

Harbour haven

Waterside Living in a Shipyard

Analysis NFH-House:

No Footprint House by A-01

Possible Takaways:

Design and Concept

Sustainability
Modular Construction
Prefabrication

Environmental Characteristics

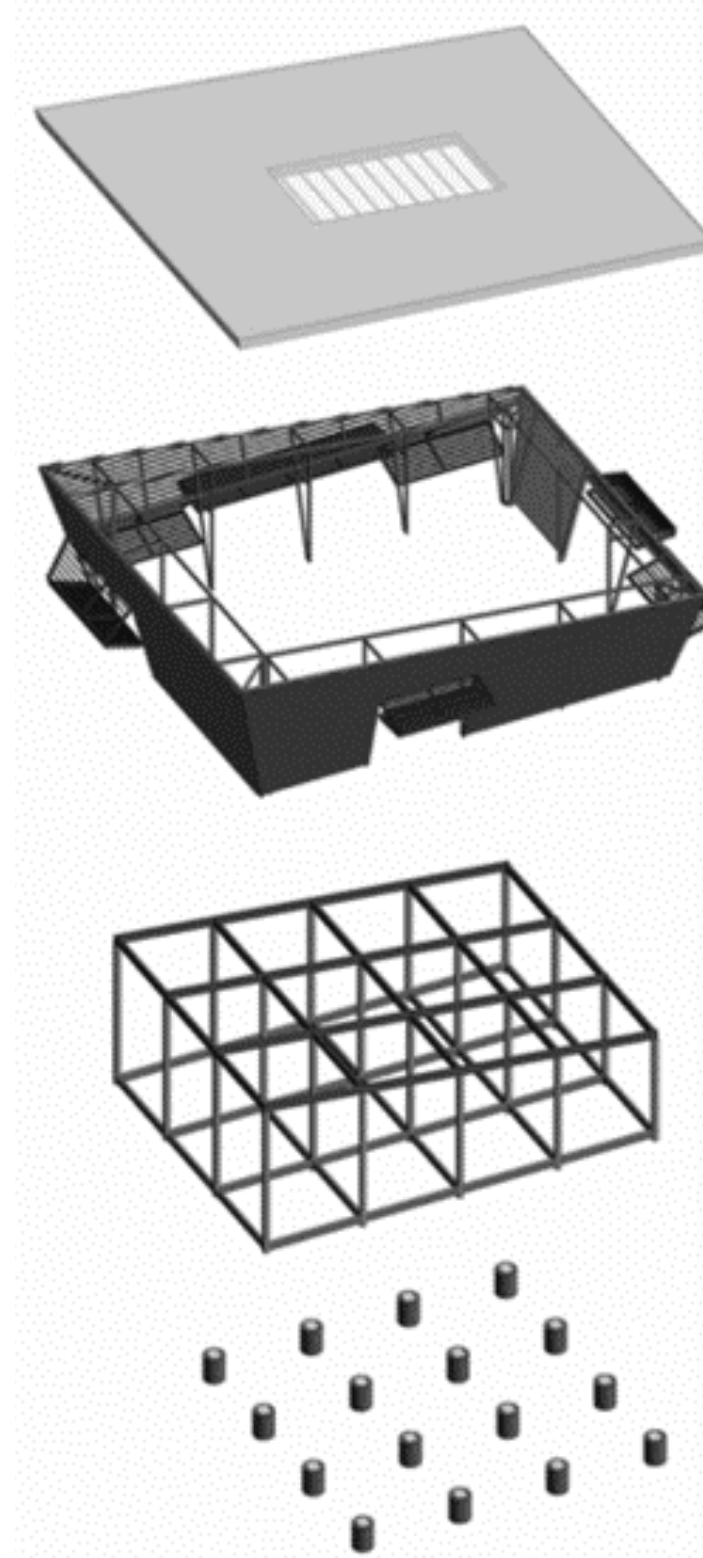
Natural Ventilation
Renewable Energy
Water Management

Materials

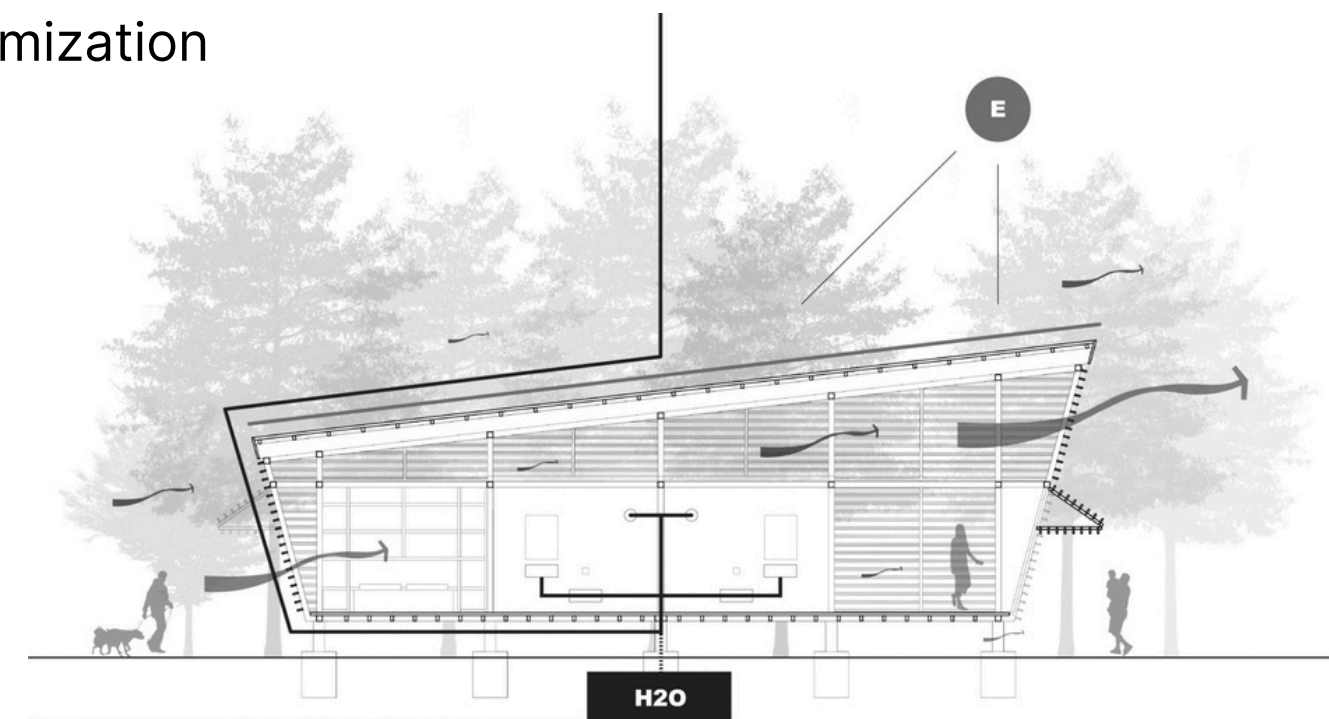
Environmentally friendly materials
Low-Impact Foundation

Adaptability

Climate Responsive Design
Customization



(Ott, 2022)



(Ott, 2022)

Location analysis M4H:

Address: Gustoweg 10, 3029AS Rotterdam.
51.91273526842996, 4.413945045795769

The current location is an industrial harbor area with a floating farm on the water and grassy areas for cows and parking along the quay. The immediate surroundings are a working area with large warehouses, active mostly during the day, while the evenings are quieter. A large residential area with old apartment buildings and row houses is across the dike, with little to no new construction. The location is easily accessible by car and public transport, with a tram line connecting to Rotterdam and Schiedam, and a water taxi service operating every 15 minutes. The municipality of Rotterdam and local businesses aim to transform the area into a residential and work zone, supported by a zoning plan and an environmental impact report (MER).



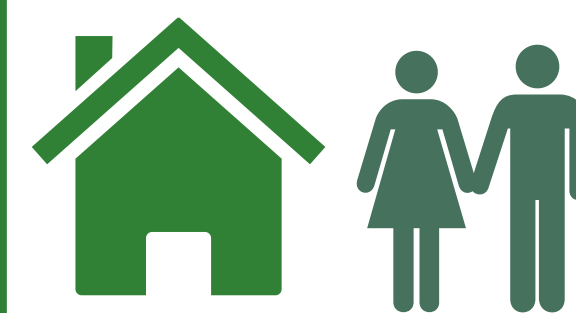
Location



Target audience

Merwehaven is being developed into a new sustainable and green neighborhood. It will become an attractive place to live with homes being built on the water, on land, and in the city.

The Merwehaven is being developed with three target groups in mind. The first target group is small households of 1 to 2 people. Currently, there is a significant shortage of housing for small households, while their numbers continue to increase. Therefore, this group will be one of the most important. The second target group is families. Families are an essential part of social interactions within the neighborhood. There will be homes for families, but since most prefer to move outside the city, this will only make up a small portion of the housing. The last target group is the elderly. At the moment, there is a significant shortage of senior housing in Rotterdam. Therefore, homes for the elderly will be built on the Marconi Strip. Our primary target group will thus mainly be small households/starters. (Gemeente Rotterdam, 2023)



Climate analysis:

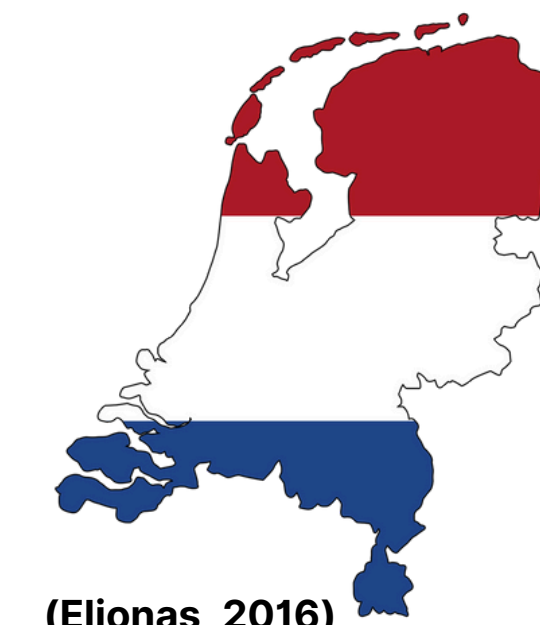


(Kjirstie, 2015)

Avg. 26°C
88%
Rainseason on
our location

Temperature
Humidity
Rain

Avg. 10°C
75%
7% of the year



(Elionas, 2016)

Takeaways:

From our climate research, we will take into account that the building layers of our house must be completely different due to the large temperature difference between the two countries. It will also be more challenging to work in the Netherlands with minimal installations, as installations are required to comply with BBL regulations. In the Netherlands less consideration needs to be given to wood rot due to lower humidity levels.

Logistics for the project:

1. To compensate for CO2 emissions as much as possible, the biggest step we will take is to replace the trucks with electric trucks.
2. We will optimize the routes to avoid unnecessary trips. The goal is to drive the minimum number of kilometers needed to transport all goods.
3. We will take busy rush hours into account. We aim to drive as much as possible during times when the roads are less crowded. This way, we spend less time on the road and reduce emissions.
4. We will make optimal use of the space in the trucks. We will avoid driving with half-empty trucks and ensure fewer trips are made.
5. We will provide training to our staff to raise awareness about reducing CO2 emissions. This way, we hope our staff will make more informed decisions.

