Graduation studio: Advanced Housing Design

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Studentnumber: 4563271
Main mentor: Olv Klijn
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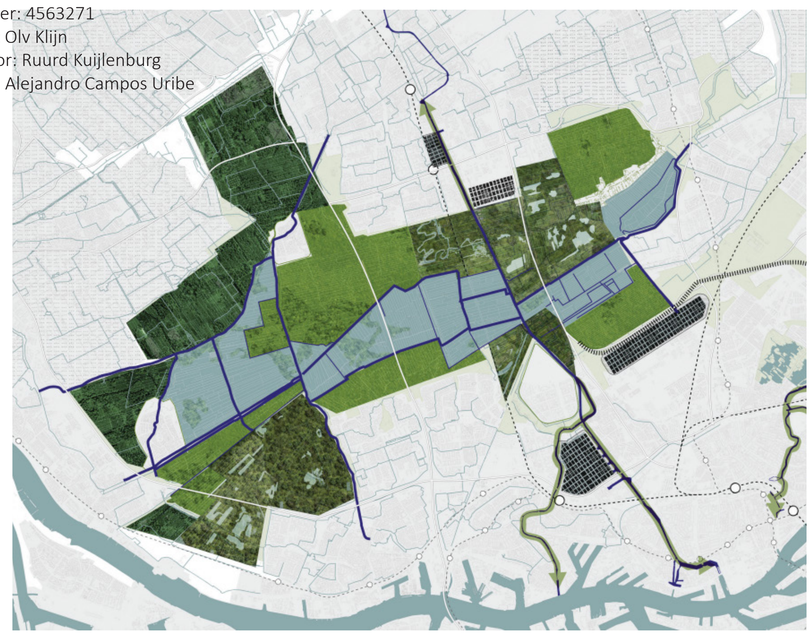
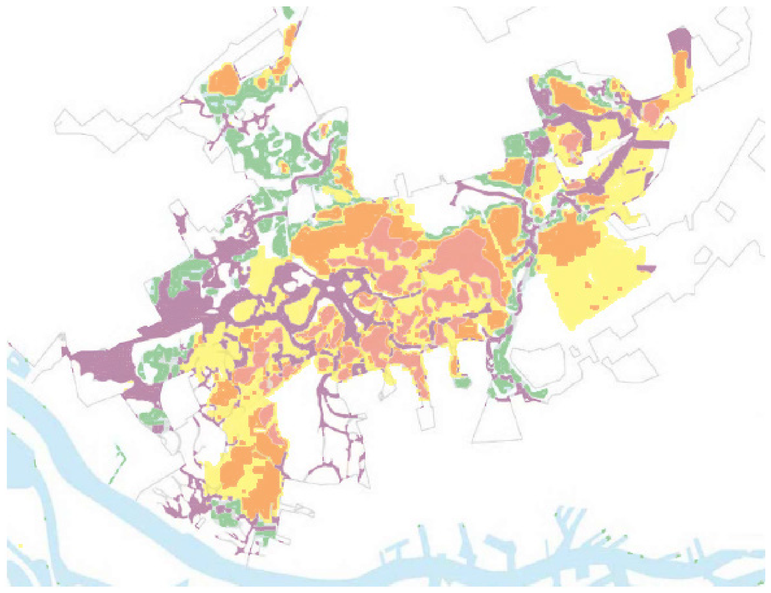
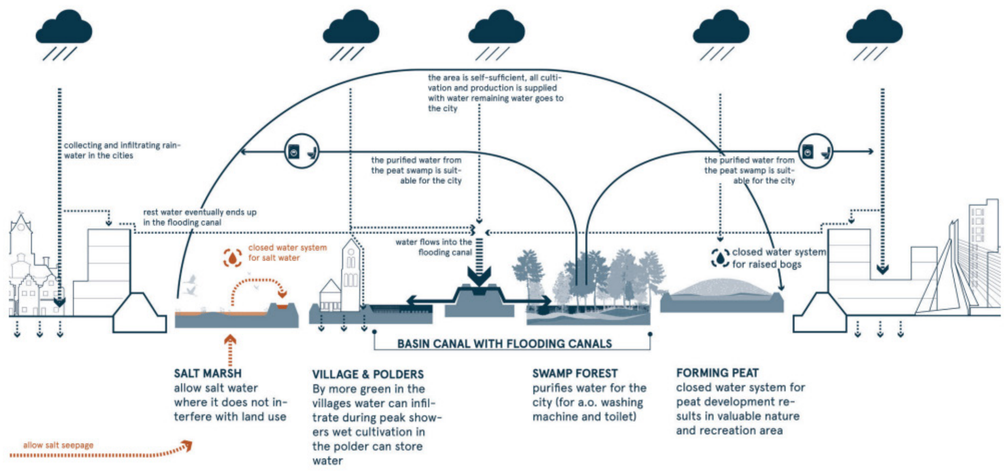
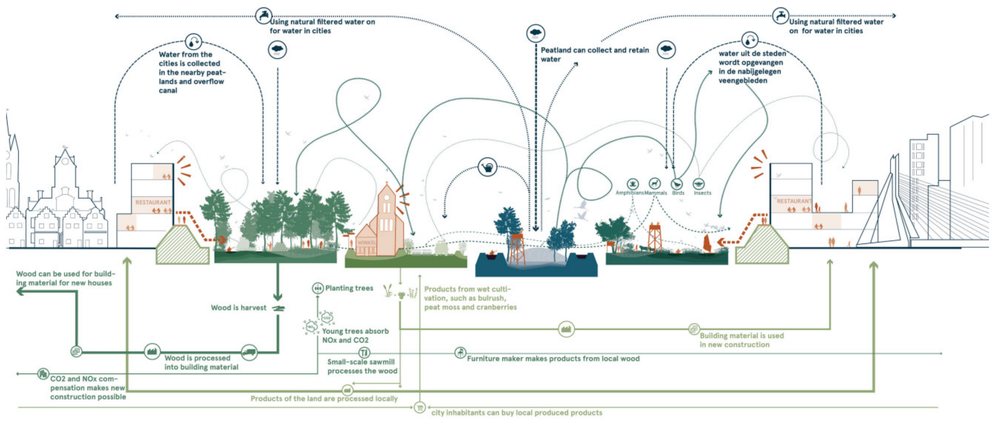




