North Sea: Landscapes of Coexistence
Transitional Territories Studio 2019-2020

MSc Graduation Research Report

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„Make Food Great Again“

- An Architectural Spatial Strategy to implement the Technological Advantages of the 4th Agricultural Revolution in the Built Environment for Reciprocal Benefit

Index

Abstract

Make Food Great Again is a prototype for the future of Urban Agriculture. Thereby its a spatial strategy to address the urgencies connected to the biochemical pollution of agricultural enterprises on the example of the Netherlands. It aims to find a solution for the burden of ultra effective state of the art agriculture on the environment, while sustaining the foodsupply in a circular economical manner.

It's the architectural answer to the question of how can our food become local and approachable again, while being an actually integrated part of infrastructure in contemporary urban society?

Key words: Urban Agriculture, Society Acceptance, Urban & Industrial Infrastructure

Territory

1. Territory: North Sea

1.1 Identity - Historical Precedents

1. “Dutch East India Company”, Encyclopedia Britannica, last modified date unknown, Accessed January 8, 2020, https://www.britannica.com/topic/Dutch-East-India-Company..

2. “Nova Totius Terrarum Orbis Geographica Ac Hydrographica Tabula”, Antique Map Categories, Raremaps, accessed January 8, 2020, https://www.raremaps.com/gallery/detail/45643/nova-totius-terrarum-orbis-geographica-ac-hydrographica-tabu-hondius.

3. “Origins of Agriculture”, Encyclopedia Britannica, last modified date unknown, Accessed January 2, 2020, https://www.britannica.com/topic/agriculture.

4. *Brockhaus Enzyklopädie,* (Gütersloh: Bertelsmann, 2005).

5. “Geschichte der Landwirtschaft” Planet Wissen, last modified date unknown, Accessed January 2, 2020, https://www.planet-wissen.de/gesellschaft/landwirtschaft/geschichte_der_landwirtschaft/index.html.

The North Sea has been the center of trade for many centuries in Europe. Its importance rose during the rise of the colonial empires and it became a gateway for the European colonizing countries.

Shipping commodities has a long history in the North Sea, specially with food and agricultural products. The Dutch East India Company thereby was the biggest driving force in what we call now globalized trade. After the Spanish invasion 1580 in Portugal the trade routes for the Dutch traders were disrupted since both Empires where in their first quarter of what later would be called the 80 years war. In 1602 the United East India Company was found in the Hague to use privately invested money to launch trade connections in Asia. Their enterprice was very successful and they ruled the global trade for two centuries. Thereby the VOC are arguably the most successful company ever been. The global trade has been dominated by the Spanish and Portuguese Empire long before and also had the Pope’s blessing, which was an important authority during this time. This theoretical dilemma of who does the sea belong to got critically reflected by the Dutch thinker Hugo de Groot who published Mare Liberum in 1609. (fig. 2) He claimed the sea as an international territory where everyone is free to travel with the exception of an extended area along the national coastline. For him measured in the distance as far a canon can fire. This change in perception from a spiritual understanding of things to a rather worldly matter perfectly resembles the Spirit of the Time of the secularisation in Europe. The Oost-Indisch Huis built in 1604 was built as their headquarter and shortly after in 1608, the former commodity exchange building in Amsterdam was rebuilt to become the first stock exchange.[1]
(fig. 3) Thereby the VOC built the foundation for the Dutch Golden Age trough colonial power. Their rise also brought a refined nautical understanding of Asia and its islands, but also Australia and New Zealand which in fact got discovered by the VOC fleet. This knowledge of the globe is displayed in the map by Henricus Hondius from 1630.[2] (fig. 1)

Nova Totius Terrarum Orbis Geographica Ac Hydrographica Tabula (1630)

Henricus Hondius
www.raremaps.com, 05.01.2020
figure 1

Mare Liberium (1609)

Hugo de Groot
www.peacepalacelibrary.nl, 05.01.2020
figure 2

The same ambitious nature one can see now a days within the Dutch international food trade. The Netherlands are the second largest food exporter in the world which is, considering that the USA is the biggest exporter and almost 240 times bigger then the Netherlands, an immense output. (fig. 5) After the 2nd World War the port of Rotterdam became gradually the most important sea port of Europe. In the same period the Dutch refined their agricultural enterprises to their current output. The Wargeningen University and their research played an important role during this process. Still the Wageningen is the worldwide highest raked University for agricultural studies.

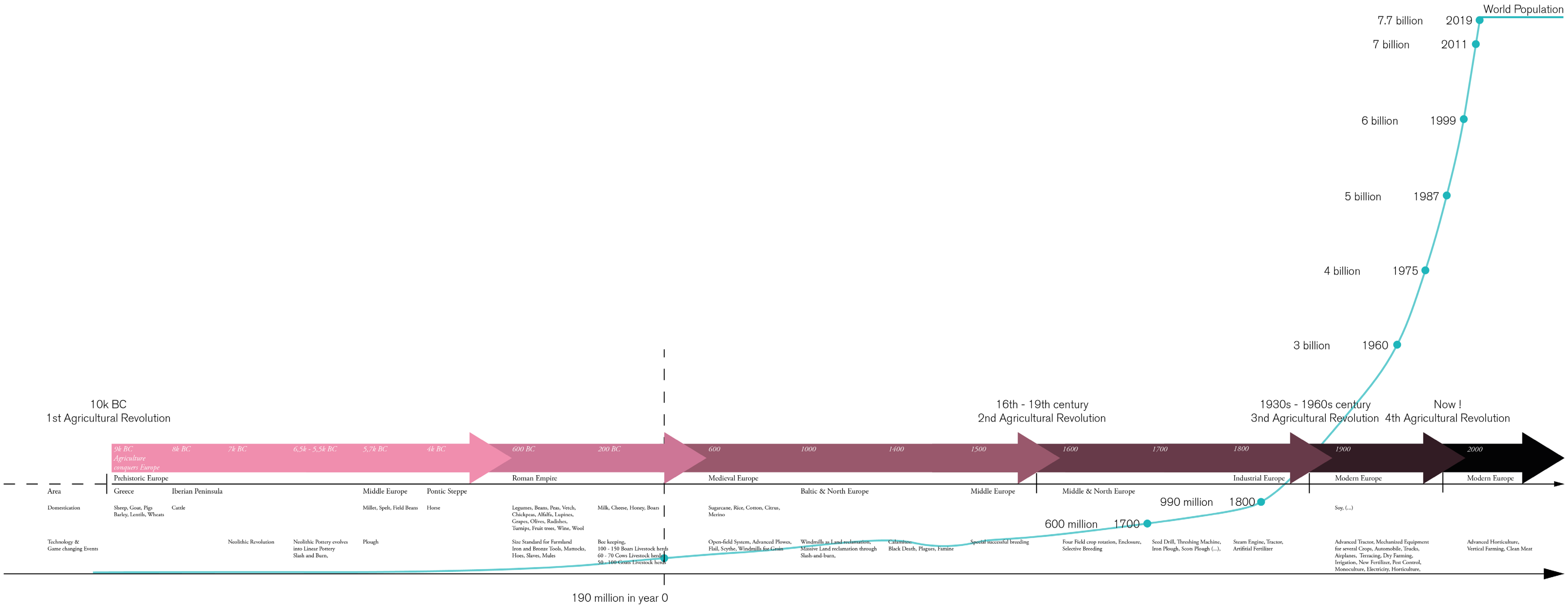
The relevance of agriculture in Northern Europe really started in the medieval times with technological breaktroughs such as Windmills for land reclamation and the practice of Slash and Burn also to claim land. Its obvious that with the domestication of diverse crops and animals the first food commodity trade happened, also over long distances since crops like wild Wheat came a long way from East Asia to domesticated Wheat in Northern Europe. Thereby lays a strong correlation between the technological development in agricultural tools and the growth in population. With technology the agricultural range became broader and more efficient. The second agricultural revolution happened with the mechanization of the work process during the industrialization. Ploughs where pulled by Tractors not horses and a lot of the former necessary man power was compensated by other machines like the Threshing machine. With the invention of Fertilizer after 1800 the whole process accelerated even further. With the use of Pest control and Electronic tools in the midst of the 20th century the third agricultural revolution happened, making it as efficient as never imagined before.[3,4,5] (fig. 4)

Amsterdam Stock Exchange (1612)

Hendrik de Keyser
geheugen.delpher.nl 05.01.2020
figure 3

Agriculture in Time
(2019)

Author
Encyclopædia Britannica, Brockhaus, www.planet-wissen.de
figure 4



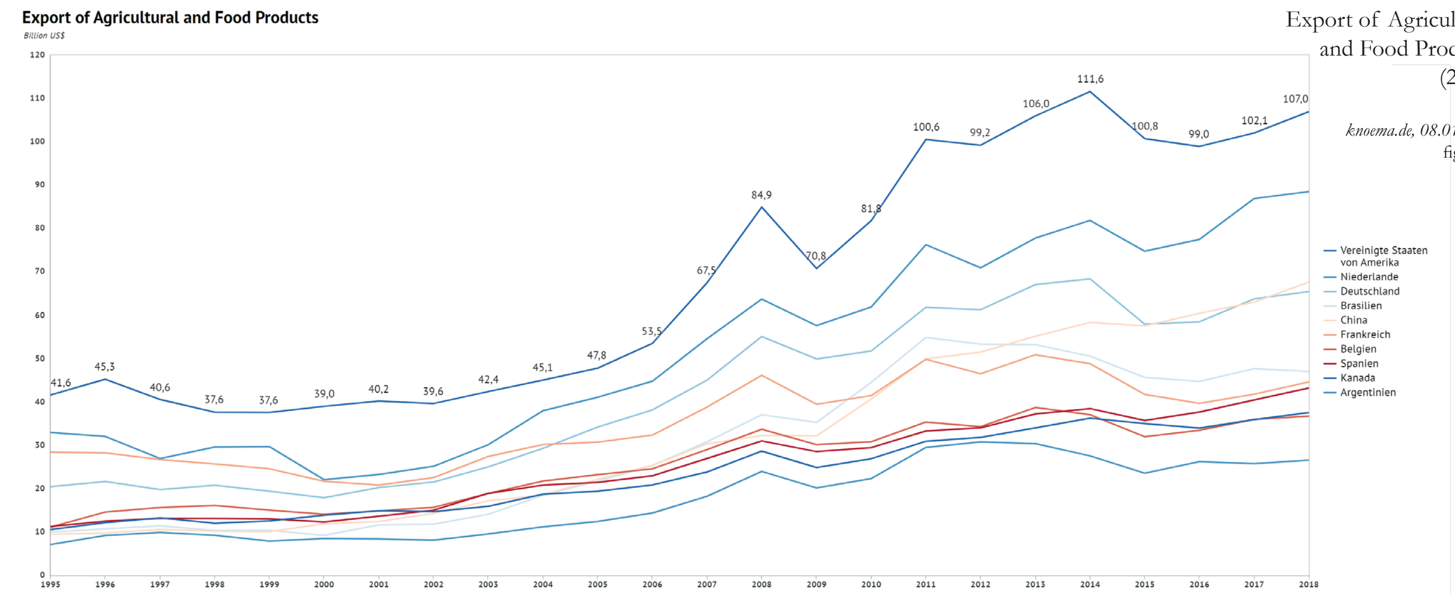
1.2 Territorial Analysis

6. “RCP Database”, IIASA, last modified date unknown, accessed January 8, 2020, https://tntcat.iiasa.ac.at/RcpDb/dsd?Action=htmlpage&page=welcome.

As touched before Netherlands are the second largest exporter for food on the globe. All this international trade and efficiency comes for a cost of the environment. High doses of exhaust by-products, fertilizer and pesticides are getting through the water cycle eventually into the North Sea and spread around the globe. The following maps will display phenomena connected to agricultural activity and its international trade.

The map to the right s the expected NOx concentration along the shipping routes by 2100 under the RCP 8.5 scenario. RCP 8.5 is the most extreme out of four representative scenarios describing greenhouse gas concentration paths out of anthropogenic emissions. Overlaying major ports and shipping routes one can see a significant in the concentrations alongside them. Specially due to the melting of the polar ice cap new pathways become accessible for commercial shipping, increasing the concentration of NOx along the coast of Norway drastically.[6]

Concerning the Planetary Boundaries Research by the Stockholm Resilience Center, there is a larger issue connected to agriculture. The biochemicals flows of Nitrogen and Phosphate have already been as devastating that their impacts are uncertain with a potential of high risks for the environment. (fig. 6) The amount of Nitrogen and Phosphate in the North Sea is mapped in the following two maps.



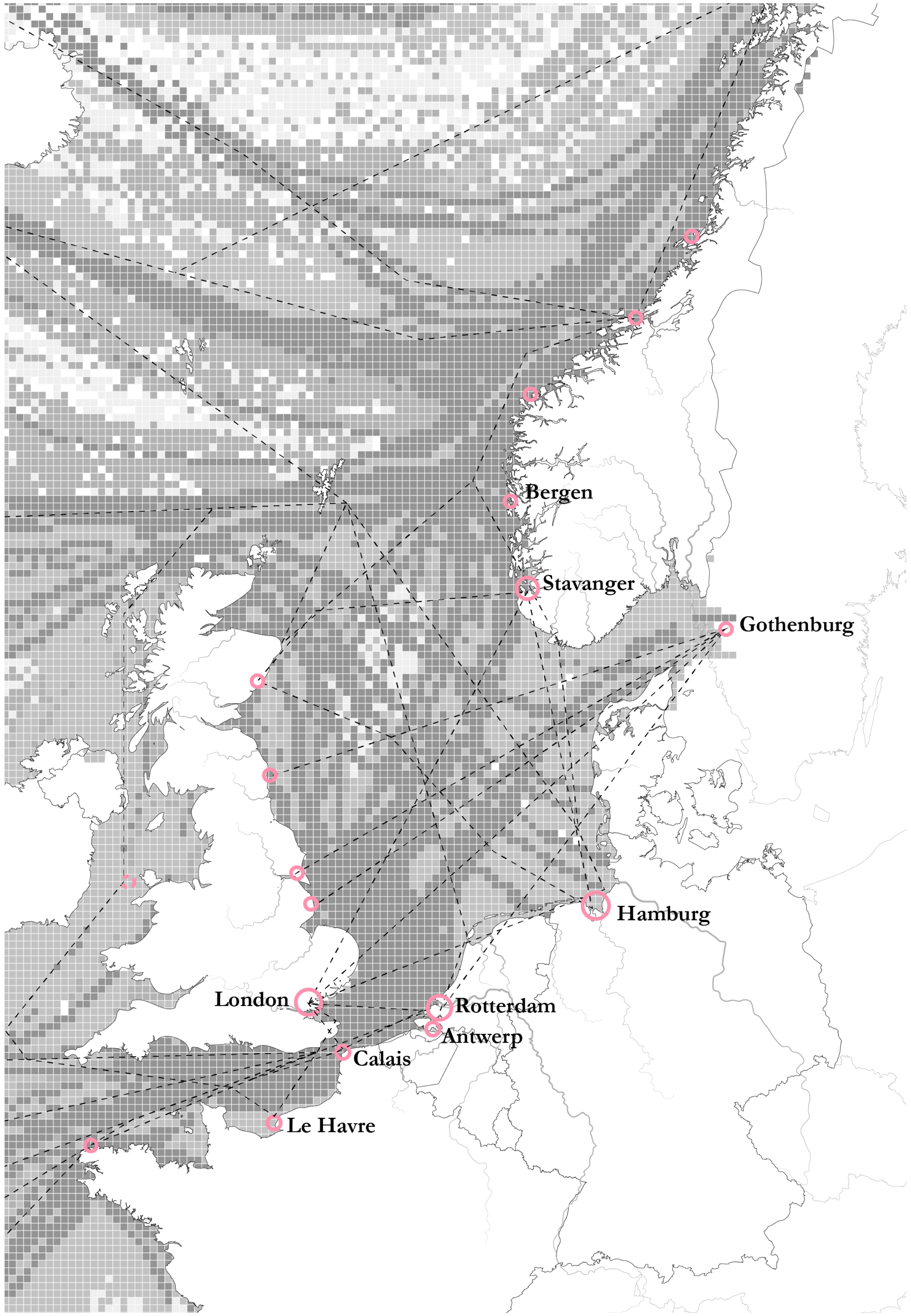
Export of Agricultural and Food Products (2019)

knoema.de, 08.01.2020
figure 5

NOx Emissions 2100 RCP 8.5 in relation to Port Activity

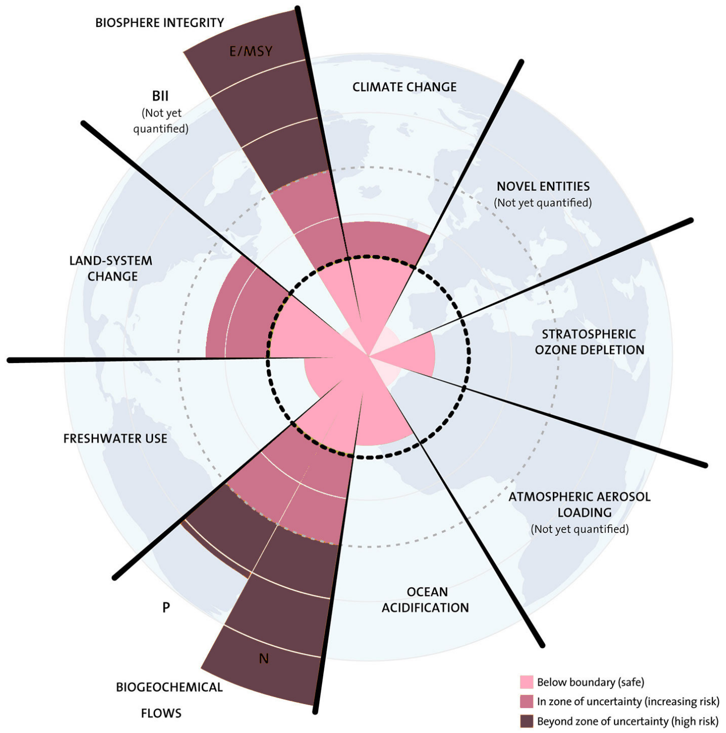
1:10.000.000
Atlas 18/19

- 3.55 E-11
- 2.04 E-12
- 1.18 E-13
- 4.22 E-15
- 4.15 E-15



Planetary Boundaries
Diagram (2015)

Stockholm Risilience Center
www.stockholmresiliencecenter.org,
05.01.2020
figure 6



7. "Eutrophierung", Umwelt Bundesamt, last modified date unknown, Accessed January 8, 2020, https://www.umweltbundesamt.de/themen/wasser/gewaesser/meere/nutzung-belastungen/eutrophierung.

8. "Eutrophierung eines Gewässers", Klassewasser, last modified date unknown, Accessed January 8, 2020, https://www.klassewasser.de/content/language1/html/6174.php.

9. "Eutrophierung", Spektrum, last modified date unknown, Accessed January 8, 2020, https://www.spektrum.de/lexikon/biologie-kompakt/eutrophierung/3958.

Along the Dutch and German coastline is the highest concentration of Nitrogen in the North Sea. The phenomenon gets caused by the high agricultural activities of both countries. Specially the Wadden Sea is affected due to its uniqueness of slow water exchange. The Phosphates map on the next page leaves a similar impression behind.

