Hey there and welcome to my graduation presentation at the Architecture faculty of the TU Delft.

7 years ago I started with my study thinking architecture meant that I would learn how to build a house. Quickly I learned that there is much more to architecture than meets my definition.

The first courses were modelmaking courses where we would learn about “form and contraform” at the time it felt as though it had almost nothing to do with architecture.

Now that we are standing at the end of my architecture study trajectory I have a new definition: Architecture is the art or practice of designing and building structures and especially habitable ones.

These designed structures come in many forms and scales, ranging from regional planning, to urbanism, to landscape architecture and the actual making of a house

During this presentation I want to take you on a journey highlighting how architecture improves our quality of life throughout four different scales:

The scale of regional design, the design of a township within this region, the design for a farmyard system within township and finally a dwelling connected to this system.

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- use water and soil as guiding principles for a new form of agriculture, with an emphasis on construction materials.
- use soil qualities to create a sponge for the occurrence of heavy rainfall in the neighbouring cities.
- use soil qualities to create a carbon sink, storing carbon in our earth

Secondly I will explain how my four-man-team has designed a township within this context

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- That is a tactical location at the crossing of several important access roads and waterways.
- That is characterised by its participation in the circular system of Midden-Delfland as a place for storage, transshipment and craftsmanship relating to new forms of agriculture.
- That re-interprets the historic architectural and urban typologies of Midden-Delfland, creating architecture that fits the current landscape.

Within this township I personally designed an urban micro-system for almost fully self-sustained living in a re-interpreted farmyard for future Midden-Delfland that:

- Provides the inhabitants with renewable heat and electricity from the Sun and Wind, even in winter times.
- Uses microbes and plants to create local sustainable water system where water can be stored for periods of drought.
- Provides the inhabitants with the tools to find re-used and circular materials
- provides inhabitants with non-toxic, non-flammable, electric energy storage possibilities

And finally I have designed a house attached to the urban micro-system:

- That has almost fully renewable walls and roofs that can be sourced from locally harvested materials.
- That has a fully circular, concrete- and pillar-free foundation made from locally sourced “waste”.

- Which volume is determined by the heating capacity of the urban micro-system.
- Which shape is determined by the urban micro system in order to maximise solar output.
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I will now start with explaining the regional project going down in scales. I will start with explaining the challenges on this scale, after which I tell you about the proposed approach.

Midden-Delfland is a peat meadow landscape surrounded by the large cities of Rotterdam, Delft and The Hague.

The pressure on the vast open territory in these cities is vital to meet the housing needs.

The claim for space that comes with urban development is large:

for housing, logistics, agriculture, infrastructure and generating energy.

In addition, the rural area faces major challenges in the field of

biodiversity,

climate

and energy.

SLIDE 21 AANPASSEN If we want to keep living in the cities lying below sea level in the year 2100 we will have to change our system drastically and design an integrated solution.

With the expectation that weather conditions will be increasingly extreme due to climate change, the valuable fresh water should no longer be discharged.

Instead, it should be stored to be used in times of drought.

It is essential to redesign our poldersystem so that the boezems get more space and become green-blue infrastructures connecting with the surrounding urban areas.

In the Advanced Housing studio Ecology of Inclusion we take the design for 'National Productive Park Delfland' developed by the office of ZUS as our point of departure.

In their plan they build further upon the boezemsystem of midden-delfland

by improving the east west water connection, Strengthening the existing water management system

In between the newly proposed boezems we can see a blue area. This area consists of mainly peat soil, which can store and, with the correct planting, even clean the overflow of water. Creating a green lung and sponge that enhances the liveability of the surrounding cities.

The wet peat soil, also functions as a carbon sink, as organic matter sinks after it dies it does come into contact with oxygen and therefore does not decompose, storing the carbon encapsulated in the plants or animals within the soil

All in all creating a resilient and future proof water system

Secondly they redesigned the landscape based on the morphology of the underground

Click

The new produce is mainly construction material oriented, harvesting wood in the upper areas, elephantgrass and reeds in the peatlands and flax and lifestock on the remaining grasslands.

The Boezemsystem is improved

Finally transforming the landscape from lush open green field into a bog like, biodiverse, productive Park.

Now I will go into some group work. How me and 4 other have designed a township within this Productive Park, as you can see on this picture, we have done many excursions to see the old Midden-Delfland and its boezem system for ourselves

On these images you can see the height differences of the boezemsystem clearly, as well as the characterising wide open landscape

Every group within the studio received a part of the site analysis as well as a topic for choosing a location as well as for giving a seminar to the others. I was in the site model & building resources group.

With my group, we build a huge model of the site. After which we also made boxes and a design family so everyone could make a model for their own groups chosen location.

Next we chose a location, we chose to build on the crossing of two boezems, the old vlaardingervaart en the new boezem for de Zweth.

There were already plans to strengthen the accessibility of this location

Creating an interesting crosspoint of access roads, making it easy to participate in the resource exchange and circularity system of Midden-Delfand.