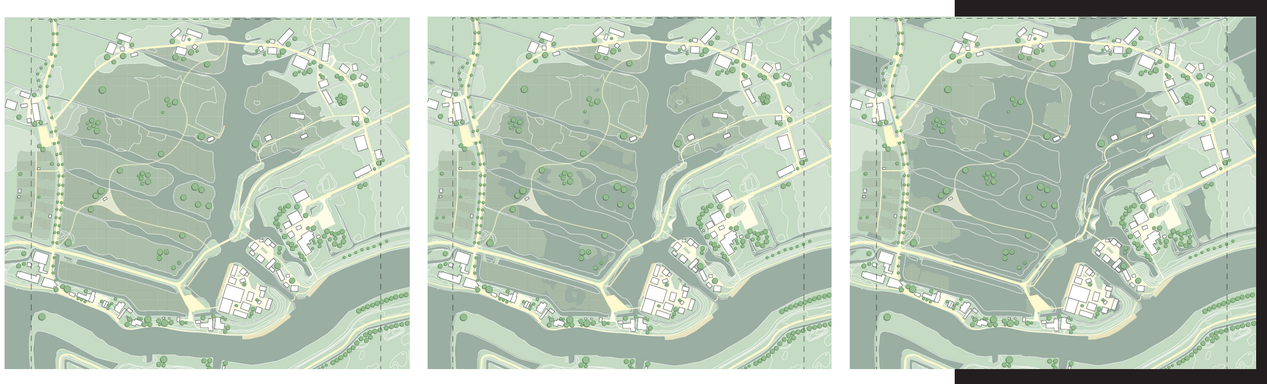


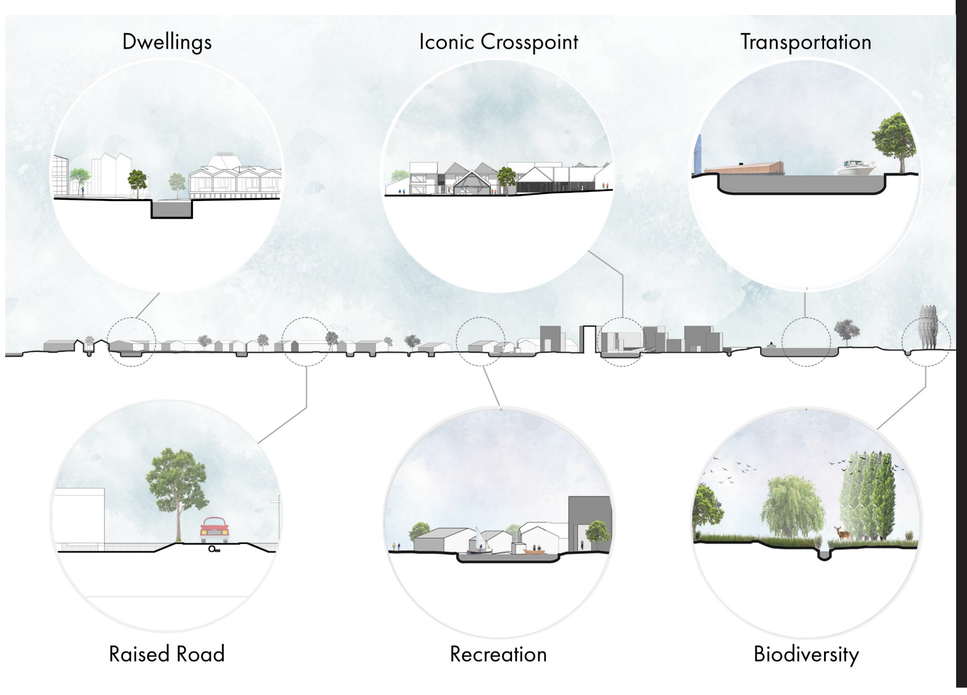


Productive Park Midden-Delfland

The Productive Park Midden-Delfland is characterised by its many height difference as result of the boozem-system, as well as its bog-like landscape.

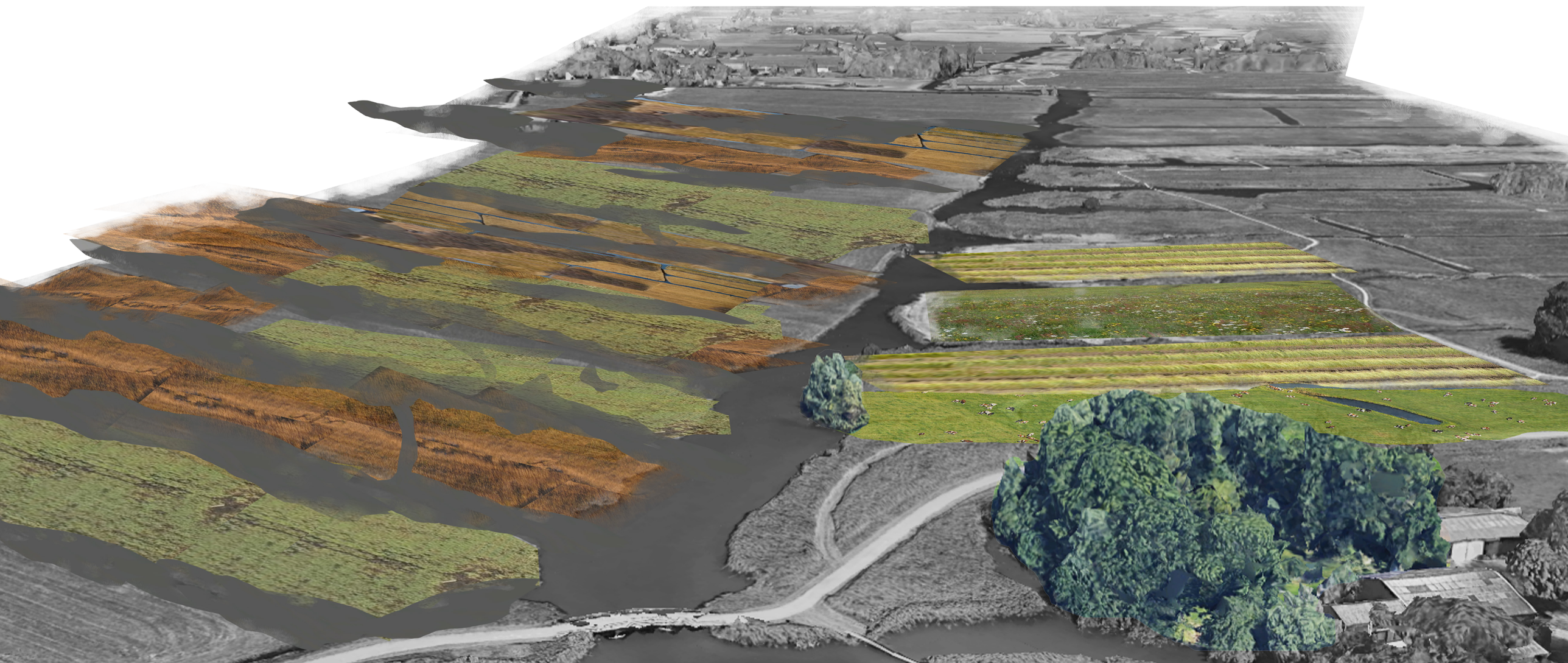
The new crops are selected based on proper soil conditions and mainly focus around building materials, promoting bio-based construction and enhancing bioiversity





Township Vlietpoort

Township Vlietpoort is characterised by its interesting urban layout, based on ideal soil types for construction, that are also higher in the landscape, protecting the buildings from water.
A lock is placed around which resource exchange happens, providing livelyhood during the day in the form of resource exchange. The land is transformed into a patchwork of different crops and infills.