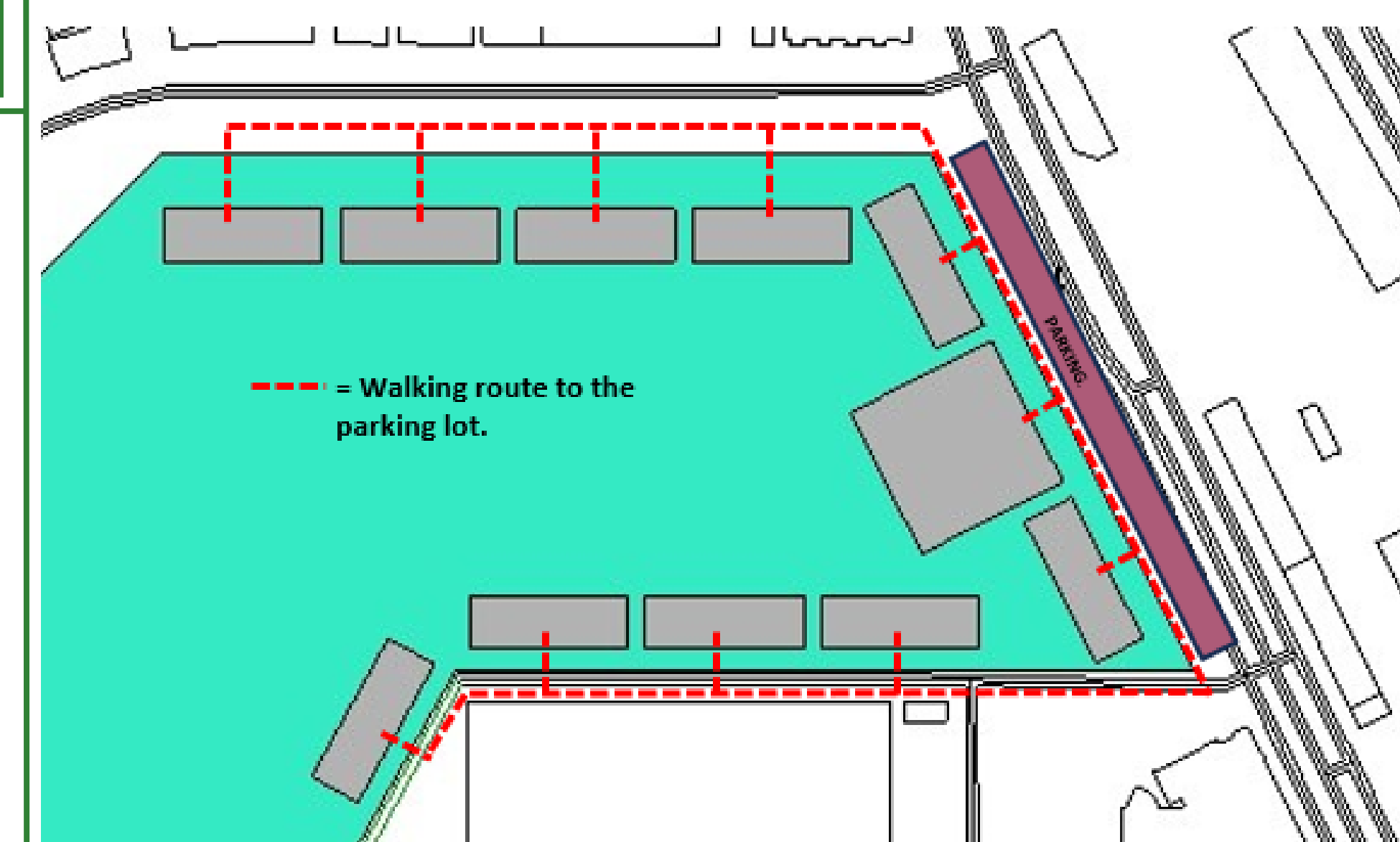
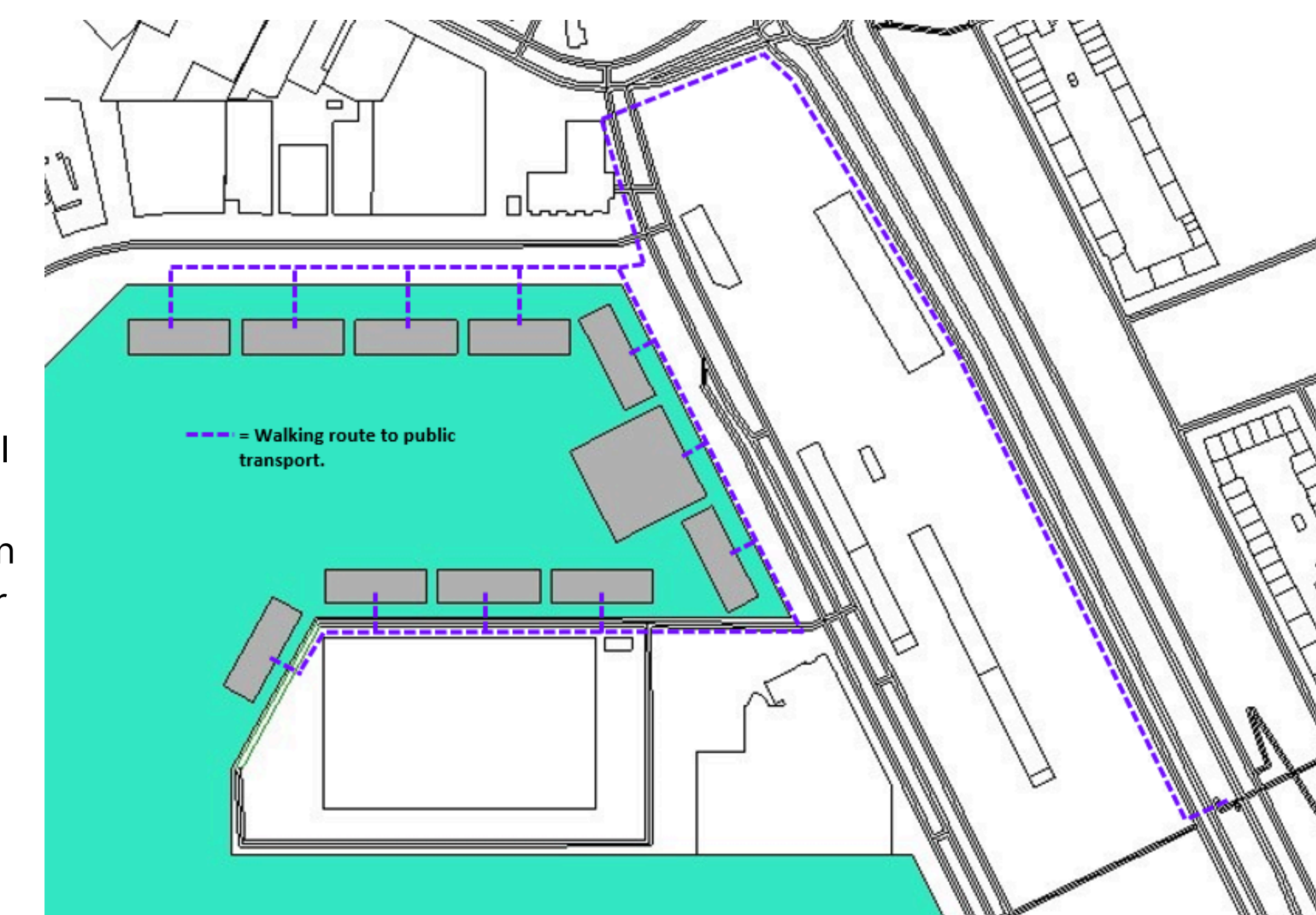
What do we include?

1. We will install a charging station at the construction site so that the truck can charge while loading and unloading.
2. Purchase advanced route planning software.
3. Keep track of busy times on the road to adjust our planning accordingly.
4. Install racks in the truck to maximize the amount of cargo transported.



Blueprint of the new neighbourhood:

The Merwehaven is easily accessible by public transport. It is 500 meters from the Hogeбанweg tram stop and 600 meters from Rotterdamsedijk. From there, it is possible to travel to Marconiplein metro station to continue on the metro network. In case the trams are not running or residents prefer to walk or cycle to the metro, it is easily doable with a distance of only 1500 meters.



The homes are accessible via walking paths along the water. These paths lead to the short end of the harbor, where the community center and parking spaces are located. The homes themselves do not have parking spaces to maintain tranquility in the neighborhood.

Program of requirements

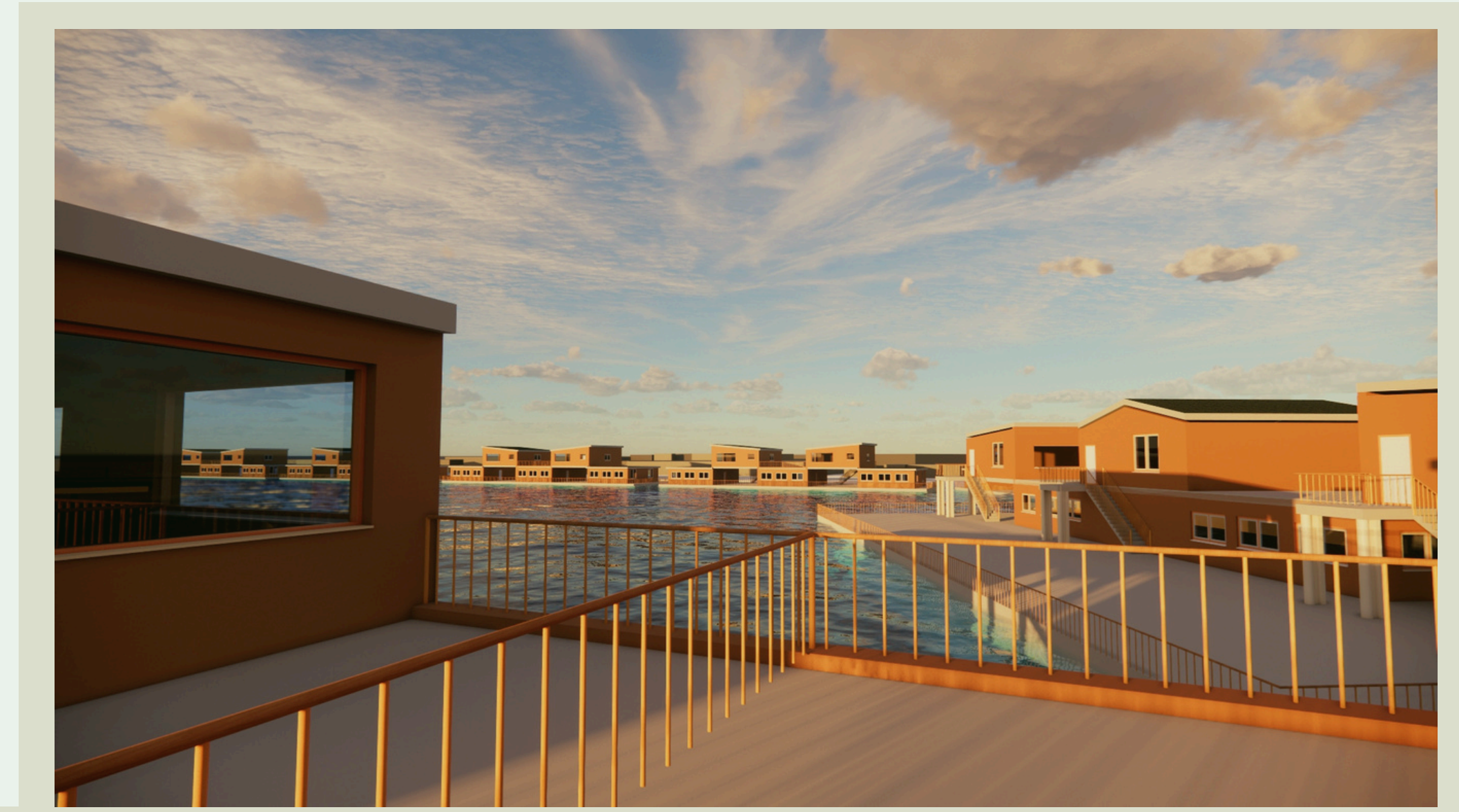
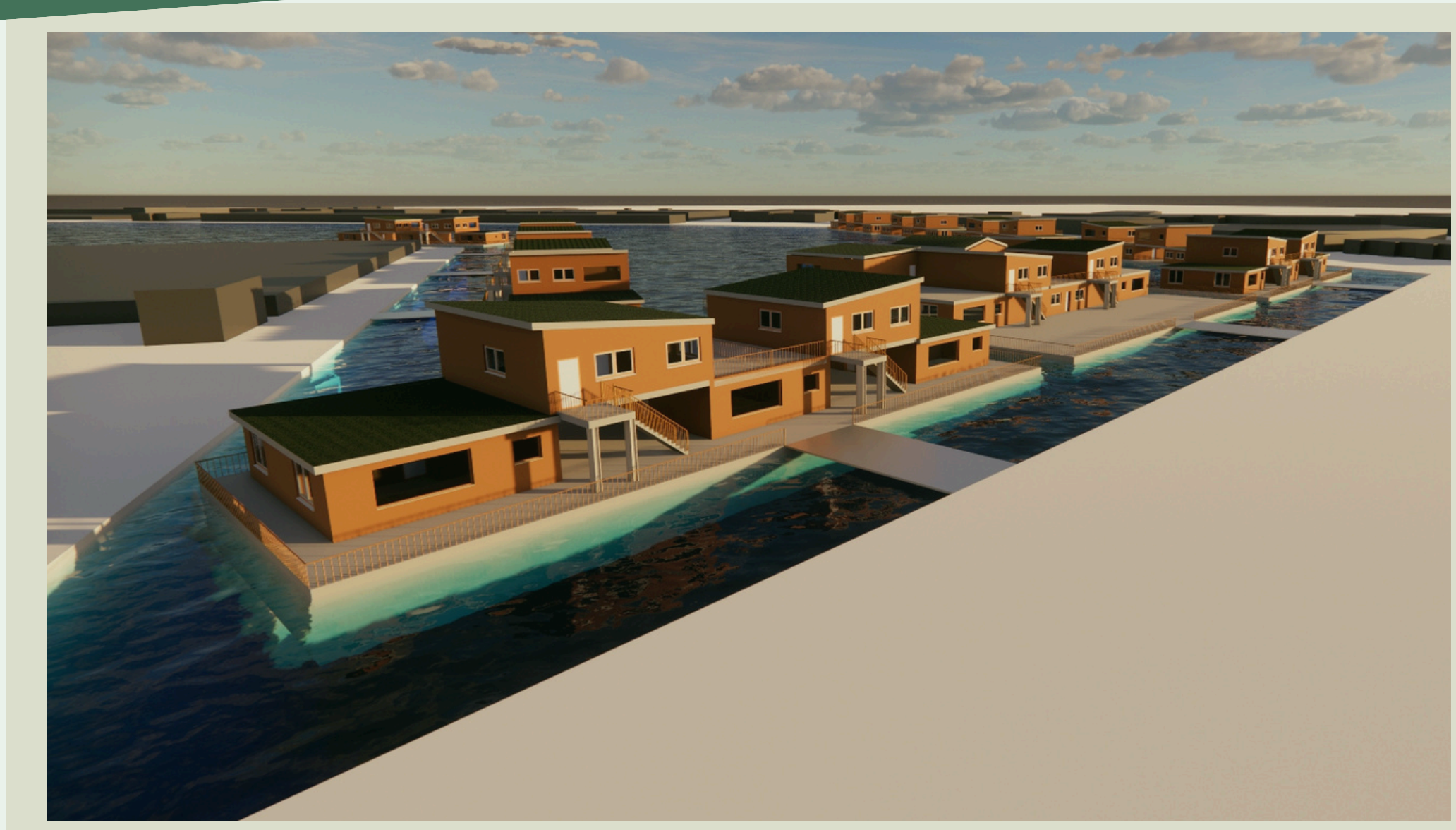
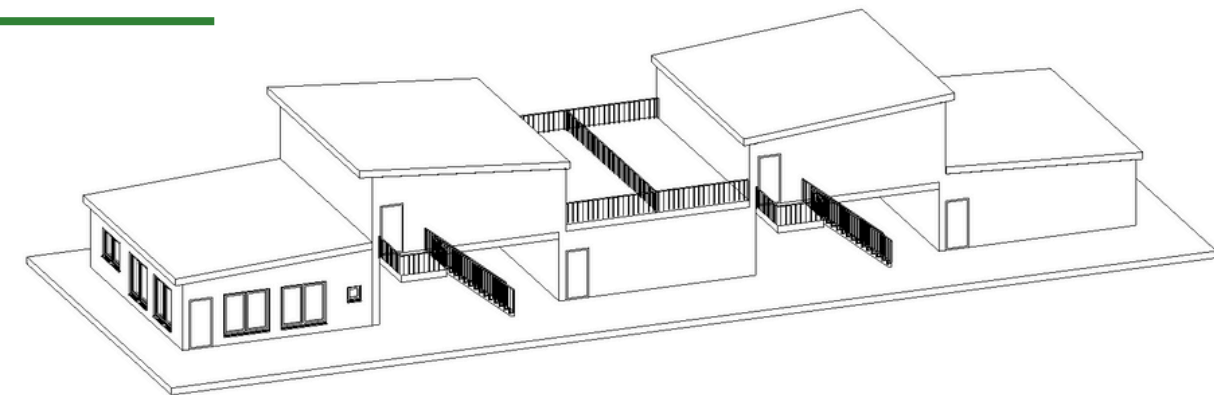
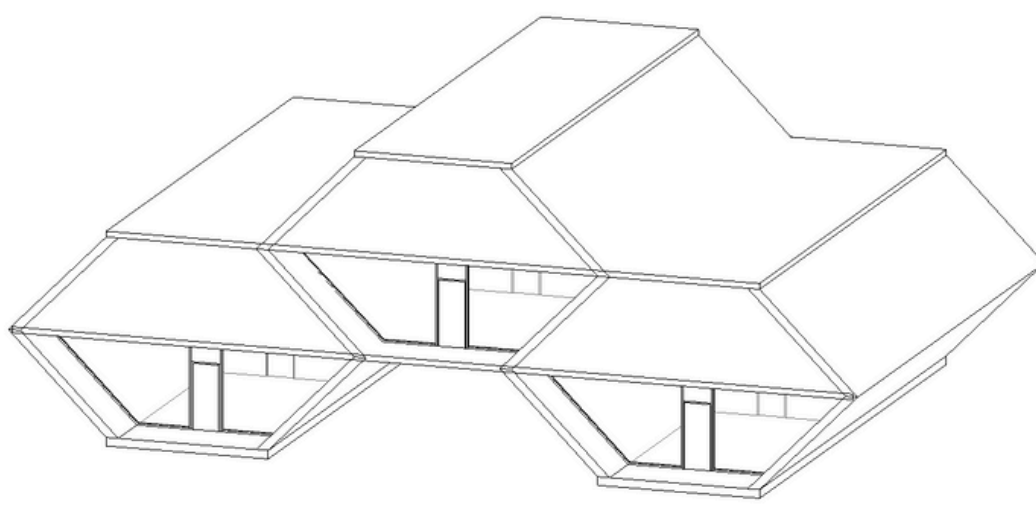
- The buildings must be scalable to the rest of the environment.
- The houses must be built to be as CO2 neutral as possible.
- The houses should have minimal installations to remain comfortable.
- The roofs must be equipped with green roofing.
- The neighborhood must offer residents the opportunity to express their culture or art.
- A house has a maximum volume of 400m3.
- The houses must provide enough space for starters.
- All buildings must comply with the BBL.
- The buildings must be floating.
- The neighborhood must have recreational and green spaces.
- The houses must be built cheaply enough to be affordable for starters.
- The construction must be demountable.
- Structural materials must be circular.
- The living room must be at least 25m2, the kitchen at least 9m2, and the bedrooms at least 6m2.
- All floating farms around our building site will be removed.