Nitrogen and Phosphates are potential high risk biochemical flows because of their fertilizing potential. What both are used for on land in agriculture to maintain the high yields, on the other hand also federalizes algae bloom in the Sea. Until a certain point this is a natural process, but when there is so much fertilizer in the Sea that Algae grows as rapidly that no sunlight can penetrate to the seabed, any flora on the seabed dies. This causes an imbalance on oxygen in the water which lets the fauna die, too. This process is called eutrophication and its a natural process which happens with small lakes in the summer at a certain stage. Due to higher average temperatures and high doses of fertilizer this process accelerates also in the North Sea. What happens with the organic matter of the algae is, after it dies and sinks on top of the sea bed, it transforms due to the absence of oxygen into sapropel and toxic gases. Hydrogen sulphide, carbon dioxide and methan are three of them.[7, 8, 9] (fig. 7)

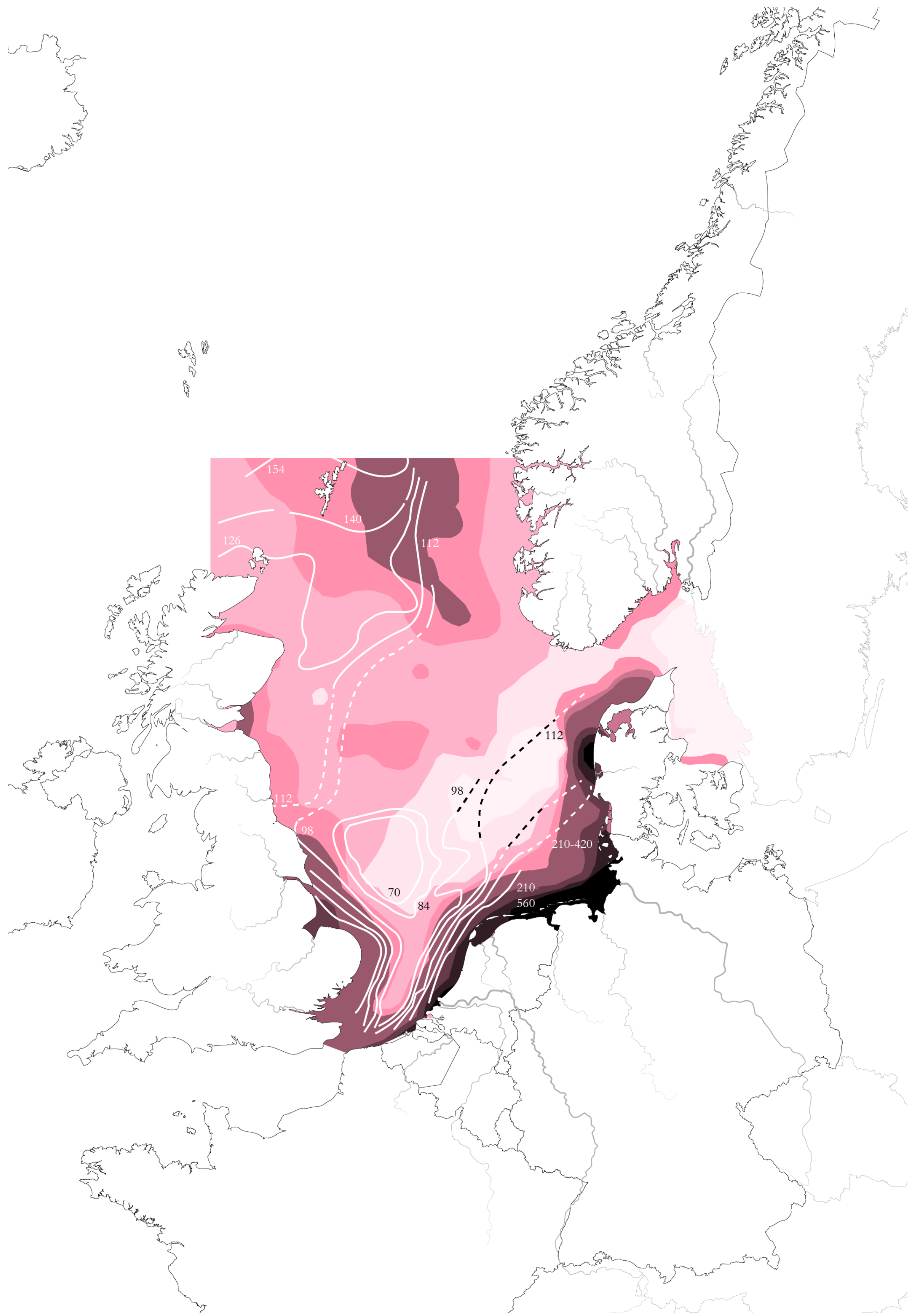
NO2 Pollution

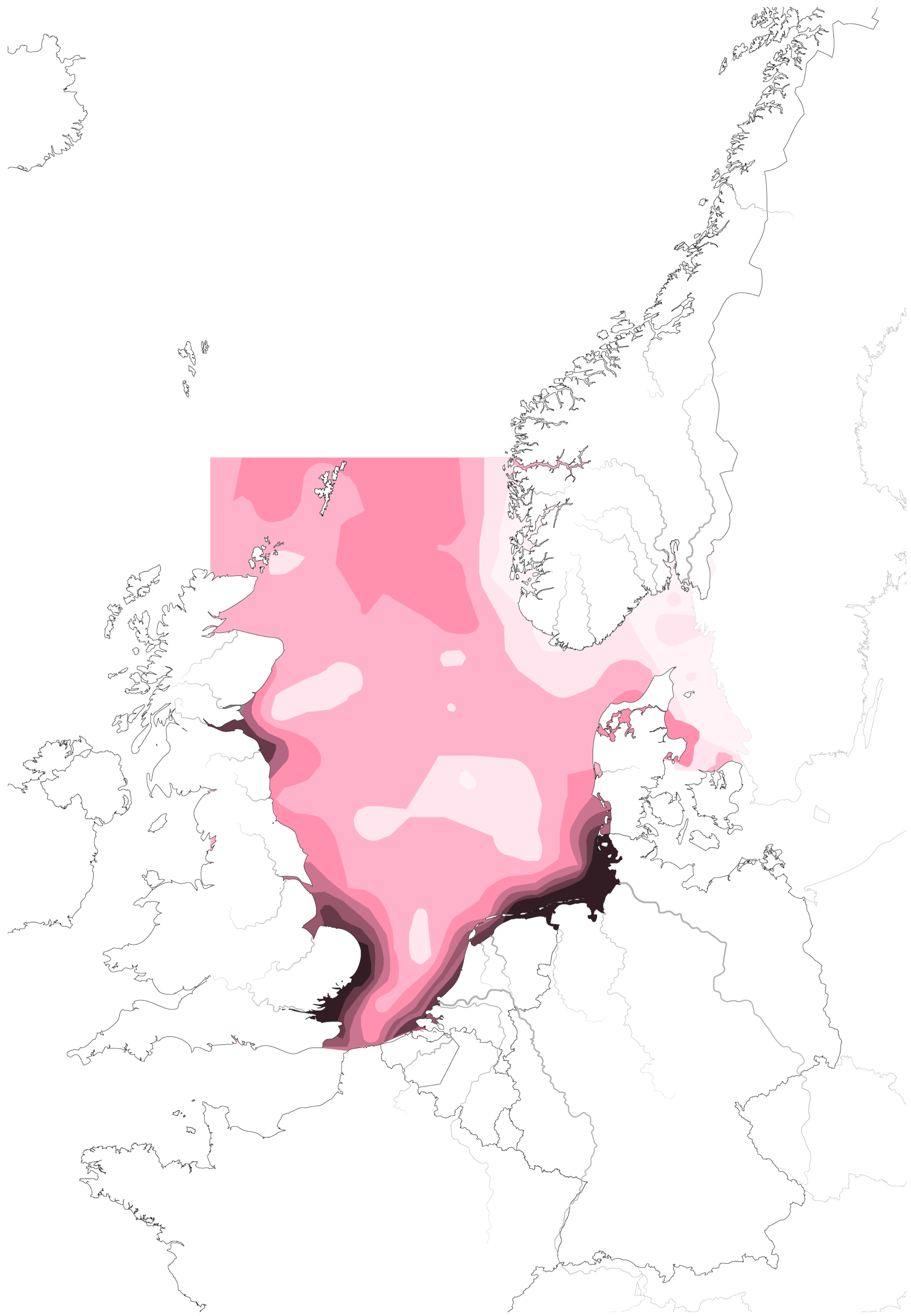
1:10.000.000
Atlas 18/19

movement of NO2 mg/L

0 95µM

dissolved inorganic Nitrogen





Phosphorous Pollution

1:10.000.000

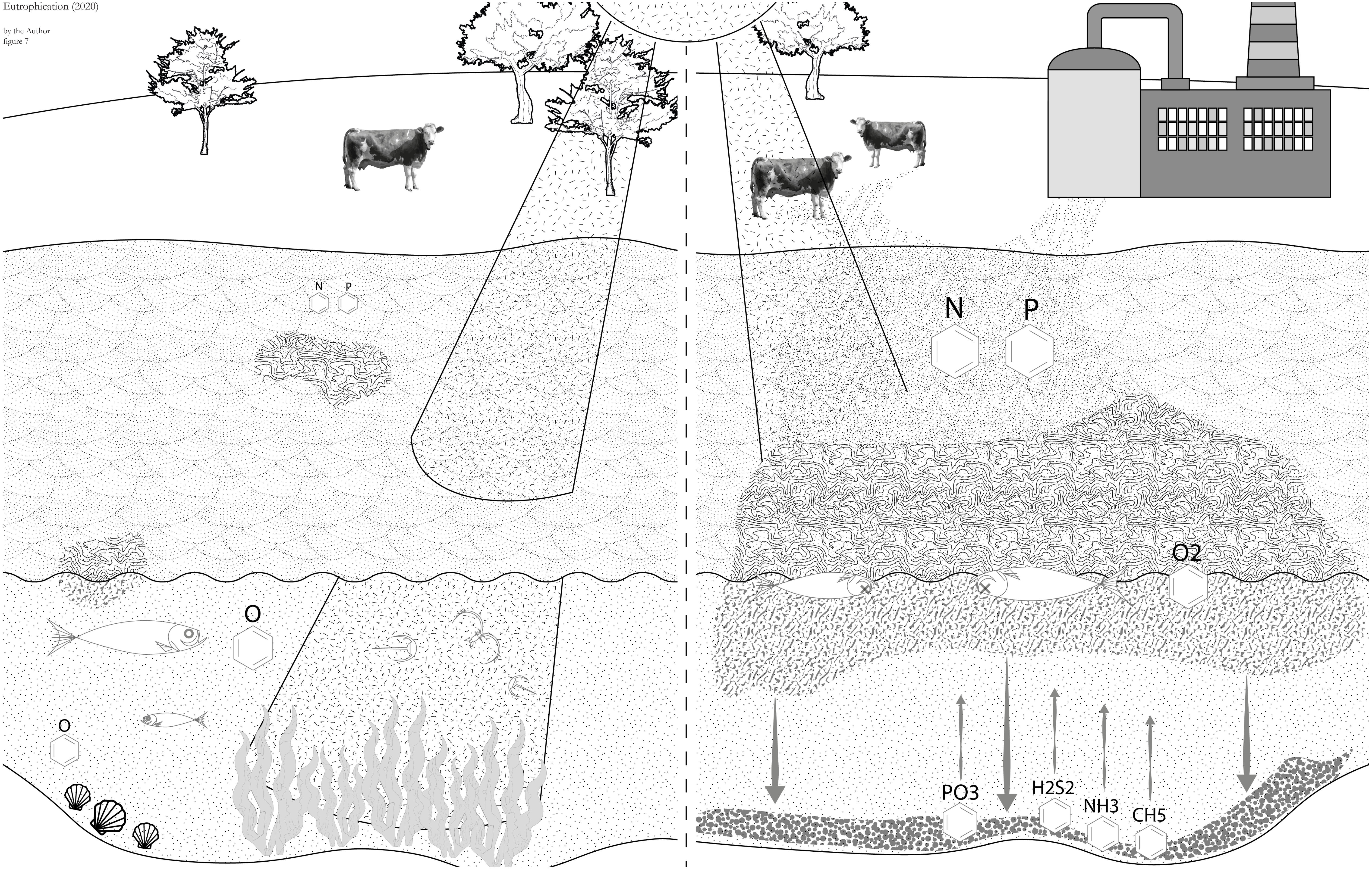
Atlas 18/19

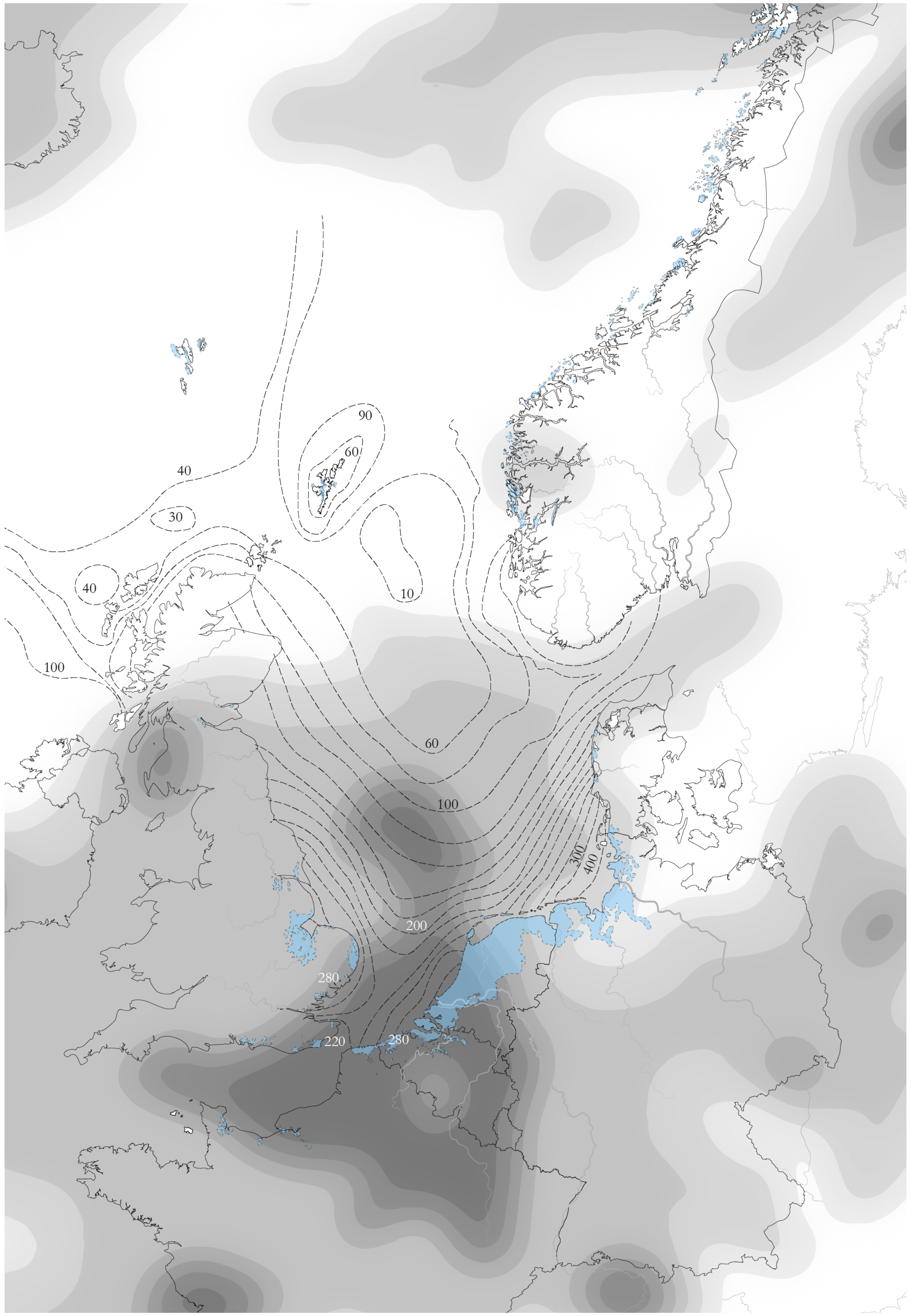
0.1 — 4.0 µM

dissolved inorganic Phosphorous

Eutrophication (2020)

by the Author
figure 7





Vulnerability SLR 2100 RCP 8.5 & Wind

1:10.000.000

Atlas 18/19

Future daily maximum wind speed

-20 -10 -5 -2.5 +2.5 +5 +10 +20

Long term extreme surge prediction

60 Surge height and the uniform winf/ pressure field

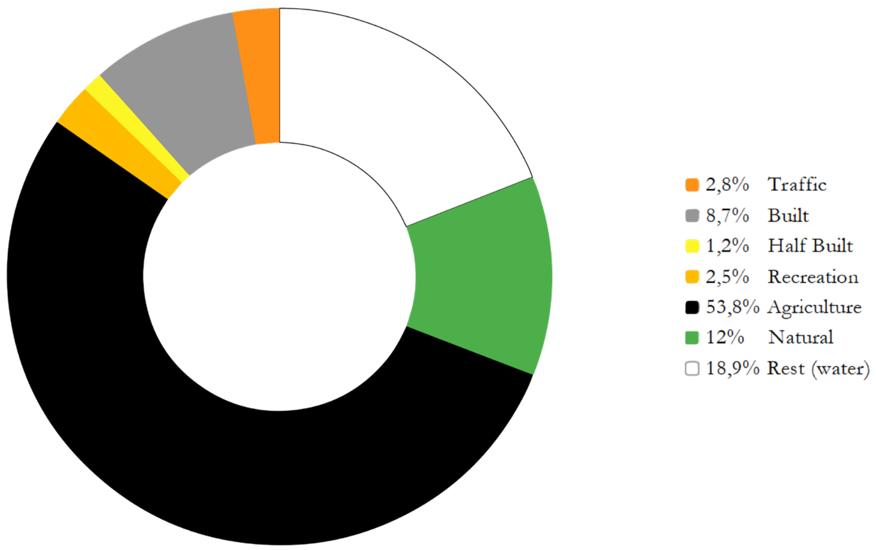
SLR 2100 RCP 8.5

1.3 Territory Analysis: Netherlands

Agriculture is the most dominant enterprice on the Dutch land. On the map to the right, one can see that almost two thirds of the Dutch land is occupied by agriculture. (fig. 9) This comes from historic tradition since the process of land reclamation during medieval times, with the invention of the windmill, was practiced to claim land for agriculture and food production. Since then the efficiency has been continuously developed. The current state of high agricultural efficiency is due to mechanization, fertilizer and pest control, maintaining otherwise not viable circumstances of overcrowded cattle farms and mono cultural fields.