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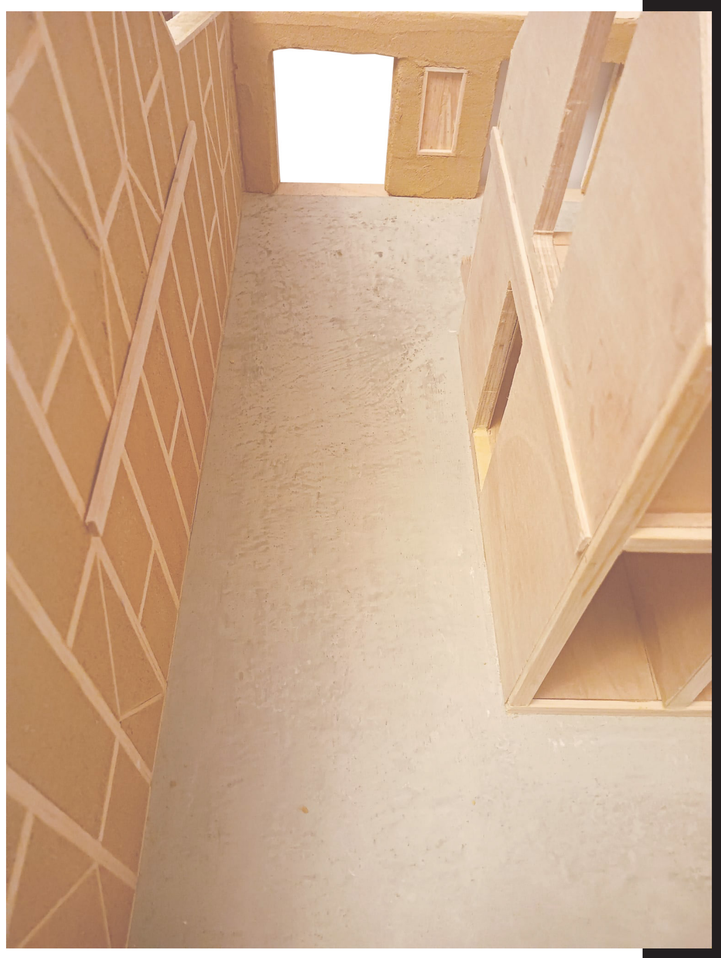
A Flexible House

The interior of the house features two half-timbered walls that show the construction of the ecococon panels. These half timbered wall are opposed by a central DLT core with all housing essentials, such as technical rooms and toilets. The extra height can be used to create new floors within your home. Creating the possibility to grow from within the warm confines of the ecococon straw panels. The floor plans show different lay-outs for different family groups, starting with the empty space.



A couple of two just bought the dwelling. Next they choose a location for the kitchen on either side of the inner module, after which they use the space as workspace, bedroom, living room, dining, kitchen and bike storage all at once.

The couple is pregnant! In preparation for the child they construct their first floor. After they build their floor they realise that they might want to increase the privacy of their bedroom, therefore they also build a wall.

After the first one, they quickly started on the second one. Now they have two children, with two floors. Also, the bathroom upstairs felt a little bit small. The couple sacrificed a little bit of their spacious bedroom in order to have a private bathroom. The oldest is going to high school so a study room was requested and built.

Oh, how they have grown quickly... The children have left the nest. The couple feels quite lonely and could use an extra coin. They transform the study room into a bedroom, add a small kitchen in their old bedroom and move upstairs. The new bedroom and living area are rented out to a friendly third party who also wants to live an ecological lifestyle.

Another interesting concept would be to create a co-living situation. Within the floor plan to the right, all bedrooms are equally sized, resulting in a U-shaped living area with the possibilities for a kitchen, dining area, bar and a tv-room.

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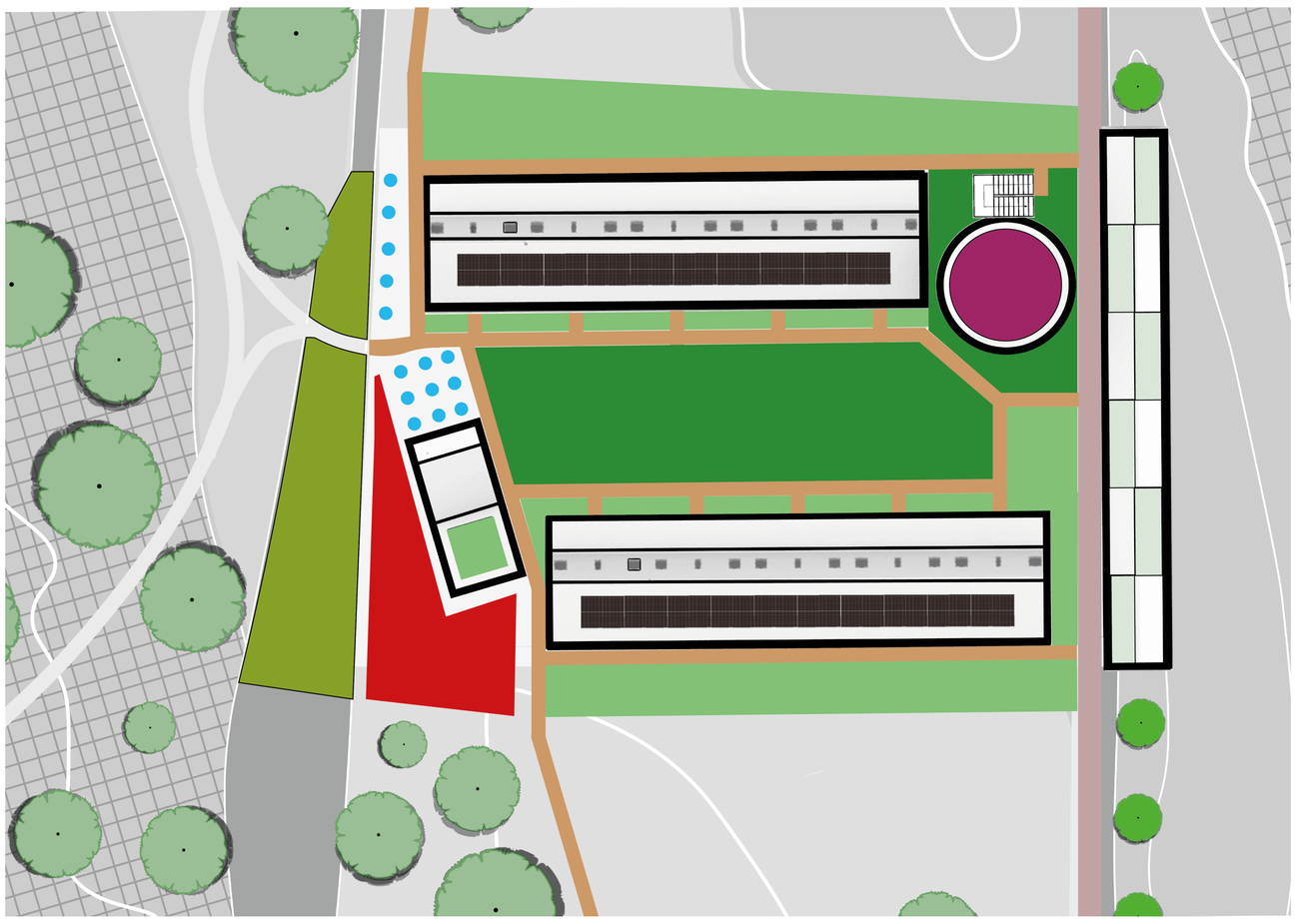
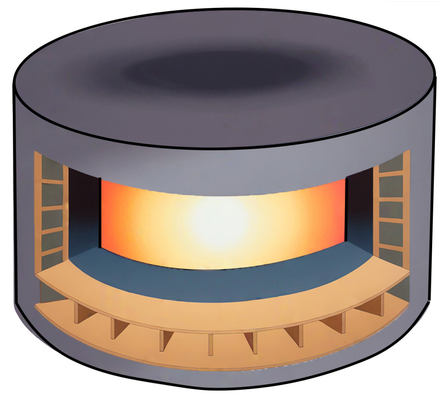
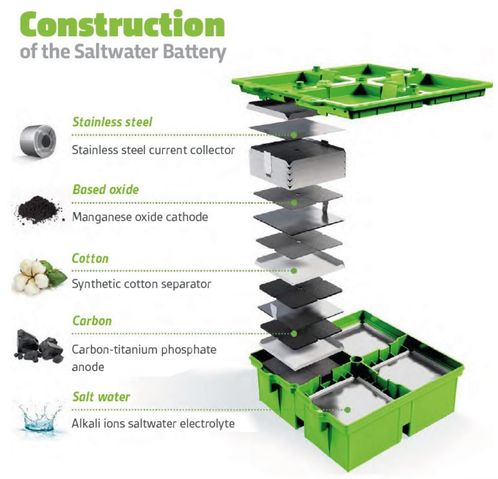