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Renders:

Our design options:

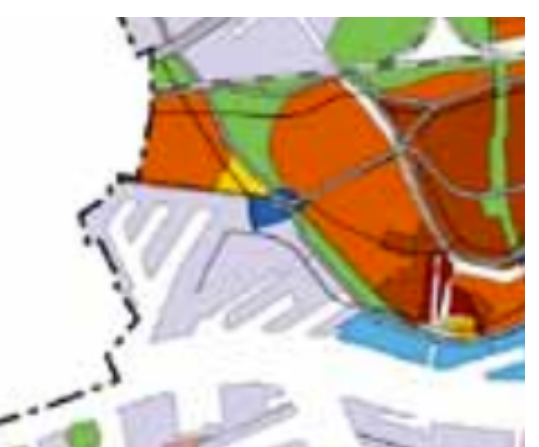


Harris profile for the designs:

Design (Ben)	--	-	+	++	Design (Rick)	--	-	+	++
Efficient use of materials					Efficient use of materials				
Aesthetic					Aesthetic				
Scalability					Scalability				
Building physics opportunities					Building physics opportunities				
Constructive opportunities					Constructive opportunities				
Feasibility					Feasibility				
Logistics					Logistics				
Interieur design freedom					Interieur design freedom				

To choose between the two designs, we created Harris profiles. The meanings of each part of the Harris profiles can be found in the appendix. Both designs scored very high. Ben's design was aesthetically more appealing but also more complex to construct and less practical. Rick's design was simpler, making it easier to design a matching structure that is also scalable. Additionally, the design is easier and quicker to execute on the construction site.

Aesthetic requirments:



(Welstandsnota Rotteram, n.d.)

Merwehaven is part of a Port and industrial area. That means that the design should take in consideration the following aspects:
Spatial Integration
Architectural Quality
Materialization and Sustainability
Public Space and Ground-Level Facades
Specific Guidelines for Merwehaven

façade:

For our façade, we chose a red cedar wood finish. From our research into the best type of wood, this one came out on top. The properties on which the wood was tested can be seen in the Harris profile next to this.

Chosen materials:

Western Red Cedar (WRC) wood	--	-	+	++
Volumic mass				
Inherently sustainable				
Durability class				
Lifetime				
Origin				



(Coyle Timber Ltd, 2024)

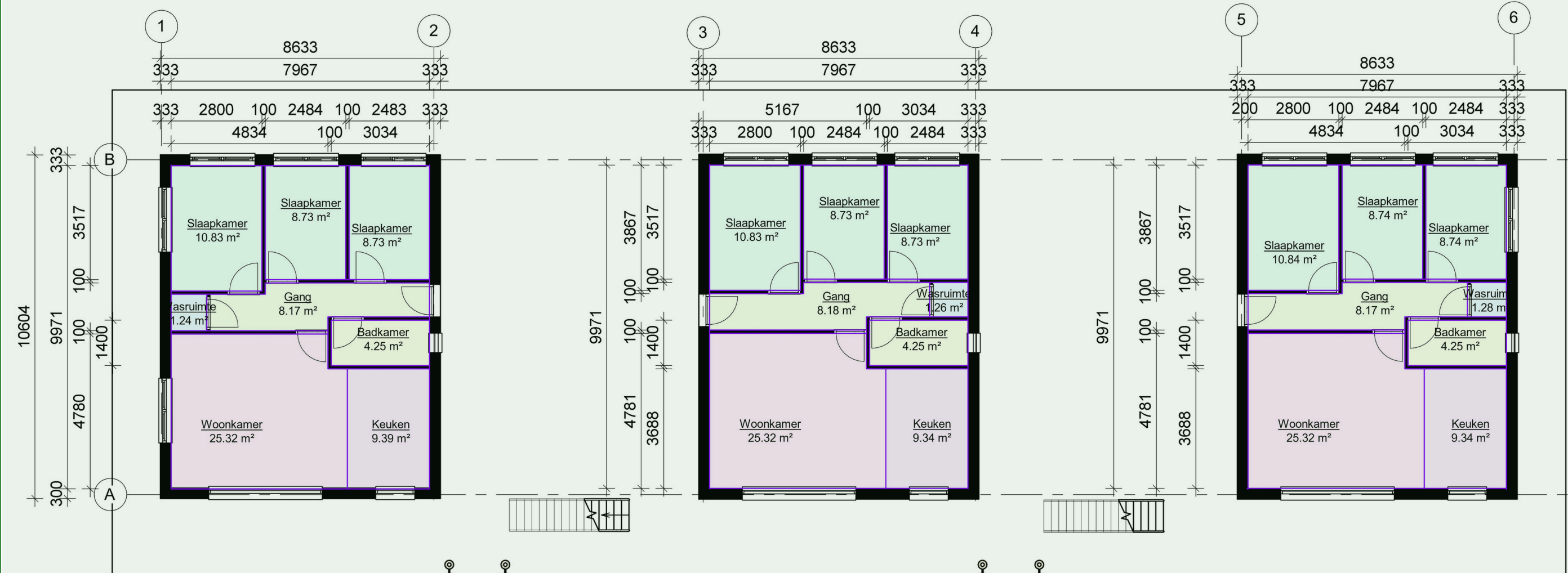


(How Do Green Roof Plants Survive?, n.d.)

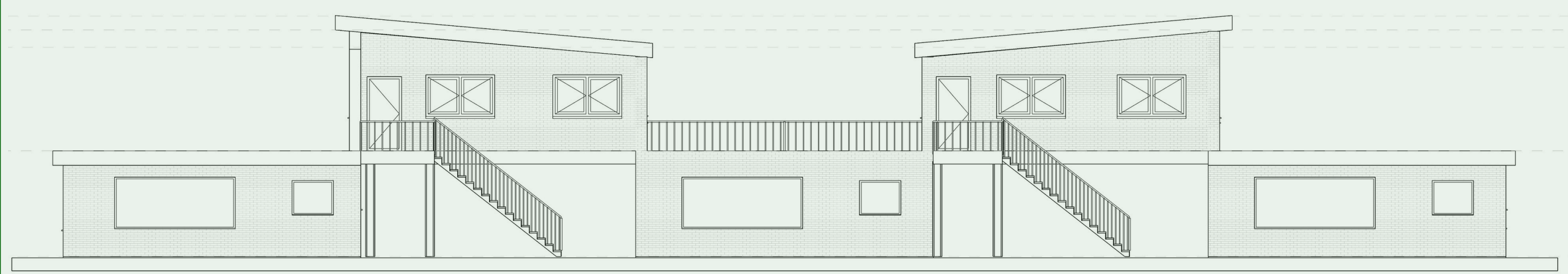


(Muur Stucen, n.d.)

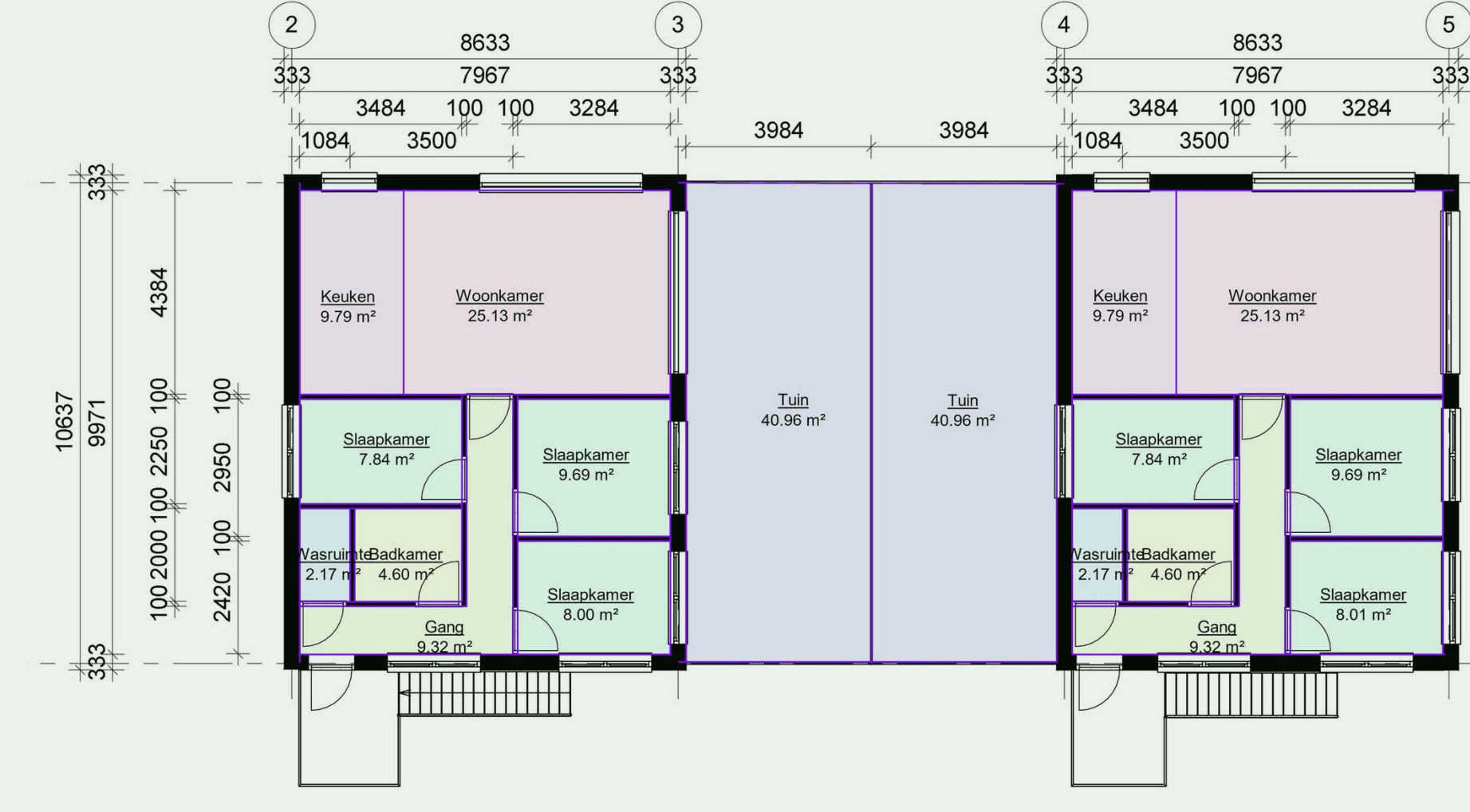
Ground floor:



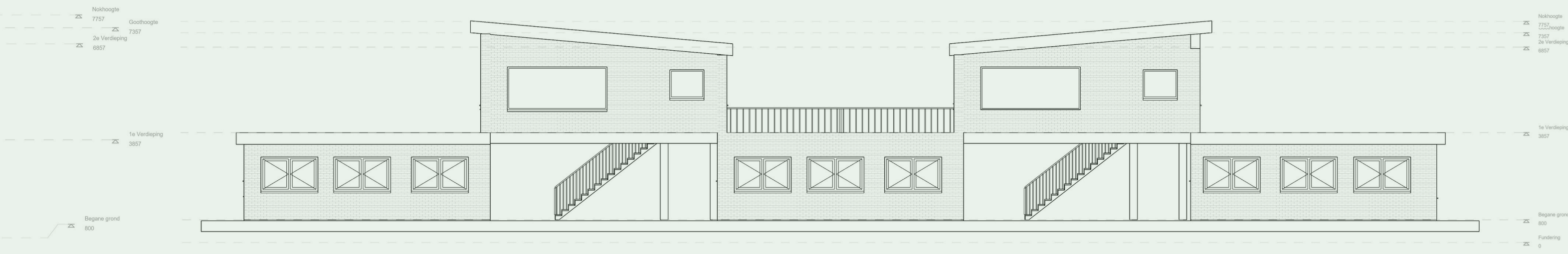
Front view:



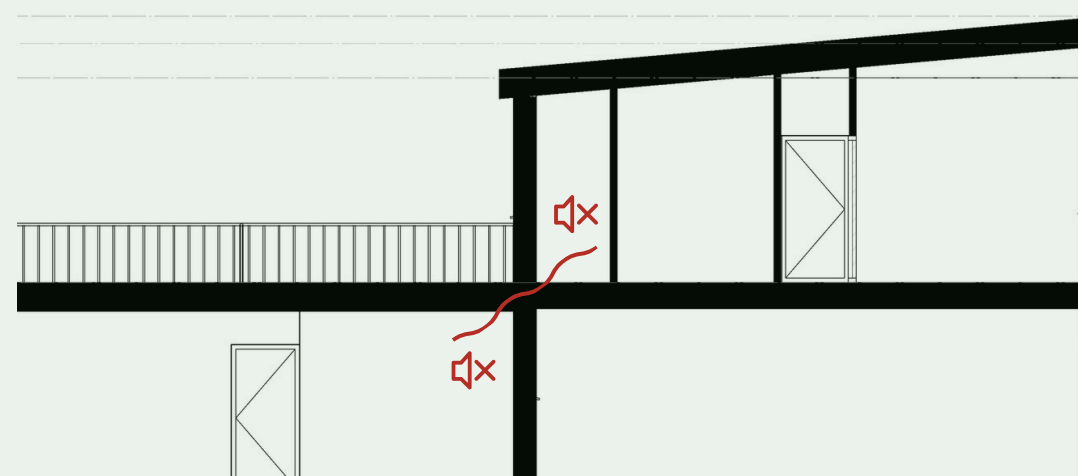
First floor:



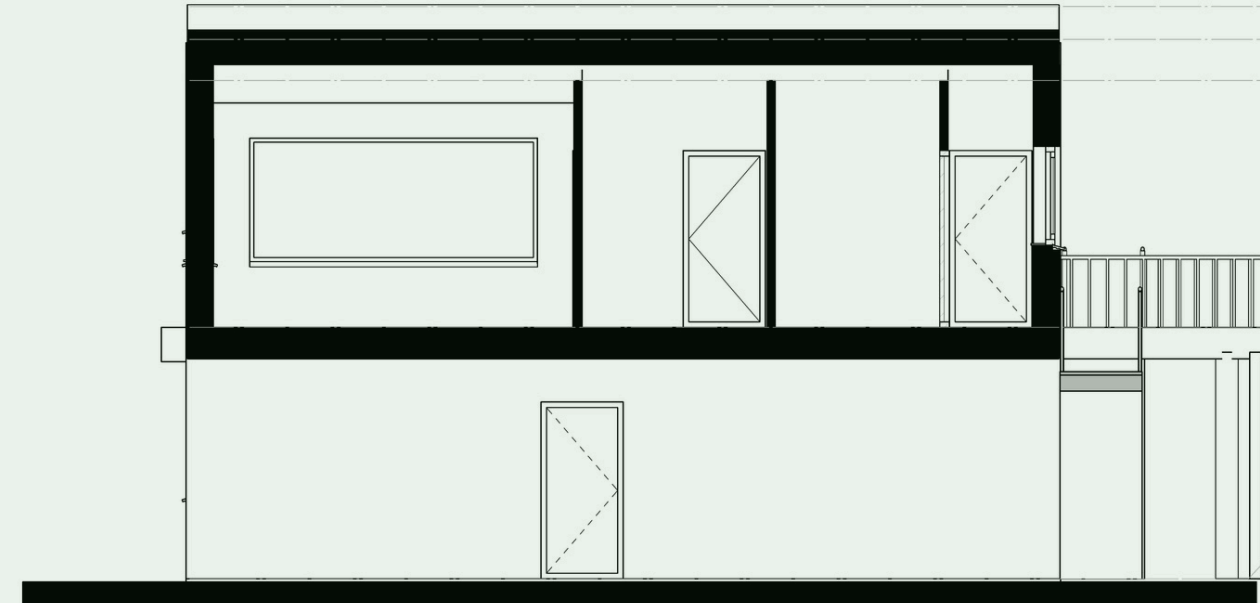
Back view:



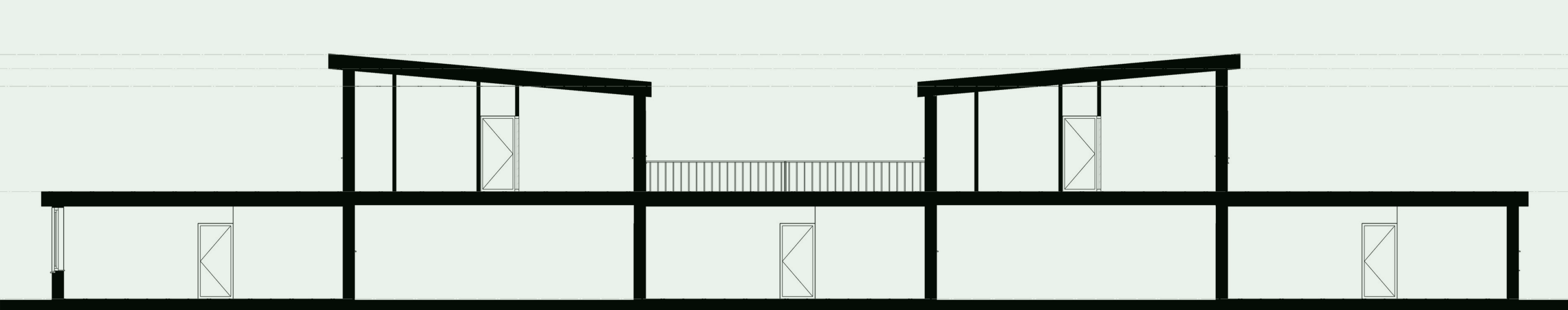
In the design, a great deal of attention was paid to noise pollution. This is evident in the design, as the homes are staggered. As a result, the homes experience little noise disturbance from each other.



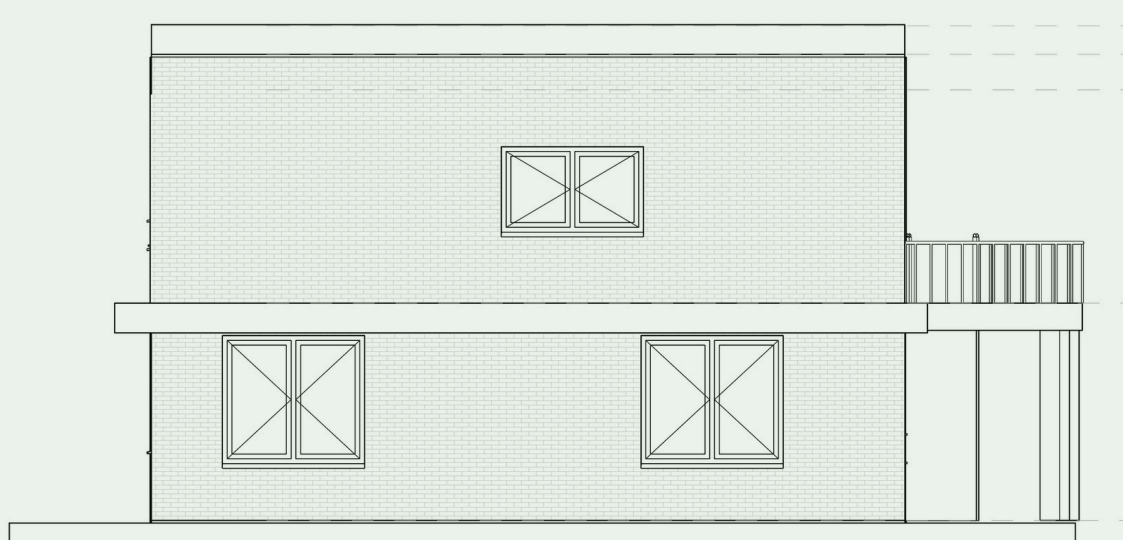
Cross section 1:



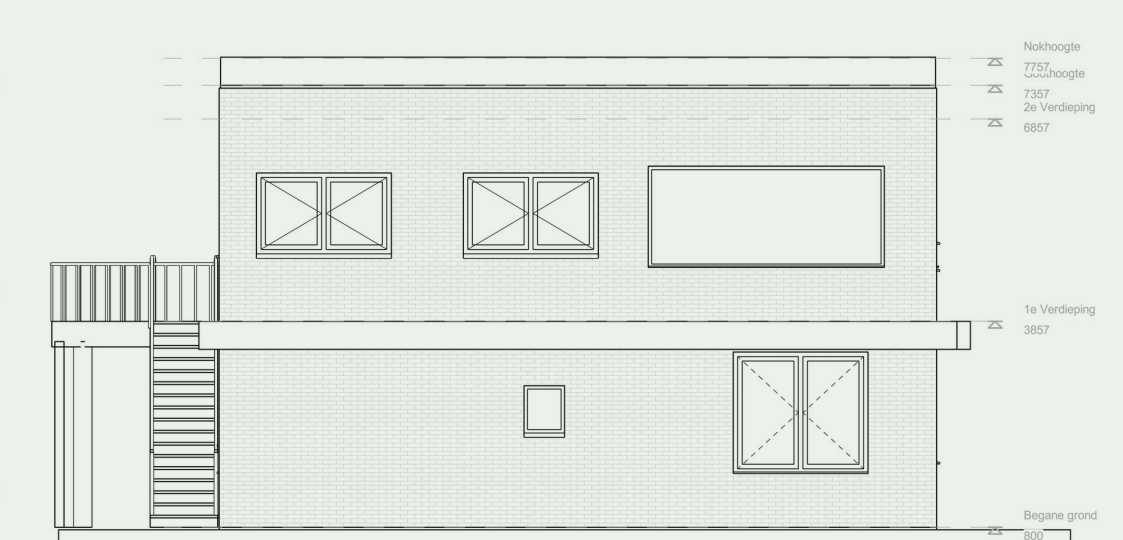
Cross section 2:



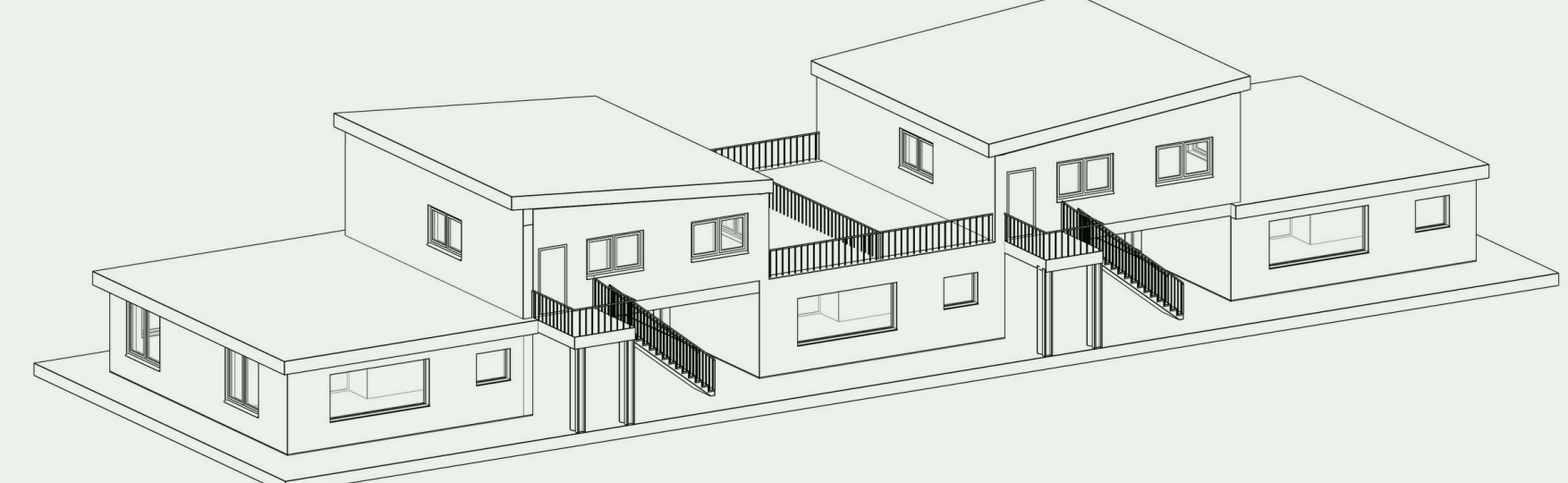
Left side view:



Right side view:



3d view:

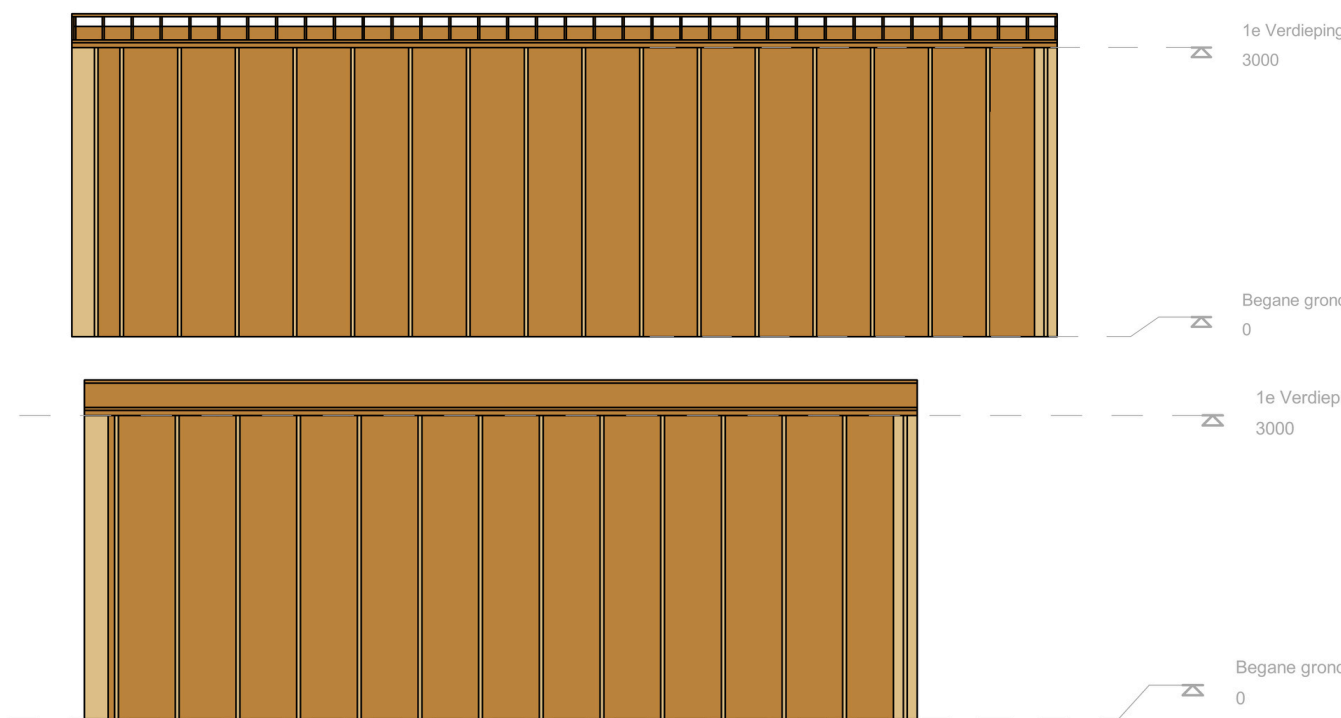


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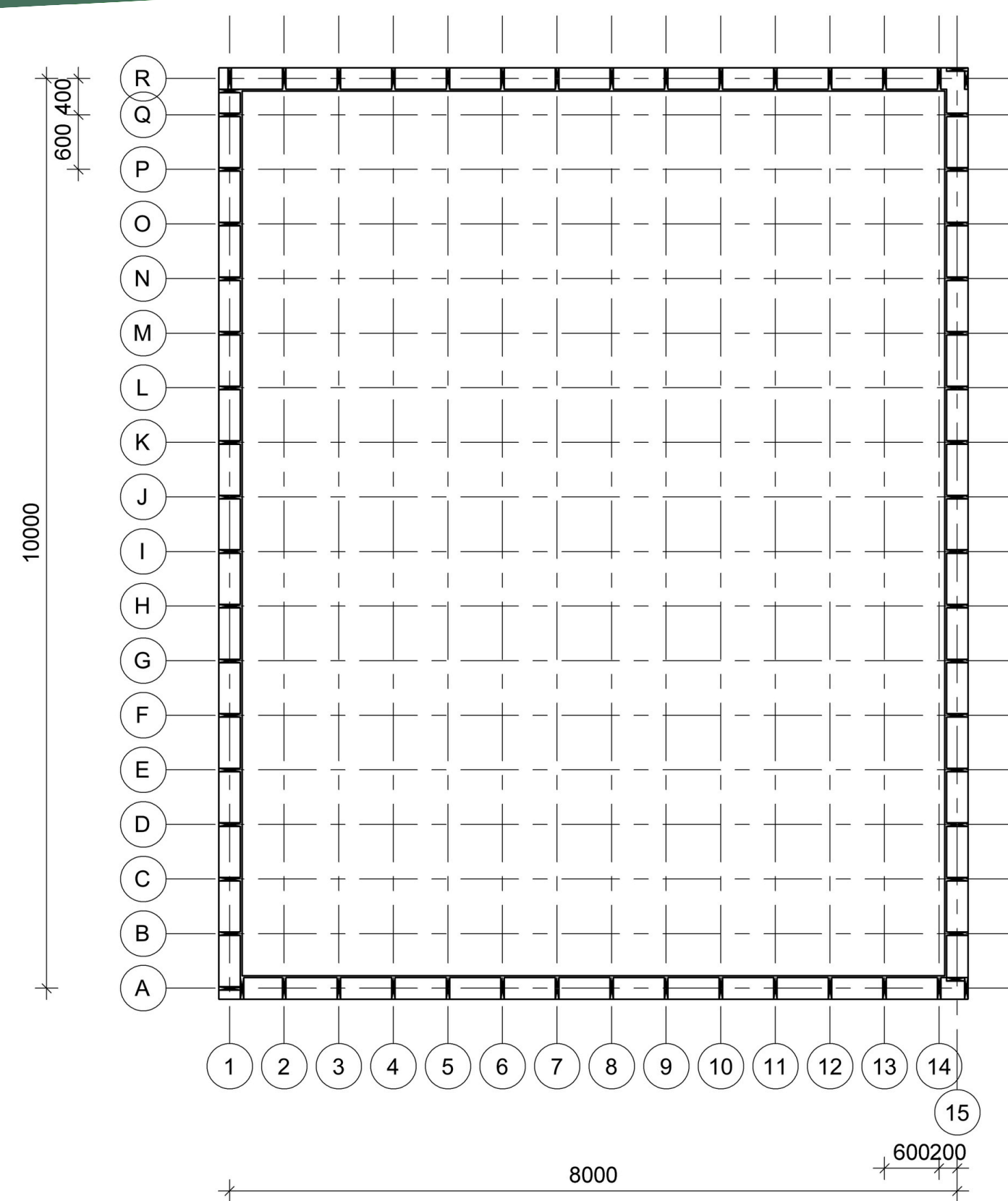
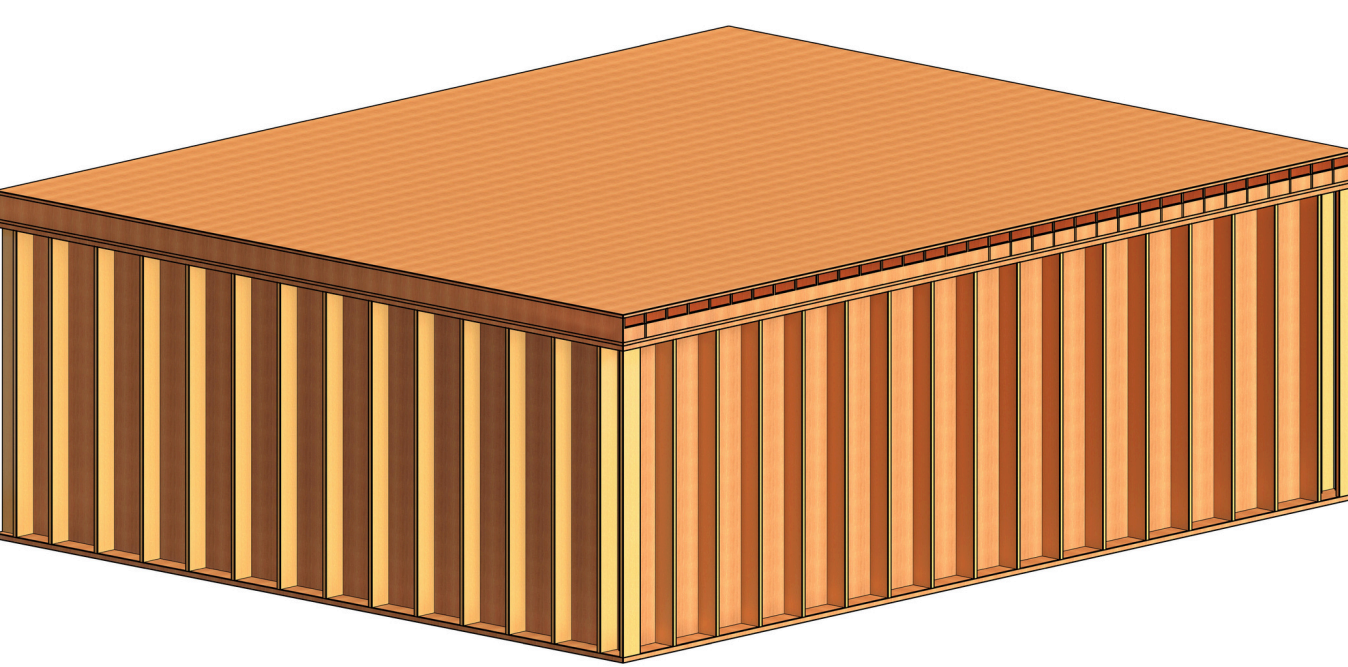
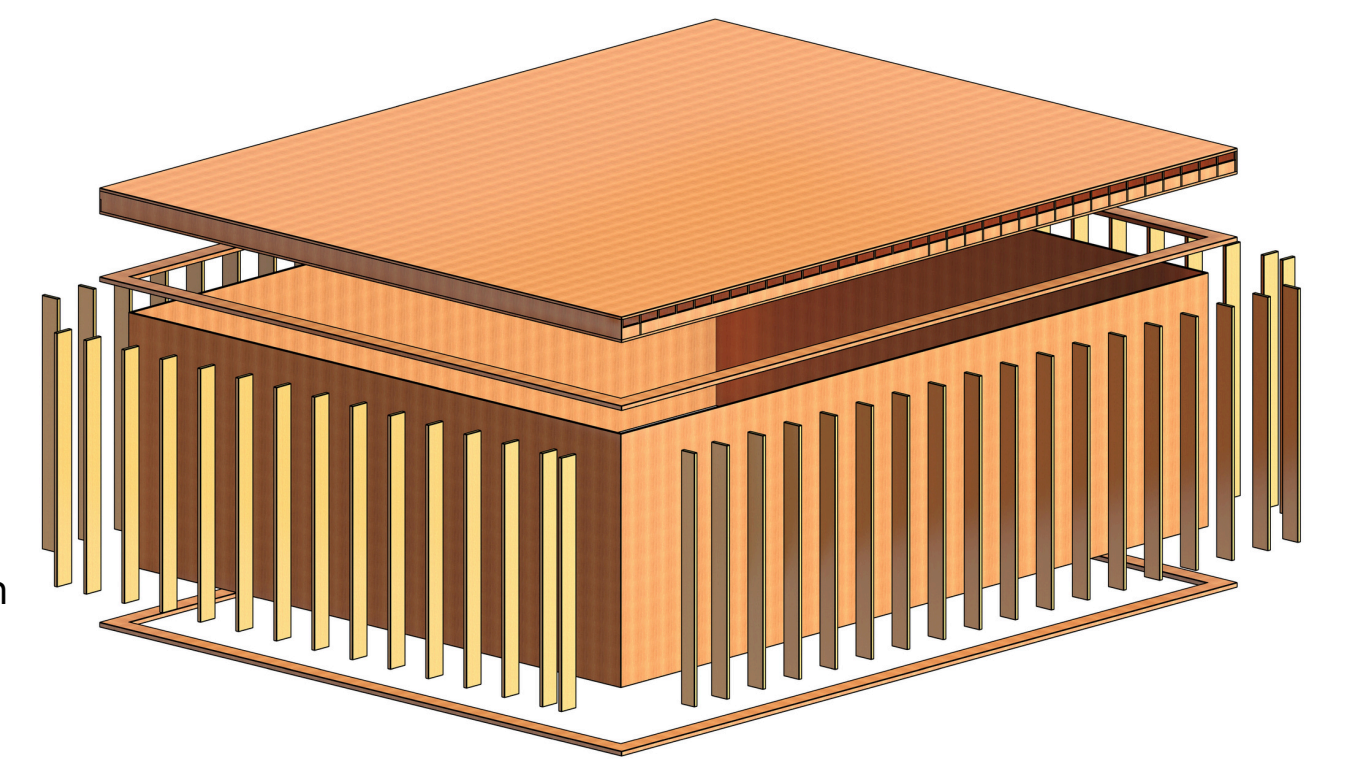
Columns	--	-	+	++
Required amount material				
Flexibility				
Sustainability				
Feasibility				
Standard TFC	--	-	+	++
Required amount material				
Flexibility				
Sustainability				
Feasibility				

For the construction, two timber frame (TFC) concepts were developed and tested using a Harris profile. The first structural design featured a column structure with larger spans, allowing for extensive flexibility in layout. The second structural design was a more standard timber frame construction. Both designs scored equally high on many aspects, but the second design required less material, which was crucial for keeping costs and weight low.

