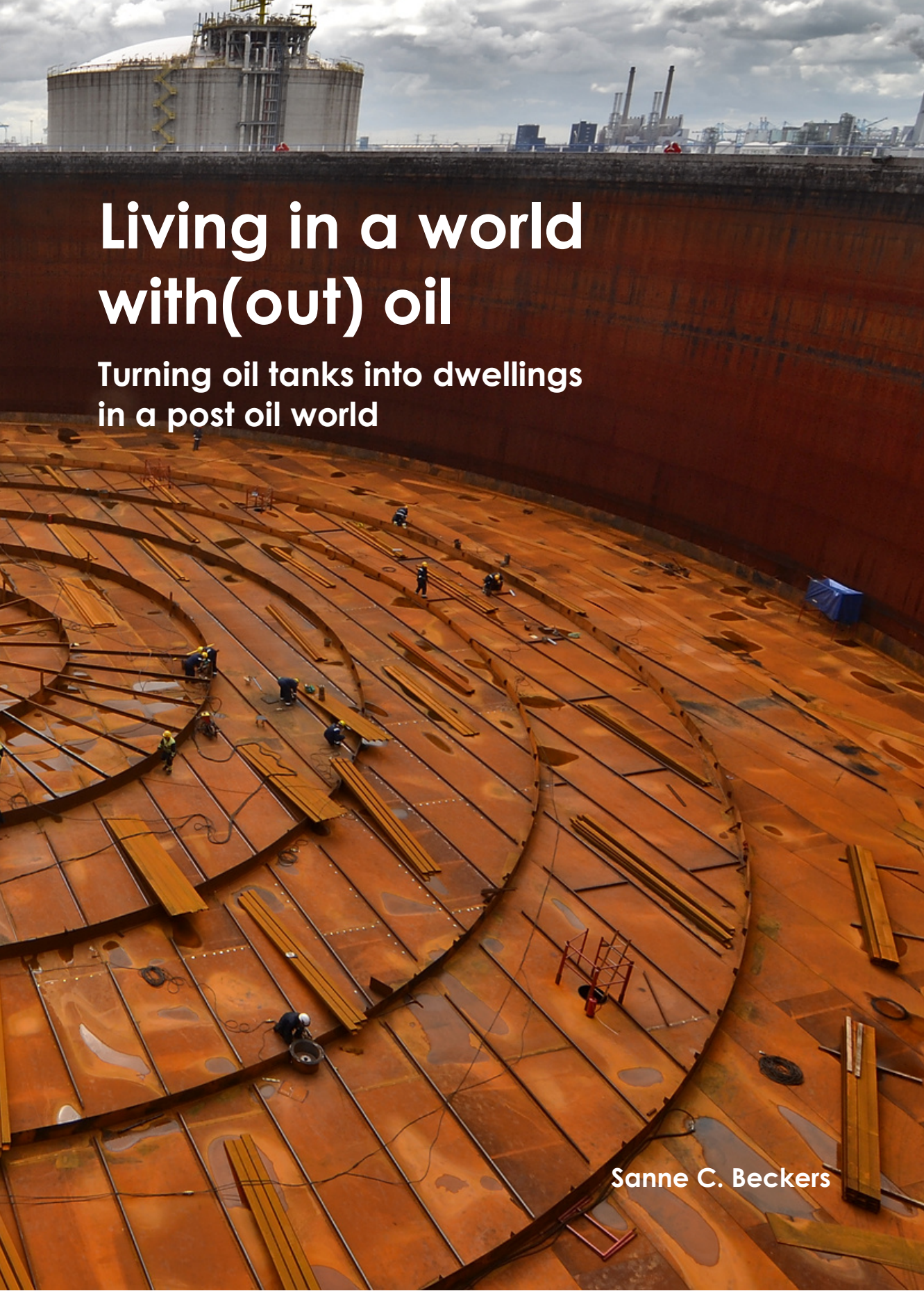


Living in a world with(out) oil

Turning oil tanks into dwellings in a post oil world

Sanne C. Beckers

Living in a world with(out) oil

Turning oil tanks into dwellings in a post oil world

Sanne C. Beckers

(own image, 2018)

Abstract

We are getting close to the so called peak of oil and this will result in a shortage of oil and therefore oil products. We can assume that the oil industry will get in decline, therefore we should think about the heritage that the oil industry will leave behind. An iconic element of the petrol industry is the oil storage tank. We can knock these tanks down, but what if we could repurpose them. This paper will set an example by repurposing an oil tank into multiple dwellings.

During a process of research by design I attempt to define the problems and the solutions which one will face when repurposing an oil tank into multiple dwellings. The main problems I defined, when designing in an oil tank, are daylight, privacy, construction and climate. These particular elements make the design process more challenging from standard dwellings. However solutions can be found in our own frames of references.

Keywords

Oil tank, oil industry, re-use, sustainability, research by design

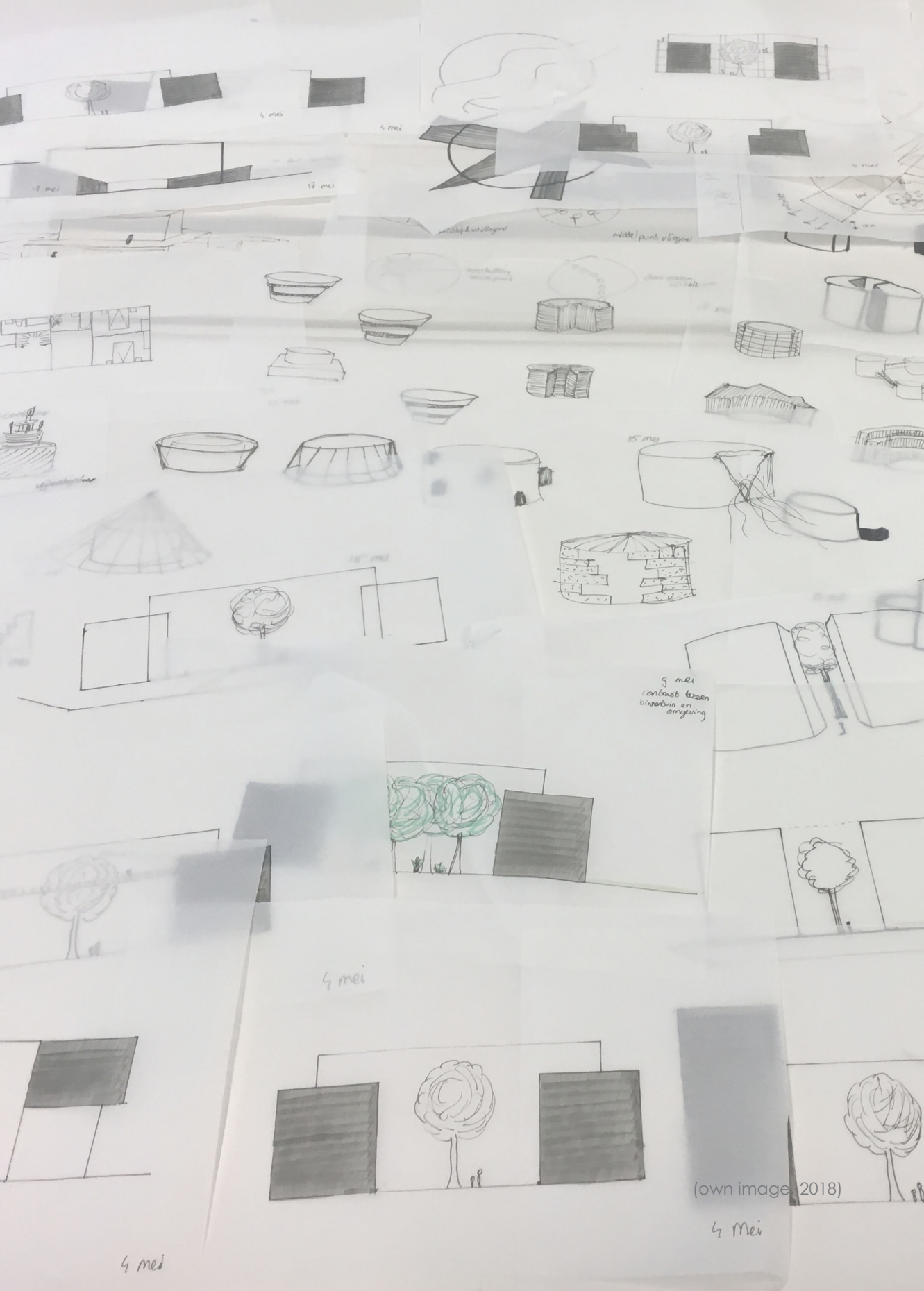
(OGW, 2014)

Introduction

According to many sources we are getting close to the so called peak of oil. After this peak we will have a shortage of oil and therefore oil products. Society has to adapt to this fact. Therefore, we could assume that the oil industry will decay, just like the coal industry did. However, the oil industry is intertwined in many forms in the Netherlands. In the Rotterdam harbour alone there are multiple oil refineries, for example one of Shell and one of BP.

One iconic element of the oil industry which can be found all over the world, is the oil storage tank. In the harbour of Rotterdam there are over 700 oil tanks (Port of Rotterdam Authority, 2016), so worldwide this would amount to millions of oil tanks which will be empty and useless, when the oil industry decays.

We could demolish all these oil tanks and built the next industry, like we are used to in our consuming society. Having said that, what if we could repurpose these oil tanks. This will be our future challenge and it is up to architects, designers and innovators to think about possibilities. In this paper I want to set an example by redesigning and repurposing an oil tank into multiple dwellings.



(own image, 2018)

Method

To research, how to make dwellings using an oil tank, I used the method of Research by Design. Via designing I tried to define the problems and solutions of making dwellings in an oil tank. According to Cross and Dorst (2001) designing is not a matter of first fixating the problem and then searching for solution. Designing is a matter of developing and refining both the formulation of a problem and ideas for a solution, at the same time. This process of constant analysing and evaluating takes place in the problem space and solution space.

The design process of defining problems and solutions will be based on sketching, model making, references and a visit to an oil tank terminal in the harbour of Rotterdam. Research by Design is relatively new, to that end there are no strict guidelines.

However, according to Hauberg (2011) this method should not be alarming, as long as the research is done systematically and the new insights are communicated and expressed in a way that is useful to others. By sketching and model making, the architect tests, selects and rejects elements on the basis of professional knowledge, programme and relation to a certain context. According to Hauberg (2011), research by design is based on practical experiments in laboratories resulting in reports and step-by-step diaries (logbook), which are clear about what is being achieved and communicated through the activity of the design process.

Therefore, this guide will be based on a logbook of my design process and the design steps I made, which can be found in the appendix. This guide forms the second part of which Hauberg states, a clear report of the results from the design process.