CESAR HEAT BATTERRY

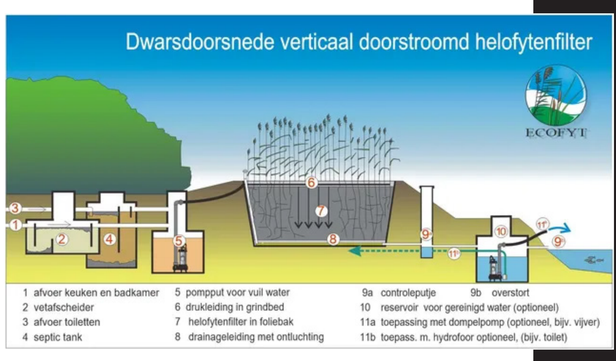
Cesar is the solution for the economical and maintenance-free storage of solar energy, wind energy or energy from the overloaded grid. A Cesar heat battery retains heat for long seasons, has a high efficiency and is extremely effective in reducing grid congestion.

A Cesar heat battery supplies heat all year round to homes, without the use of fossil fuels, CO2-emission-free, with a storage capacity of 250kWh per m3



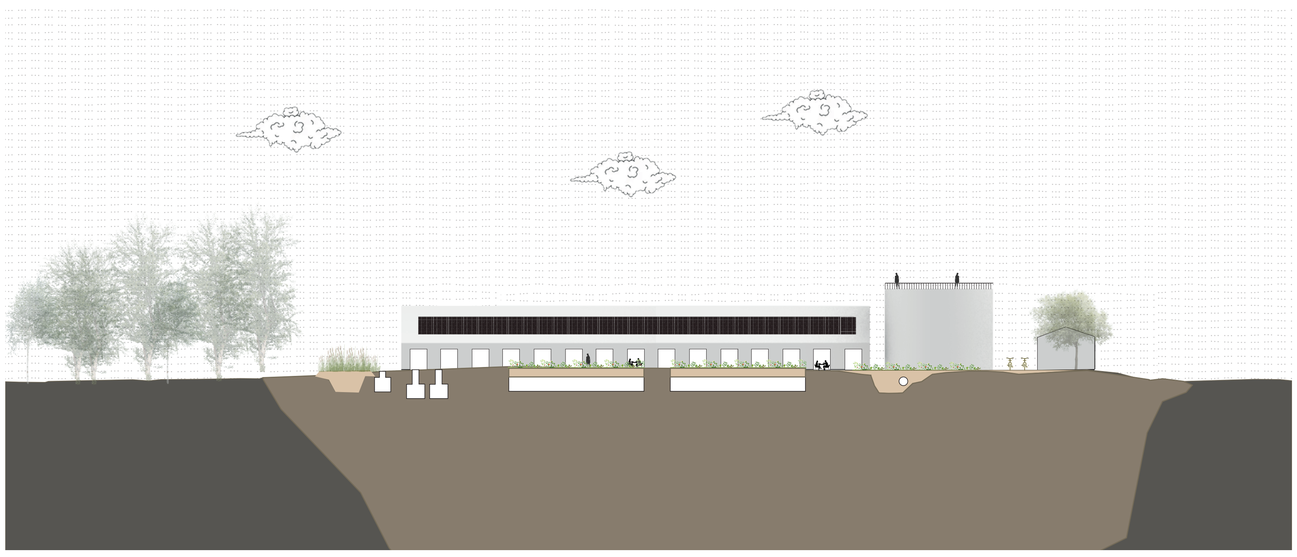
GREENROCK salt watter battery

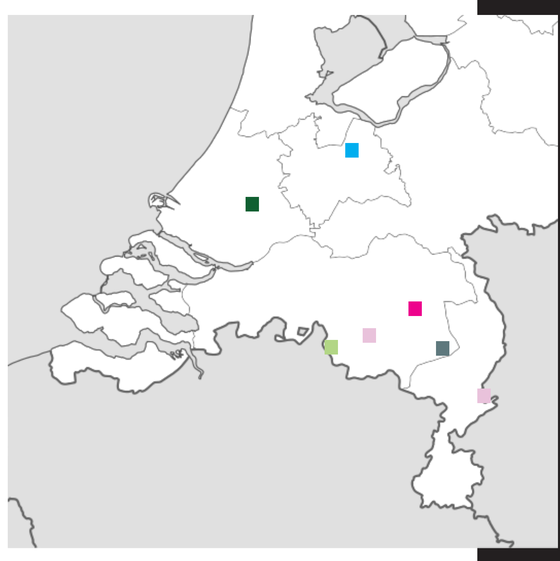
The GREENROCK Saltwater battery is based on a sodium-ion technology that behaves similarly to lithium-ion batteries.As you can see here, it has the same components of a lithium-ion battery. The only difference is that it is based on sodium ions, not lithium ions like Tesla's battery.