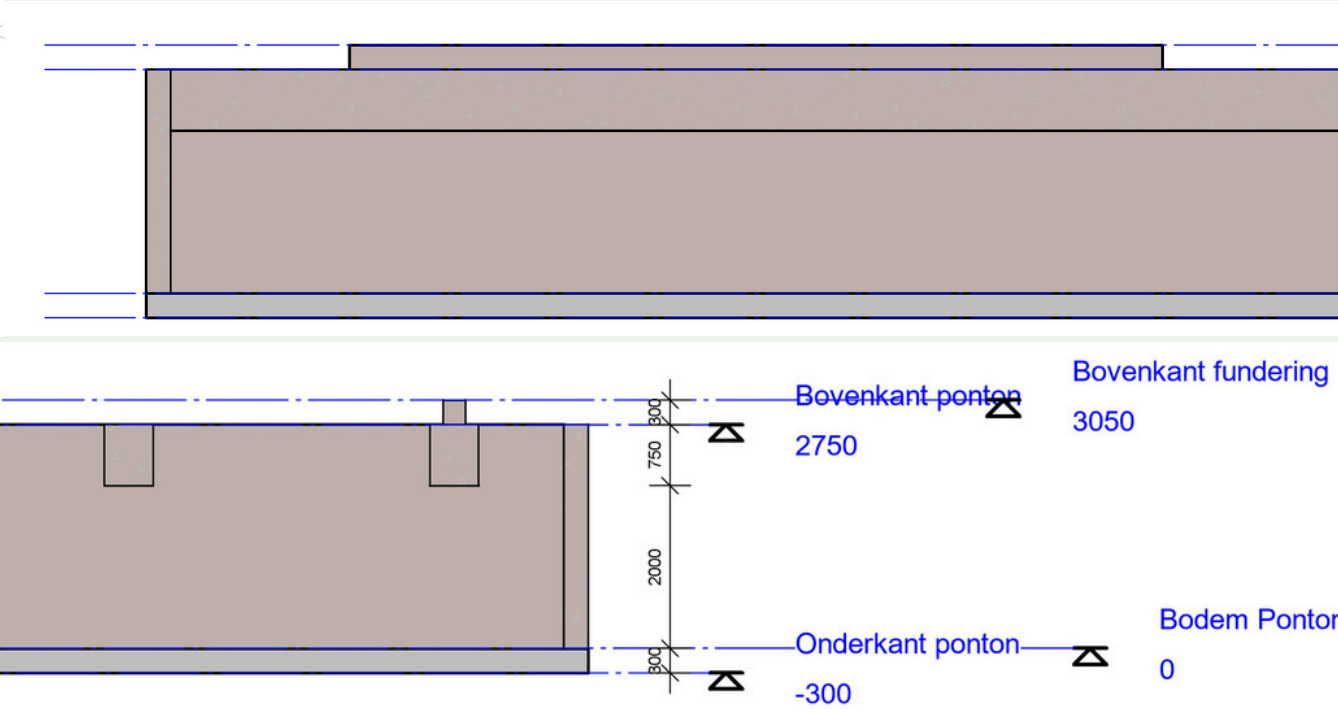
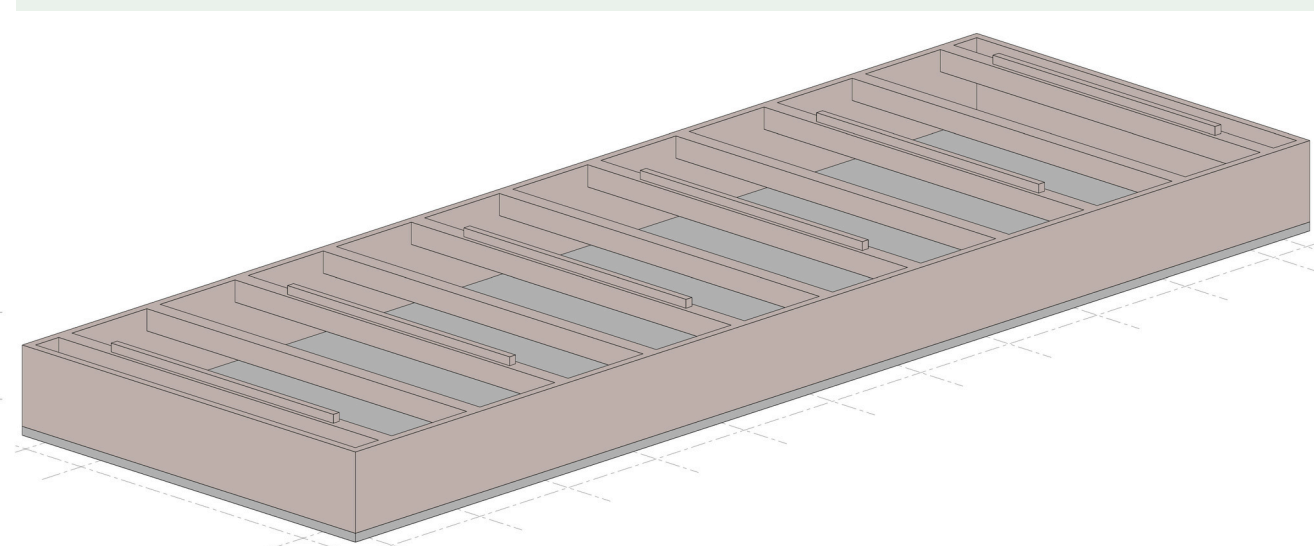
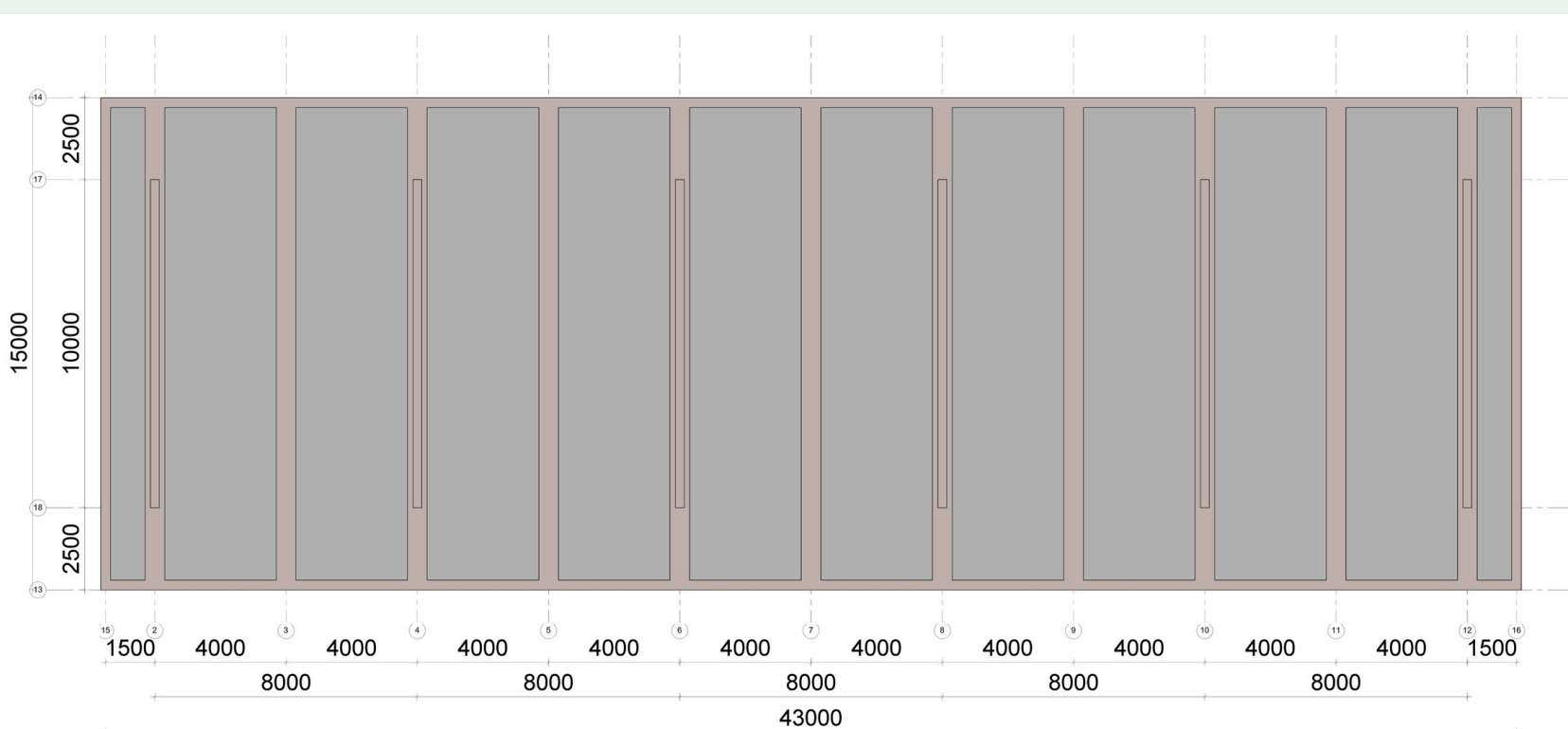


Our structural design is made of timber frame construction (TFC). The vertical studs of the structure have dimensions of 235mm x 38mm. The horizontal beams on which the studs will be placed have dimensions of 235mm x 50mm. The stability of the structure is ensured by OSB panels attached to the inside of the wall. The floors (on the ground floor & upper floor) are wooden hollow core floors. The type we use is the Kerto Ripa Box. Rotational stability is guaranteed by using Fermacell 2e35 panels, which ensure that the floors form structural diaphragms.