(own image, 2018)

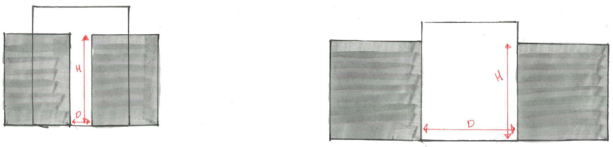
Reading guide

The results of my design process will form a study to the problems and solutions of redesigning oil tanks into dwellings. This design study could be an endless project, however at some point there will be enough problems and solutions defined to form a guide of designing dwellings in an oil tank.

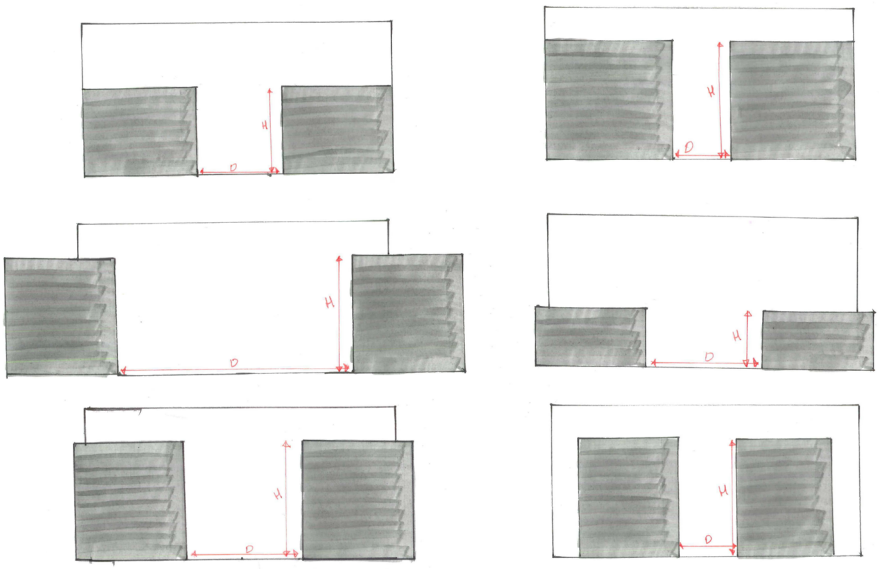
According to Van Dooren (2014) one can distinguish five domains in the design process: space and form; material, structure and climate; function; site and the fifth one context. In this guide I will go through the problems and solutions in the order of the four domains. However the context will be omit, in this way the design study will be applicable worldwide. Nevertheless one should use the context in his or her own design.

In the second part of this guide I will show four scenario designs for oil tanks in the harbour of Rotterdam.

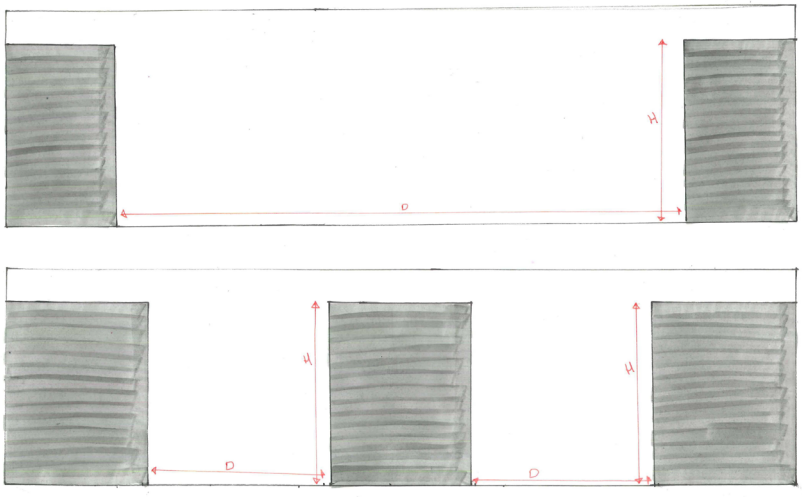
- The world is out of oil, sustainable housing
- The site is given back to nature (dunes)
- The harbour is in need of a new landmark (tank on its side)
- Due to climate change we want to live in a controllable climate (jungle in the tank)



10 m in diameter



32 m in diameter

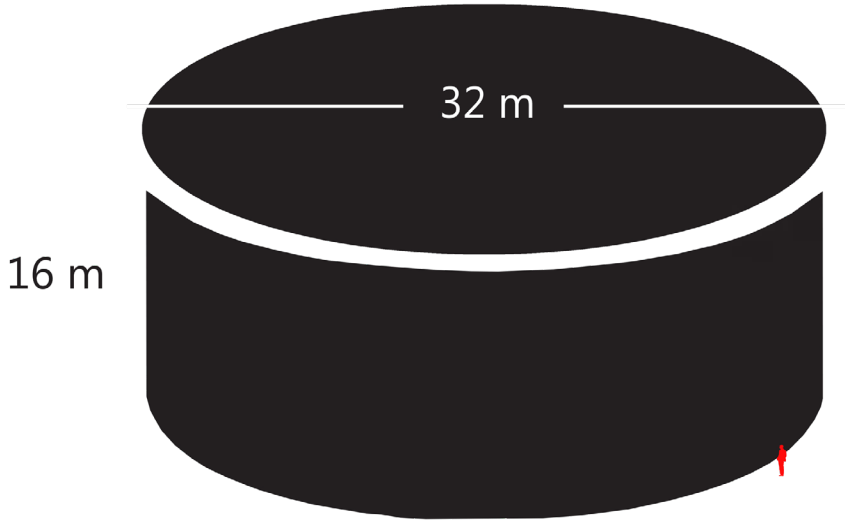


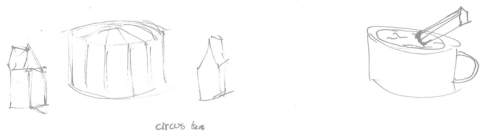
85 m in diameter

Space and form

Size of the tank

Oil tanks can have different sizes from 10m in diameter and 12m high, to 85m in diameter and 22m high (Wikipedia, 2018). For this guide I used a middle sized tank with a diameter of 32m and a height of 16m. One should consider the consequences of the size of a tank, while making dwellings in an oil tank. On the left page one can see examples of building blocks in different sizes of tanks. A tank of 10m in diameter could be used as an apartment building with apartments filing the whole floor. A tank of 80m in diameter could be used to place multiple blocks of housing in. And a middle size tank of 32m diameter could be used for a housing block with an atrium or courtyard in the middle.




circus tent


Frame
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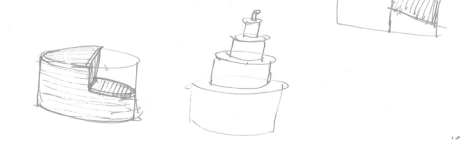


Vijzelbezemsteel
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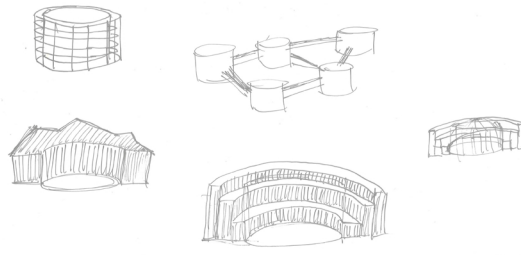
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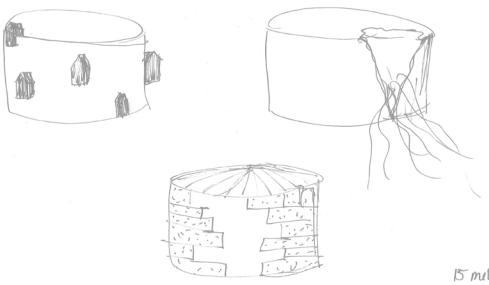
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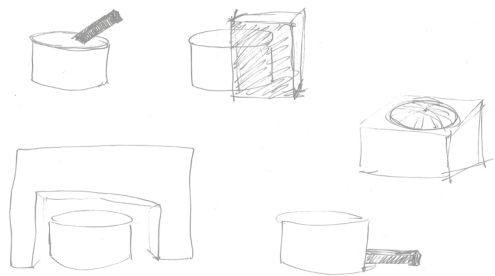
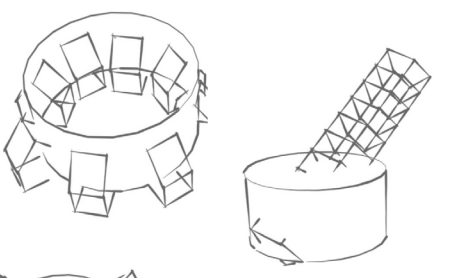
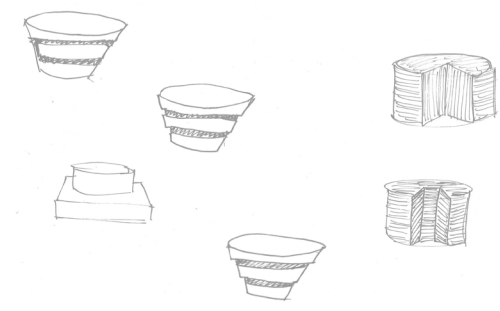
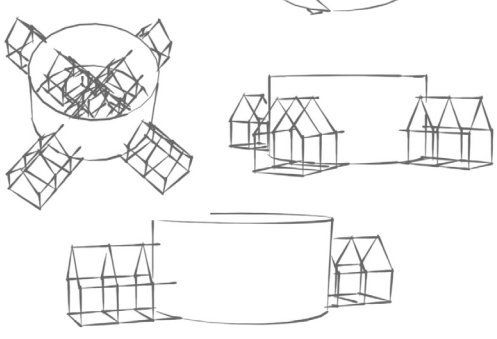
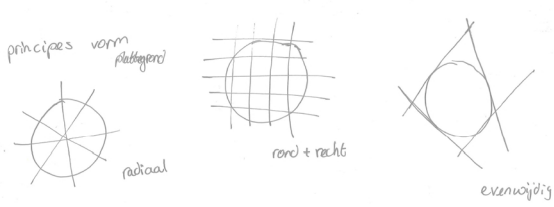









principes vorm
radiaal
rond + recht
evenwijdig
cirkels
negren
gekromde lijnen

Space and form

Form typology

An oil storage tank is a circular space and has therefore other characteristics than for example square or oval spaces. A circular space is a static shape which is centrifugal and therefore often feels oppressive. A circular space is uniform and often lacks direction. One should take these elements in mind while designing in an oil tank. When one of these characteristics is unwanted, one could take a look to other shapes with other characteristics or use architectural elements to get a different effect.

(own image, 2018)

(Uusheimo, unknown)

(own image, 2018)

Material, structure and climate

Making holes

An oil tank consist in general of steel plates. For a tank with a diameter of 80m the plates are around 60mm thick. For a tank with a diameter of 32m they are around 20mm thick. The plates which are used for modern tanks are between 2 and 2,5 m high and often only welded together, in masonry bond, so the welds are never right under each other.