Helophyte filters

Helophyte filters have been known and used for many years, they require space but provide an ecofriendly solution to local water sanitation.
In this system, toilet water is separated from the rest of the water and directed to a sceptic tank. The sceptic tank relies on living organisms to slowly decompose the black water, it is therefore important to never use strong detergents like bleach since this kills the organisms and clogs the tanks. The water is then directed to the helophyte filter where it seeps through 3 or four layers of gravel with different coarseness going from coarse to fine. While seeping through, helophytes like Phragmatis Australis (common reed) filter out the last contaminations, after which the water can be re-used or dispersed into surface waters.





Mass timber (CLT & DLT)

CLT is an engineered wood product consisting of layers of kiln-dried dimension lumber (usually three, five, seven or nine) oriented at right angles to one another and then glued to form structural panels. By gluing layers of wood at right angles, the panel delivers excellent structural rigidity in both directions.
DLT is the adhevise-free alternative, it uses hardwood dowels instead of glue to bind a multitude of lamels into one solid panel

Carbon cost: -1.8 kgCO2/kg wood
Total carbon stored per dwelling: 19645 kg

in order for something to truly become sustainable **it must be detached from all unsustainable systems**

Sustainability knows many forms and sizes in the built environment, as has the shape of my architecure. On the left is one of my first drafts, highly inspired by the earthship village in Olst. In the end my research pointed out that ecodorp Boekel had a more fitting energy-system so a new design was made, fitting the new system

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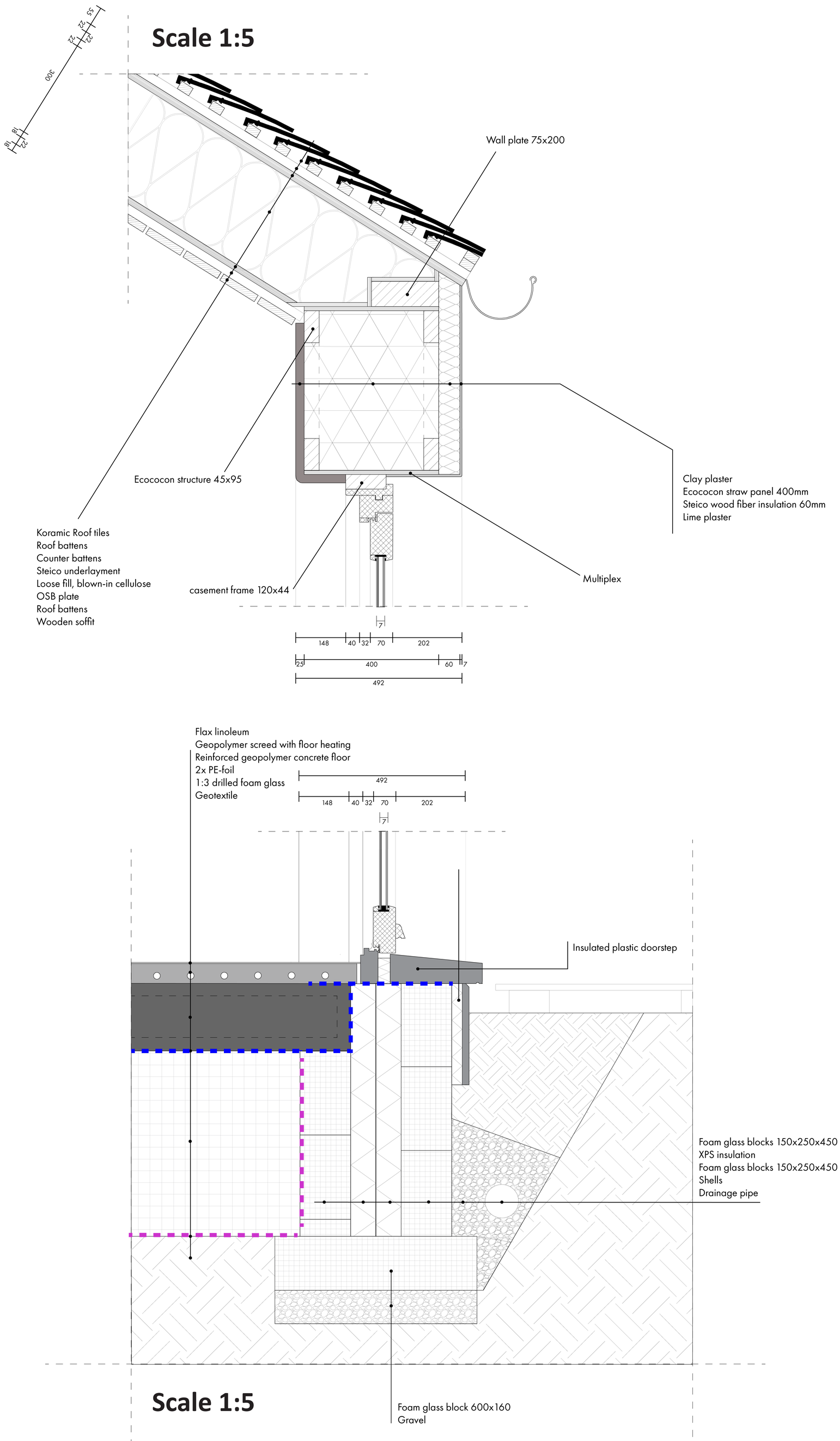
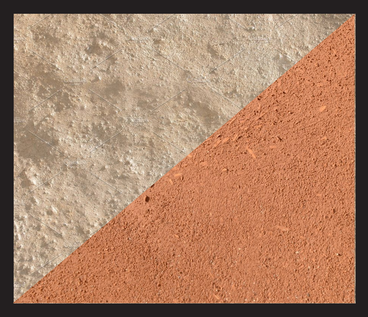
Average R-values

Roof: 8,1 W/m2K
Facade: 6,4 W/m2K
Foundation: 8 W/m2K



30.743 kg CO2
stored per house



Clay/lime plaster

Clay comes from the earth and can be used without firing, creating a healthy, breathable finish for internal walls and ceilings.
Lime plaster, however, is made from preheated limestone. The stone is heated to 900C in order to become workable. The carbon used is retrieved during the natural calcification process in which the lime plaster binds with CO2 molecules, making the plaster waterresistant & breathable while offsetting it initial firing costs.