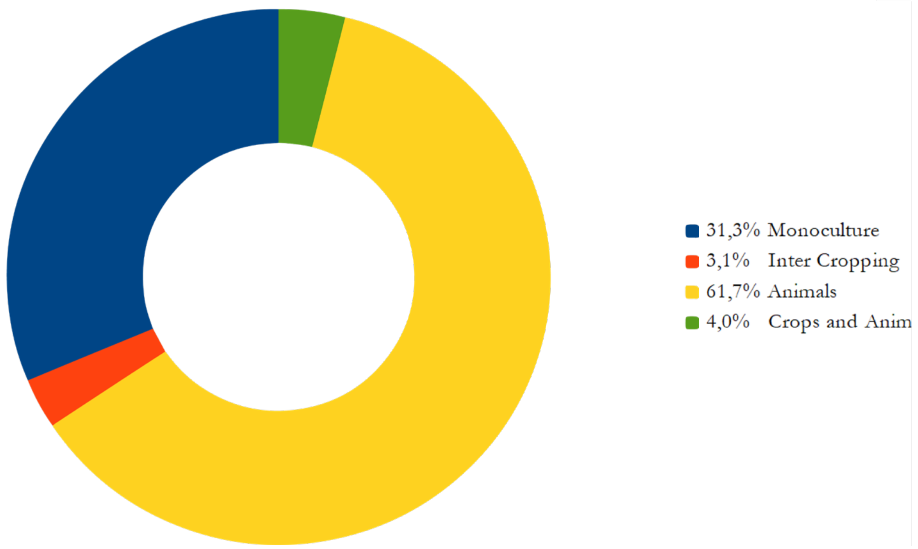
Land use in the Netherlands (2019)

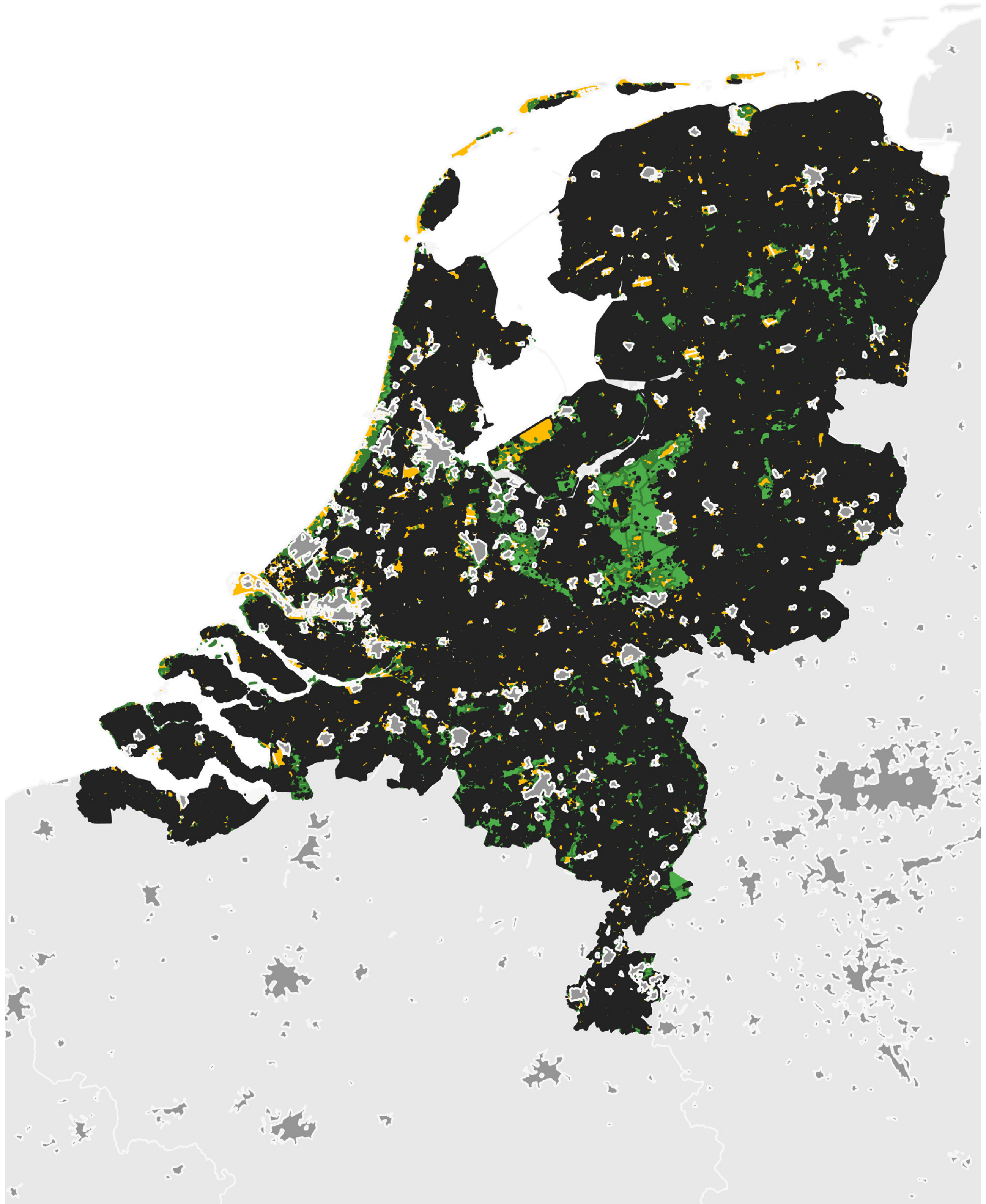
by the Author
www.cbs.nl, 05.10.2019
figure 8



Agricultural Land use in the Netherlands (2019)

by the Author
www.cbs.nl, 05.10.2019
figure 9





Land use Netherlands
https://www.pdok.nl/datasets

The UN Report "The Future Is Now" from 2019 addresses the issue of to much fertilizer in agriculture which eventually out balances the natural Nitrogen and Phosphate cycle. In 2013 Mark A. Sutton states in Our Nutrient World:

"While recent scientific and social debate about the environment has focused especially on CO2 in relation to climate change, we see that this is just one aspect of a much wider and even more complex set of changes occurring to the world's biogeochemical cycles. In particular, it becomes increasingly clear that alteration of the world's nitrogen and phosphorus cycles represents a major emerging challenge that has received too little attention."[10]

Recently scientific awareness for the issue is emerging it also finds its way into the general media. The Sustainable Development Goal Report from 2015 directly declared agriculture is playing a major role in achieving the SDG for 2030, and nitrogen as the most important nutrient has to be used more efficiently.[11] The Report from 2019 even says:

"Nitrogen fertilizer is also responsible for more than 30 per cent of agricultural related N2O emissions, with the sector being the major source (approximately 60 per cent) of global N2O emissions, which has potent greenhouse gas effects and thus has the potential to contribute to climate change (approximately 300 times greater than CO2)"[12]

Out of this urgency and to meet the goal of a sustainable nitrogen management by 2030 the Dutch government was about to submit a law that the farmers have to reduce their cattle by half until 2020. A sustainable nitrogen management in this case means that the cattle industry just produces as much nitrogen, via cattle dung, that could actually be used as fertilizer on near by fields. With this future in mind the Dutch Farmers went out and protested, because a law like this would lead to bankruptcy for a lot of them. (fig. 11) After several waves of protest where The Hague has been blocked in the early morning by tractors, the Dutch Government decided to rather change the speed limit from 130 km/h to 100 km/h on the motorways to tackle the nitrogen issue. (fig. 10, 11 & 12)

10. Mark A. Sutton et al., *Our Nutrient World: The Challenge to Produce More Food and Energy with Less Pollution*, (Edinburgh: Centre for Ecology and Hydrology, 2013), 1.

11. Achim Dobbermann , *Looking forward to 2030: Nitrogen and the Sustainable Development Goals (2016)*, Accessed January 8, 2020, http://www.ini2016.com/pdf-papers/INI2016_Dobermanna_Achim.pdf.

12. United Nations, *The Future Is Now: Science For Schieving Sustainable Development*, Accessed Januray 8, 2020, https://sustainabledevelopment.un.org/content/documents/24797GSDR_report_2019.pdf: 73.

News Article (2019)

Janene Pieters,
bbc.com, 08.01.2020
figure 10

Netherlands forced to slash speed limit to reduce emissions

13 November 2019 Share

The current motorway speed limit is 130km/h although a lower limit can apply at various times and places

News Article (2019)

Eline Schaart
www.politico.eu, 05.01.2020
figure 11

Furious farmers drove their tractors to The Hague, causing rush hour traffic chaos | Vincent Jannik/AFP via Getty Images

The Netherlands struggles with nitrogen headache

Farmers are angry at being the main target of efforts to slash nitrogen pollution.

News Article (2019)

Janene Pieters,
nltimes.nl, 08.01.2020
figure 12

BUSY RUSH HOUR EXPECTED AS PROTESTING FARMERS, BUILDERS TAKE TO THE STREETS

By Janene Pieters on December 18, 2019 - 07:35

Tractors on the A15 highway between Gorinchem junction and Ridderkerk, 18 December 2019. (Rijkswaterstaat, @RWSverkeersinfo / Twitter -)

Motorists must take longer travel time into account on Wednesday morning due to protests by farmers and construction workers. The construction workers are planning go-slow actions on Dutch highways and provincial roads. A court banned the farmers from blocking distribution centers, but other types of actions are planned.

"It will not be a black rush hour, but it will be a busy one", Heleen de Geest of travelers' organization ANWB said to NOS. Large traffic jams are expected on the A9 and the A4 from Alkmaar to The Hague, and on the A13 towards The Hague. Access roads to the highways will likely also be congested. "We advise people who need to be on the road to check in

Why did it got there?

As previously touched agriculture today is a highly efficient business and is has to be because over the years the only way to survive for farmers was to increase there yields efficiently since the prices for food are very low. The raw milk price for instance is highly volatile but without any even speculative chance of it actually increasing. In comparison the CPI in the Netherlands rose steady and almost linear since the 1950's while the Raw Milk Price stagnated. This means that in order for a farmer to keep the relative purchasing power of the income, the amount of milk to be sold has to increase. (fig. 15) This kind of urgency to hyper effectiveness spreads over every branch of the agricultural sector.

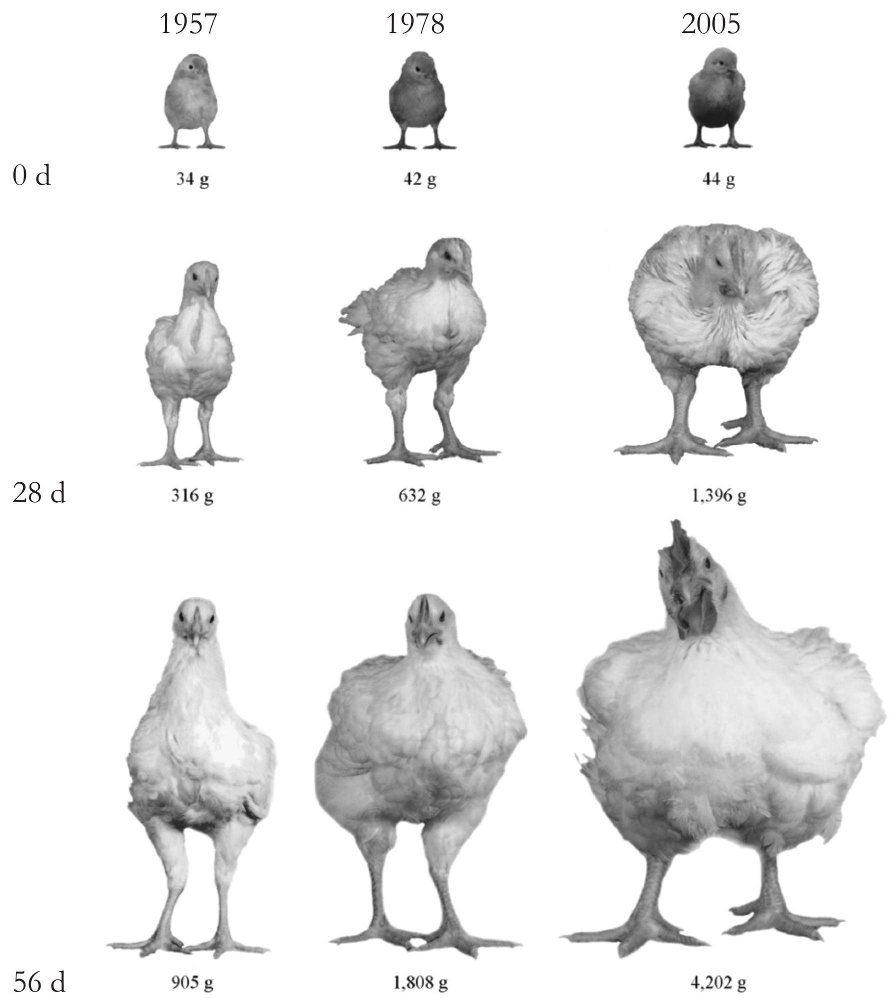
All these causalities have strong impact on the animals, whether its dairy or fattening animals. Selective breeding quadrupled the size of a commercial chicken in not even 50 years.

"If humans grew at a similar rate, a 3 kg (6.6 lb) newborn baby would weigh 300 kg (660 lb) after 2 months."[13]

But the rapid growth isn't the only absurdity, the process of selective breeding made broilers also more vulnerable to certain diseases or malformations. Dense rearing and insufficient direct sunlight also contributes to these issues.[14] Dutch law demands 22 chicken per square meter maximum (the drawing even just shows 21 chicken on the square meter because of a lack of space). (fig. 14) These circumstances lead to high doses of antibiotics to keep the birds healthy during their short miserable life.

13. R. F. Wideman, D. D. Rhoads, G. F. Erf & N. B. Anthony, "Pulmonary arterial hypertension (ascites syndrome) in broilers: A review," *Poultry Science*, Vol. 92, Issue 1, (January 2013): 65.

14. ASPCA , *A Growing Problem Selective Breeding in the Chicken Industry: The Case for Slower growth*, Accessed January 8, 2020, https://www.aspca.org/sites/default/files/chix_white_paper_nov2015_lores.pdf.

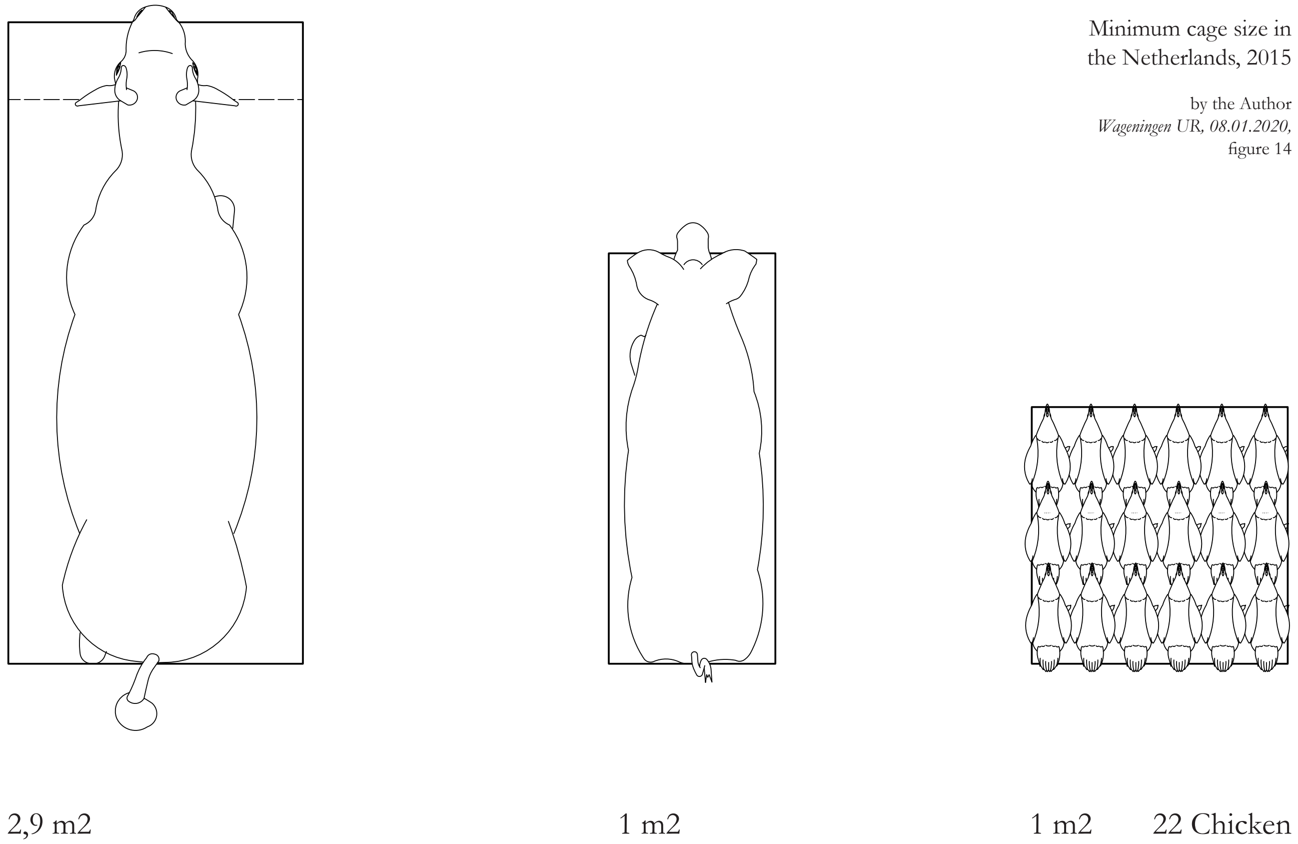


Commercial Broilers from 1957, 1978 and 2005 (2014)

https://doi.org/10.3382/ps.2014-04291, 08.01.2020,
figure 13

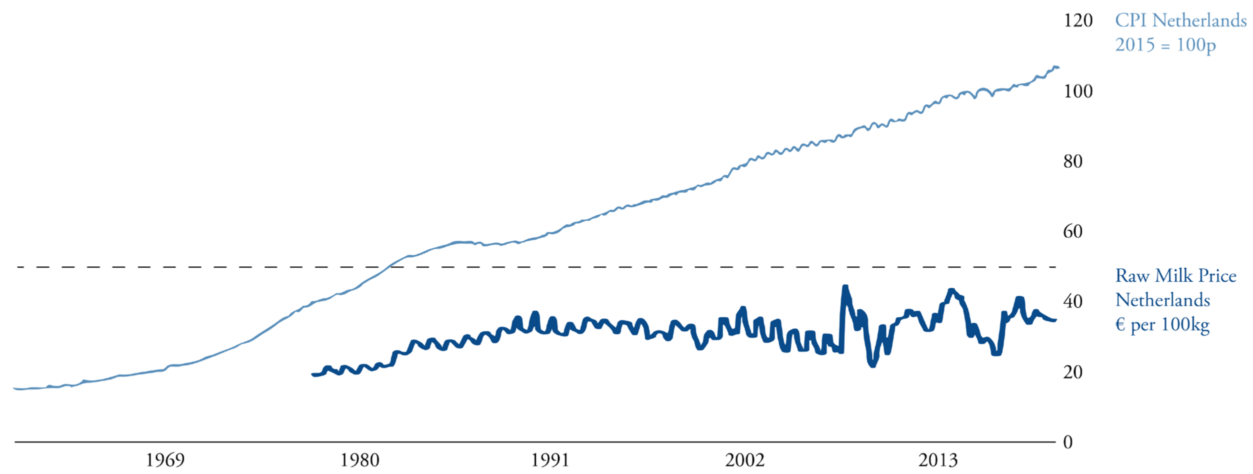
Minimum cage size in the Netherlands, 2015

by the Author
Wageningen UR, 08.01.2020,
figure 14



Raw Milkprice comparison with CPI (2019)

by the Author
cbs.nl, ec.europa.eu, 08.01.2020,
figure 15



Soybean Meal Import Netherlands compared with Dollar Price (2019)

by the Author
oec.world, www.indexmundi.com
08.01.2020,
figure 16

Apart from the obviously terrible rearing situation for the animals in the food industry, there is another part which has an ethical and measurable effect. Most animals are feed with Soybean meal, which gets imported to the Netherlands, mostly from South America. As previously touched the whole process of shipping these products produces NOx as exhaust from the shipping, which pollutes the Sea and contributes to the imbalance in the nitrogen cycle. Furthermore there is an ethical dimension to this practice: The major importer for Soybean Meal to the Netherlands, specially lately, is Brazil. (fig. 16) Since Bolsonaro is president in Brazil the deforestation of the rainforest along the amazonas has accelerated drastically. Specially Bolsanaro's reckless political behaviour are the reason for this issue. (fig. 17)

In figure 16 the import in $ is compared with the $ price for a ton of Soybean Meal to have a realistic understanding of the amounts of commodities being imported. Even tough the investment from 2013 is more then double the amount then it is in 2017, due to the sinking prices for the ton, the actual imported amount could be considered the same both years.