In general only manholes are created in the tanks, these holes can be 500 mm in diameter, when the plate around the hole is reinforced with an extra 12,7 mm on top of the 20 mm (American Petroleum Institute, 1958). So making small holes in the tank would be possible.

When one wants to make bigger holes, like the size of an double door one would need extra structural reinforcement in the shape of ribs (horizontal and vertical).

(Platecon projects, 2018)

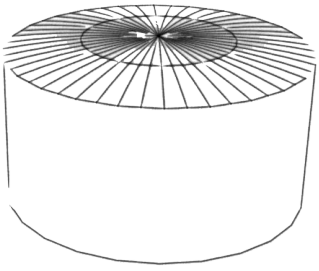
(Van Allen, 2018)

(Ramussen, unknown)

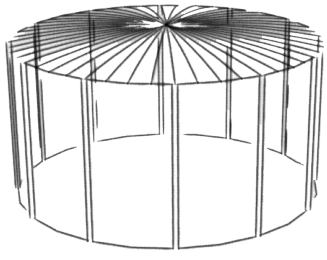
Material, structure and climate

Structure

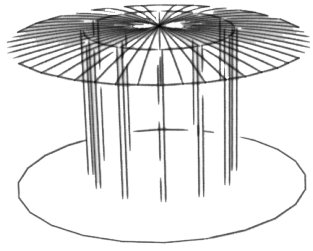
To use the construction of a tank you should first understand which kind of constructions there are. Roughly speaking there are three kind of constructions supporting the roof of the oil tank. You can have a carrying wall, columns in the wall or columns in the middle of the tank (see drawing underneath). There are also roughly three roof types: a self-supporting cone roof (see photos on the left), self-supporting dome roof and a floating roof. For the second part of this guide I will use a carrying wall, with a self-supporting cone roof.



Carrying wall



Columns in the wall



Columns in the middle

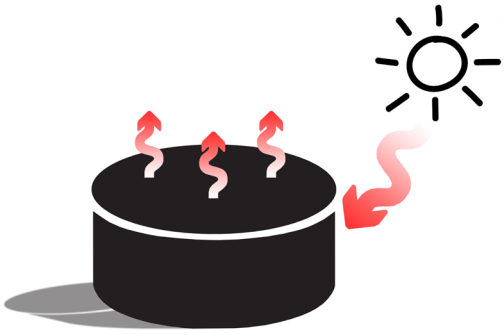
(own image, 2018)

Material, structure and climate

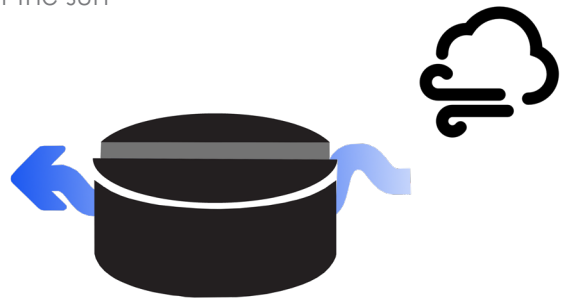
Climate

When designing dwellings in an oil tank one should take in mind the effects of the steel walls. The walls will be heated quickly by the sun and have no thermal mass. When designing one should take these effects in mind and try to use them in a positive way. For example the steel wall could be used to collect heat, by creating a solar collector. Or one could for example make use of a sun chimney effect to create a better indoor climate.

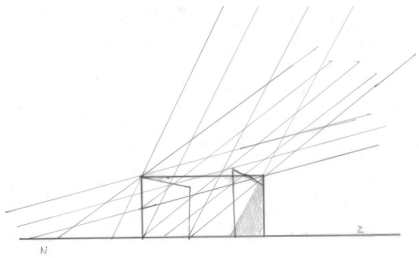
Another aspect one should take in mind is wind, especially when the tank is close to the sea. A natural airflow can be created, when you make openings in the tank. This airflow can function in either a positive or a negative way, for example by cooling the tank.



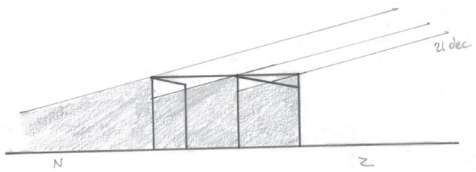
The effect of the sun

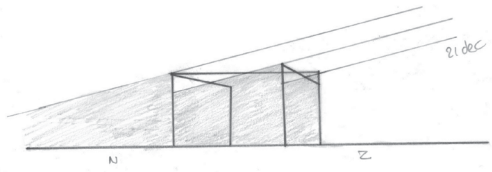


The effect of wind



Solar angles and shadows





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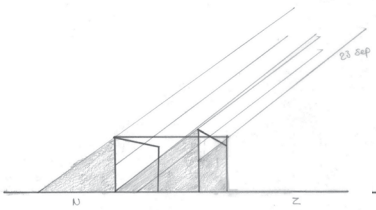

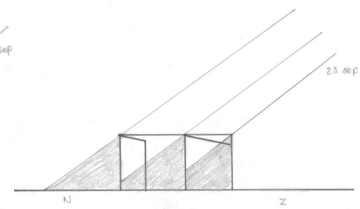

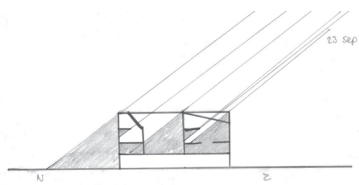

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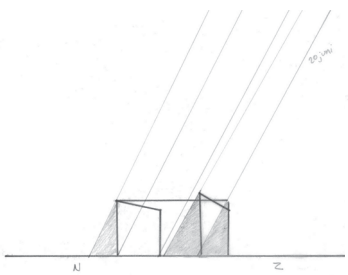
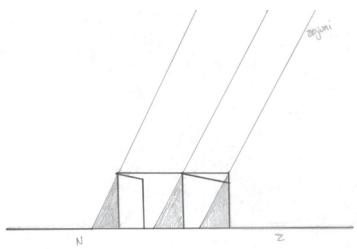
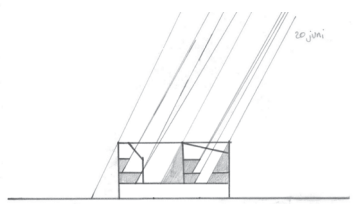






20 juni

Function

Daylight

An important aspect for the function of housing is daylight. People need daylight to live comfortably, but the tank is made with solid walls of steel. So when designing dwellings in a tank one should take in mind how to get daylight into the dwellings. There are two options to let sunlight in, firstly by opening the roof and secondly by making holes in the tank wall.

However, as told before you will need extra construction if you want to make bigger holes in the tanks wall, so in most cases the light should mainly come from the open roof. Here you have to take in mind that the tank is 16 m high, so when the sun is low, like in winter, in the morning or evening, no direct sunlight is coming in (see drawings on the left).

To that end, when designing dwellings in the tank, you should take in mind the placing of the windows. Placing skylights in the dwellings is one solution which would help with the daylight problem. Another element one should take in mind is the plan of the dwellings. Bedrooms need less light than kitchens and living rooms. So therefore it is better to place the bedrooms on the ground floor in the darker space and the living area's on the top floor with skylights, so these spaces will be lighter.

Mainly due to the effects of daylight it is recommended to make dwellings which all have access to skylights. Therefore, houses (in the sense of a dwelling with multiple levels) are more recommended than flats (dwelling with a single level). Another solution for the challenge created by the shadows of the high cylinder wall, is to move the dwellings upwards to catch more sunlight.

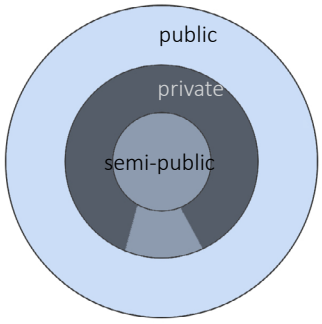

(own image, 2018)


(own image, 2018)

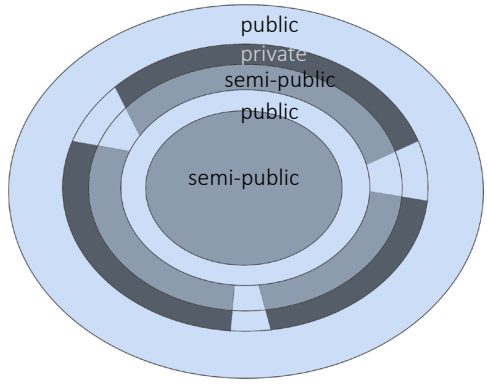
Function

Public – Private

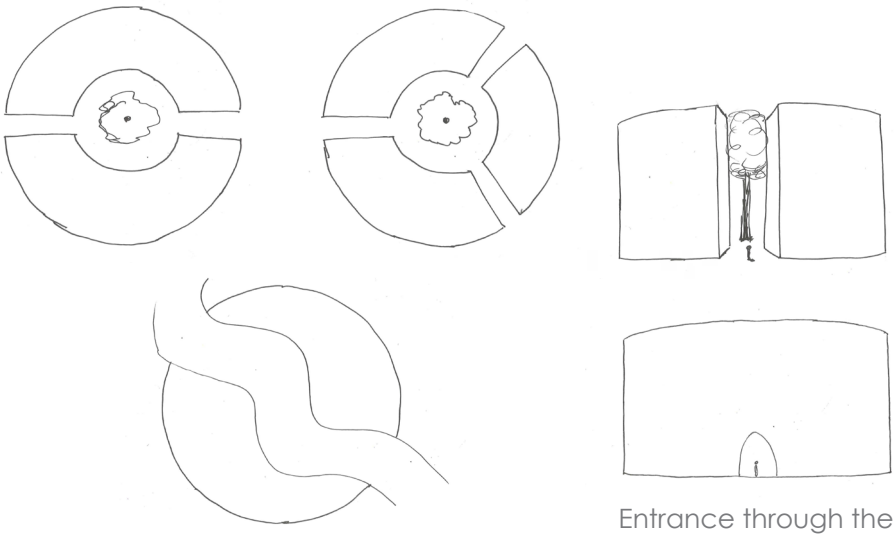
Another aspect would be public and private, when people are living on such a small area, within all probability lots of windows directing to the middle due to the lack of sunlight, the dwellings will lack privacy. So when designing in an oil tank one should create privacy for the residents. One way would be to work in layers of public, semi-public and private (see schemes underneath). Another way will be by placing elements in the middle like a tree. Or one could create privacy in the dwelling itself, with for example curtains, walls, angles, etc.