Carbon cost: neutral
Total carbon stored per dwelling: 0

Blown-in cellulose insulation

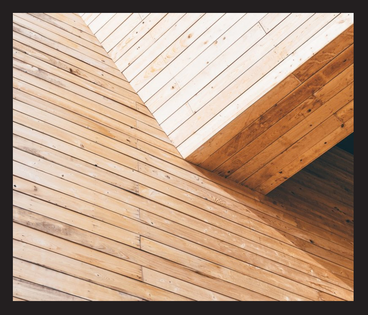
Blown-in cellulose is made from old newspapers. This cheap and easy-to-install material is fully circulair and easily removed after the building lifetime

Carbon cost: -22.95 CO2e/m2
Total carbon stored per dwelling: 2775 kg

Spruce wood

Wood is one of the most commonly known carbon storage materials. A tree uses photosynthesis to grow, taking carbon from the atmospheric carbondioxide, releasing oxygen and storing the carbon within the wood. For the purpose of this research spruce wood with a density of 450 kg/m3 was used.

Carbon cost: -1.8 kgCO2/kg wood
Total carbon stored per dwelling: 19645 kg



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DLT is the adhevise-free alternative, it uses hardwood dowels instead of glue to bind a multitude of lamels into one solid panel

Carbon cost: -1.8 kgCO2/kg wood
Total carbon stored per dwelling: 19645 kg

Wood fiber insulation

Wood fibre insulating materials are characterised by a particularly high raw density and thus support effective noise protection. STEICO products uniquely combine high bulk density with low thermal conductivity and thus equally support energy efficiency and noise protection.

Carbon cost: -85 kgCO2/m3
Total carbon stored per dwelling: 714 kg

Ecococon straw wall panel

The EcoCocon straw construction system provides sustainable and healthy living combined with exceptional energy efficiency. It is a combination of 10% wood, 89% compacted straw and 1% screws.
The compacted straw ensures a noise protection of 54 db, making it possible to use it either as outerwall or as separating wall.

Carbon cost: -97,6 kgCO2/m2
Total carbon stored per dwelling: 13664 kg

Linoleum

The EcoCocon straw construction system provides sustainable and healthy living combined with exceptional energy efficiency. It is a combination of 10% wood, 89% compacted straw and 1% screws.
The compacted straw ensures a noise protection of 54 db, making it possible to use it either as outerwall or as separating wall.

Carbon cost: -0.58 kgCO2eq kgCO2/m2
Total carbon stored per dwelling: 65kg

Foamglass

Glass foam is a lightweight foundation material. The glass foam is an extremely sustainable and circular aggregate made from foamed recycled glass, which gives the glass waste a new purpose. The air bubbles in the glass foam make it a lightweight foundation material on the one hand and an insulating material on the other. Furthermore it is able to withstand high pressures. After the buildings lifetime it can be retrieved and used elsewhere.

Carbon cost: +29,34 kgCO2eq kgCO2/m2
Total carbon stored per dwelling: 65kg

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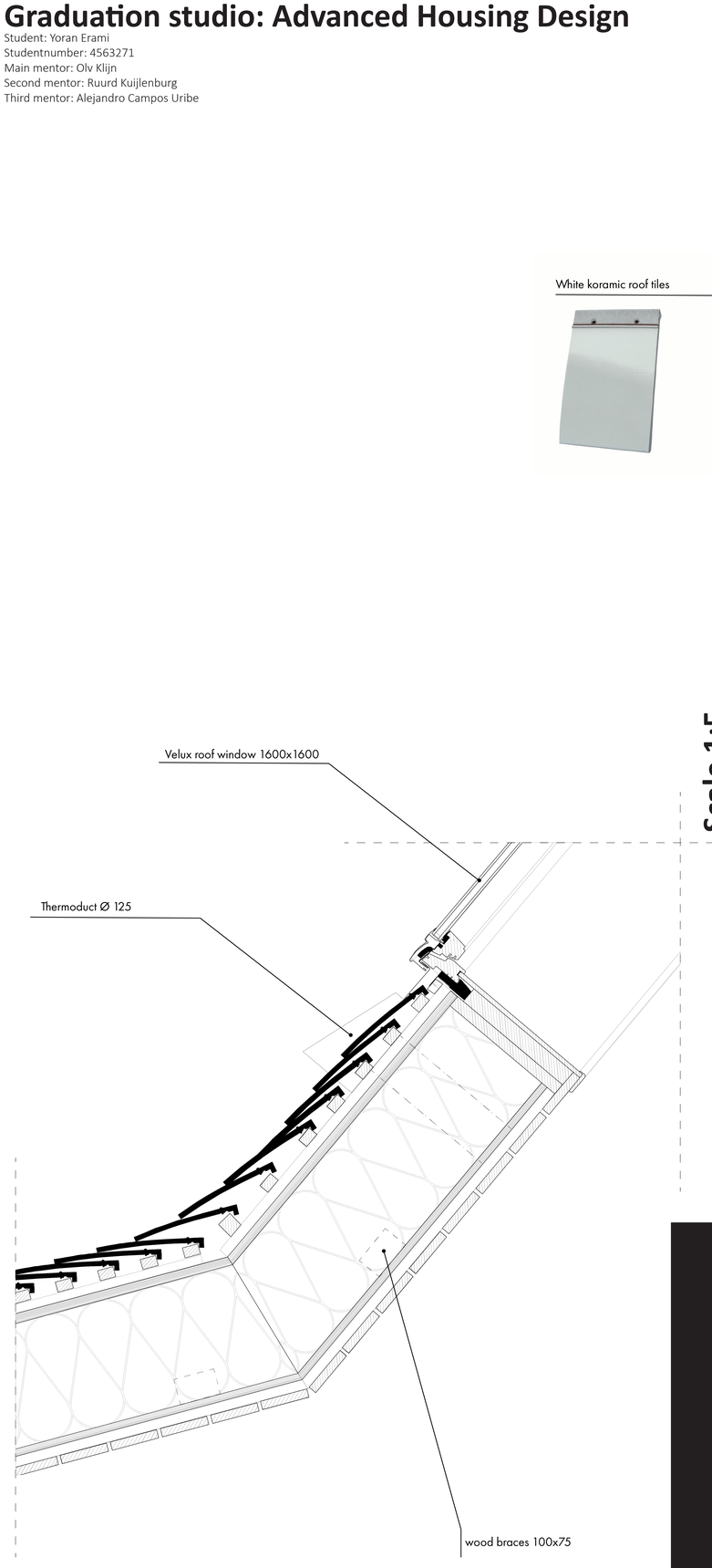