News Article (2019)

Unknown Author
theguardian.com, 08.01.2020
figure 17

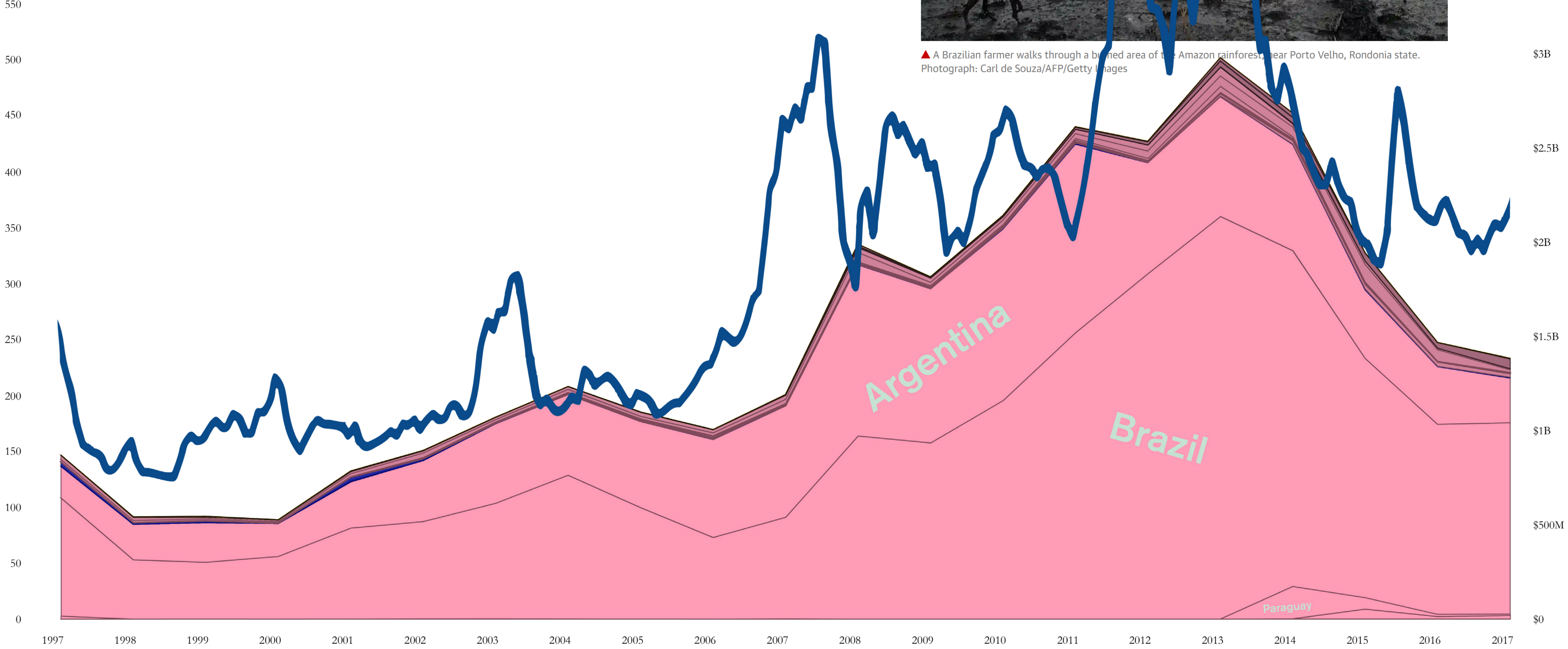
Amazon rainforest fires: Brazil to reject $20m pledged by G7

Senior official says funds should be spent on reforesting Europe and not on 'colonialist practices'

Amazon fires: what is happening and is there anything we can do?

▲ A Brazilian farmer walks through a burned area of the Amazon rainforest, near Porto Velho, Rondonia state. Photograph: Carl de Souza/AFP/Getty Images

$ per Ton



Import Value Netherlands Soybean Meal Total: $31.3B

Society Resonance

Its remarkable how people are rallying against naming a vegetarian patty Burger, specially since the word burger except of the English speaking countries might have adopted the term in the last 10 years. Still there is an almost an religious set of beliefs people and also politicians debate, in the case of the burger, about what is the identity of a burger. This intellectual philosophical exercise on its own is quite interesting. Since there is no perception of an internalized identity within a burger, which obviously is not capable to think and therefore internalize anything, every facet of identity the burger expresses is put on it by individual people. Vice versa this means that the vegetarian patty being called a burger doesn't effect the Burger itself and its identity rather its challenging the identity of the individual. I think these topics are so tense discussed because they make individuals question and challenge their own identity. Anyway, this philosophical exercise was just for my own amusement.

The facts are that scientists in the field of clean meat production are well aware of the yuck factor which basically internalizes everything what I just refereed about. A new technology changing something to a degree where people have to question themselves whether or not they can relate to it. I think the only way to address this issue is by making it sensually experienceable. To get people to actually try the produce and experience it fully.

News Article (2019)

Jon Stone, *www.independent.co.uk, 08.01.2020*
figure 18

Campaigners rally against EU 'veggie burger' name ban

EU regulations could see veggie burgers and sausages renamed 'veggie disks' and 'veggie tubes'

Jon Stone Brussels | @joncstone | Monday 13 May 2019 17:27 |
41 comments

News Article (2016)

Oscar Rousseau, *foodnavigator-usa.com, 08.01.2020*
figure 19

Lab-made meat rebranded 'clean meat' to address 'yuck' factor

By Oscar Rousseau
08-Sep-2016 - Last updated on 09-Sep-2016 at 07:25 GMT

SuperMeat's CEO Koby Barak said he was 'supportive' of the clean meat term

RELATED TAGS: Meat

1. Territory: North Sea / Netherlands

1.4 Problem Statement

The North Sea is currently in an over nutritioned state. These high doses of nitrogen and phosphates one can specially find along the Dutch and German coast line lead to eutrophication, meaning low level of oxygen in the Sea. This process transforms the whole maritime flora and fauna. The imbalances in Biochemical Flows are creating high risks for the environment and eventually Human life in the future.

Agriculture plays a major role in this dilemma, causing probably 60 percent of the global N2O emissions. This situation comes from the development an highly efficient agricultural enterprice which can not afford to not expand. Animals are being treated in horrible ways, monocultural fields are being held alive with high doses of pesticides and the imported soy grows on deforested rainforest territory somewhere along the amazonas. All these practices are results from the 3rd Agricultural Revolution mid 20th century.

Today Agriculture is close to the 4th Revolution. The process of producing food is detaching from most natural processes. Crops can be grown without soil and direct sunlight and Meat can be grown in incubators. The question is now whether these technological developments will change the stated issues, because their might be able to.

1.5 Research Question

How will future technologies of food production potentially transform the agricultural space of the Green Heart and how can this shifted space be beneficial with tackling the urgencies displayed in the planetary boundaries diagram, specially the Biochemical Flows?

Sub-questions

1. How can biochemical pollution be avoided in agriculture by sustaining the current food supply?

2. What is necessary for the metabolism of these new technologies?

3. Which characteristics are strategically important when choosing a site for the facility?

4. What is natural space in the Dutch context?

Tower to the People
(2019)

by the Author
figure 20

Site

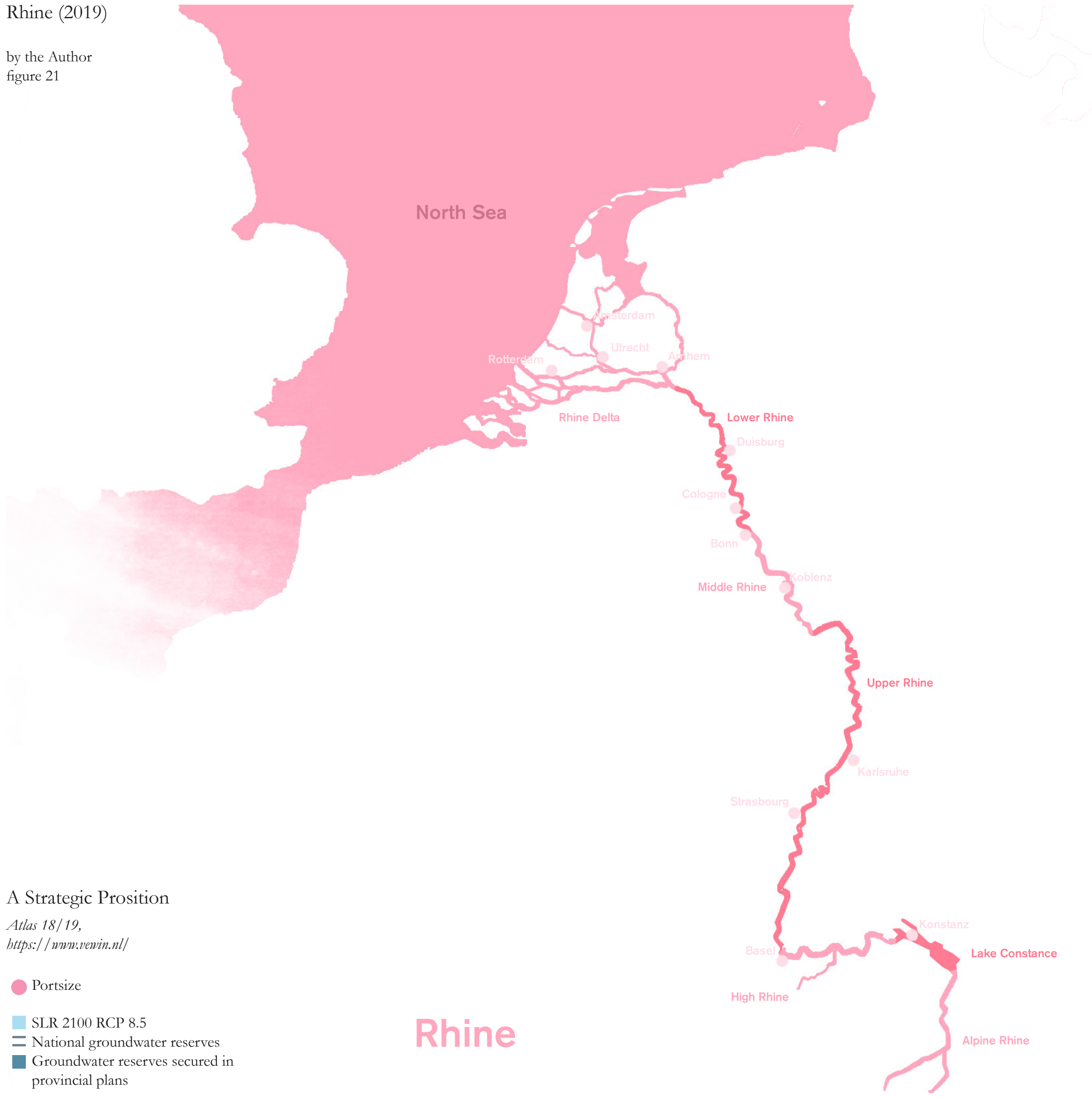
2. Site: Dordrecht

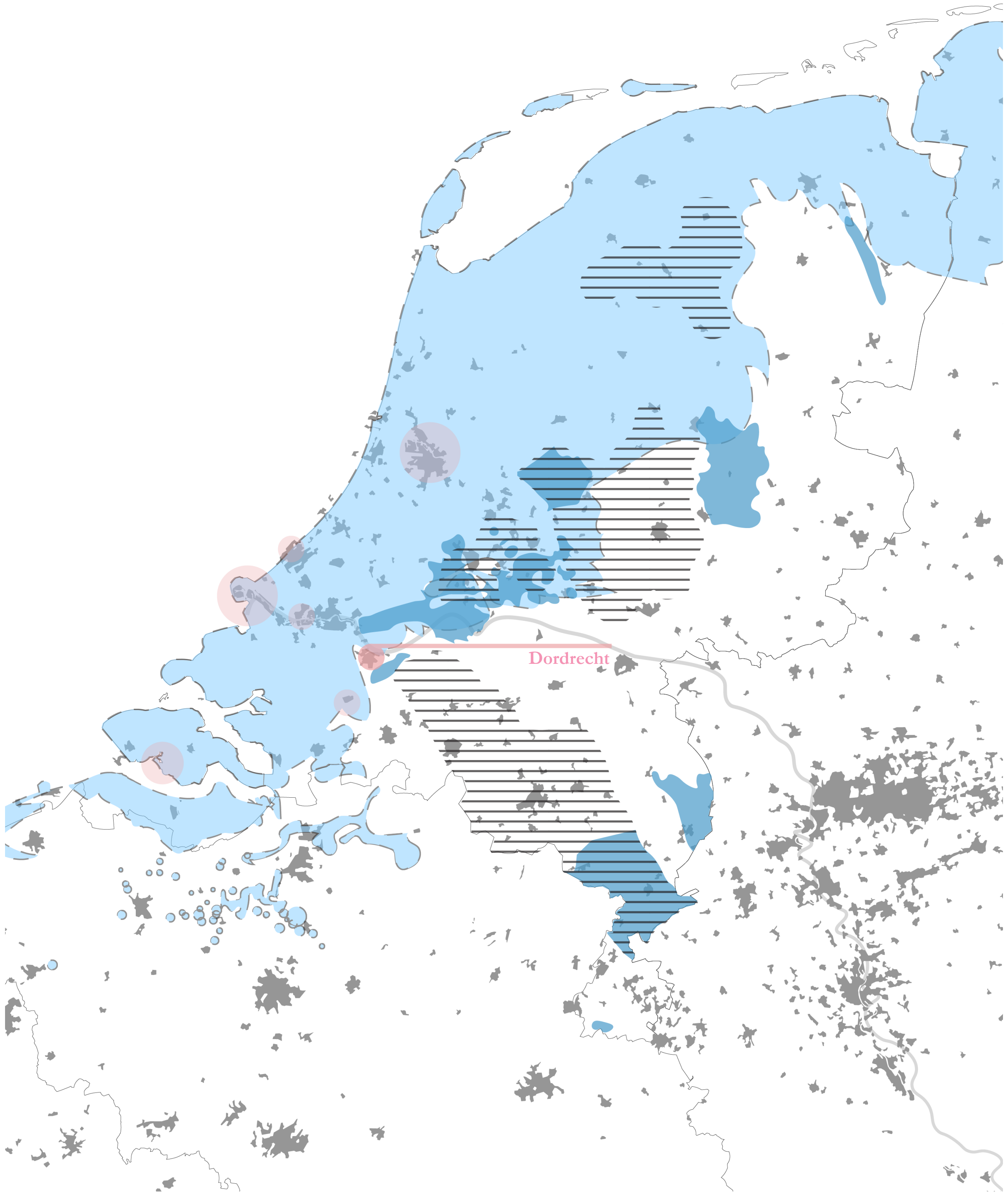
2.1 Choice of the site

The site of the project has to be in relation to several issues spatially which where further discussed in the previous chapter. Dordrecht connects several strategically important necessities with a complex urban tissue. Its sits at the edge of the Green Heart and on the edge of the most extremely expected water level rise scenario for 2100. Dordrecht has a medium size port in the Rhine Delta with inland shipping options, plus the close connection to the Port of Rotterdam. Also the currently transitioning urban situation of Dordrecht, like many people leaving into bigger cities, makes the site interesting for a new Economy.

Rhine (2019)

by the Author
figure 21





A Strategic Prosition
Atlas 18/19,
https://www.rewin.nl/

Portsize

SLR 2100 RCP 8.5
National groundwater reserves
Groundwater reserves secured in provincial plans

2.2.1 Urban Identity - Historical Precedents

15. “Diversa sed Una: A Literary Society’s Collection > Dordrecht’s history in a nutshell”, Het Geheugen, last modified date unknown, Accessed January, 12, 2020, https://geheugen.delpher.nl/en/geheugen/pages/collectie/.

Dordrecht was found in the 12th century as a settlement and bloomed in the second half of the 13th century until the point where is became the capital of Holland from 1418 - 1421. This came to an abrupt end when at St. Elizabeth night, the 18th November 1421, when the dikes broke and part of the city and its farmland flooded. After the big fire in 1457, which lasted for five days and burned down 700 houses, Rotterdam took over the wine trade and Amsterdam the timber trade which have been formally Dordrechts trade relations.

After a period of stagnation resulting from the mentioned catastrophes, Dordrecht started to reclaim the during the flood lost land in the 16th century. 1636 the plague hit the region and claimed 3600 deaths, 1 out of 6 people. Later Dordrecht had a important role in the patriot period, when a rising middle-class stood up against aristocracy in the 17th century. 1795 the Patriots came into power, which 1815 after the French invasion turned into the still present constitutional monarchy.[15]

In the beginning of the 19th century an epidemic of cholera led to hundreds of deaths in Dordrecht. Canals where filled and houses disconnected from the water-system to keep the disease from spreading further. After 1850 the city expands because of the rising of the population. But the substantial growth to the current size came after the second World War in 1950.

Birdslife (2020)

by the Author
figure 22

Medieval Layer (2020)

by the Author
figure 23

What makes a Glasshouse? (2020)

by the Author
figure 24

Art Route (2020)

by the Author
figure 25

Pancakes for Lunch (2020)

by the Author
figure 26

2.2.2 Urban Identity - Space

The old part of town in Dordrecht is picturesque and what one expects from a Dutch medieval city center. (fig. 23) It has a lot of galleries which, apart from the core streets, seem to be the only surviving retailers in the city center. (fig. 25). Next to the main streets there are always these small narrow alleys which are either just paths, residents streets or even used as storage space from locals. One can experience the observations Cullen made and published in "The Concise Townscape" from 1961.[16]

With this sequence of alleys the observer should get a grip on the many layers present in the center of Dordrecht and its transitions. The old center of Dordrecht does not have an open character, its rather interleaved and reveals itself just to the attentive observer. But the openness when its present and reveals itselft becomes more spectacular this way, as Cullen also states. (fig. 27)

16. Gordon Cullen, *The Concise Townscape*, (Oxford: The Architecturalpress, 1961)

Poffertjes Alleys (2020)

by the Author
figures 27

2.2.3 Urban Identity - The Death of Small Town Holland

Another present observation is that many stores in the center of Dordrecht are vacant. This goes for the small stores but also for lager units, specially the ones on the outer ring of the city center. The following collection intends to give an impression about this state of the dying retail culture. (fig. 28)

Death of Small Town Holland (2020)

by the Author
figures 28

2.2.4 Urban Identity - Industrial Identity - Water Tower

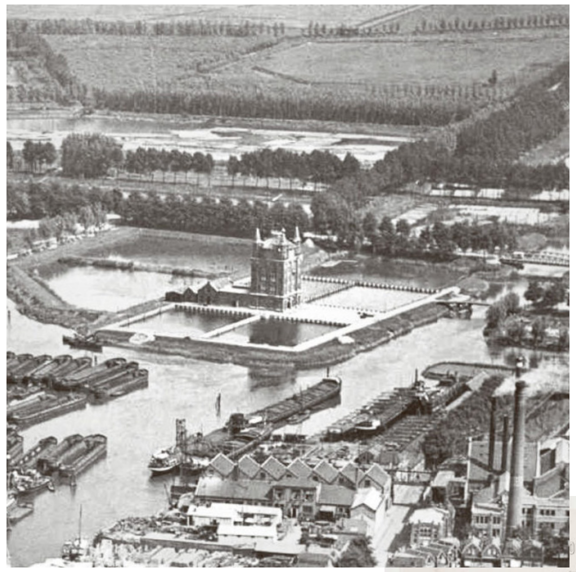
The development of industrial architecture can be viewed by further penetration of Dordrechts industrial area, coming from Oranjelaan. The first large industrial building one encounters is now the Villa Augustus. Formally the first watertower of Dordrecht, built in 1881, has written

"The enemy, often the terror of the Dutch lowlands,
has entered this house.
and it leaves again, as a good friend of the sick and the healthy,
towards Dordrecht."[17]

on the facade. The building was designed from J A van der Kloes, who later became a teacher at TU Delft (formally called Delft Polytechic, and is directly built on the Wantij stream which comes from the Biesbosch. The 33 meter high tower is a national protected architectural monument.[18] With the refurbishment after 2003 the former vacant watertower became a hotel. (fig. 31)

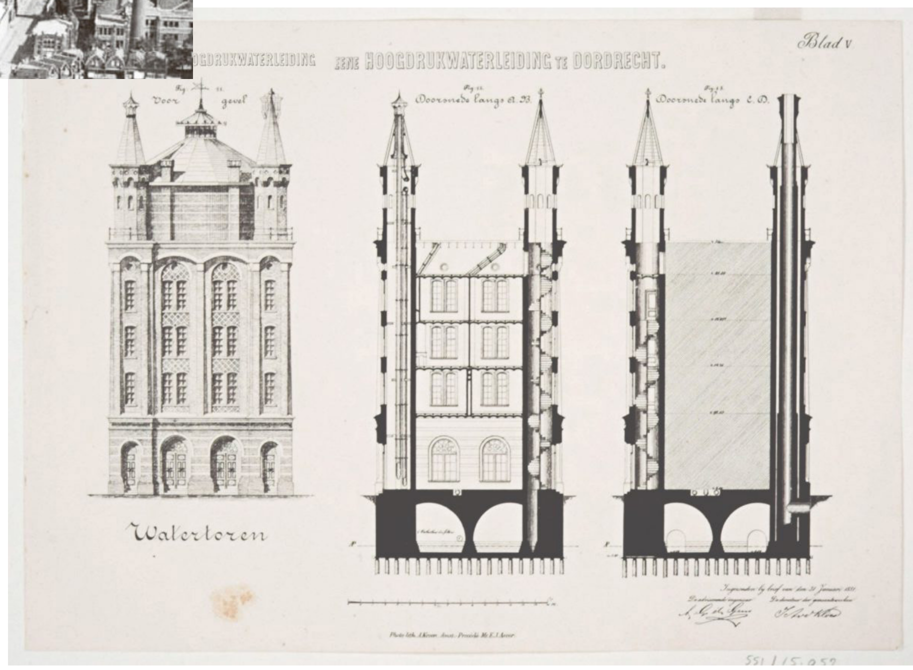
17. "De vijand, vaak de schrik van Neêrlands lage gronden. Heeft hij dit huis betreên. Vertrekt, als weldoend vriend van zieken en gezonden, En richt naar Dordt zijn scheren" - Original text, Geschiedenis van Villa Augustus, last modified date unknown, Accessed January 12, 2020, https://www.villa-augustus.nl/en/history/.