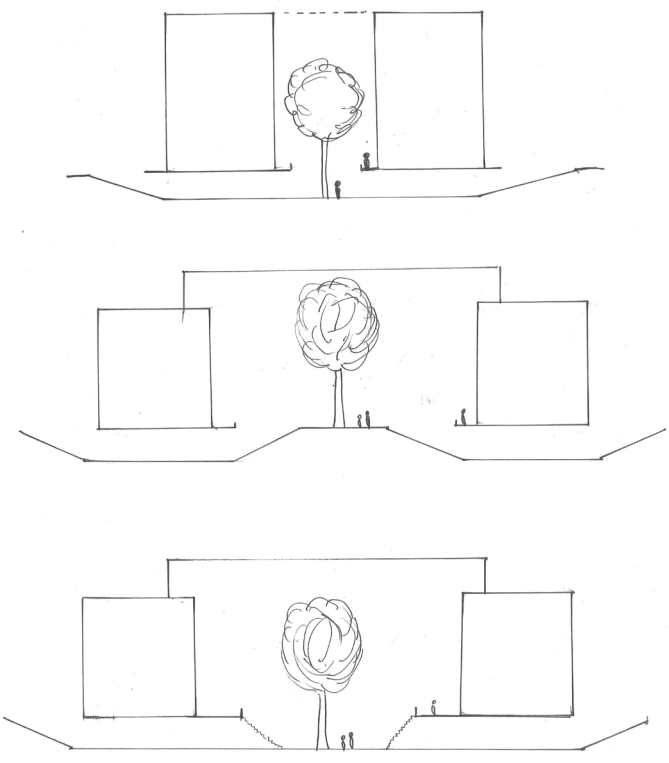
Layers of privacy of the reference in Eindhoven
(bottom picture on the left page)



Layers of privacy of the reference in The Hague
(top picture on the left page)



Entrance through the wall



Entrance from underneath

Function

Entrance

Due to the tanks construction the entrance to the dwellings is a significant aspect. As told before we need extra construction for windows in the tank wall, similarly for doors in the tank wall. One has three options for the entrance:

- underground
- from the top, via the roof
- through the wall

When making the entrance underground you have to take in mind that you still need to go through the steel plates on the bottom of the tank. Likewise the doors in the walls, you would need extra construction. So this option would mean a lot of effort without many benefits.

A better alternative for doors in the tank walls, would be entering from above via the roof. In this way the construction of the tank could stay intact. That is to say the tank wall could stay solid. Furthermore, the area around the tanks would also be untouched, due to the fact that all infrastructure is in the air. The hanging infrastructure means however a lot of construction work. And the construction will also block some significant daylight.

Therefore, the simplest solution would still be a door in the tank wall, with extra supporting construction in the form of vertical and horizontal ribs.

(own image, 2018)

(own image, 2018)

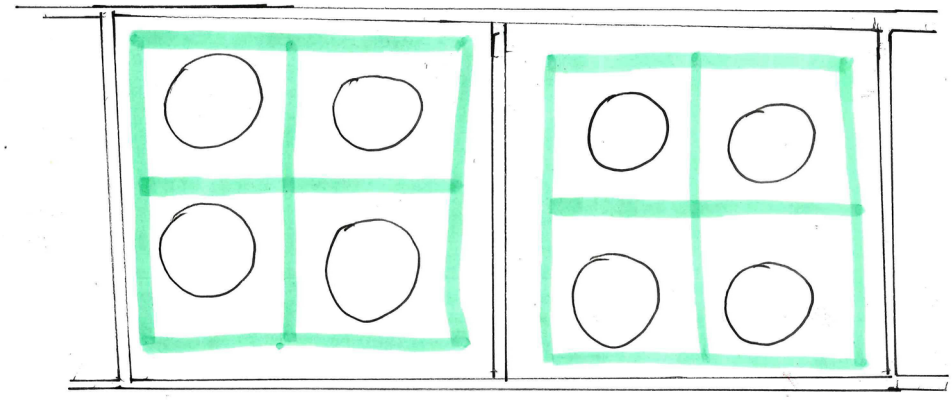
(own image, 2018)

Site

Typical site

To design with oil tanks one should also know how a typical site of an oil storage tank is built. In general every reasonable size oil tank has his own tank pit, this means every tank is surrounded by an earth wall (dyke). This dyke is high enough to hold all the oil of the oil tank when the oil tank is leaking.

The tanks with their oil pits are often clustered in groups and surrounded by straight roads (see drawing underneath). These typical sites have a very strict scheme and rhythm, so tanks are hard to distinguish. When designing dwellings in the tanks, one should take in mind how to make the tanks distinguishable, for example with a route, colours, urban planning, etc (see pictures on the left for examples).



Typical site of an oil tank terminal


(googlemaps, 2018)


(googlemaps, 2018)

Four secnario's

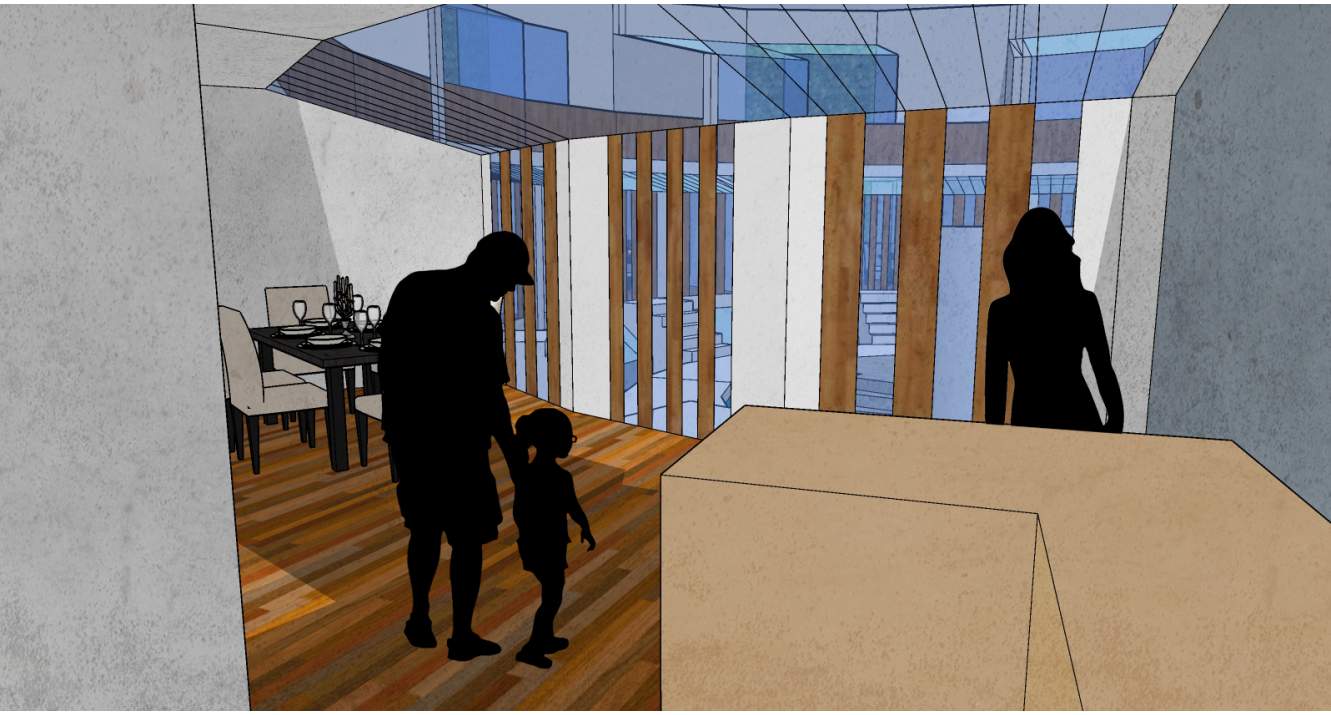
To show how these problem definitions and solutions could help one during his or her design process of designing dwellings in an oil tank, I will show four design scenarios for the oil tank, with some problems and proposed solutions. These will be my own view and designs, and should be regarded as examples.

The four scenarios are:

- The world is out of oil, sustainable housing
- The site is given back to nature (dunes)
- The harbor is in need of a new landmark (tank on its side)
- Due to climate change we want to live in a controllable climate (jungle in the tank)

Context

In contrast to the first part of this paper which is context free, the four design scenarios are placed in a context. The location for the four scenarios is in the harbour of Rotterdam at the very edge of the Maasvlakte, next to the North sea. The site is an oil terminal called MOT (Maasvlakte Olie Terminal). This terminal has an important logistic function for all five oil refineries in the Netherlands. Almost all the crude oil imported to the Netherlands, enters our country via this terminal. 38 oil tanks are placed in a grid, where all of the tanks are placed in their own oil pit surrounded by dykes. Most tanks are clustered in groups of four and surrounded by straight asphalt roads. An asphalt road and a railway to get to the site is already present.

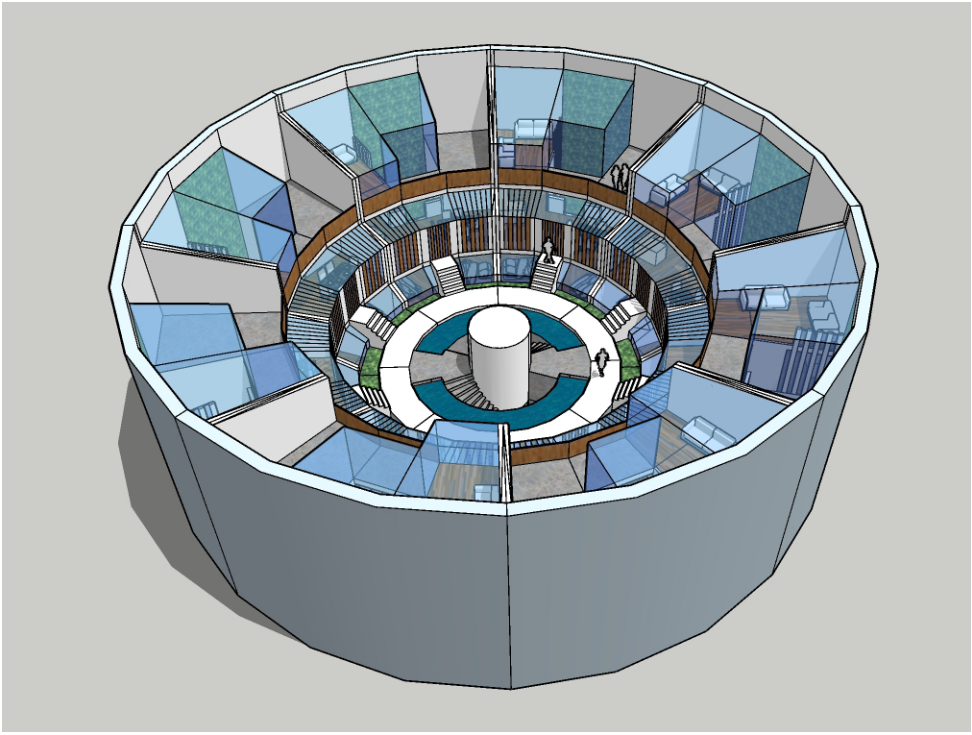


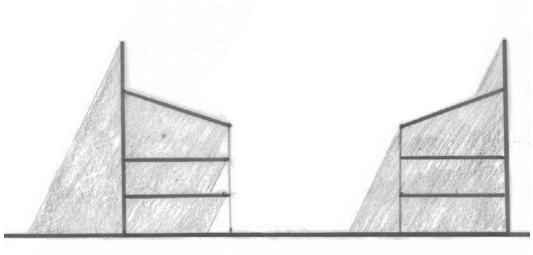
Sustainable dwelling

The world is completely out of oil, so it is essential to find new ways to generate energy. Therefore sustainable, zero-energy housing (housing which generates the same amount of energy as it consumes) is created inside the tank.

