind direction and the relief of the surface provide unique work that also plays with time. The work is formed in a time of about an hour, after which it is completely blown away and disappears.
Working in the open nature, the beach in this case, is important to me. The project will speak more if there is an image and result from the natural environment, the beach.

“The presence of absence” – Olafur Eliasson

(fig. 20 part of “Presence of absence” – Olafur Eliasson)

In this work, blocks of ice have been used to create shapes that also contain an uncontrollable factor. The blocks of ice were poured into cement and melted away in a period of one month. During this melting process, the ice carved unique shapes into the cement and were fixed in this way.

The interesting thing for me in this project is the use of natural processes to shape. Eliasson has opted for melting ice, I want to do this with wind. However, this project is designed in a controlled environment, I want to do this in a partially uncontrollable environment. This brings in uncertainty and challenges. The use of materials in this project can also be of value to me.

“Tree Trunk Chair” – Maarten Baas

(fig. 21 model of “Tree Trunk Chair”- Maarten Baas)

This work shows a new way to produce a chair in this case. At a time when society is predominant, Baas shows a way to grow a chair in 200 years, directly from the tree itself. In doing so, he questions our current way of producing and the impact in our environment.
An important part of this project is how Baas deals with time. That is a factor in my project which I would prefer not to address to much because it is more about form than about time. The way Baas shows a convincing image of the process and the result is instructive for me. He also uses digital fabrication techniques to communicate his intended result.