We looked at the plan of ZUS from the perspective of resource management and found that in order to build the newly proposed boozem. We would need

Around 10 times this amount of trucks filled with sand to create the desired height. Instead of a new boozem, we propose a lock at the crossing of the vlaardingervaart and the Zweth, saving a lot of sand.

Next we took a look at the soil of our location and discovered a circular sandbed, ideal for the construction of houses.

These sandy soils are remnants of an old river delta, and due to the subsidising of the surrounding soils these sandbeds lie higher than the surrounding soils.

We simulated how de zweth would overflow during heavy precipation and found that even in our worst scenario, these old creekbed remained dry, creating the ideal location for construction in the productive park.

While investigating the common urban layout of Midden-Delfland we found that the area mainly had two typologies, in historic times they used to also build on these creekbeds, creating these farmyard island typologies, while along the access roads mainly ribbon development is created.

We bundled all this information into the following urban plan with ribbon development at one side of the creekbed ridge, a farmyard island typology on the other side and an active center for the exchange and storing of resources around the lock.

Introducing the township of Vlietpoort

Next we made a model of our location and chose a part to further develop individually, I was tasked with designing the farmyard island typology.

In order to properly fit the housing assignment into the landscape of Midden-delfland, I had a look to the spatial qualities of the historic farmyard. In this image we can see a multitude constructions surrounded by trees. These trees protect the house from harsh winds of the open fields.

Interestingly enough, this is also one of the recommendations for enhancing the climate as provided by the climate consultant, a tool architects use to understand the challenges of a site.

Therefore I grouped several trees and shrubs along the prevailing wind directions.

Furthermore I wanted to try and incorporate the diverse nature of architectures that can be seen on farmyards, creating a farmyard for future midden Delfland.

Going back to this diagram, I have now shown you how I did the group work making a site analysis and choosing a location, yet we also still had to give a seminar on building resources. I wont bother you with all the details of the seminar but one sentence stayed with me and inspired my personal research.

It was by this man William Rees, the inventor of the carbon footprint. He stated that in order for something to truly become sustainable it must be detached from all unsustainable systems. I wanted to explore what this meant for my farmyard.

Introducing the third scale. The farmyard system design.

I will now talk a little bit about my research, called OFF-GRID IN CONTEXT.

Taking a closer look at the built environment I found that it is responsible for 39% of the Annual Global CO2 Emissions. 28% comes from building operations such as heating and cooling, while 11% comes from the production of building materials and construction.

Secondly we currently experience a water shortage in the Netherlands. I had a closer look to this issue and found that from the 127L of fresh water we use on a daily basis only 2.6 is used for cooking and drinking, while the rest is used for cleaning, and thus essentially used to transport organic material from your house to a central sanitation plant.

This sewage system costs the Netherlands 1.4 billion euros on a yearly basis and it is already at maximum capacity, resulting in sewage water streaming into our surface waters whenever there is heavy precipation

During my research I stumbled upon several communities that have been busy with solving these issues since the 90s. These communities are grouped under the Eco village movement.

A network of different ecological communities also exists in the Netherlands

These ecovillages come in many shapes and sizes, all trying to find an ecological way of living

For the purpose of my research I focused on two specific examples: Ecovillage Boekel and Ecovillage Olst, two radically different complexes that both try to minimise their building operations by utilising the energy of the sun

In Ecovillage Olst they chose for an active approach powered by 600 solar panels on their roofs. The electricity of these solar panels is used to heat op their CESAR-battery

This Cesar battery consists of a husk with a 2m thick insulation layer, within this husk 400 cubic meters of steelslag is stored. This steel slag is heated via steel pipes that are put under high electrical current. The heat is stored in the steelslag, for later use during colder times.

The Ecovillage Boekel also experimented with a new concrete-free foundation made from foamglass. This material has high insulation properties while it is also able to withstand high pressures.

The Ecovillage Olst took a radically different approach to their heating demand. Their was to passively warm up the houses in winter times with only the heat of the sun.

In order to do this, they have adapted the earthship model by Ryan Reynolds. This concept makes use of overhangs and ideal roof angles to shade the interior from the summer sun while maximizing solar gain in winter times. This heat is stored in compacted soil, that dissipates the heat during the night.

The Earthship model also promotes the use of second hand or waste materials. Here you can also see the use of tires in their walls, and on this image you can also see the roof angle that contributes to the passive heat gain system. During my excursion there, they mentioned that sourcing second hand/waste materials proved to be a hard task.

Therefore I have made this map highlighting different second hand building material shops.

These I arranged based on their offer, to make the use of second hand materials easier for the inhabitants of my farmyard complex

Several elements were present in both ecovillages as they are already proven technologies. The first one is this helophytefilter, which makes use of plants and microbes in order to create a local and ecological waste water system. The clean water can be re-used creating an almost never-ending supply of water.

They both catch and store rainwater for grey water purposes in underground water storage tanks

Finally they both have lush gardens providing the inhabitants with food, while also creating a common goal that increases the community feeling

Although they are almost completely self sufficient, both complexes are still connected to the dutch energy grid.