18. Geschiedenis van Villa Augustus, "De vijand".



Aerial Photograph
(1930)

Unknown Author,
www.villa-augustus.nl/geschiedenis,
12.01.2020
figure 29



Ontwerp van de
Hoogdrukwaterleiding
(?)

J. A. van der Kloes,
www.villa-augustus.nl/geschiedenis,
12.01.2020
figure 30

Enchanted Watertower
(2020)

by the Author
figures 31

2.2.5 Urban Identity - A brief selected Industrial History of Dordrecht

The Boterbeures built in 1841 is also a national architectural monument. It is right in the center of the old part of Dordrecht and for hundred years it was the local butermarket. As the watertower the monument has been transformed and now it hosts luxury apartments.[19] (fig. 33)

Historically the building on Oranjelaan 1 has almost a socialist rigidity to it and first appears on the maps in 1960. (fig. 34) Further one encounters later examples of the type industrial buildings which are not quite as refined architecturally, (fig. 35) with the exception of the last industrial complex. Architecturally it clearly comes after Centre Pompidou with a touch of De Stjil coloring, although the depth of utilizing the language of Cente Pompidou in the context its imported from makes the presence banal but pleasing to experience. (fig. 35-38)

19. "Dit rijksmonument wordt omgebouwd tot woonplek met vijf moderne lofts", In de Buurt, last modified date unkown, Accessed January 12, 2020 https://indebuurt.nl/dordrecht/wonen/dit-rijksmonument-wordt-omgebouwd-tot-woonplek-met-vijf-moderne-lofts~47318/.

Dutch AT-AT (2020)

by the Author
figure 32

Boterbeurs (2020)

by the Author
figure 33

Unknown 50's (2020)

by the Author
figure 34

Rational Tube (2020)

by the Author
figure 36

Blue Stages (2020)

by the Author
figure 35

Layered Identity (2020)

by the Author
figure 37

Robo Chicken (2020)

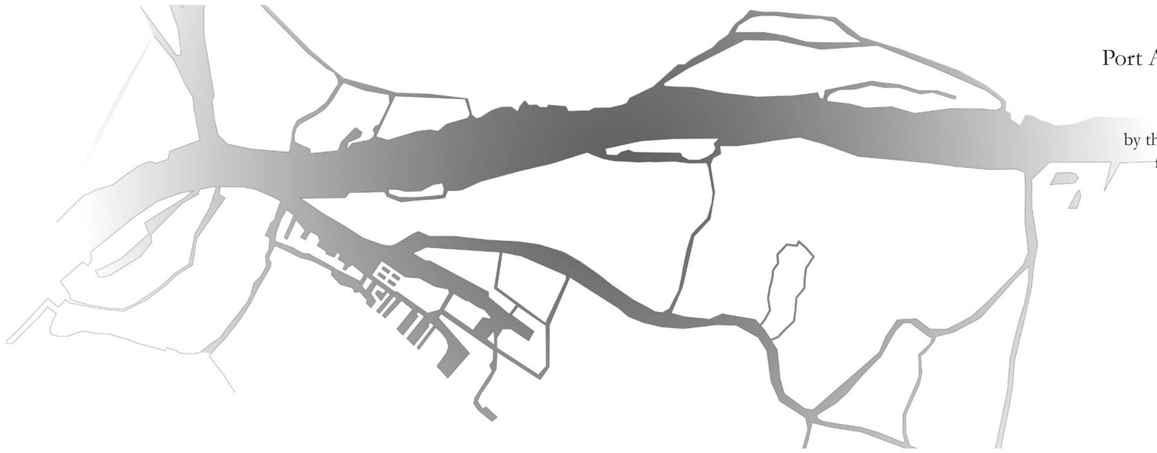
by the Author
figure 38

2.3 Site Analysis

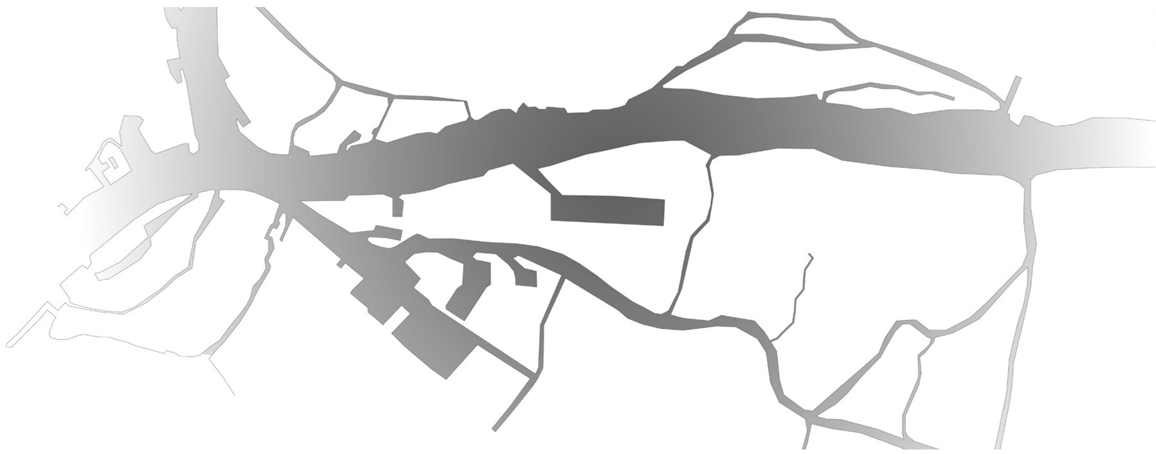
When considering the stages of development in the history of Dordrecht its important to have a look also on how the water scape changed, specially since 1900. One can see from the schematic drawings the port of Dordrecht started off close to the old city center and was rather small individual units, probably per company or enterprice. In 1936 the scheme transformed drastically, the port moved further out, basins where united and enlarged which has to do with increased shipping but also larger ships. Until 1960 the port activity almost completely moved further from the center and some of the central basins got filled. Also on the opposite of the Maas, in Papendrecht are port basins. These ports on the Dordrecht side received further basin refinement until 1970, plus the local water storage basin got built. In the 2000's until now the enlargement of this basin and cutting of the arm coming south from the Maas in its direction, is the only major change on the water scape in the industrial area.
In the same period the water scape on the opposite side connected to Dordrecht city experienced several changes from industrial land reclamation till recreational land reclamation.

Port Analysis
(2020)

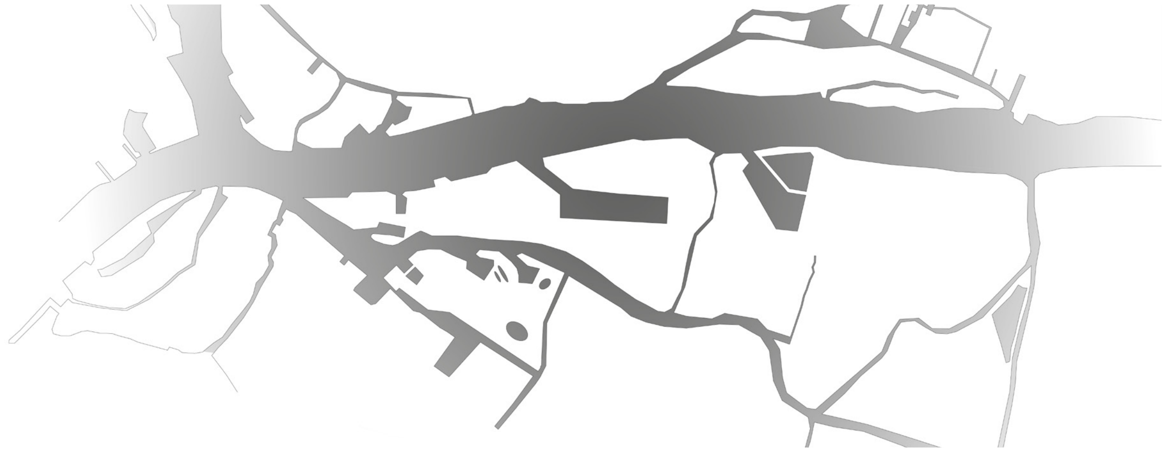
by the Author
figures 39



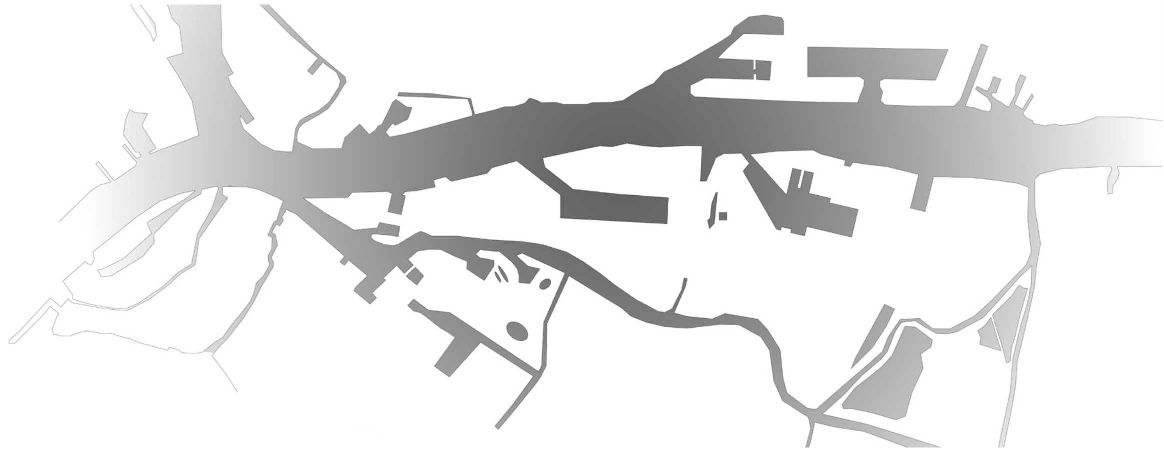
1900



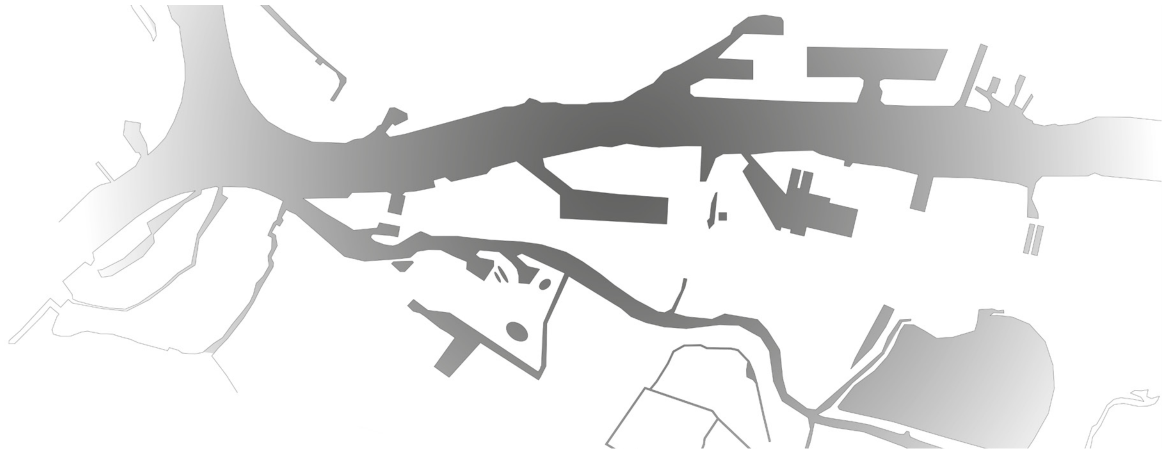
1936



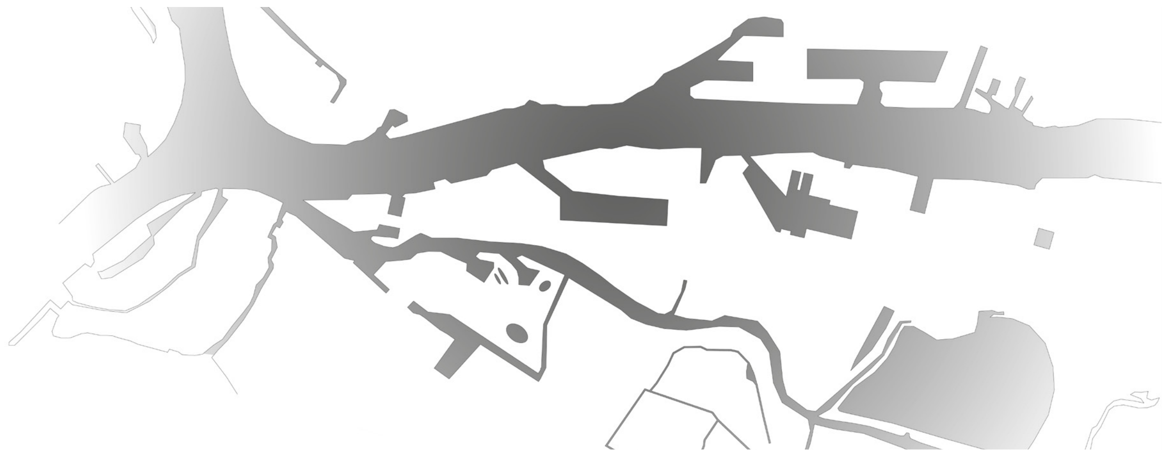
1960



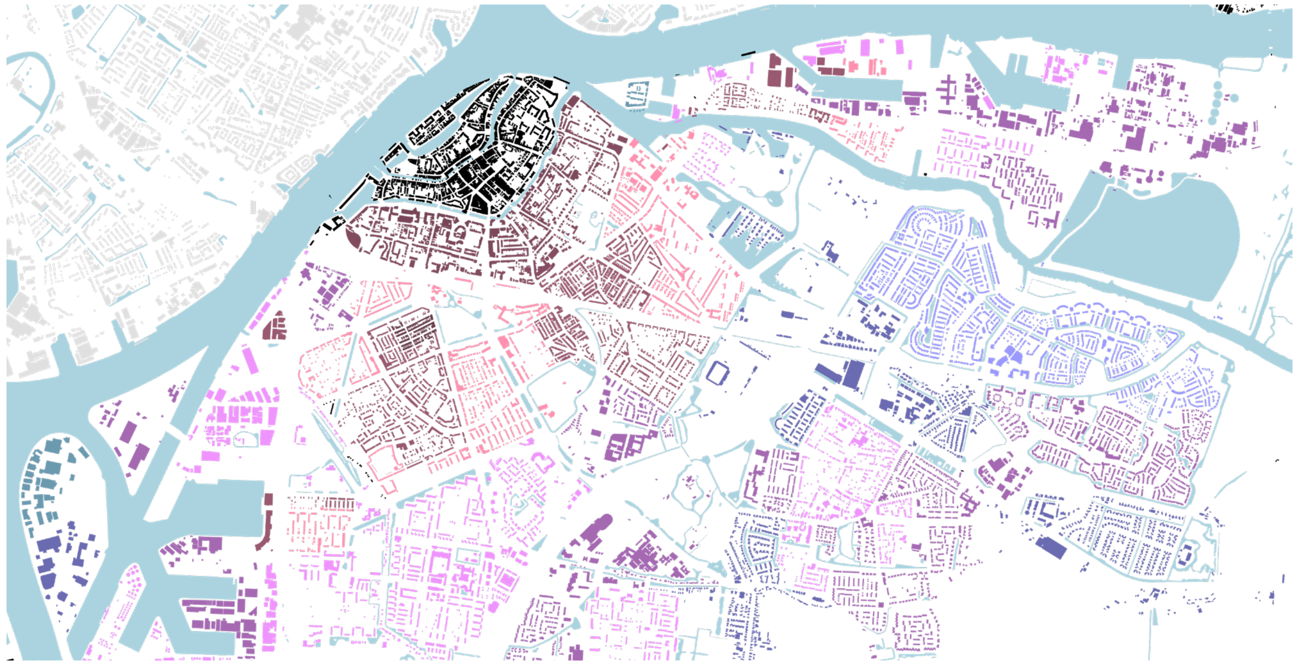
1970



2000



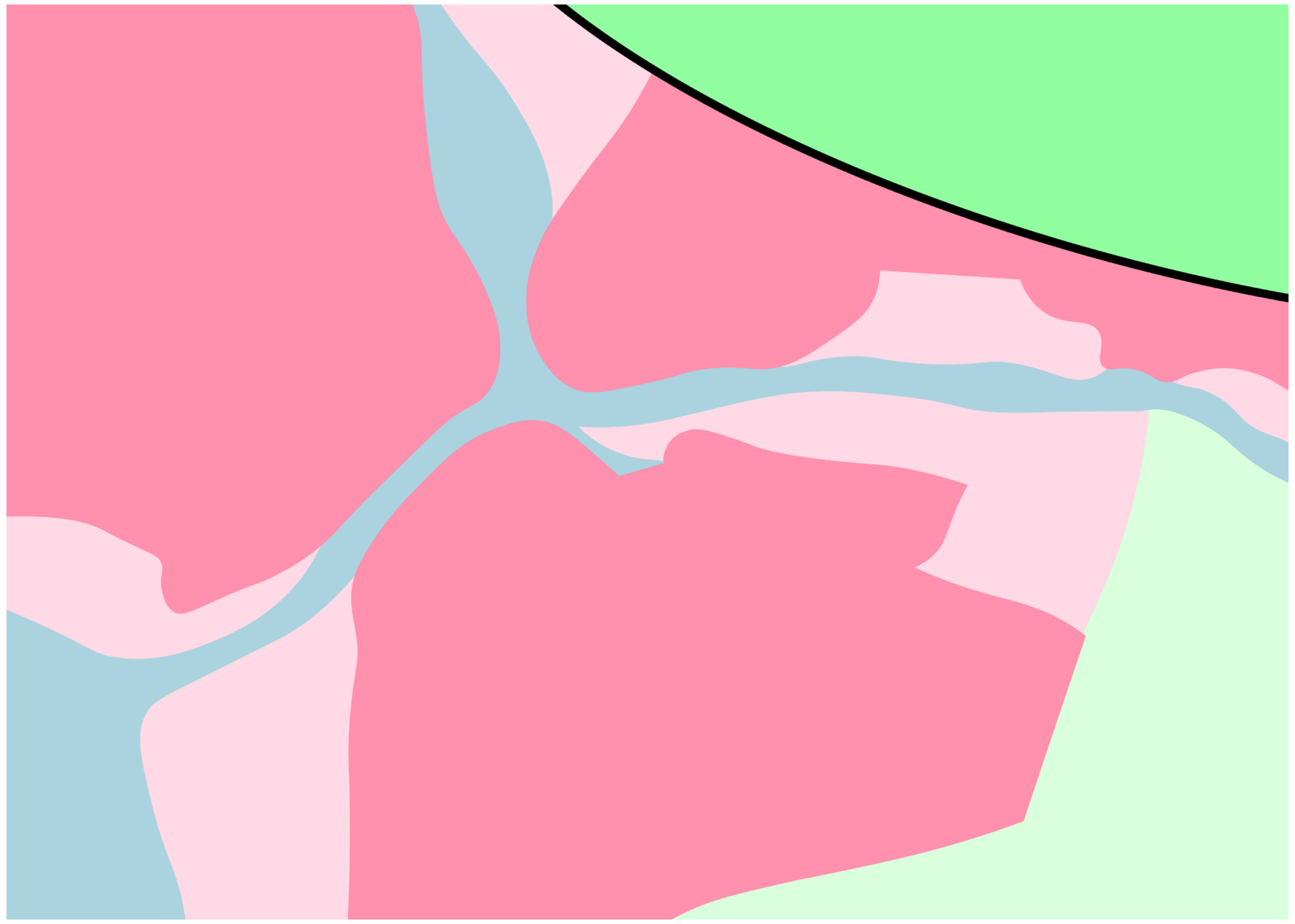
2018



Dordrecht is a layered city consisting of a historic core, surrounded by a bit of small town city around, which apart from the major roads seems relatively vacant. Both are surrounded by layers suburbia which scatters more the further one moves from the center. Along side of it sits the industrial area on its own island. To the North industrial buildings and South the former workers apartments. This is not an unusual phenomenon for suburban cities which grew fast with the population and economical growth in the second half of the 19th century in Europe. One can see the development phases of the built environment on the top map and the perception of districts on the bottom one.