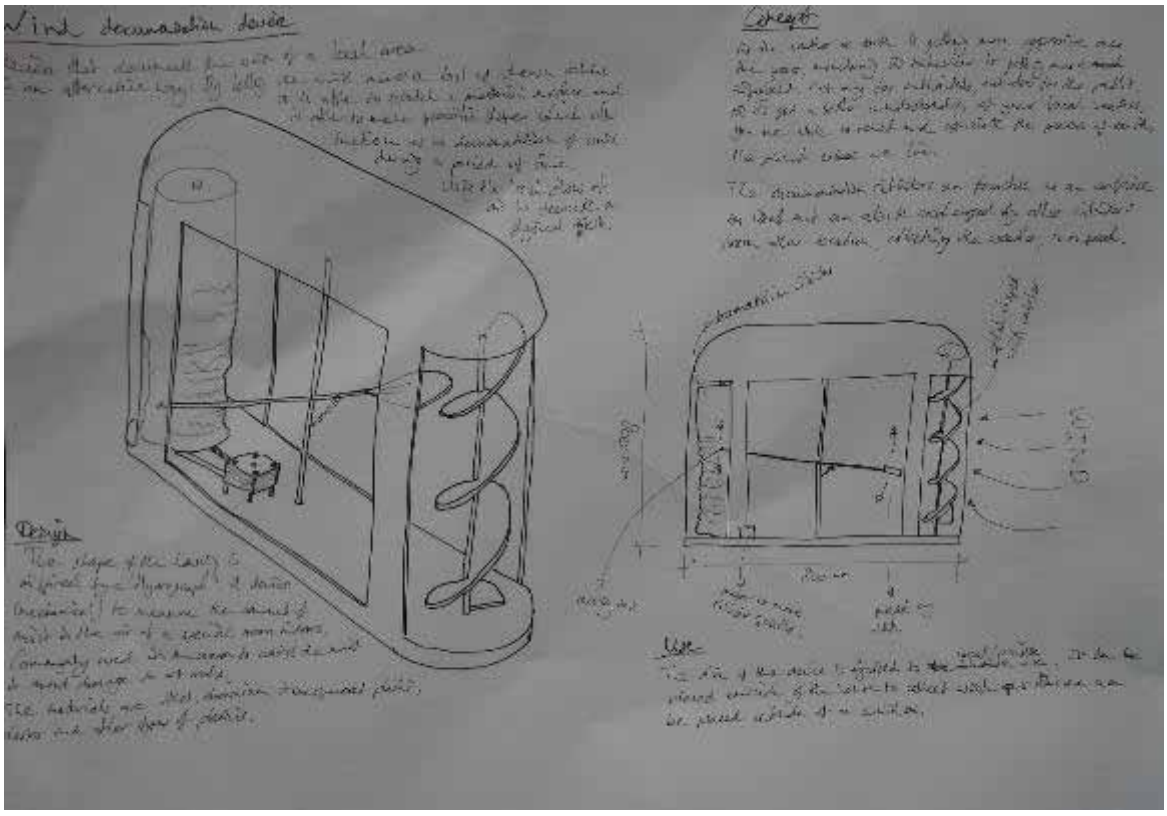
3 Process

Chapter 3 *Wind and Myself*

3.1 *Wind Apparatus*

In this project I want to establish a collaboration with the wind as a designer and to be able to apply this as a design tool in the design process. I have worked out a number of options that I would choose to further work on. I will go into two options that I have worked out based on my research and a choice will be made for the final project.

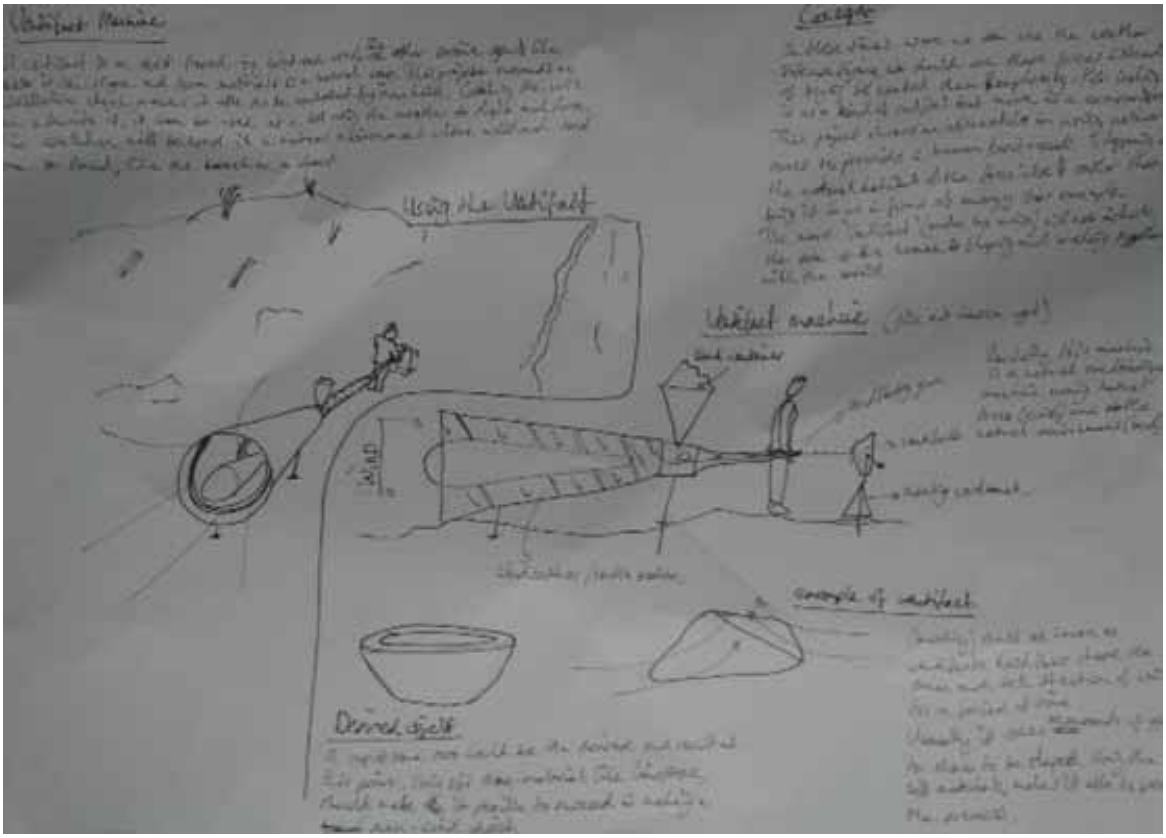
Wind documentation device



(fig. 22 "Wind Documentation Device")