When they developed their ecovillages, the only viable battery system in the market was the highly pollutive and flammable lithium-ion battery. I have found a solution to this issue in the form of the greenrock saltwater battery. It does the same job as the lithium ion battery, yet it does not rely on rare metals, is non-toxic and not flammable. The only major downside is that it requires much more space than the lithium ion battery and should therefore be taken into account at the start of the design process.

Comparing the two heat gain systems, the active system of ecovillage boekel came out as the winner. Since the earthships sometimes still needed to heat using a fireplace.

All these elements are placed in context of the Midden-Delfland farmyard of the future, resulting in the corresponding image.

The newly proposed farmyard makes use of the old polderstructure. On one side of the complex the poldercreek is used to create a modular helophyte filter, while on the other side the poldercreek is used to harbor all piping necessary to create this system.

The 166 solar panels on top of the houses power the Cesar Battery system. While the solar panels placed on the group houses can be adjusted to the amount of inhabitants, powering the saltwater batteries. The helophyte filter and trees around the complex, again, protect the area from the harsh winds.

To create this system, the underground needs to be utilized. On this image we can also see the creekbed, as well as the dug away soil that is placed in the old poldercreeks.

Now that the urban micro system is in place, it is time to start designing a dwelling within the farmyard. In order to do so I first had to know what people are willing to migrate to rural areas.

Research has shown that the rural migrant of the Netherlands has an above average income, often migrates from the city to the rural landscape and are most often couples looking for more space and a slower pace of live to start a family.

The average home size for a Midden-Delfland couple is 100m2, while the average home size for a full family home is 160m2

Taking this into account I will now tell you how I designed a dwelling with a fully circular foundation, a biobased shell, with a volume and shape fitting and enhancing the proposed farmyard system, while providing a fully flexible interior that enables the inhabitant to grow within the confines of their home.

First and foremost, the house is north south oriented, maximising solar gain on the southern side, the roof on the south facing façade is angled to optimise the electrical output of the solar panels, while on the northern side the roof is kinked to match the volume with the cesar battery output.

I started with the foundation, that I adapted from the ecovillage boekel. Within this foundation all piping, connected to the urban micro system, emerge at a central location within the home.

On this central location I have developed a module with all the elements that connect to the urban micro grid.

The biobased shell is wrapped around this inner core resulting in an open floor plan

For the biobased shell I did a case study into the dutch natural pavilion at the 2023 Floriade Expo.

Many new biobased technologies are presented in this building with the most viable options for quick integration into the built environment being: ecococon straw wall panels, that function both construction as well as insulation, wood, mass timber, wood fibre insulation, cellulose insulation made from old newspapers and flax based linoleum for floor finishings.

These materials can all be harvested from the newly proposed Productive Park Midden Delfland. And together create my biobased shell.

The ecococon wal panels function as stabilising walls for the outer shell, while the core is made from mass timber panels, providing its own stability. The roof spans from the south and north facing façades to one central beam that is carried by the ecococon panels and mass timber core.

The roof consists out of 10, 2m wide, prefab panels made from laminated veneer lumber that are stabilised via steico wood fiber underlayment of 22mm.

The beams that form the panel that bears a kink on the northern façade are made from three different parts, that are finger joint together. You can see how this is done in one of the samples I brought. The roof panels are filled, on site, with 300mm thick layer of cellulose insulation.

In winter times the house is kept warm via floor heating on ground floors and convectors on the upper floor. The house makes use of mechanical ventilation paired with a heat recovery system ensuring that the warmth stays inside. Also the sun heats up the thermal mass of the geopolymer concrete floor, releasing this heat in the colder nights when the floor heating is turned off.

In Summer this system flips and uses the piping of the floor heating system for floor cooling. The thick walls shade most of the thermall mass surface from the sun and the heat recovery system now functions as a coolth recovery system.

All rainwater is harvested and the used water from shower and toilet is directed to the helofyte filter.

The extra height of the home, together with the exposed construction of the ecococon straw wall panels, create the possibility to create more living space within the interior, enhancing the flexibility of the house. So that

Whenever a couple buys their first house, they start with an empty space. They have some arguments and decide on which side of the inner core they want to attach their kitchen to.

They have decided on a kitchen at the east side of the core, after which they have decorate their interior and started talking about having kids.

The first one is on the way, so they build him a floor. At the same time they realise that they might need more privacy so they build two walls, creating a master bedroom.

One of the parents gets a job in Groningen, which is to far, to work remotely they need a workroom, so they build another wall.

Quickly after their first child, the mother is pregnant again, so they construct another floor on the other side of the home

When the kids left their nest, the parents felt lonely, and wanted to earn some extra money to repay their childrens study loans. So they decided to add a bathroom and kitchen in their old master bedroom, renting out their old workroom and master bedroom as a shared living studio. I invite you to read the story on my posters after the presentation where I also explain a fully co-living situation that could house 4 bedrooms.

The floors are easily constructed, you just need to screw a beam into the inner core and the ecococon panels, on which you can mount your floor.

Now in this last part of my presentation I will briefly tell you about the construction methodology on the smallest, 1:5 scale.

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