The industrial area is shrinking since local industries can't compete with global trade prices and also the port activities got exported to the major port region of the territory, the port of Rotterdam. Same goes for the small retailers in the city center. The plenty vacant estates are also the outcome of international and specially digital trade via internet. One can observe in both branches a centralization of businesses and a loss of small businesses. Interesting to observe is the flourishing market for small creative retailers and galleries in the center of Dordrecht. This might have to do with tourism and the individualist urge to purchase an unique artefact souvenir. Generally it seems as if there is a market of luxury rather then the ordinary. Starting with the small galleries and craftsmen in the center till the Augustus Hotel.

Dordrechts population stayed more or less stable during the last 10 years, with 118.654 residents in 2019. Statistically the observation of retailers and leaving industry is invalid the number of 7.943 businesses in 2013 rose to 9.195 in 2019. On the other hand the average income in Dordrecht is about 23.900 €, ranking the city in the lowest quarter in Zuid-Holland.[20]



Urban Development

oldmapsonline.org, 20.02.20

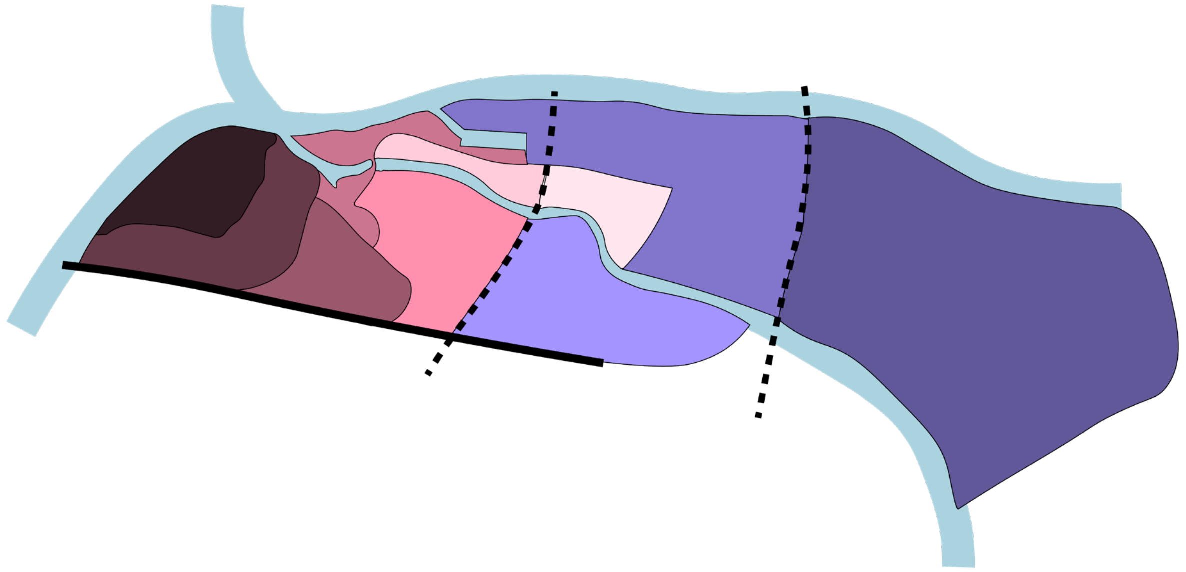
1815 2020

Spatial Use

- Urban
- Industrial
- Green Heart
- Nature Reserve

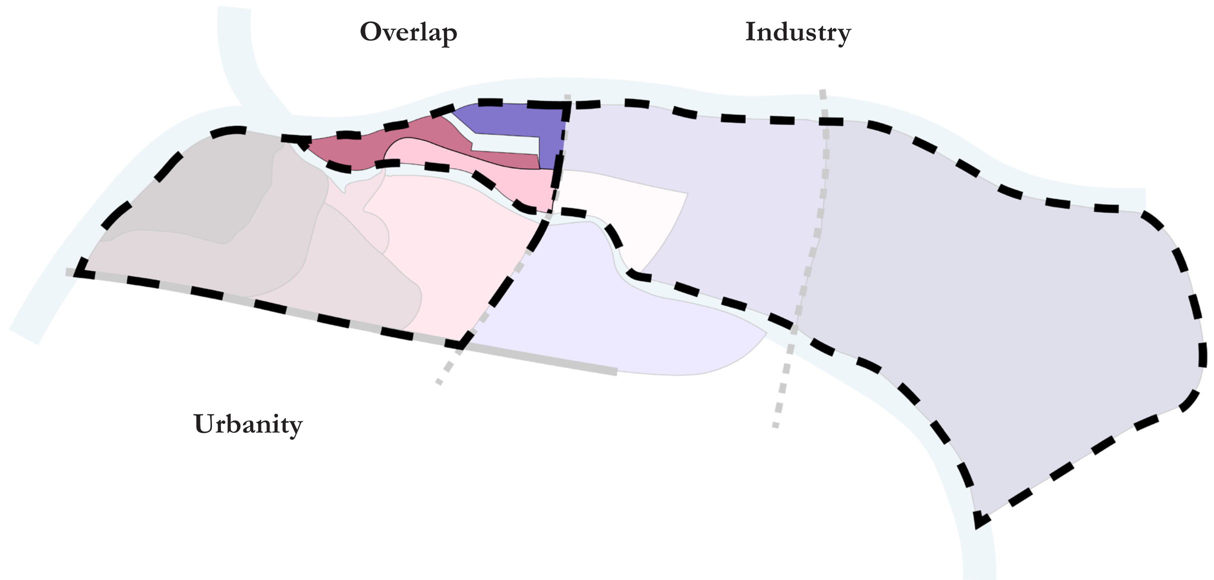
City of Layers

Dordrecht really is a city of layers which one experiences in each of these layers differently, from the medieval center, the suburban to the stretched out industrial area.
Zooming in and visualizing these layers one finds that there are two main parts separated by the river, railway and even the highway. Most interesting in regard to the project is where the industrial and urban part overlap. This overlap is the perfect spot for the project to connect a new industry with its consumers. The potential for this integration in to everyday life is highest at this spot.



Layers of Dordrecht
(2020)

by the Author
figure 40



Location Overlap
(2020)

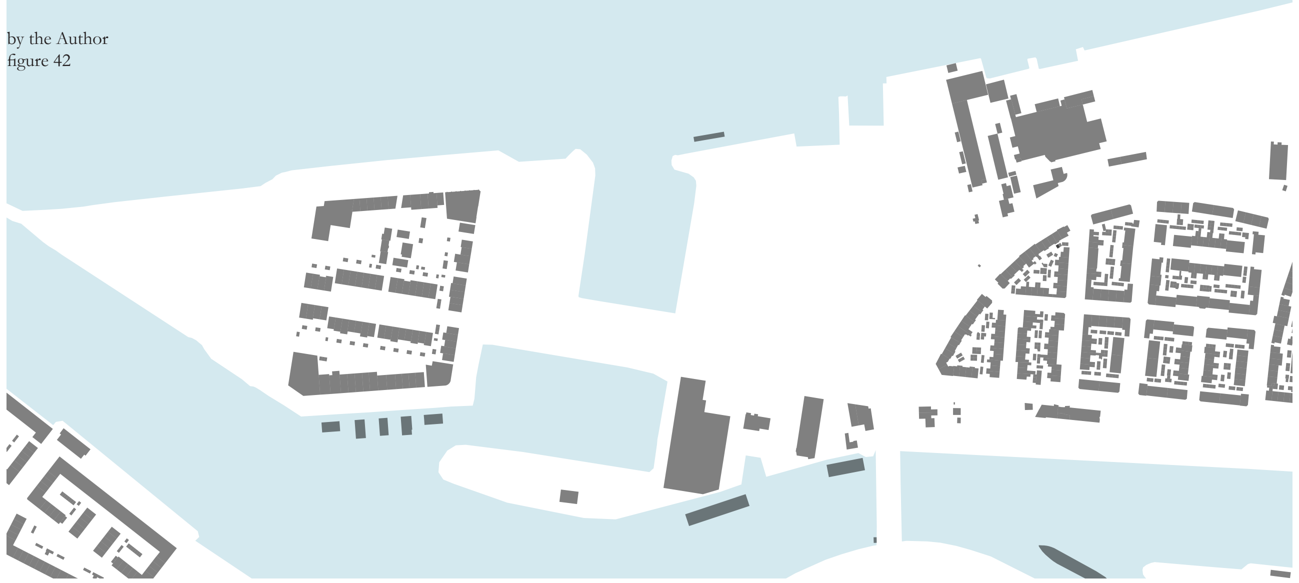
by the Author
figure 41

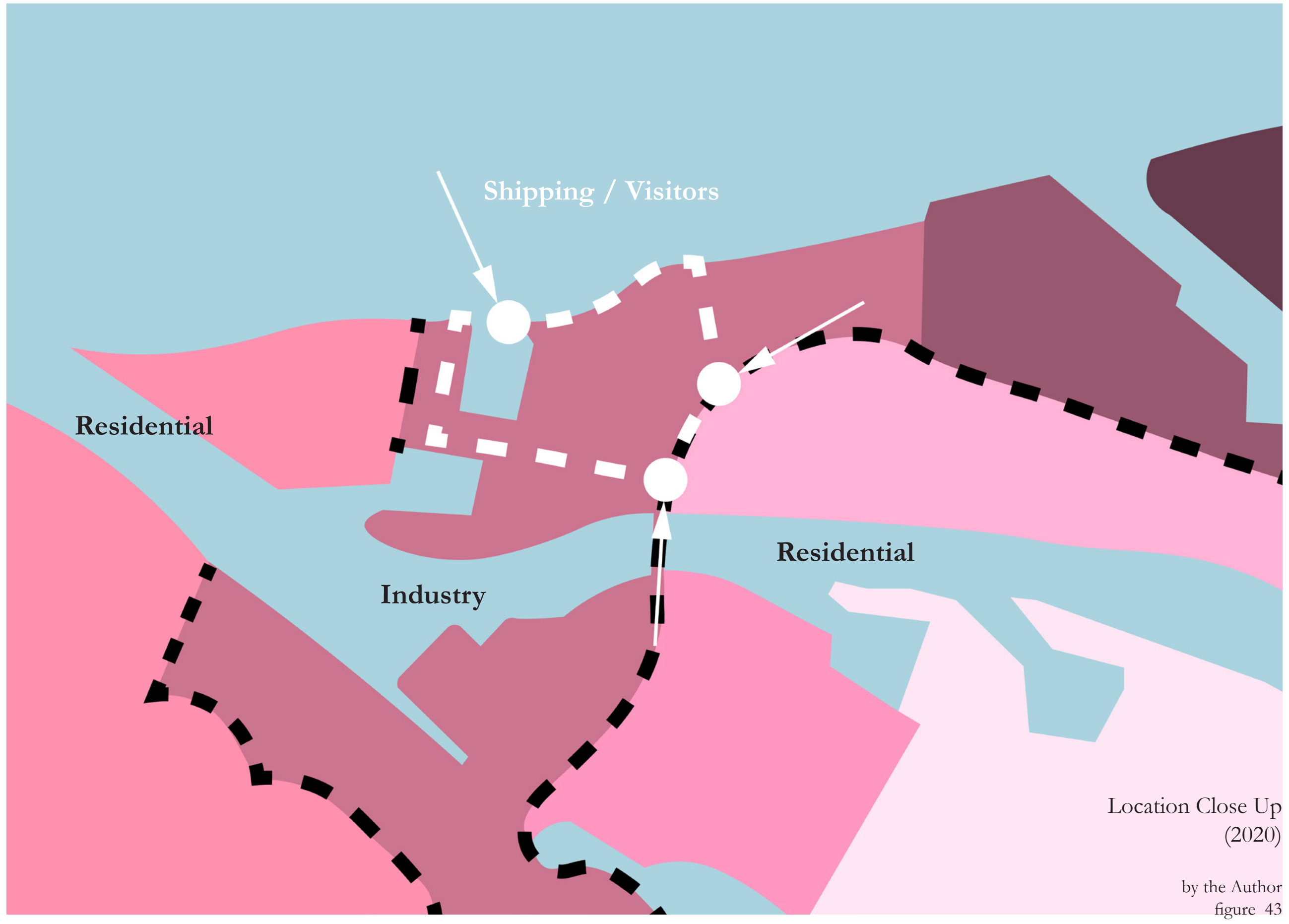
The existing urban situation at site is changing, the former industrial inhabitation is decreasing and decommissioning. In figure 39 one can see a big empty plot in the center where a ship yard used to be. Its surrounded by an residential development in the west and a concrete brick factory in the north east. The southern part is connected to an old industrial facility which became a museum. East from which a working class residencies from the 50's are located.

The central plot is ideal for the enterprise of this project. It connects with bringing the urban and the industrial together. Thereby the infrastructural connections are also ideal. Shipping via close by highway connection and river is possible. Also the river will function as the main water resource for the facility.

Figure Ground Existing Situation

by the Author
figure 42





Location Close Up
(2020)

by the Author
figure 43

2. Site: Dordrecht

2.4 Problem Statement

The presence of the Port of Rotterdam shaped Dordrecht to the suburban city it is today. Historically it played an important role in the political- and trade- development of the Netherlands, but catastrophes and its not as strategically important position lead to it never becoming as large as Rotterdam or Amsterdam. It sits like Amsterdam, Rotterdam or The Hague at the Green Heart of the Megatropolis.

The agricultural activity of the Green Heart is mostly responsible for the Nitrogen crisis in the Netherlands as claimed in the 1st chapter. Possibilities like the 4th Agricultural Revolution have to make the difference in achieving urgencies like imbalanced Biochemical flows. But along with the opportunities comes a big chunk of uncertainty since the development of these technologies are on the verge and not yet fully refined. The scenario thereby becomes partially speculative and specially questions about the metabolism behind the industry have to be research on similar industries.

Since Dordrechts port is currently experiencing further decommissioning like, the chemical industry moved away from the Biesbosch which became a nature reserve, the spatial use question of the industrial area of Dordrecht is not jet solved. A new industry, aiming to transform the oldest form of industry present in the Netherlands (agriculture) will potentially influence the whole Rhine delta. These two main interventions on a territorial and architectural scale will transform the Heart of the Megatropolis by forming a new understanding of what is Nature.

2.5 Design Question

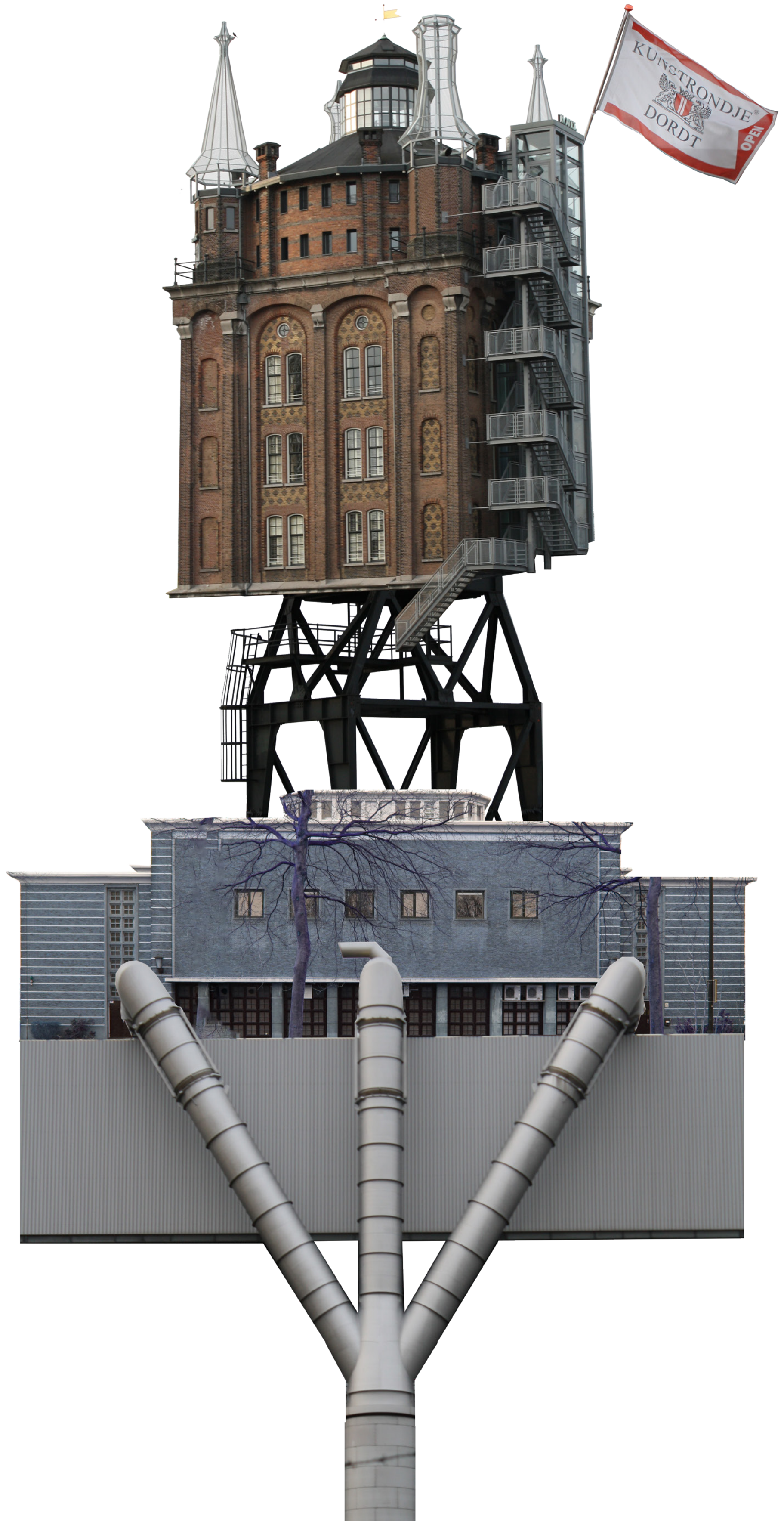
How does the architecture of these future technologies look like and how can it contribute to their acceptance in society?

Sub-questions

1. How does design and context play a role in the acceptance of a new industry?

2. What types of exhibition architecture exist, how do they perform and what's the relationship between the object and subject?