This device is able to capture the wind and its intensity by moving a sharp object and thus scratching it in a shape. For example, a pre-formed cylinder will be provided with texture which can be traced back to the wind force at a given moment. The idea of this work is that it can be placed in different geographical locations in order to make the difference of the wind clear in certain places. Unique textures based on the wind thus become part of the sculpture. The role of the designer is to make a device that is specially made for the wind that it can use to make textures. The designer's check stops after realizing and commissioning the device.

Ventifact machine



(fig. 23 "Ventifact Machine")

The ventifact machine gives more control to the designer in his cooperation with the wind. The principle is more like that of industrial sandblasting. The big difference with this technique, however, is that the wind is natural, and therefore unpredictable. The forms are made in the natural environment, the beach, with materials that are present used as medium. The natural wind blows the sand grains against a preformed object to create unexpected and unique shapes. In order to generate a wind force that can transport sand grains to the location where the object is to be formed, a machine is needed and will be build. The apparatus is a tube where the wind is compressed for a higher wind force so the sand grains can be transported and blast onto the object that needs to be formed. Although the wind is partially controlled, the natural wind will never be constant and therefore also not after the wind is compressed in the tube. Unique, uncontrolled forms will still be the outcome of this machine, where the wind will have the opportunity to choose its own path and thus make its design choices.

From these two options I chose the second one, the Ventifact machine.
During my research I encountered ventifacts formed by wind erosion. These forms, of which the former was often thought to be made by man, have a pull on me as making. I want to be able to grasp the shape of the wind just like a ventifact, but also to influence the form so that it can become a tool.

To make a ventifact, but still be able to have influence, I want to build and use a wind device. A device where I give sufficient space to the wind and sand that are not determined entirely by the hand of man as computer algorithms.

To find out what the possibilities of forming with the wind in nature are, I decided to first test in a controlled environment. I started building my own wind tunnel. All measurements with the air flows were made with an anemometer, which expresses the air flow in both Beaufort and kilometer per hour. *(fig. 24 Anemometer)*

The first tests were carried out in a plastic container with a layer of sand in it with individual fans, with wind force 2, on average 9 km / h, directed at the sand surface. First I tried to imitate the sand dunes in deserts. The first tests with low wind pressure and loose material were done in this setting.
(fig. 25, 26, 27).

(fig. 25)

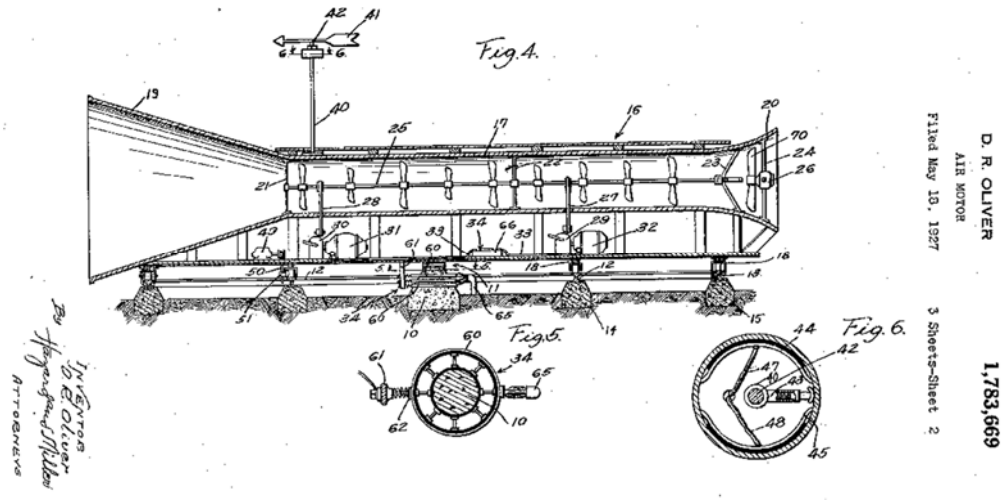
(fig. 26)

(fig. 27)

In this way, molds could be blown into the sand. The process went relatively quickly and met the expectations in general. These expectations came from looking at natural dunes and shapes in sand surfaces. In my experience, these forms were not exciting enough. I did pour in these blown molds with plaster to capture these shapes, but I decided to adapt my design for a wind tunnel. I wanted a stronger wind current where sand would serve as a medium to mold shapes into an existing shape.