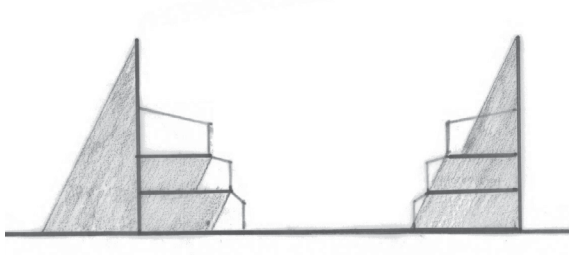
To create these houses some characteristics of the oil tank can be used. One characteristic element of the oil tanks is the construction which is designed to handle a lot of pressure from the liquids inside. This characteristic could be used for the sustainable houses, for example by keeping the water out, when the sea level is rising.

The characteristics of the construction could also be used by storing water for the houses. For example rain water or water which can be used to store energy.





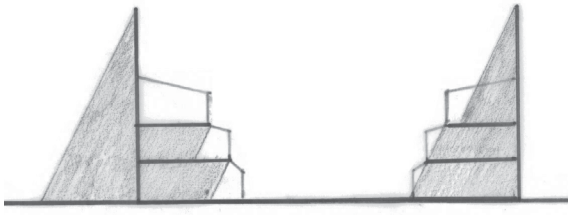
Drawing 1: standard dwelling



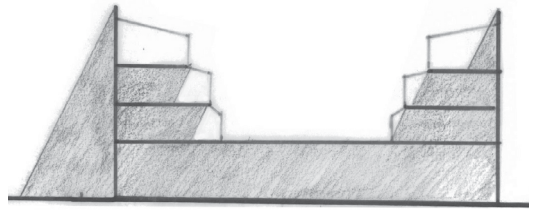
Drawing 2: skylights

Drawing 3: standard layout

Drawing 4: layout upside down



Drawing 5: dwellings land-bound



Drawing 6: dwellings moved upwards

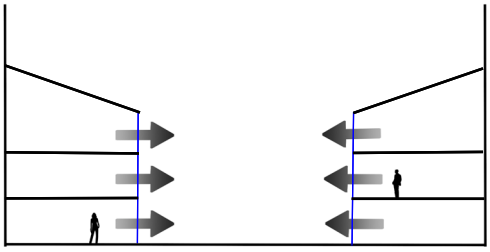
Sustainable dwelling

Problems and solutions*: *daylight

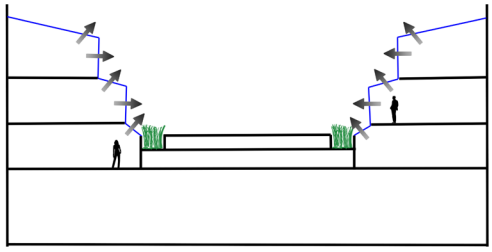
While designing sustainable houses in the oil tank, I had to deal with the problem of daylight. When the roof of the oil tank is opened, daylight can come in from above. If you place standard houses in the oil tank, with vertical windows (see drawing 1), the houses will still be dark. This problem is caused by the fact that all daylight enters from above, so daylight will hit the windows at a high angle instead of perpendicular. A solution would be a design with windows facing the light, in other words skylights. On the second drawing you can see a design with skylights on every level, in this way every level of the dwelling gets sufficient lightning.

In general the plan of a house has the living room and kitchen on the ground floor and bedrooms and bathrooms on the upper floors (see drawing 3). However, the lower floors are in this scenario design darker than the upper floors. In general people are more keen on daylight in their living room and kitchen than in their bedrooms. Therefore, a solution would be to switch the layout of the dwelling. The bedrooms will be located on the more darker lower floor, just like the bathrooms. Hereby, the bathrooms will be located at the back of the lower floor, the darkest place. In this way the kitchen can go up, just like the living room, which is now the brightest room in the house (see drawing 4).

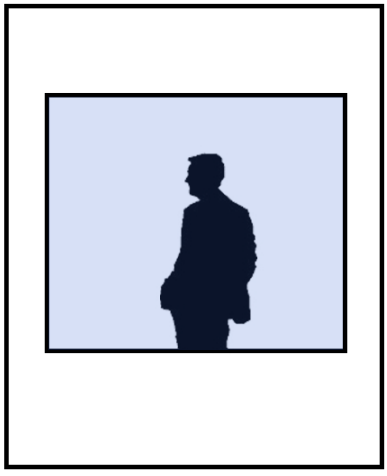
However, when the sun is not at a high point, but lower especially in winter, there is the negative effect of shadows created by the tank's wall (see drawing 5). Because of this shadow, a part of the houses will be in the shade during the mornings and evenings when the sun is low. A solution would be to raise the houses, see drawing 6, in this way the effect of the shadow created by the tank's wall is diminished. The space created underneath the houses could for example be used for other sustainable solutions, like water storage.



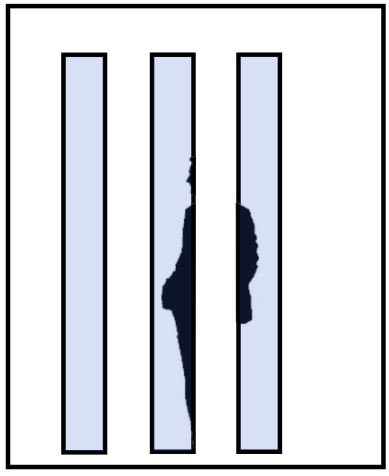
Drawing 1: standard dwelling



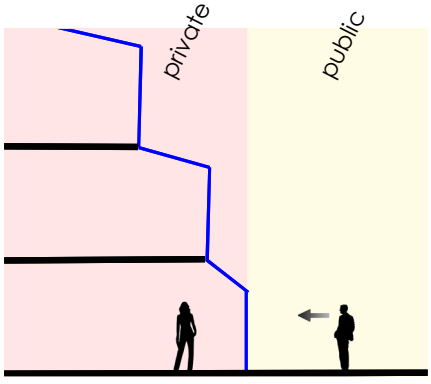
Drawing 2: skylights



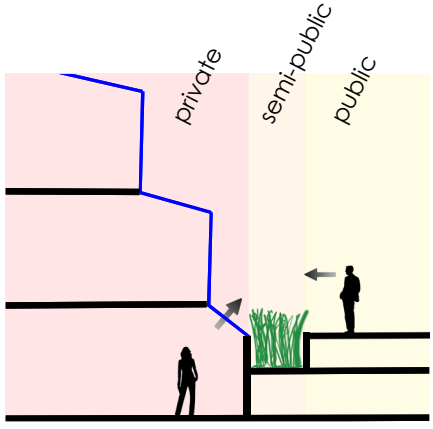
Drawing 3: standard window



Drawing 4: tall narrow windows



Drawing 5: no seperation



Drawing 6: lowered bedrooms

Sustainable dwelling

Problems and solutions*: *privacy

The many windows in the design lead to a privacy problem. By placing eight houses in the oil tank, in a circular shape against the oil tank's wall, all houses were facing the courtyard. In this way, neighbours can look right across into each other's homes (see drawing 1). A part of the solution can be found in the skylights. The skylights are placed for extra daylight, but they also give different sightlines (see drawing 2). Because of the skylights, there are less windows needed facing the courtyard.

On drawing 3 you can see a standard window, which gives a lot visibility and therefore lacks privacy. Solutions for this problem could be for example curtains or blinds. However, there are also more architectural solutions as told before. Therefore, in this design I used narrow, tall windows, for a maximum balance between daylight and privacy (see drawing 4).

Due to the problem of daylight, the bedrooms are placed on the ground floor. However, by placing the bedrooms on the ground floor a privacy issue is created. Due to the fact that people want more privacy in their bedrooms than their living room. The solution in this design is to raise the walking level of the courtyard. In this way the bedroom are partly "underground". Which gives them more privacy. Also by placing greenery in front of the bedrooms, which creates a transition zone from public to private (see drawing 6), a feeling of more privacy is created.

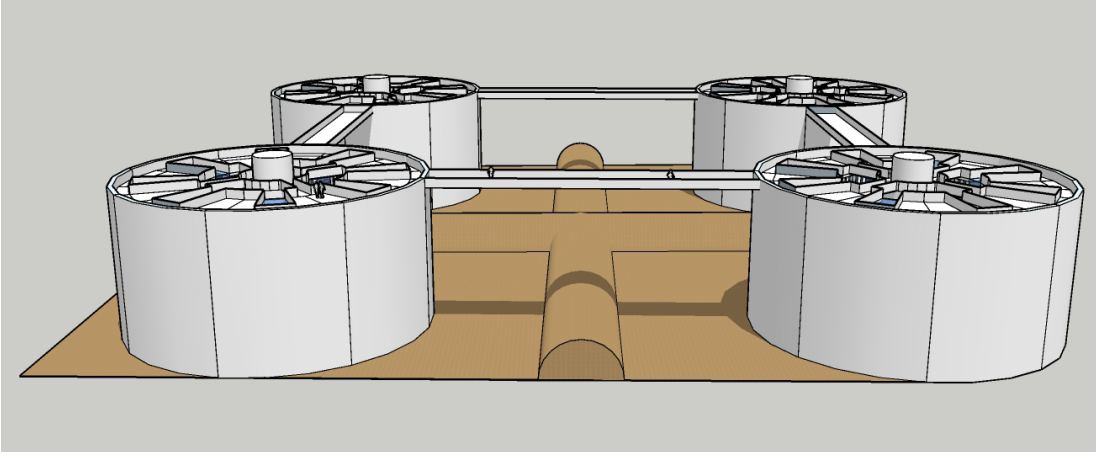
(own photo montage, 2018)