3. What infrastructure is necessary in order to create a circular metabolism for the facility?



To Build Up On
(2020)

by the Author
figure 44

Problem Analysis

3. Problem Analysis

3.1 Research Framework
Research Methods - Analysis Methods

20. Ray Lucas, *Research Methods for Architecture*, (Berlin:Laurence King Publishing, 2015), 41.

Since the collective research about the North Sea I followed an etic, positivist and quantitative epistemology with the use of different methods. Etic mapping with the goal to display objective data about capital and its flows in the territory is one of them. Often those maps where qualified with analytical diagrams. These diagrams explained for example how a specific technology works in the territory and its effects on it, like the effects of sea bed dredging on the environment and how a dredger performs. We used these diverse methods because the mapped data displayed a wicked problem which is almost untangle able. I also used these methods in my personal research with mapping etic, objective data about the territory in order to from hypotheses although I rather follow a constructivist approach which is perspective dependent. Due to its transdisciplinary nature working from territorial scale to rather architectural later I have to implement another layer of qualitative typological research of related factories since study objects of the mentioned future food technologies are not really existing yet.

Future food production means basically technology like clean / lab meat production and vertical farming. Both are on a verge to change our food production drastically. To examine the possibilities I use a dialectic methodology to discuss all that comes along with it regarding territorial space, may it be positive or negative regarding the values and goals of my research. This choice has to do with the society acceptance which I touched earlier on. Recent political discussions and protests like the farmers protest in the Netherlands and the rapid thoughtlessly political actions which came before and afterwards, show that there is a lot of friction which could led to prohibition. This displays an urgency of a dialectic discussion and eventually the architectural question of how architecture can contribute to the acceptance of such promising technologies.

> *"Architecture is, by it's nature a complex, multifaceted field of study, meaning that no single approach can tell you everything that you need to know"*[20]

Like Lucas states I am unable to frame my research in one approach specially since our studio is transdisciplinary. Architecturally as touched above I will use typological analysis of archetypes which play the role of a mediator between the subject and object to figure out the distinct nature and role of each. How each is designed in the matter of hierarchy and purpose.

3.1. Research Framework
Research Methods

thematic research

Territory

Biochemical Pollution (L + MC + MP)
Agricultural Technology (L + MC + R)
Nature & Culture (L + MC + R)

Site

Context (MC + V)
Metabolism (L + V + R)
Acceptance (L + V + R)

integration

Finding a new architectural Type
(MP + R + S + V)
Metabolism
(MP + R + S)

projection and design

Territorial Approach

Design a territorial strategy to address the hidden but rising urgencies connected with agiculture and food production in a local scenario (L+MP+S+D)

Architectural Design

Designing an architectural prototype as a circular economical mashine, implemented in the urban farbic of Dordrecht. Weaving together society and industry (V+D)

MSc 3
research

MSc 4
design (+research)

L	Literature Study
MC	Mapping Current State
MP	Mapping Projections
S	Scenario Planning
R	Reference Analysis
V	Visit
I	Interview
D	Research by Design

3. Problem Analysis

3.2 Subjects

21. Rachel Carson, *Silent Spring*, (Boston: Houghton Mifflin Harcourt, 1962).

22. Koert van Mensvoort, Hendrik-Jan Grievink, *Next Nature: Nature changes along with us*, (Barcelona: Actar, 2011).

23. Karl von Carlowitz, "Sylvicultura oeconomica" (Unknown Press, 1713).

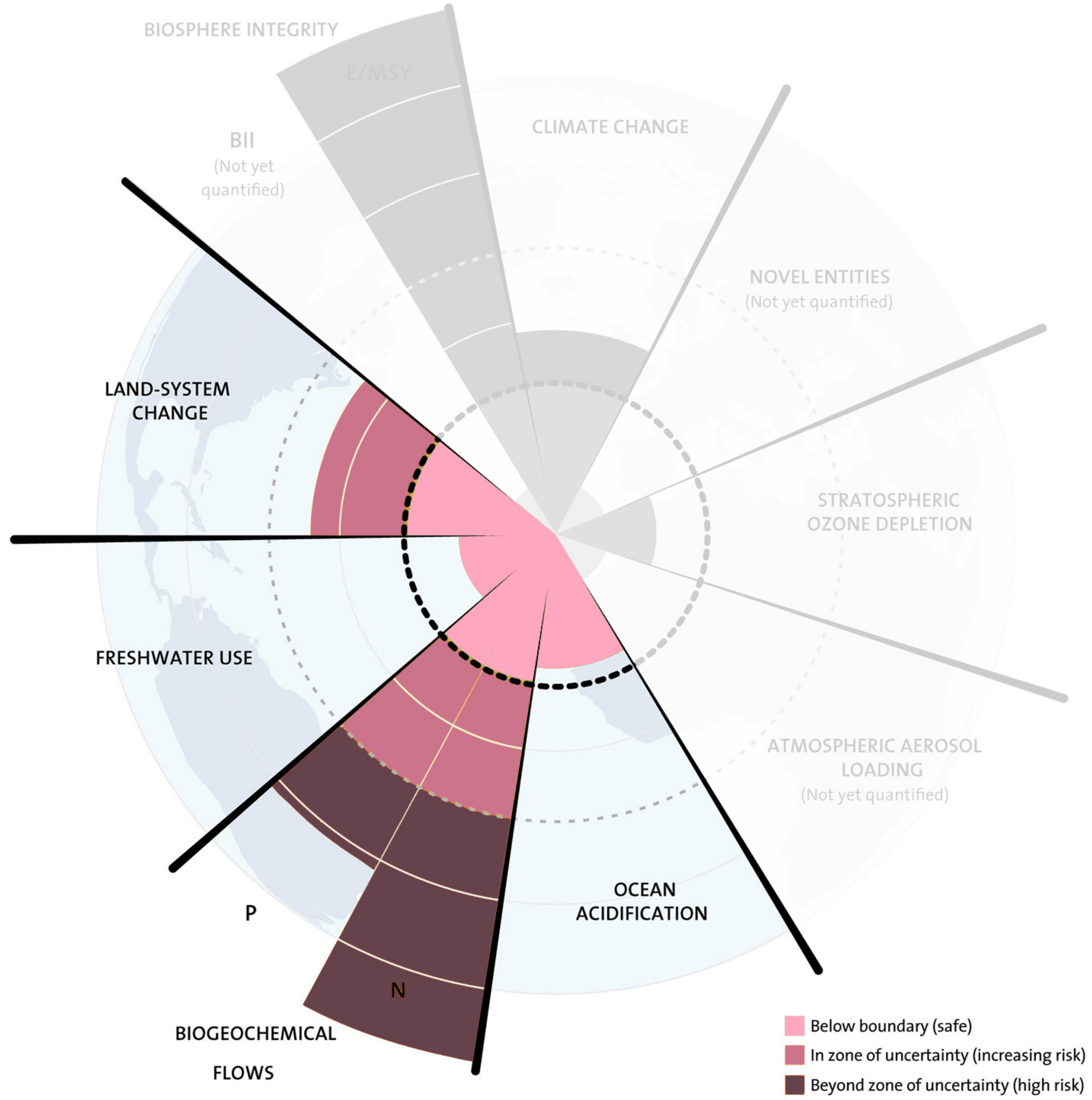
Nature & Culture

The current state of utilizing nearly every squaremetre available on the planet results in the environmental crisis scientists are sketching since the birth of environmentalism in the 1960's. [21]
The absurdity is peak paradox in the way countries treat their "natural heritage". Places and their "natural" identity is protected in a governed chosen framework, which is most often a abandoned an antrophocene place. Which means that the landscape we think of while thinking of a country is rather a translation of a landscape painting. The notions of nature and culture doesn't work anymore in the antrophocene and have to be shifted: to everything thats natural is without the human realm of control, and cultural for everything thats within our realm of control. [22]
To accept this understanding means leaving a nostalgic idea about untouched nature behind, which in central Europe does not exist since medieval times anymore anyway. Since then these major spatial interventions needed measures of sustainability, starting with the book Sylvicultura Oeconomica by Karl von Carlowitz written in 1713. [23] During the time deforestation for agriculture and construction lead to a concerning forest loss. Carlowitz understood that forestry had to be sustained for reasons from health to future wood supply.

With the refinement of agricultural technology the urgencies resolving from it also refined and political voids lobbyism and slow legislative procedures contribute to further pressure. The spatial relation of natural (uncontrolled) and cultural (controlled) space in the Netherlands is ~ 7 to 1, the antrophocene has already been entered and to balance those flows and urgencies might be achieved by balancing natural and cultural space. The project thereby addresses specifically the four displayed pieces of the pie chart. (fig. 45)

4th Agricultural Revolution

The uncertainty of a revolution is hard so grasp, considering that in comparison to an reformation things don't just adapt but radically change. Researching the possible outcome, opportunities and uncertainties though, makes them to a degree tangible. Agriculture is entering a stage where it doesn't need any soil, sun or even slaughtering anymore to produce food.



Planetary Boundaries Diagram (2015)

Stockholm Risilience Center
www.stockholmresiliencecenter.org, 05.01.2020
figure 45

The Project

4. The Project

4.1 Proposition

There once was a world of 10 billion people. They became so many and no one had a clue on how to actually create a world suitable for them. It just grew until a certain point and out of a sudden they had to produce the same amount of food in 50 years that they had produced the 10.000 years before. Also everyone used to talk about the devastating consequences of their lifestyles, depletion of materials, anthropocene, loss in biodiversity, acidification of the sea, climate change and so on. When the people now look back they question why they where so dumb in the first place. But almost everything has changed with their relationship to food. In 2019 almost two thirds of the Netherlands used to be agricultural space, spatially inefficient and unsustainable due to heavy amounts of pesticides and fertilizer. They even called it the "Green Heart"! And now meat and crops are mostly grown in factories. No more animal torturing, no more keeping cattle in cages which barely fit their body until they get slaughtered on assembly lines because their legs basically collapse under their own body weight, due to over breeding. The once flat land is now actively participating on trapping green house gases because one half of the Netherlands is a forest now. The shift in perception about what is cultural and natural from made and born to controlled and uncontrolled did a big share with this rethinking. When these technologies were on the verge basically when the 2020's where approaching, no one really knew if they could change the world for the better. But academics, students, scientists, politicians, activists, journalist etc. where pretty excited about the possibilities. Growing crops in the desert in a factory without soil and pesticides and just a fraction of the water and fertilizer it used to became an actual option. As well as growing meat in a factory by some muscle tissue in an incubator. On the other hand people were scared, meat scientists debated the Yuck Factor and legislation was on the way to argue about if clean meat should at all be called meat. I strongly believe these technologies will eventually change our whole food production world wide. People have to understand that all our food is cultivated and engineered and that there is actually not much difference in how a brewer uses an incubator and yeast to cultivate sugar into alcohol and eventually beer, to a meat grower which uses also an incubator to grow muscle cells on a nutrition medium.

I am researching on how this prototype actually looks and metabolically performs. Also about what are the odds of acceptance with a new technology?

Lastly I want to state that I am not an animal activist trying to convince people of vegetarianism or veganism, the aim is to contribute to the elevation of food production 4.0.

4. The Project

4.2 Objectives

1.

To figure out a strategy which, under certain measures implemented, can effectively produce food in a environmentally friendly (relying on renewables, low in fertilizing and resource use) to effectively compensate biochemical pollution.

2.

To find a distinct spatial expression of type for the latest agricultural technology.

3.

To understand and implement the diverse layers in which these interventions will perform in order to weave them seamlessly in the urban fabric.

4.

To embrace reciprocal coherences, for a greater connection to the industrial ecological system.

5.

To mediate between the subject (society) and the object (technology) in order to not alienate the technological progress.

4.3. Relevance

The project is relevant to the architectural scientific world, because the technologies I've been talking about have the potential to bring the 4th Agricultural Revolution. This means that first of all they are as recent that there has not been an architectural scientific work about clean meat factories. Same goes for vertical farms, they are also as new that there is not much known or even researched about their implementation in the built environment. Another important reason for the relevance is the potential shift in land use, that these technologies could offer.

The Nitrogen topic in the academic discourse came up around 2009 in the Planetary Boundaries Research. Claiming that the biochemical flows of Nitrogen and Phosphates are already beyond uncertain outcome which bring along high risks for the environment. These environmental concerns are closely related to environmental urbanism, which is sort of the core believe of the Transitional Territories studio. To the North Sea topic its obviously related since those flows are measurable in the Sea, in simple amounts of gram/litre or state of eutrophication.

Architecturally its interesting since the practice of clean meat production and vertical farming is rather a biological or agricultural science topic. But to root both within an existing context, address its cultural, natural, social or any other urban measure makes its quite architectural. Also the question about how to make the whole production process experienceable for the public to not alienate the practice is an architectural question.

4. The Project

4.4. Spatial Concept

a. Configuration and Composition

The project consists of three major elements, Clean Meat factory, Vertical Farm and a Restaurant. The three elements composite a whole, but will function as well as individual objects. Their main categories are industry and urbanity, so the project is looking for a location where the two overlap and connect.

As already introduced this site brings along all strategic necessities for the facility. The decommissioned site needs a new master plan which reinforces the implementation if the facility. The plan is a representation on the spatial identity of dordrechts heritage in urban blocks. Three main squares create diverse functions in the new development. Thereby the courtyard inside the facility plays a central role in the fluxes, in recreational area and as a representation of the Dutch landscape.

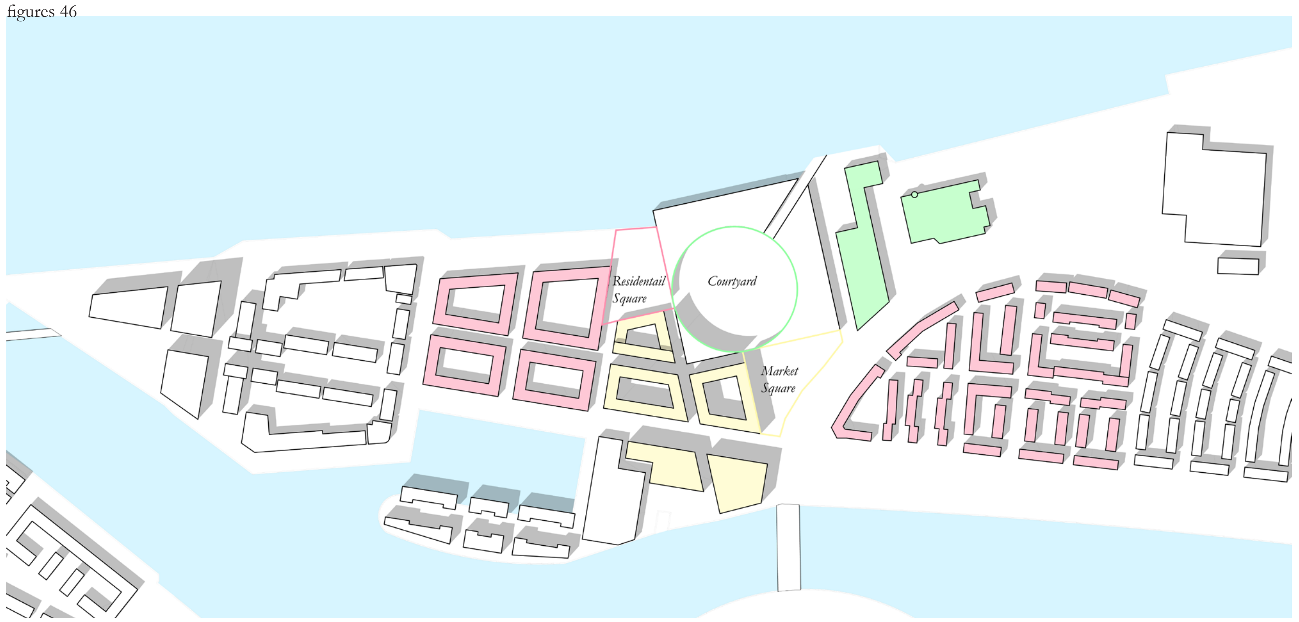
Pedestrians arrive via waterbus at the north eastern top of the facility, the architecture becomes a gate for the city in this way. Industrial and Pedestrian fluxes are separated, produce is either shipped on the eastern side by truck or in the northern side by ship.

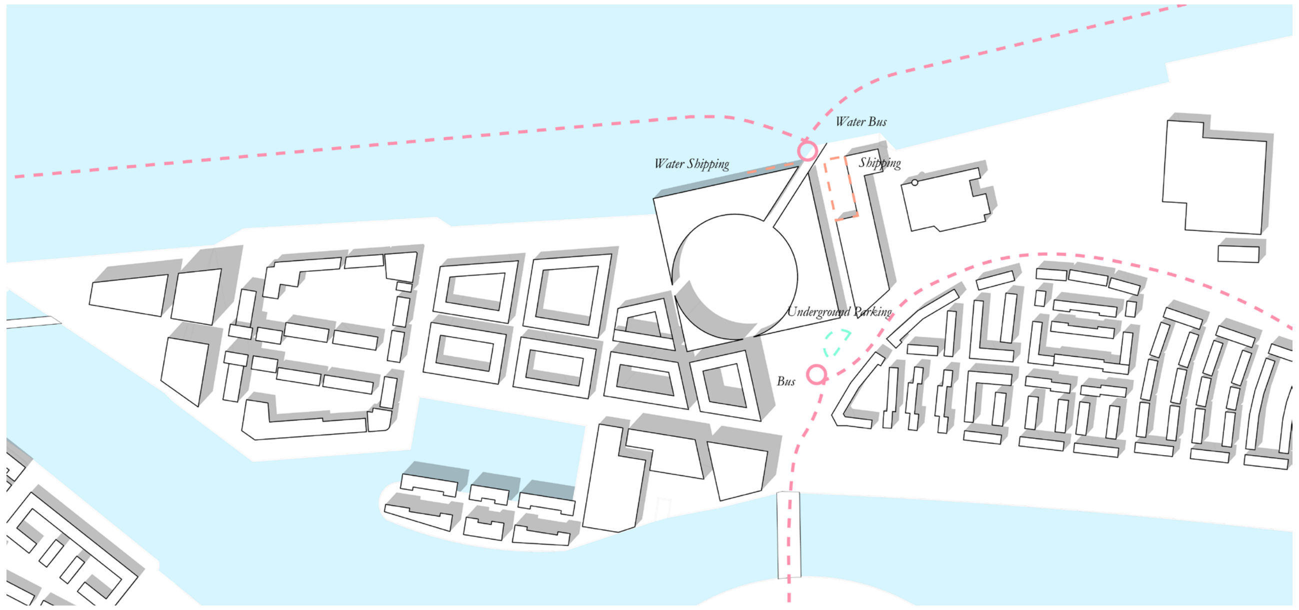
As already mentioned the architecture aims to interpret the spatial qualities of dordrechts layered character. This means that the architecture is like a medieval city rather introverted. It reveals itself to the curious explorer, it does so by visible connections from the main approach axes to the main entrances.