The next wind tunnel consists of the same plastic tray with an opening for new fans on one side and an outlet for the wind for circulation on the other *(fig. 28).* The fans I use are powerful 12-volt fans for a constant supply of wind. At the end of the fans, I made cardboard from cardboard and paper with the possibility to supply sand from above. The design is based on a patent drawing *(fig. 29)* for a wind machine and earlier own designs. The power of this turbine was wind force 2, on average 12 km / hour.

(fig. 28)



(fig. 29)

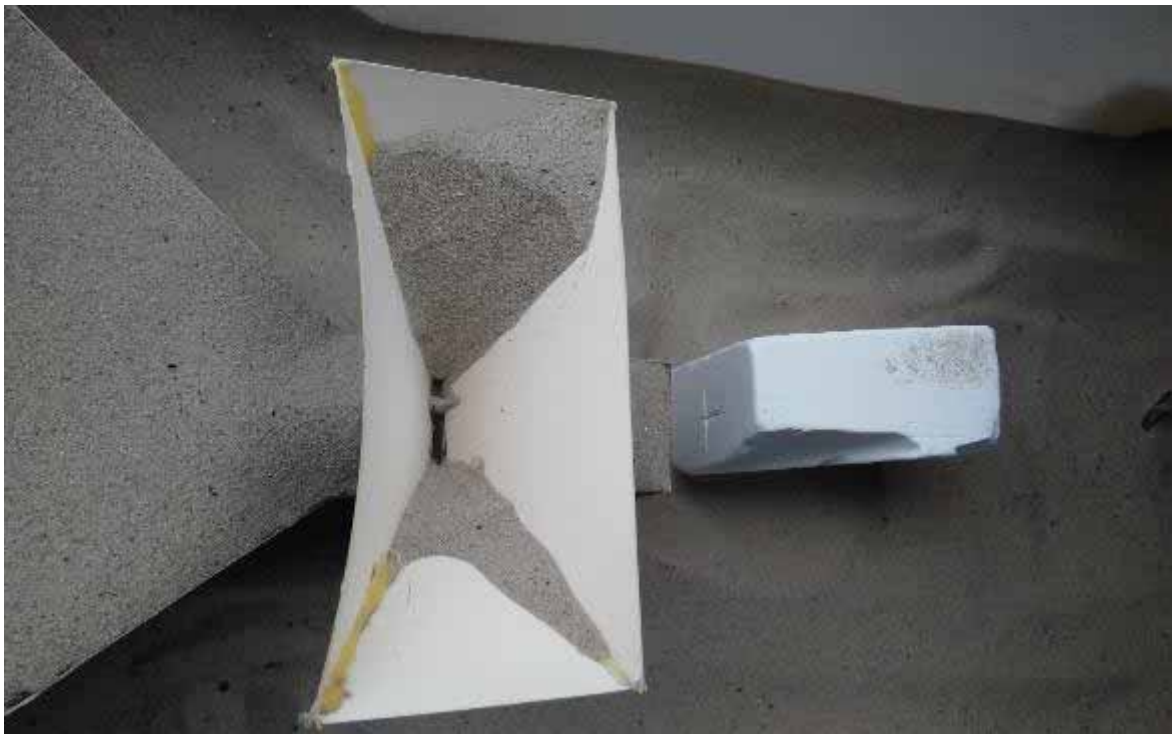
With this setup I was able to see in a controlled environment how the wind in combination with sand could affect the surface of an object. My first tests were carried out with magnesium blocks. I encountered this material during a CNC milling assignment during my work *(fig.30).* I had rarely had a fragile and porous material in my hands and determined that this would be ideal for me to test. In this phase a number of challenges came to light that I knew would come. Material and time became important at this stage.