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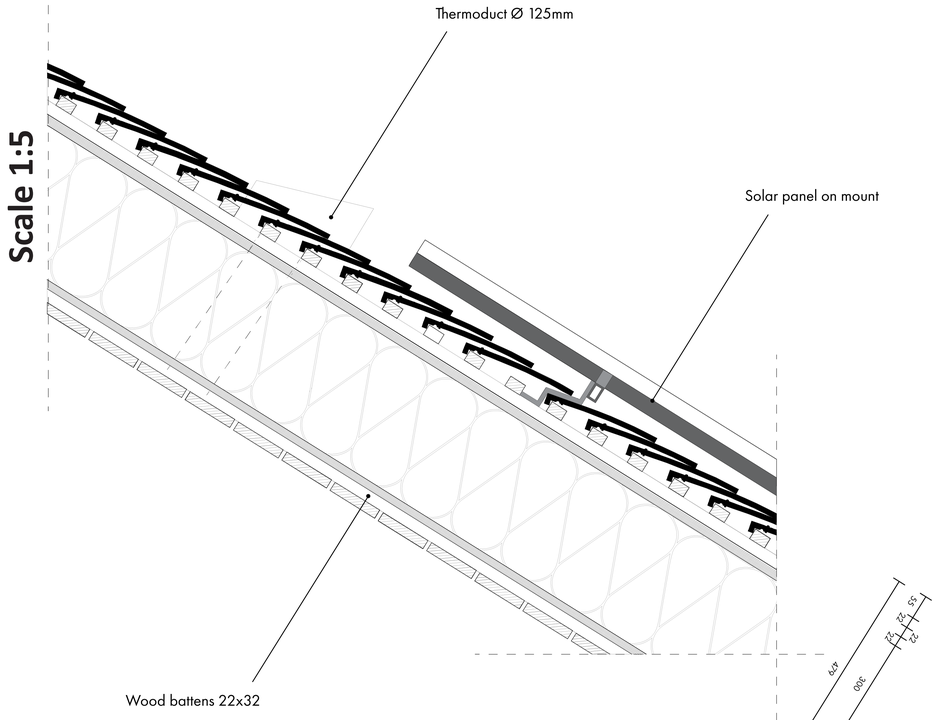

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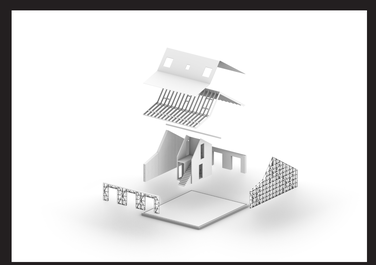
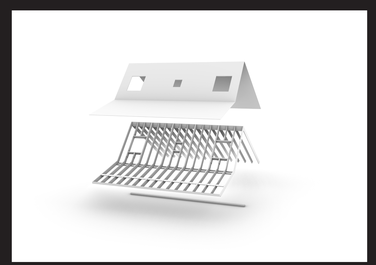
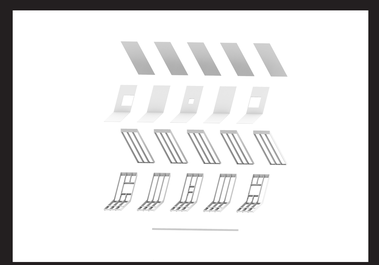
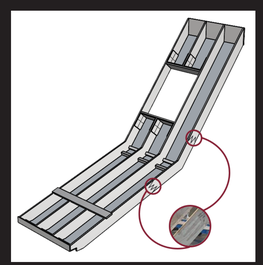





Construction

The ecococon straw panel system creates stable walls by adding cross-braced panels. The inner core is made up of DLT, creating rigid, solid walls. The roof is carried by one central load-bearing beam that rests on top of the DLT core, as well as the eco-cocon straw wall panels. The roof is made up of 10 prefab elements, stabilised by 22mm of steico wood fiber underlayment. The kinked roof is made possible by finger welding Three LVL spruce wood into one roof beam with a width of 38mm and a height of 300mm.

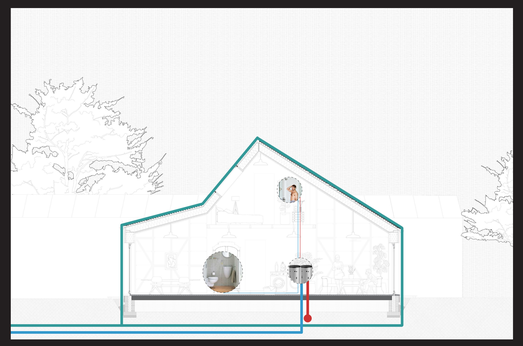
Climate Control

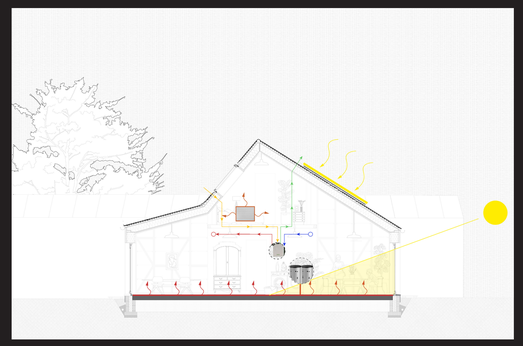
First and foremost the shell is used to harvest rainwater, the rainwater is stored in underground storage tanks and used for greywater purposes.

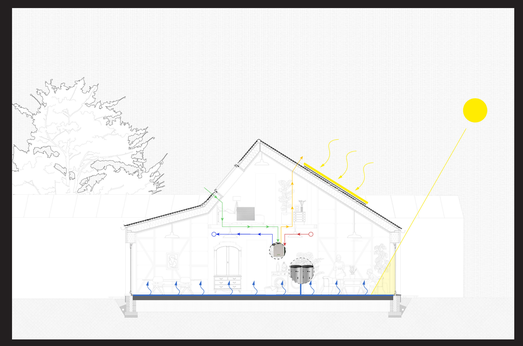
Secondly the relatively high average R-values of the facades, walls and foundation, ensure that most heat stays within the confines of the house. During winter, the CESAR battery system provides a water tank in the technical room with fresh hot water (100C), this water is used for showering and tapwater, while the rest flows into a second water tank (40C) and is used for floor heating. The house is mechanically ventilated and makes use of a heat recovery system to keep all heat inside while refreshing the air. At the top floors electrical convectors are installed. Furhtermore the low-hanging sun heats up the exposed concrete floor, acting as thermal mass that holds warmth, releasing the heat during the night.