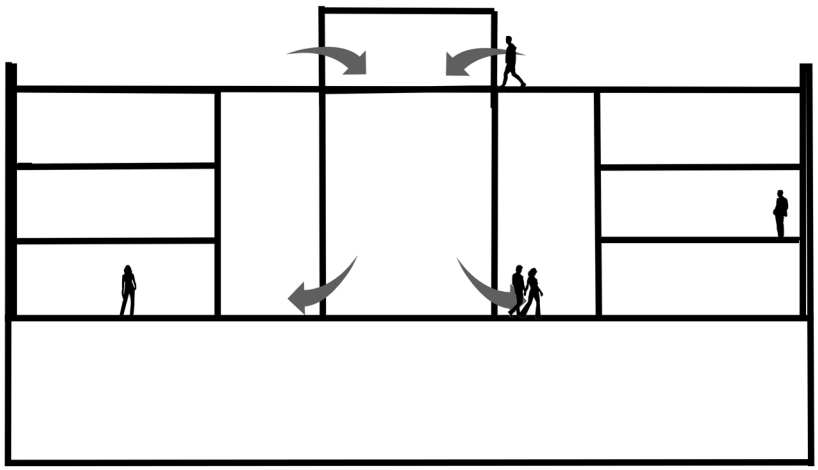
(own photo montage, 2018)

Giving back to nature

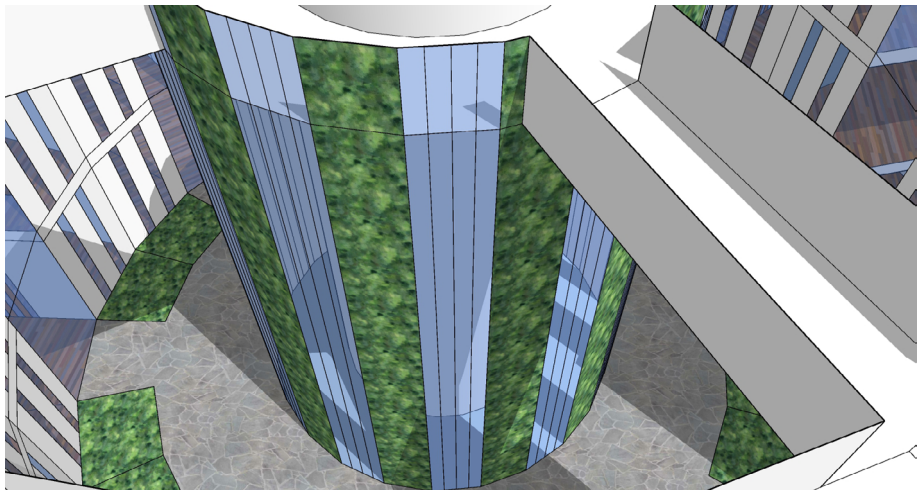
The oil industry always took from nature, so now it is time to give the site back to nature. As told, the oil tanks are located at the edge of the harbour of Rotterdam next to the North sea. Therefore the site of the oil tanks in this design scenario will be transformed into a dune landscape.

The concept for this design is the dune landscape, where the existing environment will not be touched. This means there are no new roads or other new infrastructure visible on ground level. The tanks will be lonely elements placed in the dunes. The tanks will stay unchanged, that is to say no openings in the walls, so it really feels like nature took over.





Drawing 1: entrance from above via roof

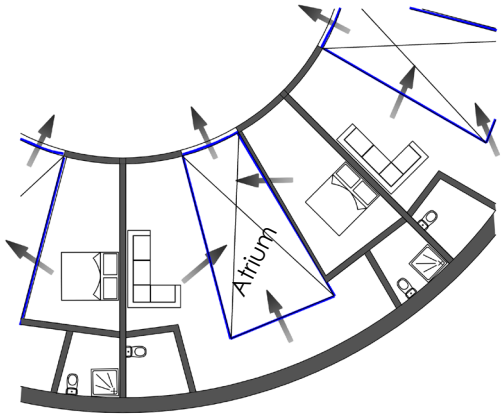


Drawing 2: new staircase connecting the dwellings with the new infrastructure

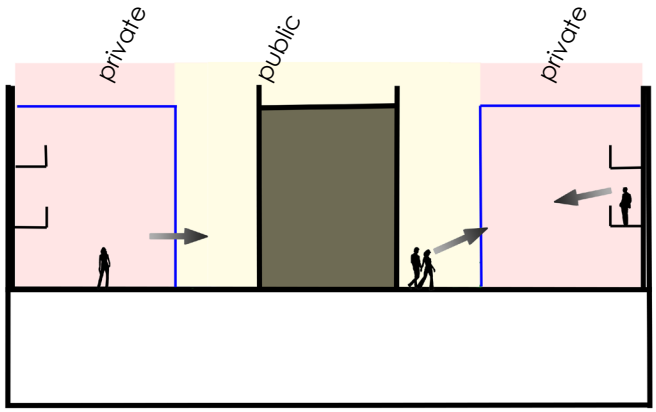
Giving back to nature

Problems and solutions*: *entrance

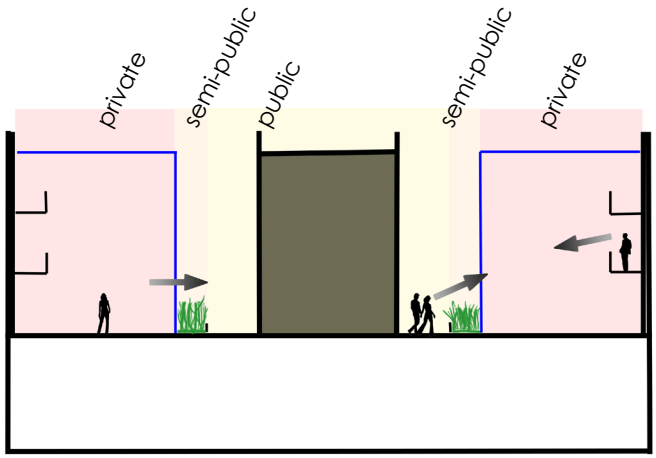
As told before there will be no openings in the tank's wall in this scenario. Therefore the entrance could be a problem. Which can be solved by moving the entrance to the top of the tank (see drawing 1). A staircase is placed in the middle of the courtyard and connects the ground level with the new infrastructure up high (see drawing 2). In this way the tank's wall stays untouched. And by placing the new infrastructure up high, nature will be able to take over on ground level.



Drawing 1: plan view of dwelling with atrium



Drawing 2: section no seperation between public and private



Drawing 3: section with little front yards

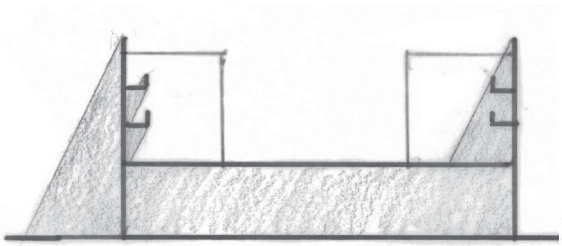
Giving back to nature

Problems and solutions*: *privacy

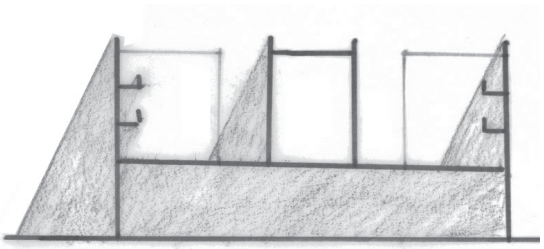
The houses in this scenario are designed around a private atrium (see drawing 1). Therefore, all rooms overlook the private atrium and not the shared circular courtyard. In this way one can create an inward facing construction, which provides a lot of privacy. Only the atrium has a direct connection with the shared courtyard. In this manner the atrium will act like a buffer zone between the public courtyard and the private rooms in the dwelling.

All houses are placed around the public courtyard, therefore it would be possible to look inside the house across the courtyard. As told the stairs will be located in the middle of the public courtyard and will provide access to the tank from above. So this staircase provides privacy by obstructing the view from the neighbours across.

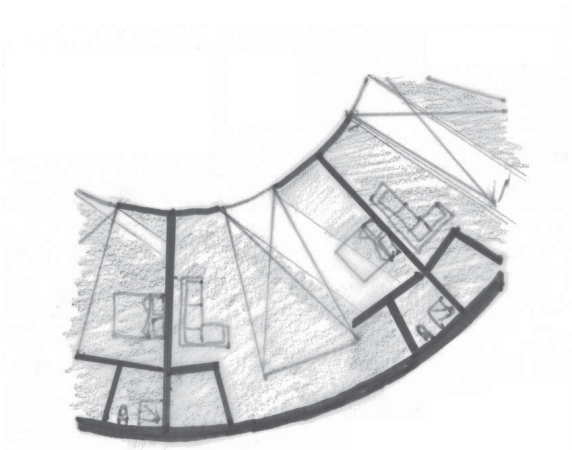
However, when people are walking in the public area they will still be able to look into your house via the atrium (see drawing 2). This could for example be solved by making a little front yard, which creates a zoning with a subtle transmission from public to private (see drawing 3). Another solution would be the use of obstructing elements like shutters.