(fig. 30)

3.2 *Material Research*

Because I wanted to test how the wind and sand would affect the object, it was important to see results as quickly as possible so that quick choices could be made regarding the further course of the research. In natural erosion, the porous material is more rapidly affected by wind erosion than solid materials. Sandstone is affected more quickly than granite, which has to do with the density of the material. It was important for me to use a material that was as porous as possible to get a quick result. My search for the right material began.

I started with magnesium blocks. This material is used in the sports world to make the skin stiffer when weightlifting, for example. With the smallest effort this material can be broken or scratched. In my test setup, however, the flow of sand had little or no effect on the material *(fig. 31).* It simply kicked off and left no more than a few pits in the surface. Only by scratching the surface could the sand wear into the material.



(fig. 31)

My previous experience with industrial sandblasting has given me the knowledge that this material could be formed with compressed air and sand. I would not want to take this step, since I want to stay within the limits of the natural wind.
That is why I started looking for new materials that could be affected more quickly *(fig. 32).* I needed results to be able to do form studies.

I placed PU foam in the wind tunnel to see what the result would be. The sand affected the surface, but because the material is so open in structure, a useful result on this scale can hardly be observed. Apart from that aspect of the material, I want to continue working with natural materials that are less harmful to the natural environment where the process ultimately has to take place.

On the basis of the tests that have been done with existing materials, I have decided to make my own material. That way I have more control over the density and strength of the material. I decided to start with plaster. By mixing the gypsum with more water than is desirable, the final shape will be less strong and thus easier to shape.
I have done a number of tests with the addition of too much water in the mixture with plaster. After a long drying time of more than a week, these tests proved too hard for use in the wind tunnel.

(fig. 32 Used materials: from top left: Magnesium, Sand, Plaster, PU-foam, Steatite, Magic-Sand)

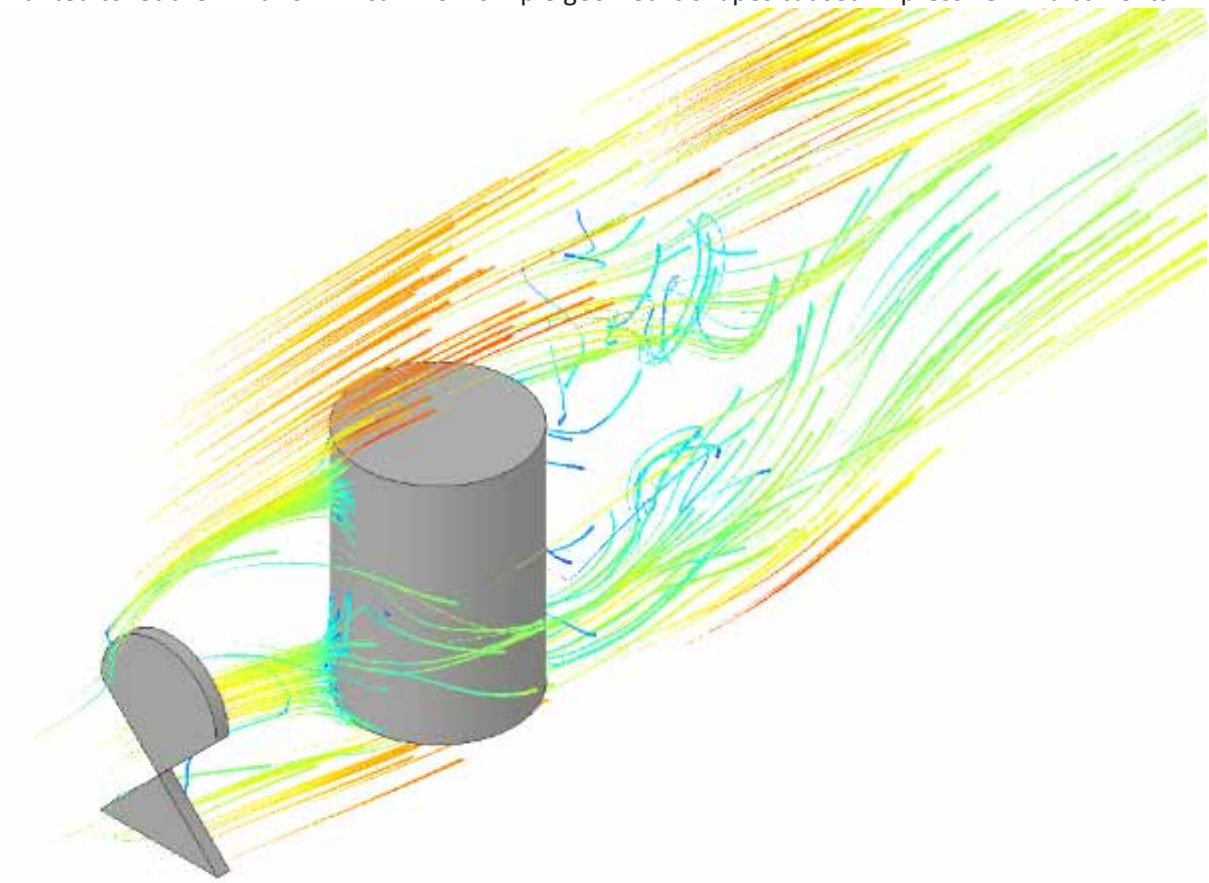
During the drying process I did tests with plaster and sand. Gypsum was the binder and sand would make the whole weaker. Although the drying time was considerably shorter, these mixtures proved too strong.