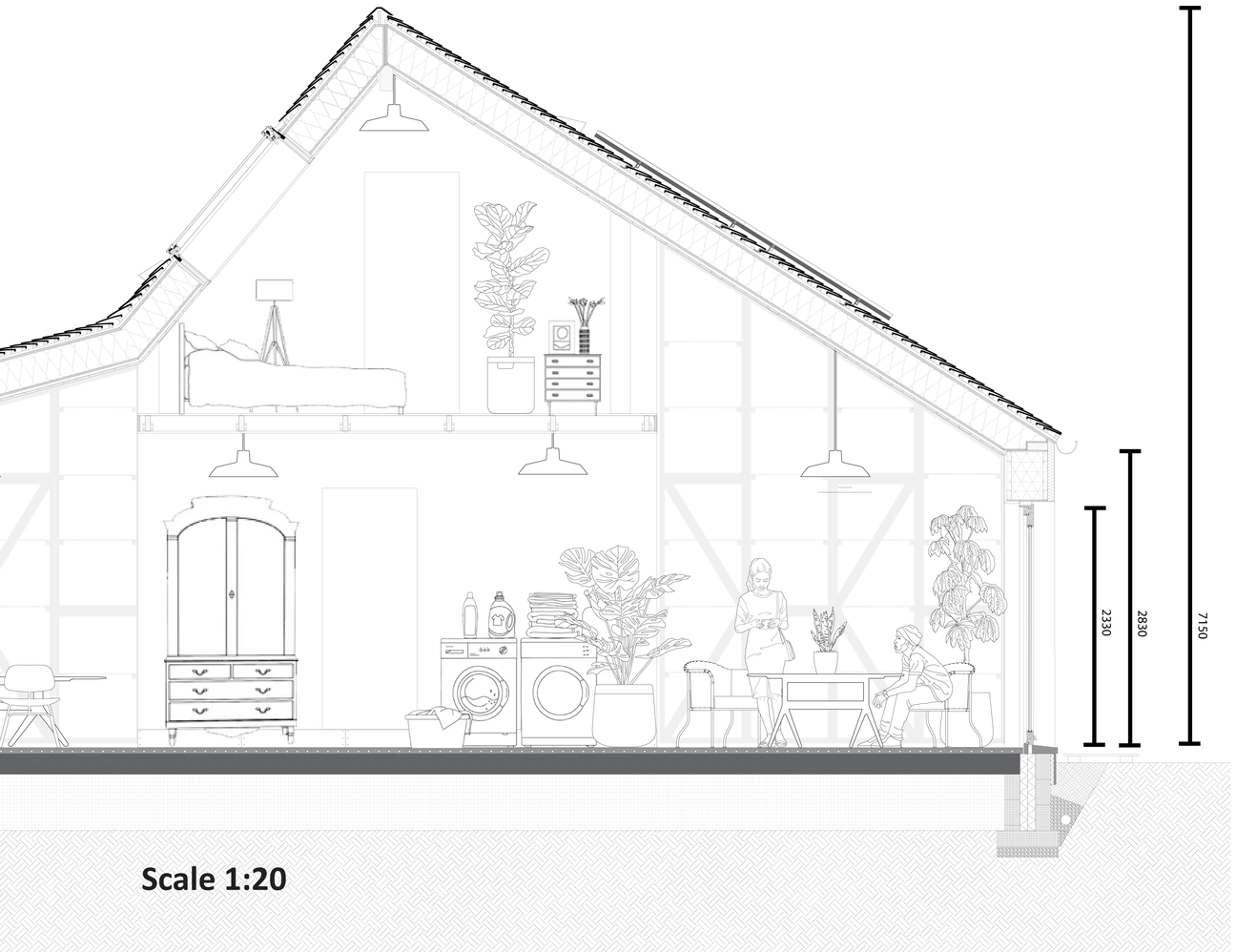
In Summer the thick walls shade the floor from most of the sun, keeping the thermal mass, and therefore the house, cool. The heat regain system now functions the other way aroudn, as a “coolth” regain system. The pipes in the floor used for floor heating can also be used for floor cooling in winter by letting cool water flow through.

All in all ensureing stable temperatures in both winter and summer.









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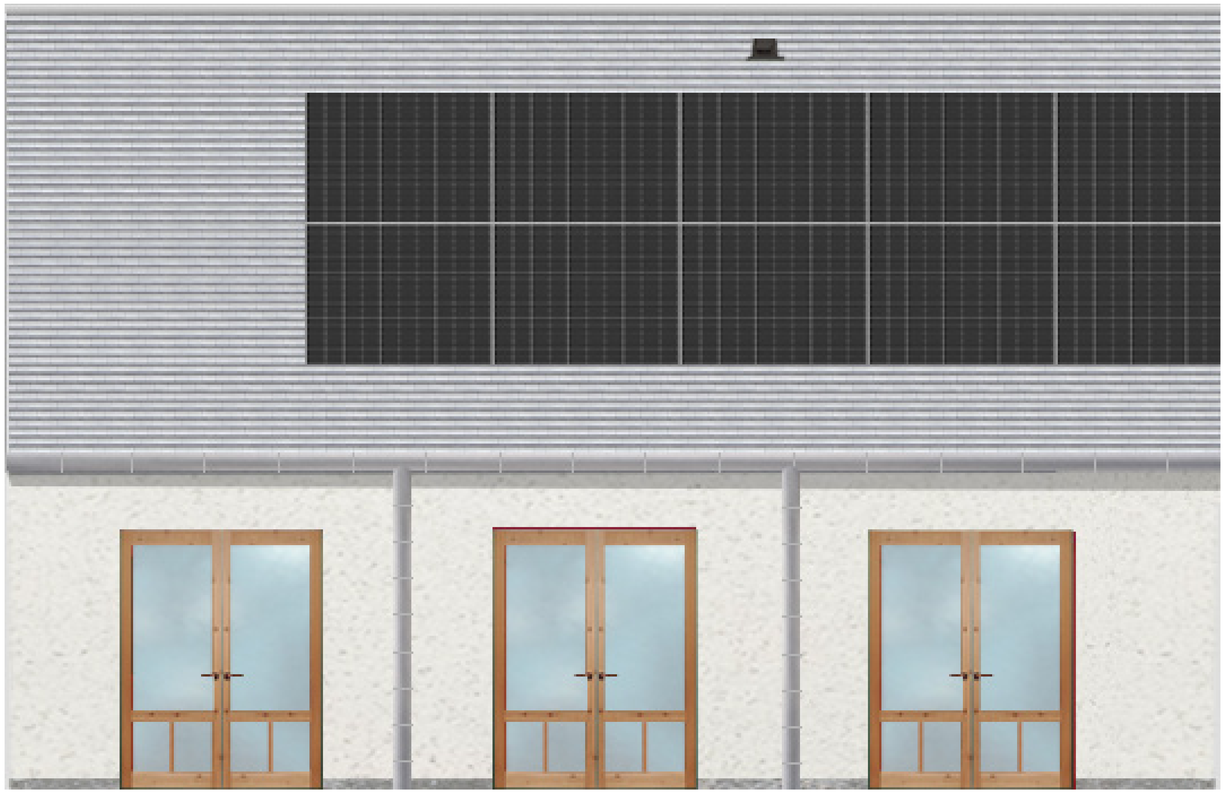

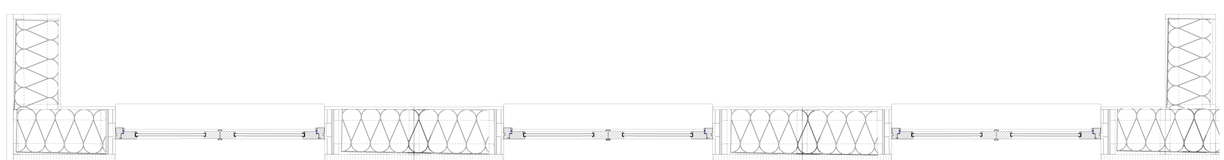

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