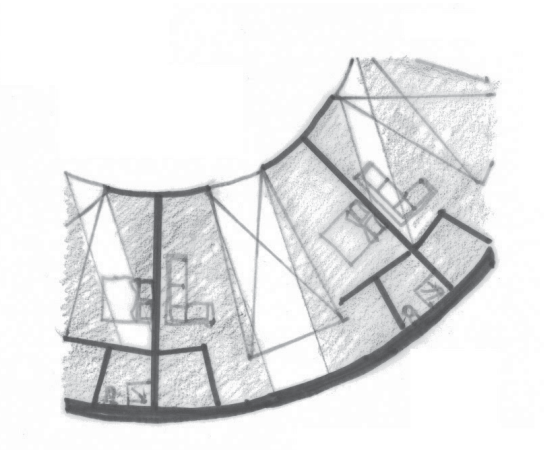
Drawing 1: dwellings with an atrium



Drawing 2: central staircase in courtyard



Drawing 3: sunlight enters via atrium in morning



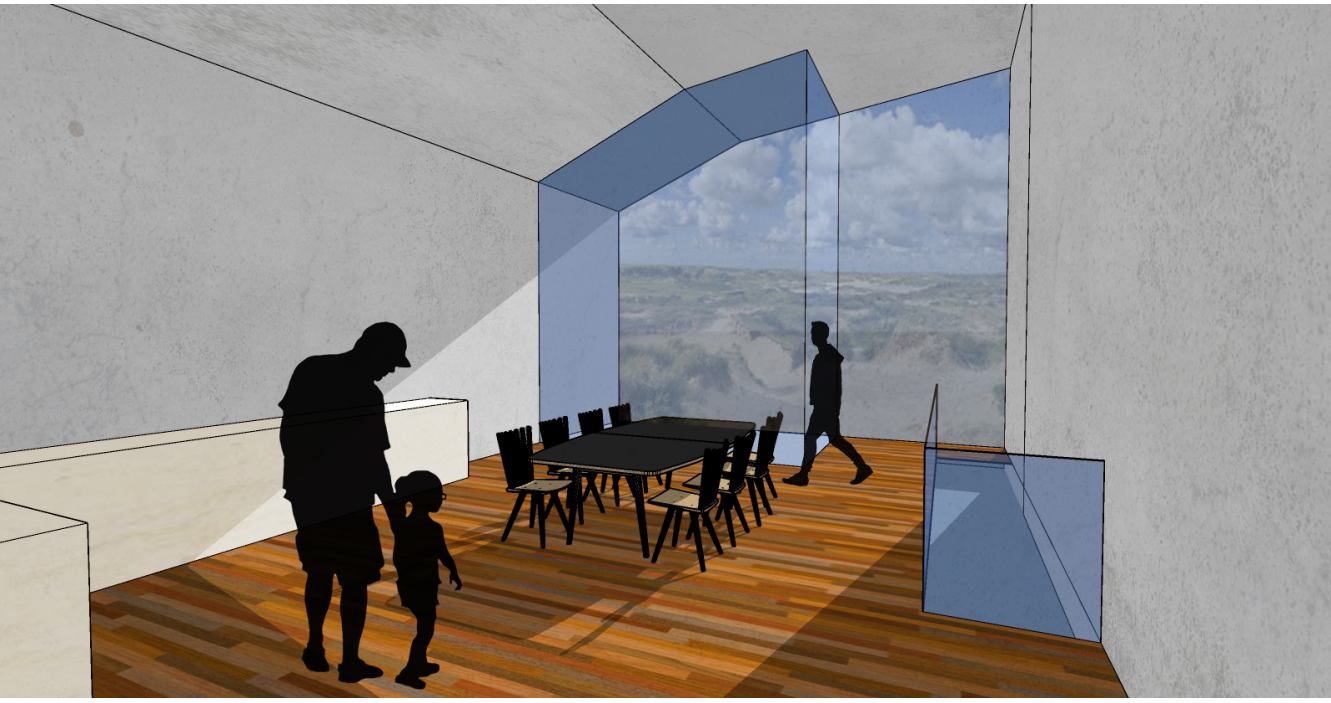
Drawing 3: sunlight enters via atrium in afternoon

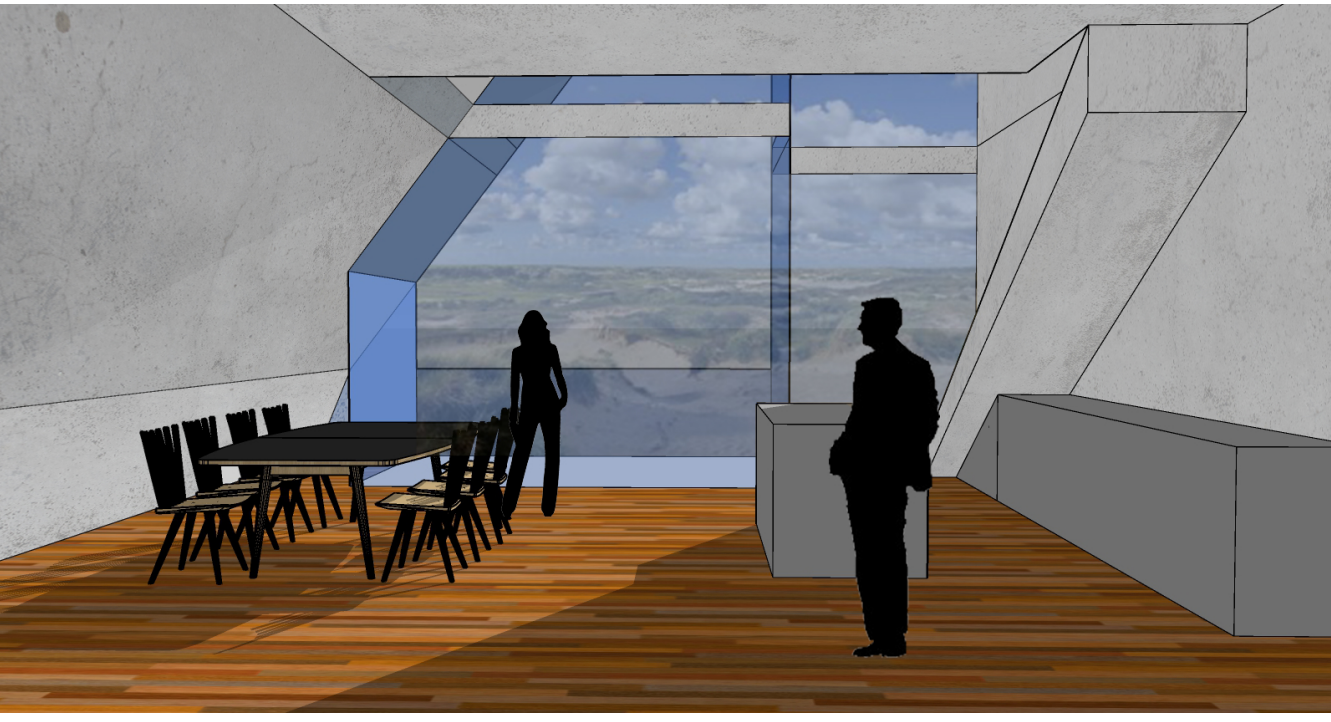
Giving back to nature

Problems and solutions*: *daylight

The staircase in the middle of the courtyard unfortunately also blocks available daylight, as can be seen on drawing 2. However, the atriums in the building will still let a lot of light in. The advantage of the atrium crossing through the whole dwelling, is that light can come in from above and the front façade. In this design I used the same solution for the lack of sunlight as for the sustainable housing, lifting up the houses from ground level, higher up in the tank. In this way the tank's wall will block less light, resulting in more natural light entering the living area.

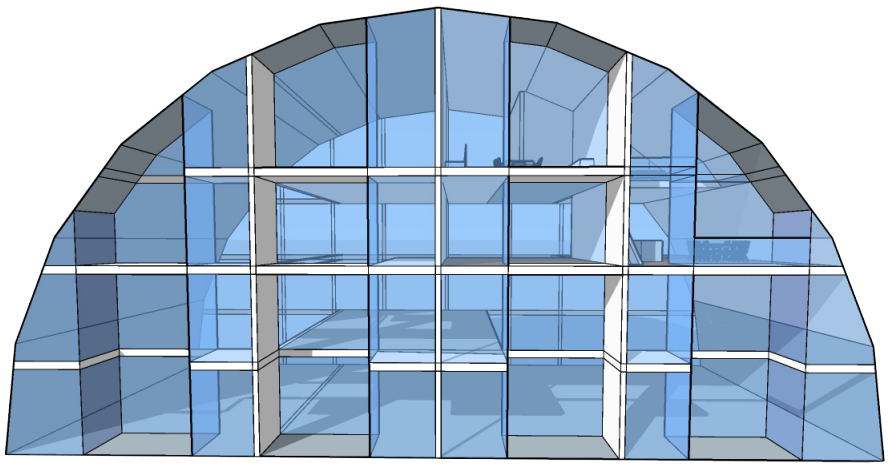
However, it is still questionable if there is enough daylight entering, in this design due to the staircase in the middle, which is blocking quite some daylight.

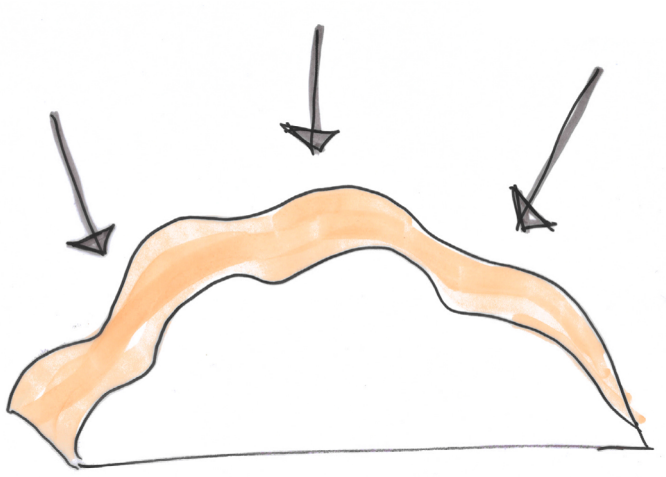




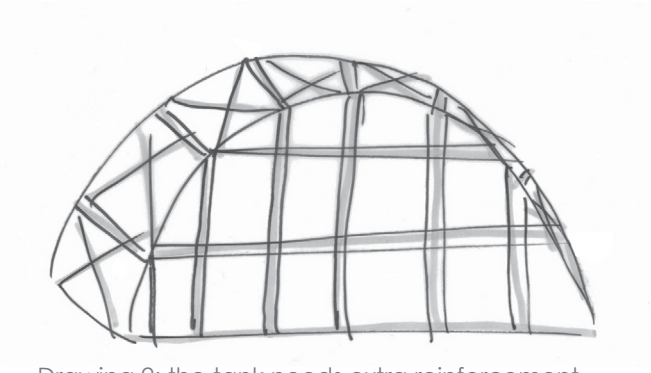
A new landmark

The location of the oil tanks is right at the entrance of the harbour. By putting the oil tank on its side a new landmark is created in this design scenario. The steel wall of the oil tank now forms the roof of a small apartment building, with two glass facades. These dwellings are the closest to ordinary dwellings, except from some curved ceilings.

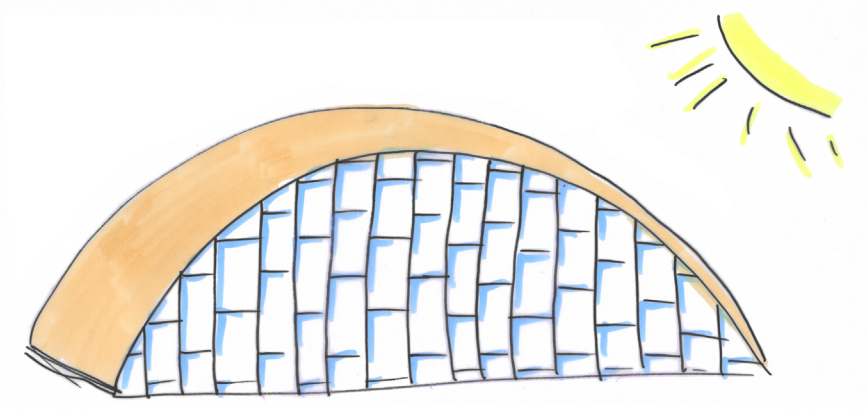




Drawing 1: rigidity of the tank is lost



Drawing 2: the tank needs extra reinforcement



Drawing 3: the tank on its side with two glass facades

A new landmark

Problems and solutions

Form typology

This design totally neglects the original oil tank, and only uses the tank's steel wall as a raincoat. However, it gives an interesting design, which gives the most ordinary houses from all four design scenarios, because the floor plan is rectangular instead of circular. Therefore, the form typology is changed in this scenario from circular to rectangular.