I decided to ask advice from specialists who had experience with concrete. I asked them the unusual question of how I could make a concrete mix as weak as possible. Cement is the binder within the concrete mix. This is supplemented with concrete mortar and possibly gravel for a strong concrete mix. Each component is weak at itself and the only component binding the others to a strong is cement. In fact same as plaster. I decided to do the sand-gypsum tests again but with cement instead of plaster.
After pouring some shapes, and an accelerated drying process in the oven, this mixture proved too strong for fast results.
Finally, I found the way by pressing a dry cement-sand mixture into a mold, unloading it and using a plant spray only to wet the outside of the object and allow it to dry. Because of this, it could not be a strong whole but just strong to hold the molded shape together. I had the idea that I had found my ideal material. But before that I had to invest a lot of time in this search and therefore was not able to work on my form study.

I have tried pushing the dry sand into molds adding Magic sand. A toy sand that is more sticky than normal sand. Again, I made a mixture with sand, but turned out to be too weak and too quickly disintegrated during or after testing in the wind tunnel. For the cement-sand mixture there was also the danger that it could fall apart, especially after molding. I could easily solve this by spraying the results with transparent spray paint and fixing the tests.

3.3 *Controlling the Windflow*

During the tests I had done with the search for the right material, I tried to influence the wind current and its forms in various ways. During this process I also started using the Airflow software to predict the wind current. I started placing 3-dimensional objects in the software to see how the wind would respond to this. At this moment I found out that I was interested in the airflow behind the object instead of in front of it. So I came up with the idea to put an object in front of the object that I wanted to let the wind form. I saw how simple geometric shapes caused impressive wind currents.



(fig. 32 Airflow result)

This fact appealed to me very much and I decided that I wanted to work with a limited number of geometric shapes, square, circle and triangle, and place them in the wind tunnel. This gave me the first 3-dimensional forms based on the movement of air from a high to a low pressure area around a 2-dimensional geometric surface. I have imposed the limitation on myself limit my influence on the wind. I was allowed to concentrate the wind, provide sand and lay the geometric shapes for the object to be formed. But I had to let the wind find its way past my blockades and form the object created and placed by me. I was curious if there would be similarities between the wind flows in the software and the physical objects.