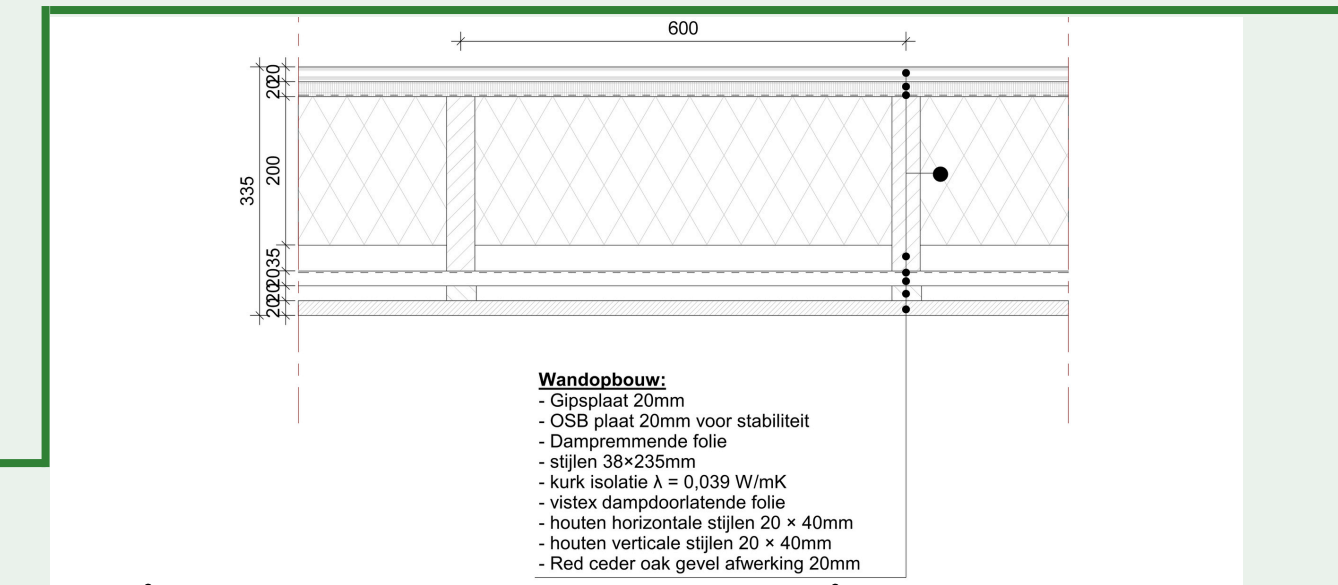
Constructive model:



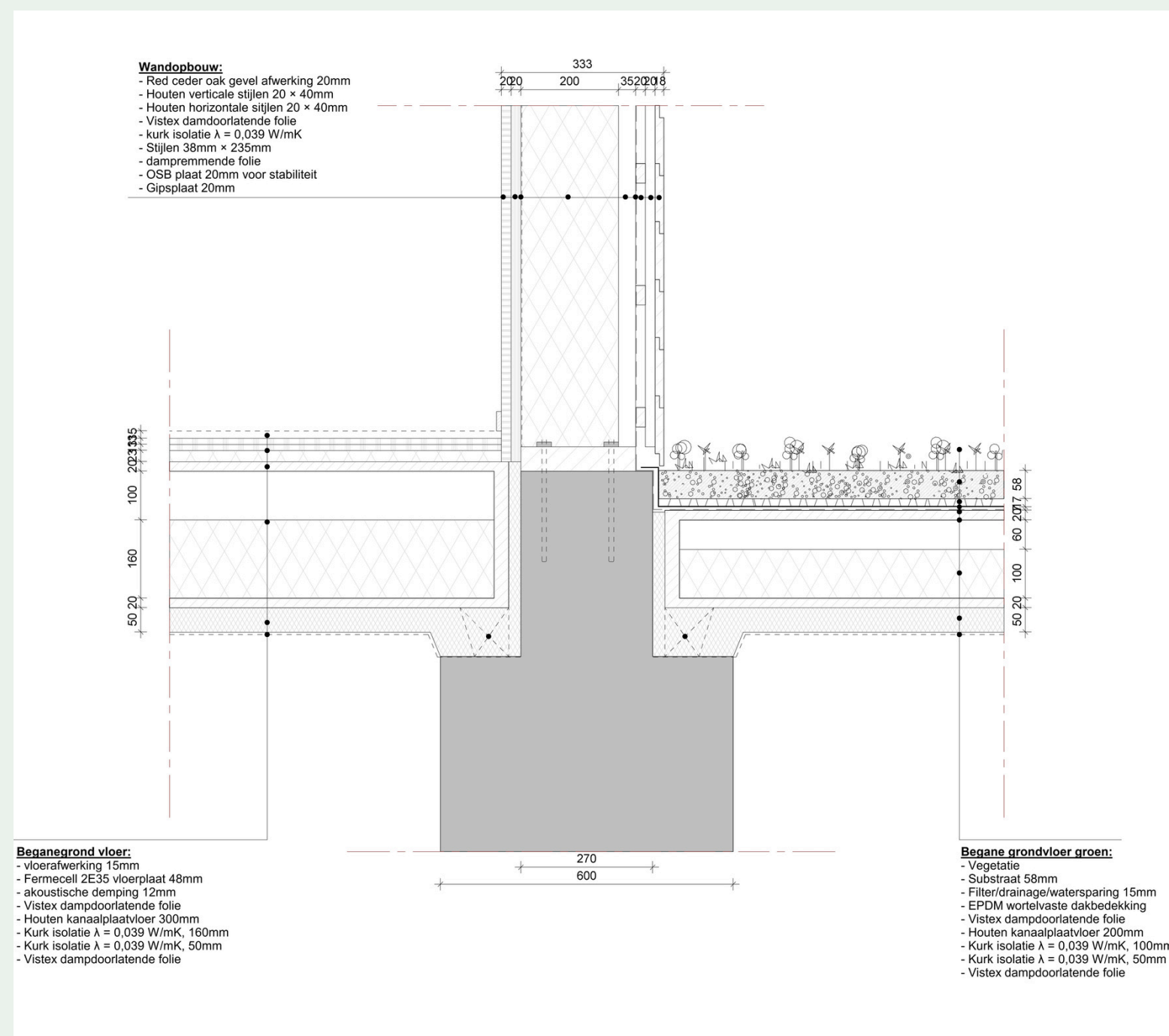
Floating Pontoon:



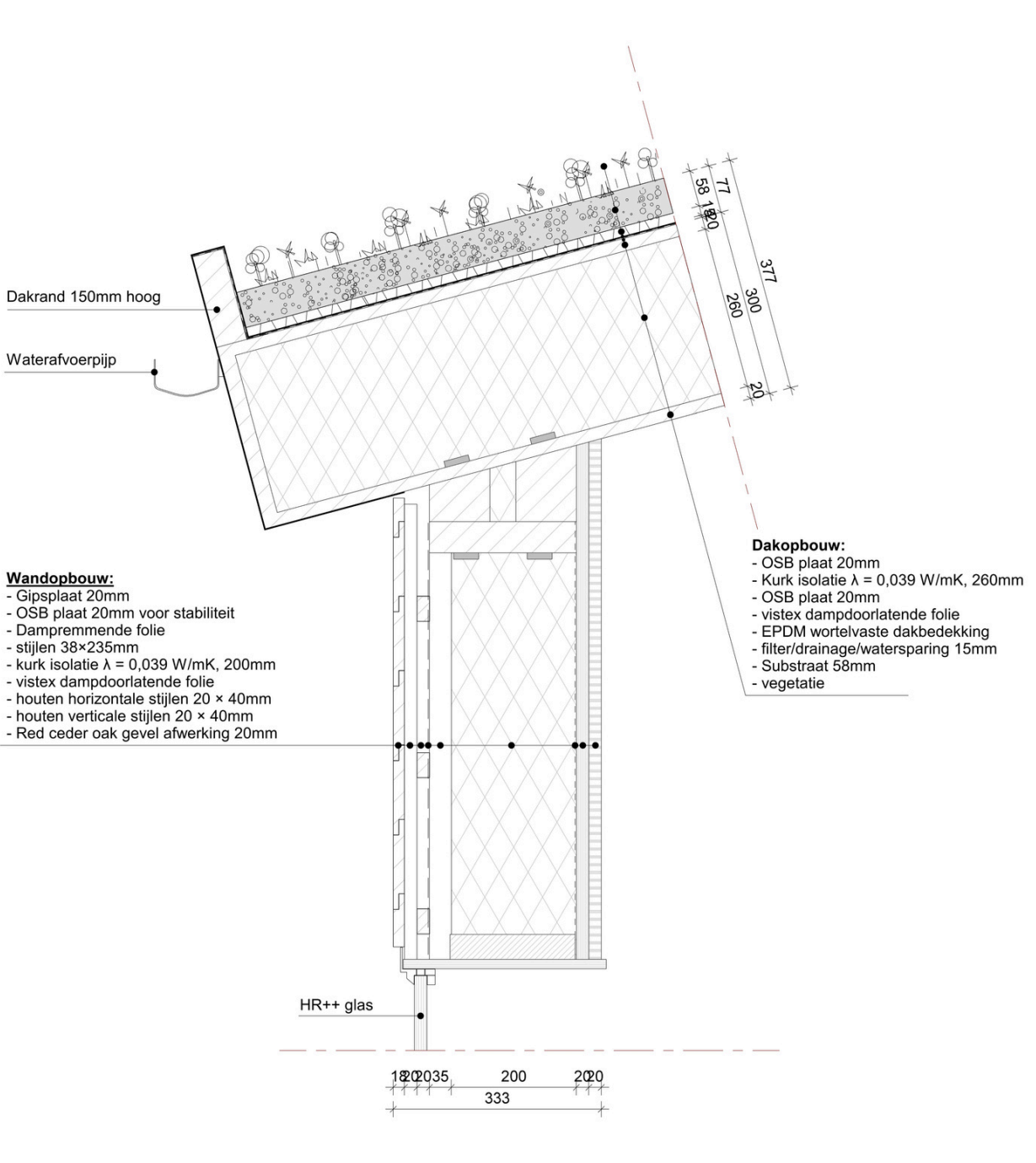
To make the houses float, concrete pontoons are used. The walls of the pontoon have a thickness of 300mm, and the bottom floor of the pontoon is also 300mm thick. Inside the pontoon, there are 11 beams that provide stability and also serve as the bearing surface for the houses and gardens. The ground floor spans 8 meters. The beams every 8 meters have a raised section where the structural framework of the houses can be mounted. The beams in between primarily function to stabilize the pontoon and support the ground floor. The calculations show that the pontoon will submerge 1.58m into the water, leaving 1.17m above the water. The calculation for this can be found in the appendix.



Details:

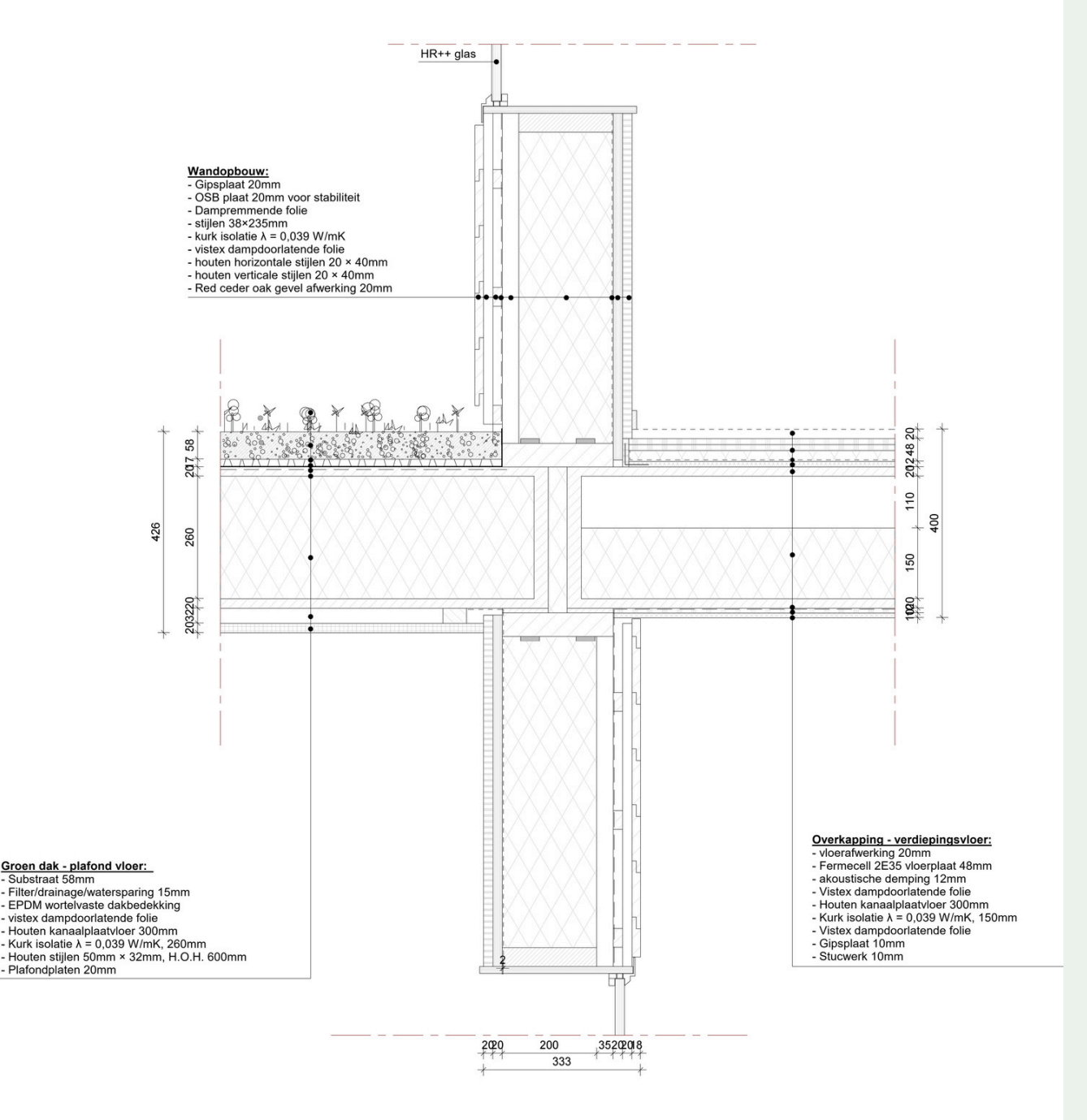


Foundation detail



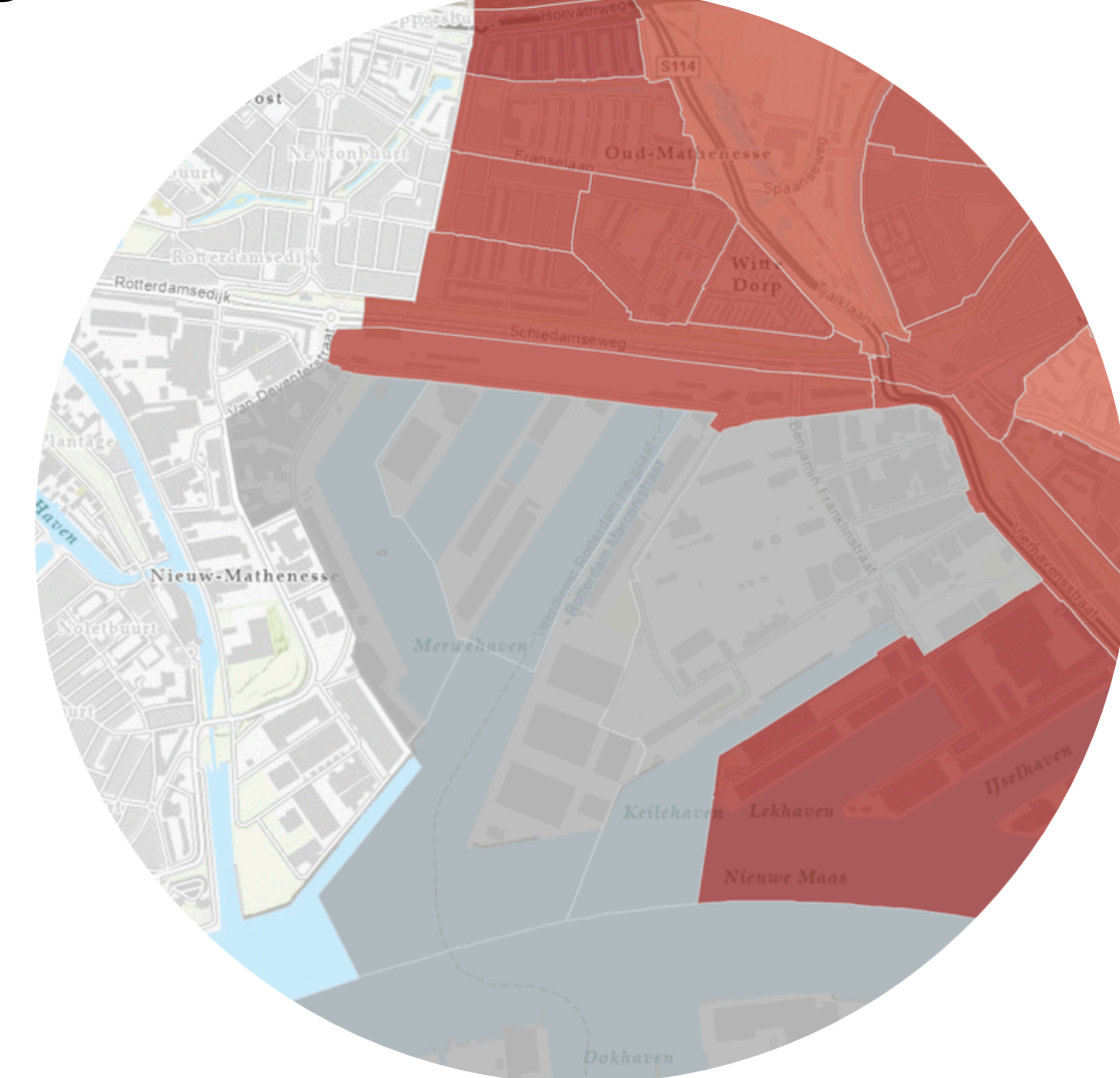
Roof detail

Horizontal wall assembly detail



Junction roof - interior floor & wall detail

Heating system + warm water system -> District heating



To heat the houseboats and provide hot water for showers and tap water, the heat grid/urban heating system is used. The port of Rotterdam is home to a lot of industry and refinery, which means that an awful lot of energy is used to keep all the factories and plants running. The energy produces a lot of residual heat, which can provide electricity.

Heating supply and drainage water pipes



Because the houseboat is in the water and the water pipes lead to the houses via the shore, the pipes through which water flows will be able to freeze in the winter without adjustments. To prevent this, tracing will have to be installed. A tracing is a heating system, which ensures that the pipes remain frost-free. This way, the water keeps flowing in any weather condition.

Sunlight study



As the sun rises in the east and is strongest in the south, we have nevertheless chosen to apply a sunshade to the facade shaded in red. The main reason for this is that, in accordance with the schedule of requirements, we need to use as few installations as possible. We want to prevent the houses from getting too hot in summer, making air conditioning a necessity.

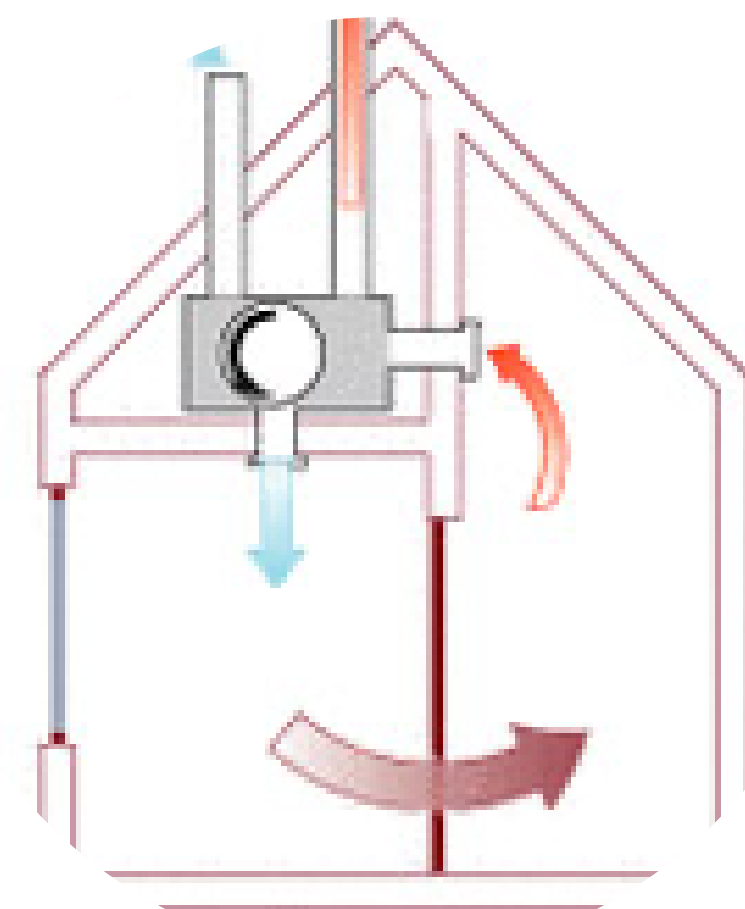
Installations & physics:

Electricity method -> Solar pannels



To provide electricity to the houseboats, solar panels are applied to the roofs of the houseboats. The installation study revealed that, unfortunately, solar panels are not enough to cover the electricity needs all year round. For instance, each houseboat has a connection to an electricity grid, which is obviously only used when the power cannot be generated from the solar panels alone.

Ventilation -> Type D



Ventilation type D	--	-	+	++
Allowed				
Common in buildings				
Temperature maintenance				
Air quality				

Insulation -> Cork



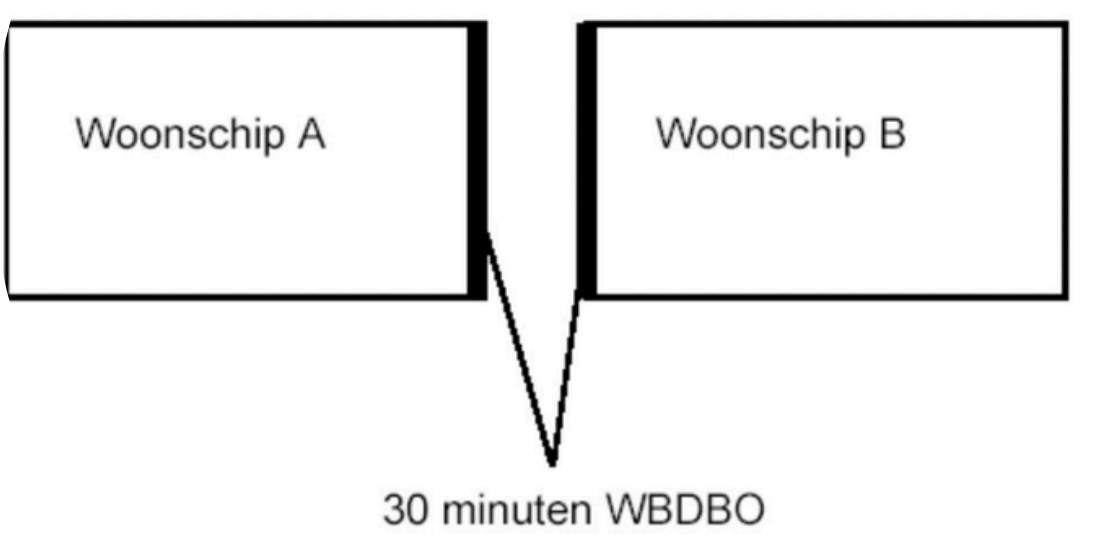
Cork insulation panel	--	-	+	++
Waterproof				
Lambda-value				
Feasibility				
Lifetime				
Origin				
Cost				
Fire resistance				

Sewage pump -> Under the stairs



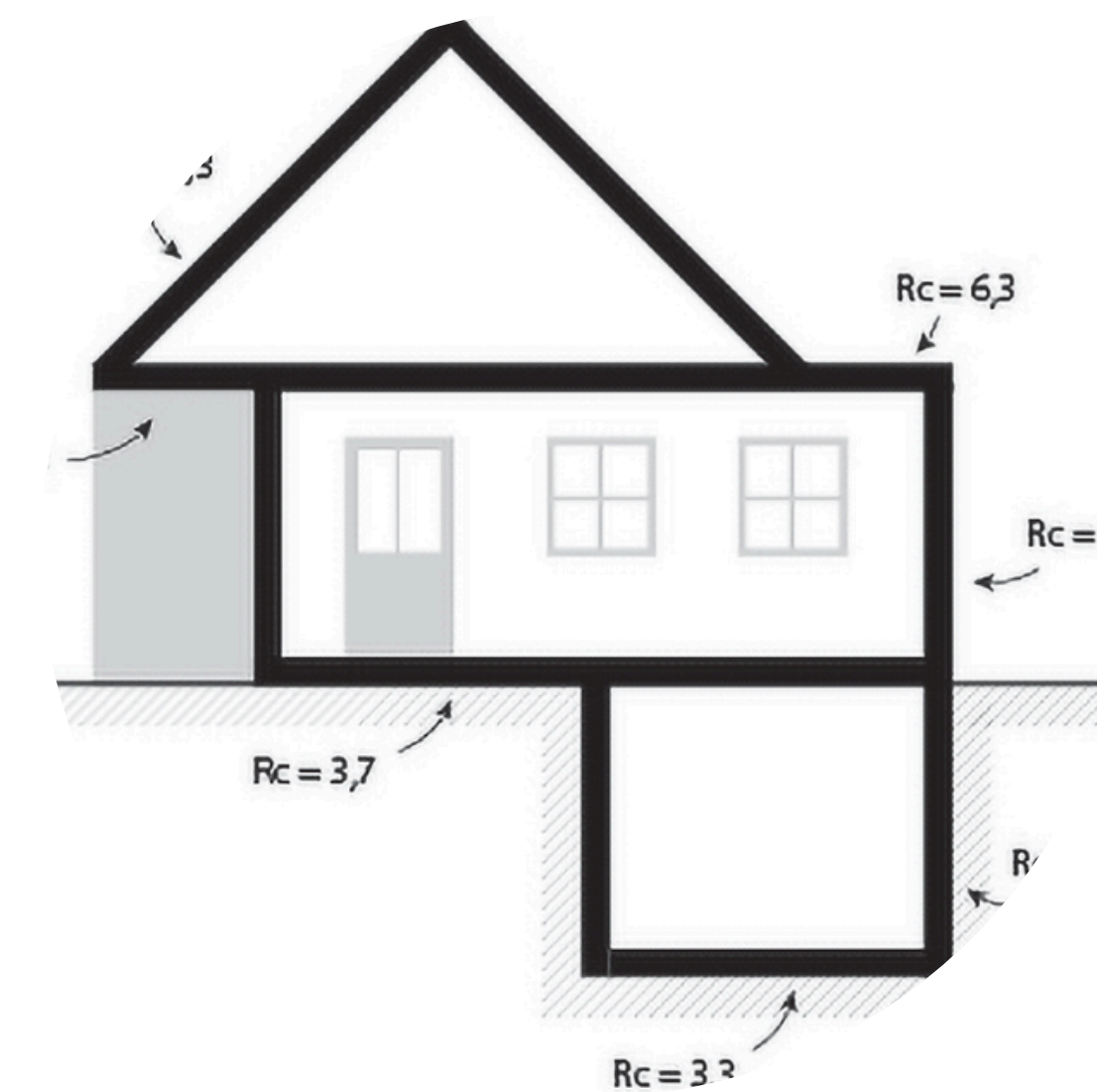
Houseboats should have a connection to the sewerage network just like other dwelling and should not discharge into the mooring water. Because houseboats are lower than street level, the waste and sewage water will never reach the shore by itself. The solution to this is a sewage pump with reservoir, this ensures that the waste and sewage water is pumped up and then taken to a central discharge point to prevent blockages.

Fire safety



Houseboats should meet a resistance to fire penetration and flashover of 30 min. With regard to fire class, the interior surface, plasterboard and exterior surface, western red cedar wood shall comply with fire class D.

RC-value



	Facade	Floor	Roof
RC- requirement	Minimum of 4,7 m²K/W	Minimum of 3,7 m²K/W	Minimum of 6,3 m²K/W
RC-achieved	5,68 m²K/W	4,33 m²K/W	6,71 m²K/W