Construction

When placing the tank on its side it will lose its rigidity, due to gravity (see drawing 1). So it is essential to support the tank in order to retain its circular shape, this could be done by columns and beams (see drawing 2). So by putting the tank on its side, consequently the advantages of re-using the oils tank construction will be lost.

Daylight

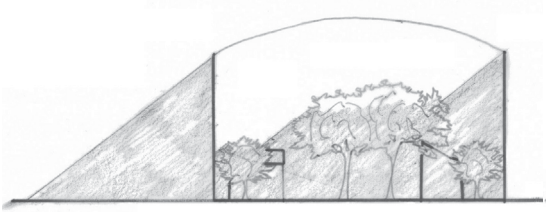
Due to the fact that this design is the most ordinary from all scenarios, daylight is not a problem. The tank on its side can have two glass facades (see drawing 3), so daylight can come in from two sides. By making high ceilings inside the apartments, windows will be higher and more daylight will come in.

(own photo montage, 2018)

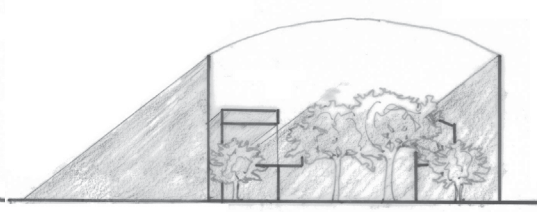
Living in a controllable climate

Due to climate change we want to live in a controllable climate. Therefore, the tank can be used as a greenhouse to create a jungle inside. In this way you can live in the climate you prefer, without moving across the world.

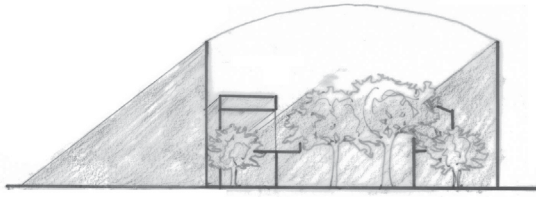
By removing the steel plates on the roof and replacing them with glass, the oil tank will be transformed into a greenhouse. Inside a jungle can be created with small houses between the trees.



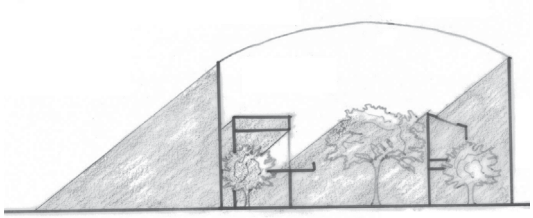
Drawing 1: a jungle in the tank



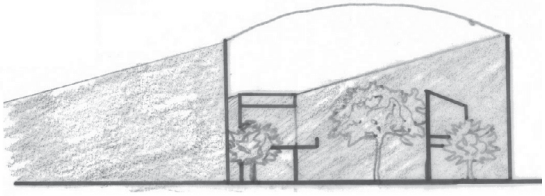
Drawing 2: dwellings are moved upwards



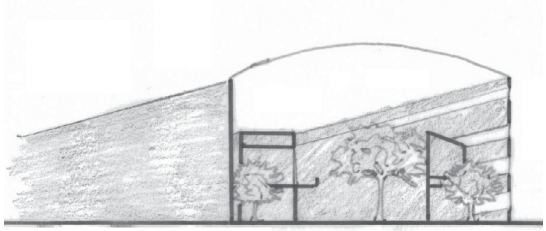
Drawing 3: the trees block the sunlight



Drawing 4: less trees to block the sunlight



Drawing 5: sun in low in winter



Drawing 6: holes in the wall for extra sunlight

Living in a controllable climate

Problems and solutions*: *daylight

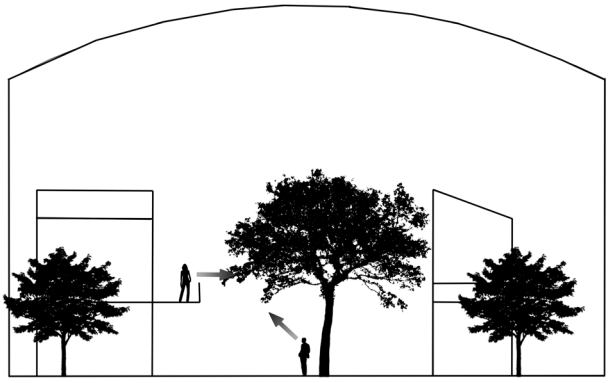
Daylight is the most problematic is this design scenario, not only the tank's wall is blocking daylight, but the trees as well (see drawing 1). So as told the steel plates on the roof will be replaced by glass, to create a greenhouse, in other words daylight can shine from above. The problem of lack of daylight caused by the tank's wall and the trees can be partly fixed by raising the little houses and putting them on poles and placing skylights in the roofs (see drawing 2).

Further one should make sure the trees are not placed too close to the windows of the houses, so more daylight can come in (see drawing 4).

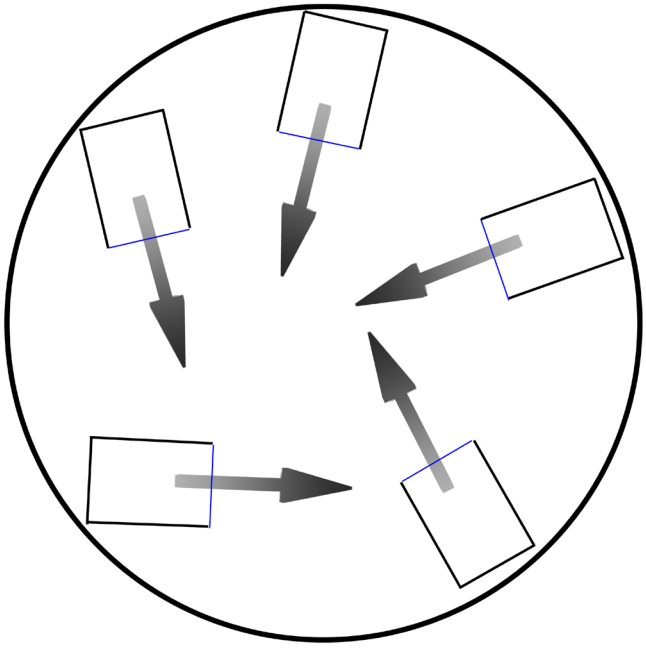
However, the tank is still really dark, especially in winter time when the sun is closer to the horizon. A solution could be to make holes on the south part of the tank's wall, so light can come in even when the sun is lower (see drawing 6).

Problems and solutions*: *construction

Downside of making holes in the tank's wall, to get more light in, is the construction. To get enough daylight in, the holes need to be quite large, a few square meters. However, as discussed before, you would need extra vertical and horizontal support with holes this size. Thus the tank will be weakened and can't be used as a supporting construction for the roof, unless extra support is placed.



Drawing 1: trees create a sense of privacy



Drawing 2: dwellings never face each other directly

Living in a controllable climate

Problems and solutions*: *privacy

Privacy is in this design scenario less of a problem, because the trees already block the view from house to house (see drawing 1), which gives privacy. By selecting the correct plants, one can make sure the trees and plants provide enough privacy all year round.

By placing all houses in a different angle, so they are never directly facing each other, even more privacy is created (see drawing 2).

(own photo montage, 2018)

Conclusion

Due to the future shortage of oil and therefor oil products we should think about the heritage this industry will leave behind. One iconic element of the petrol industry is the oil tank, which can, all things considered, be re-purposed into dwellings. However, when designing dwellings in an oil tank one will face some challenges.

Concluding, the main problems would be daylight, privacy and construction. These elements particular make designing dwellings in an oil tank more challenging from standard dwellings.

The problem of daylight is created by the tanks wall of 16 m high. The sun must stand high to shine inside the tank, or the wall creates a lot of shadow inside the tank. As seen some solutions for this problem are holes in the tank's wall, skylight based dwellings and raising the dwellings from ground level.

However the solutions for daylight create problems for the feeling of privacy. The habitants are living close and most probably have lots of windows facing each other, to compensate the lack of daylight. This causes a lack of privacy. As seen some solutions can be found in architecture of the façade or obstructing elements inside or outside the dwellings.

The construction of the tank could be used for the construction of the dwellings. It withstands the wind forces now, and will withstand them when dwellings are build inside. Therefore the walls will act in the way of a windproof raincoat. However a problem is created when wholes are made in the wall. Constructional rigidity is lost and extra contractual reinforcement is needed, so the positive characteristics of the wall are lost.

When designing in an oil tank one should especially take these elements in mind and find solutions for these problems. The problems and solutions are linked and may cause new problems. It is important that one finds the best balance between the problems and solutions in their design. This guide serves as a guideline to aid in the design of dwellings in an oil tank.

(own image, 2018)

Discussion (part 1)

As explained before the method of Research by Design is relatively new and to that end has no strict guidelines. However according to Hauberg (2011) it should not be alarming as long as the research is done systematically and the results are expressed in a way that is useful to others.

Nevertheless, one can discus if the research was done systematically enough. Designing is a creative process, which sometimes doesn't fit in a systematic system. I tried to keep track of every step I took in my diary, then again some decisions and conclusion I made were not expressed in drawings or models, but were for example the result of shower thoughts.

It is difficult to report your whole design process step by step, because we all have different backgrounds and therefore a different frame we design in. Some decisions I made are so obvious to me that I don't need to make a drawing or a model, then again for others due to a different background and working frame it might not make sense at all.

When I started with this research I was trying to make a toolbox for designing dwellings in an oil tank. However, during the research I came to the conclusion, that I was not really creating tools. I found that I was defining the formulation of the problems more and more and while defining these problems, I tried to look for solutions in my frame of references in which I was trained. By sketching and model making I came across more and more problems. Even while thinking about solutions for these problems I came across even more problems I needed to define. For example daylight was a problem, but by making windows all facing the courtyard, comes the problem of privacy. Nevertheless by making the problems more and more explicit it became easier to find solutions.

(own image, 2018)

Discussion (part 2)

As stated before the design study of finding problems and solutions for designing dwellings in a tank is endless, but I tried to cover all four domains. However during the design study I came across more problems and solutions than written down in this guide. For example one problem I found out after this paper, is the acoustic of the tank. A solution for this problem could be the use of specific materials for the facades of the dwellings.

Further in most of my scenarios I kept the tank's wall quite close, I have done this, because this gives the most specific problems when designing in an oil tank. Of course it is possible to tackle the tank's wall more like an ordinary facades and make windows in the wall. However as told before the constructional characteristic of the oil tank will be lost and constructional support should be added. So by trying to keep the tank as close as possible, I tried to find the more extreme problems and solutions of designing in an oil tank.

(own image, 2018)

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