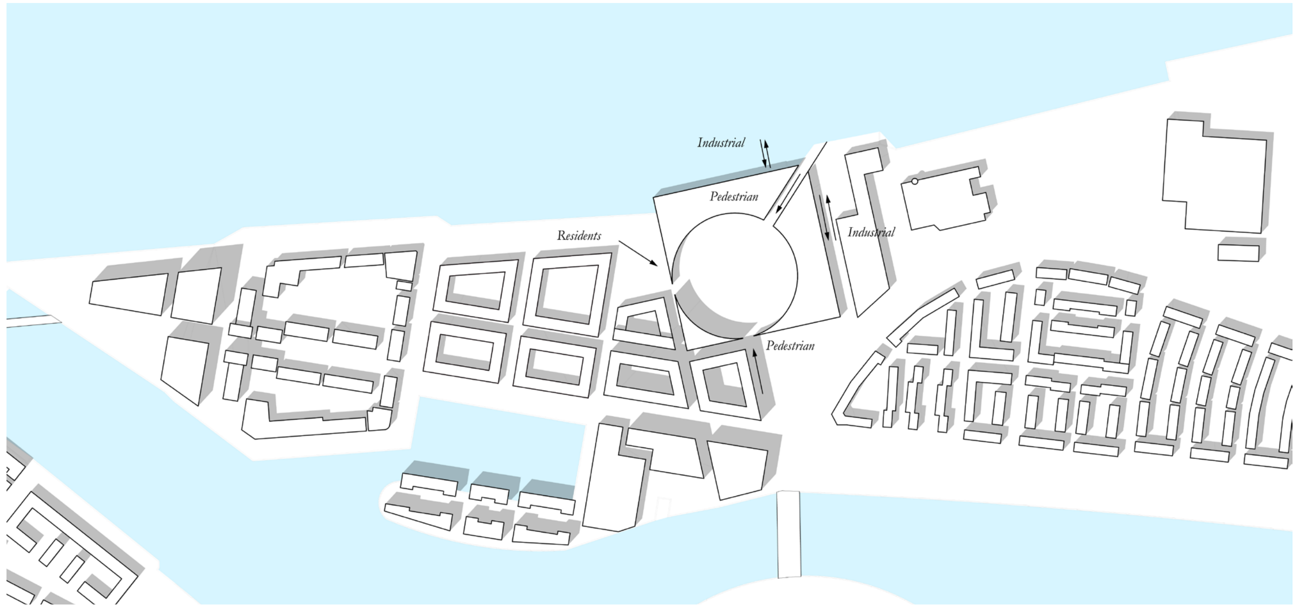
The urban form is a block, referring in its type and size to the bigger blocks in the city of Dordrecht. Its shape differentiates it from the surrounding and leaves the clear message that its something special but still recognizable as familiar. The square and the circle are not just familiar shapes, they also represent the most natural and the simplest cultural form. Combining them this way says metaphorically says with the rationalisation of the space we can create room for nature.

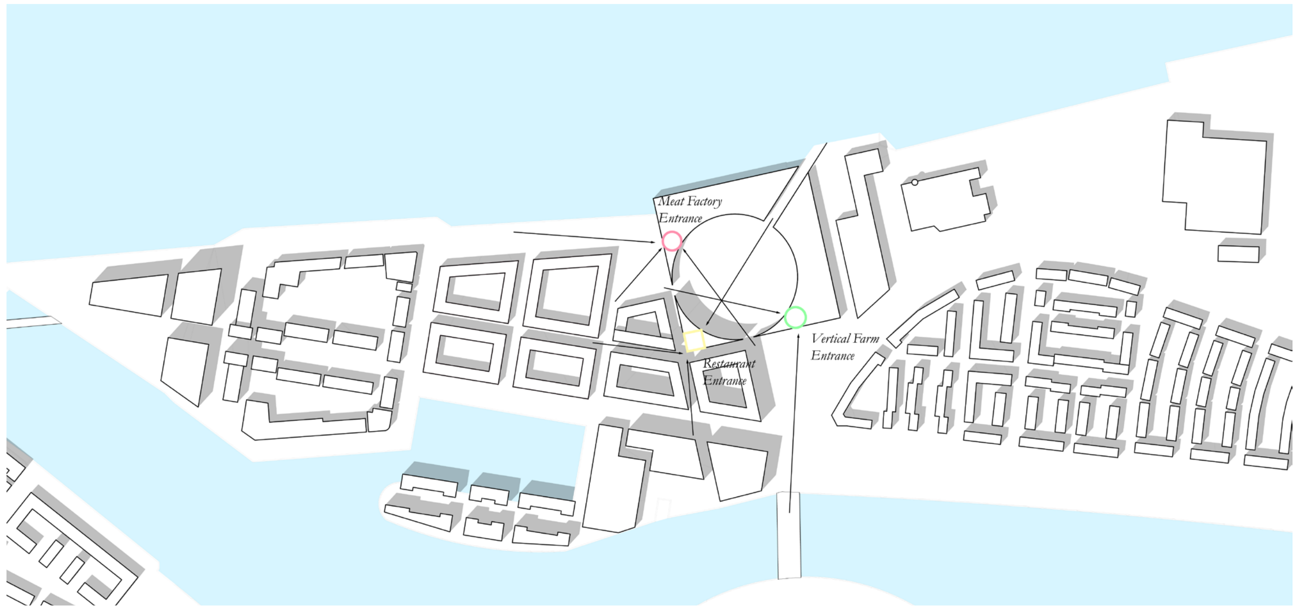
Urban Diagrams
(2020)

by the Author
figures 46









4. The Project

4.4. Spatial Concept

b. Performance

In order to find a new typology one has to understand the processes in the factory and how they perform.

Clean Meat

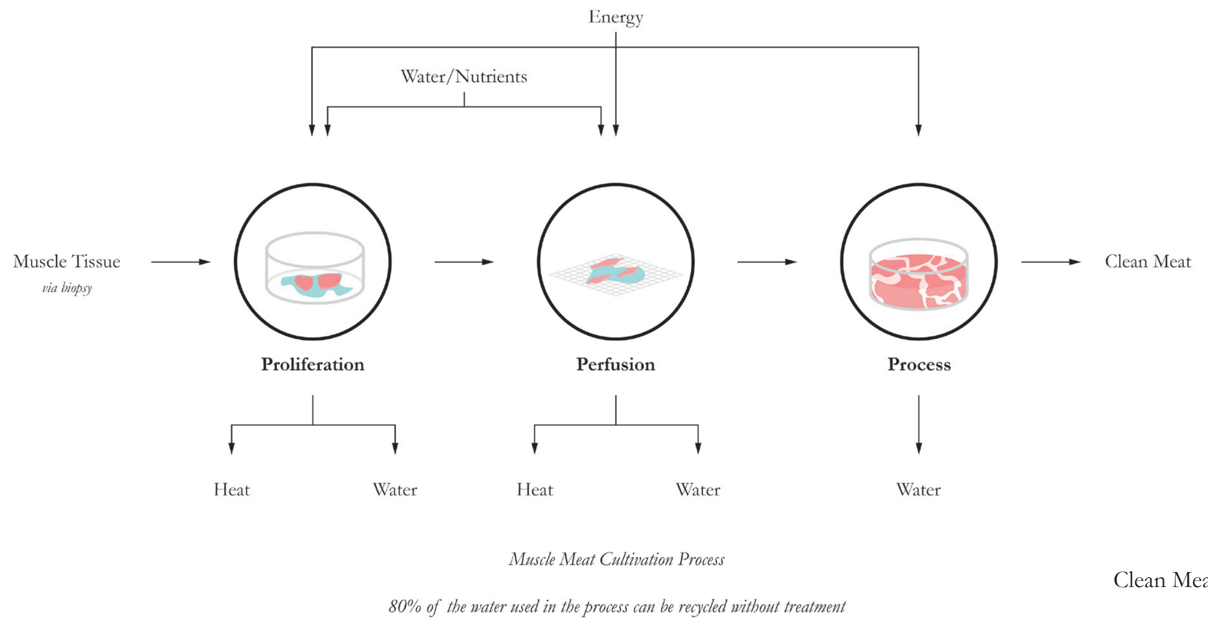
Figure 47 expresses the Clean Meat production method. Muscle Tissue is extracted from a living animal via biopsy. In the Proliferation phase these cells are stimulated to proliferate (multiply). This happens under the addition of a Nutrition medium, in this case Algae. In the next phase the cells are put on a scaffolding structure which contracts. The motion stimulates the small muscle cells to grow like they would in a body. In the last stage the produce is processed and ready to consume. To complete the whole cycle it needs about 60 to 90 days.[26] The diagrams at the right are simplified due to a certain lack of detailed information about the process since the industry is quite protective of their developing technology. However there will be left overs in this production like lactate for instance which like the other unmentioned ones in the further development of the project won't be considered for the above explained reason.

Figure 48 explains the cultivation of algae for as the nutritive medium for the clean meat production.

24. Hanna L. Tuomisto, M. Joost Teixeira de Mattos, "Environmental Impacts of Cultured Meat Production", *Environmental Science & Technology,* no. 45 (2011): 6117–6123.

25. Tuomisto, Teixeira de Mattos, "Environmental Impacts".

26. Talks to Google, "A Vision for Meat Production in 2040 | Kris Gasteratos | Talks at Google", Filmed August 2019 at Google NY, video, 55:26 min, Accessed August 12, 2020, youtube.com/watch?v=Q6xQWavrByQ&t=561s.

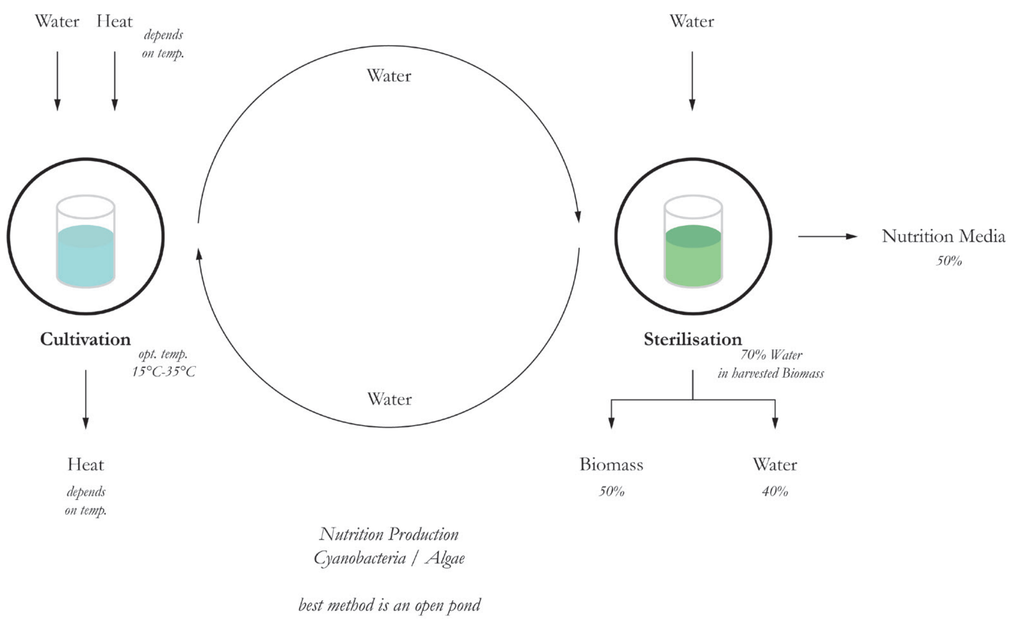


Clean Meat Process
(2020)

by the Author[24]
figure 47

Algae Cultication Process
(2020)

by the Author[25]
figure 48



27. Conrad Zeidler, Danial Schubert, Vincent Vrakking, *Vertical Farm 2.0: Designing an Economically Feasible Vertical Farm - A combined European Endeavor for Sustainable Urban Agriculture*, (Bremen: Deutsches Zentrum für Luft- und Raumfahrt e.V., 2017)

28. Zeidler, Schubert, Vrakking, *Vertical Farm 2.0*

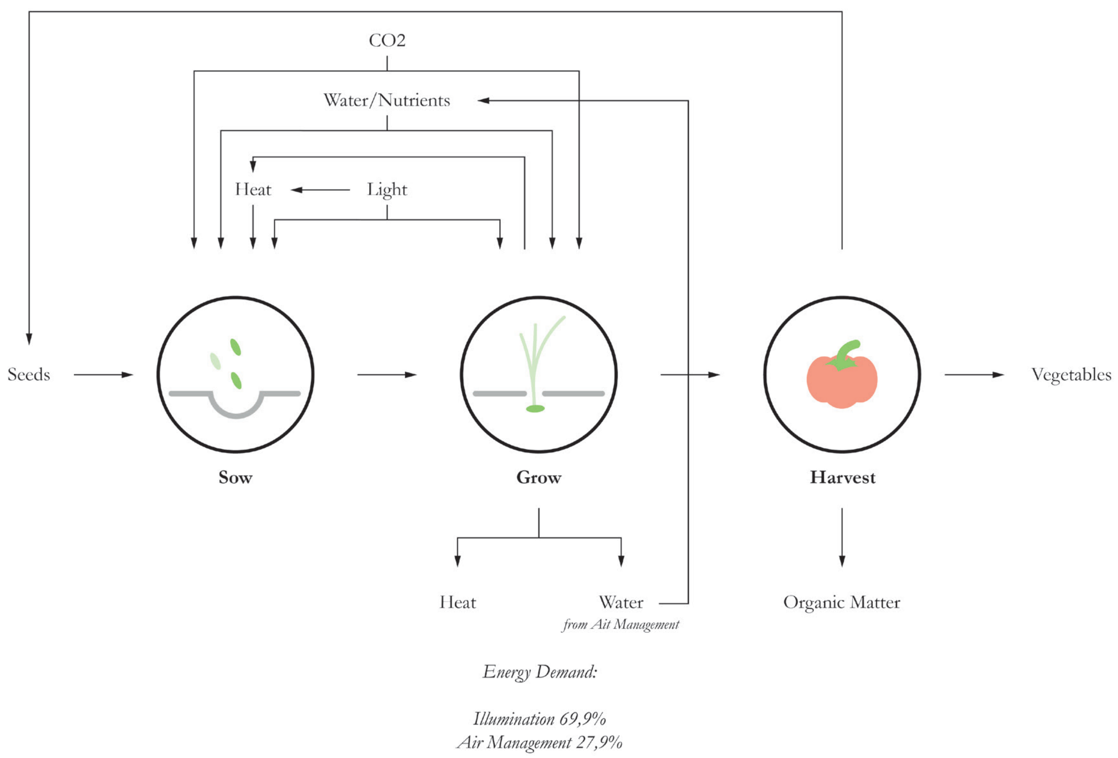
29. Zeidler, Schubert, Vrakking, *Vertical Farm 2.0*

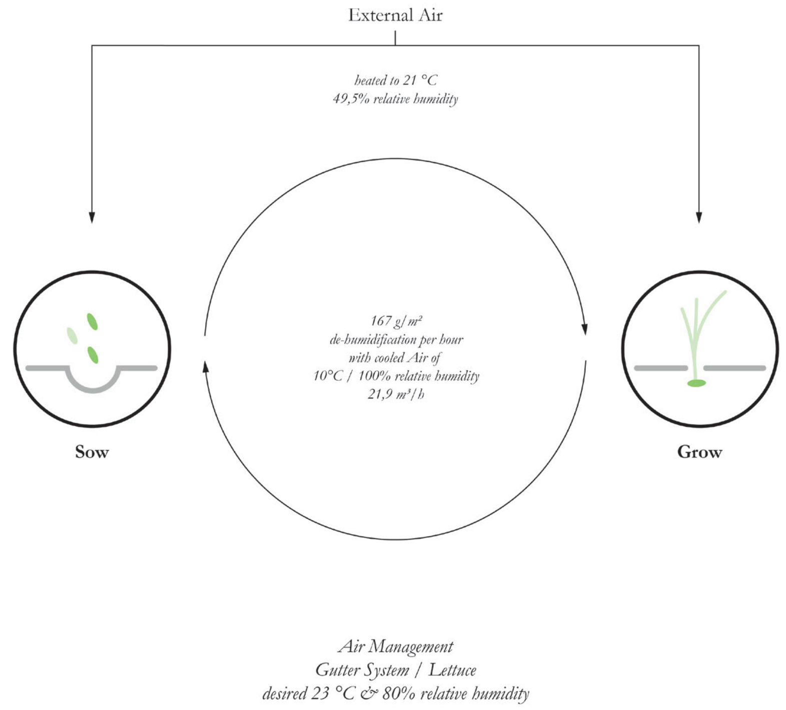
Vertical Farm

Among the two processes the Vertical Farming is rather simple. Crops grow regularly like they would on the field. In order to maximize yields the facility provides optimized conditions for them to grow. This involves watering, nutrition, air and light. Thereby the water management solely is been done with the with management system.

Crop Growing Process[29]
(2020)

by the Author
figure 51



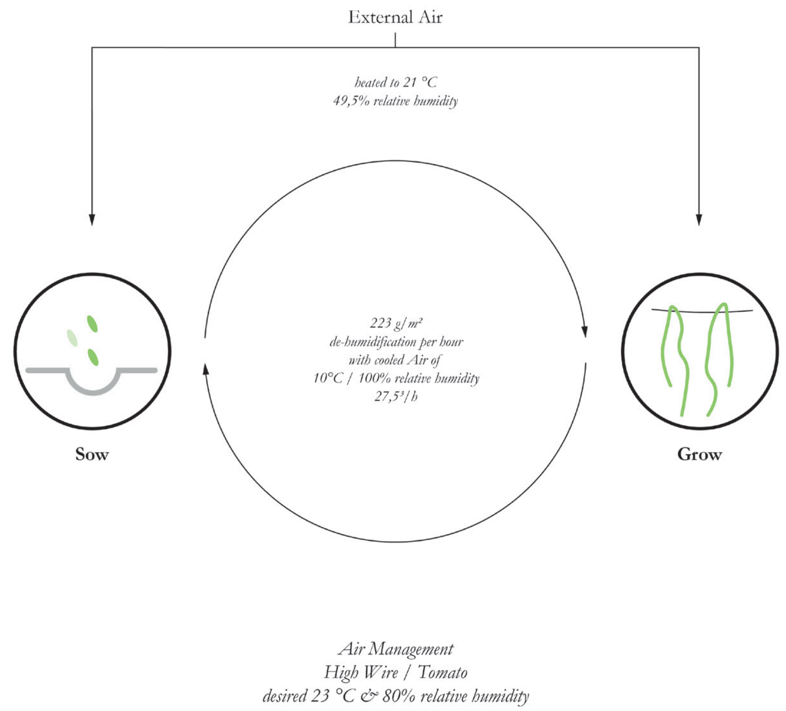


Leafy Green Growing[27]
(2020)

by the Author
figure 49

High Wire Growing[28]
(2020)

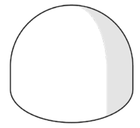
by the Author
figure 50



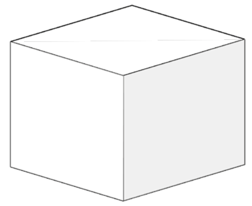
Formfinding

In order to create a form for the facility one has to start with the main units of each individual machine. In the case of the vertical farm three main shapes are up to discussion. For spatial efficiency and good accessibility the shelf structure was picked. Which then is also leading to the form. Since sun is not a concern in the growing technique of the crops, the maximized spatial efficient form is picked, the cube.

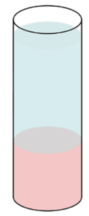
The other facilities basic module to concern are huge tubular tanks. As a reference to their shape a round shape was picked. The dome shape ensures continuous sunlight which is important in the representation of these tanks from the inside and outside. Again its a unusual shape, it show that its unusual and new while being a familiar shape.

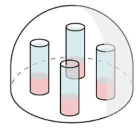


Continuous Sunlight
Distribution

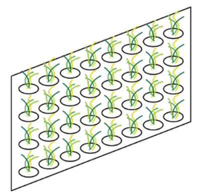


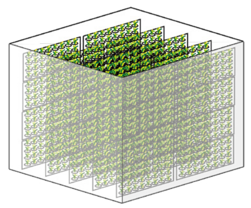
Spatial Efficiency



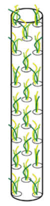


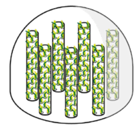
400.000 liter Proliferation Tanks
(estimated maximum future capacity)
in a dome for continuous sunlight
and a formal reference to the
tanks shape.



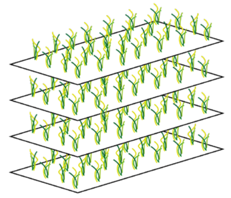


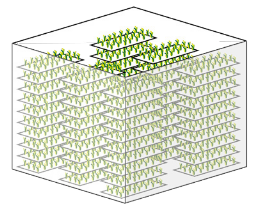
Vertical Farm sheets lined up,
efficient for sunlight distribution.





Vertical Farm towers on a grid,
highly effitient for sunlight distribution,
spatially inefficient.





Stacked Vertical Farm
in a cube for maximum spatial efficiency
with artificial light and a formal reference
to the shelf structural shape.

4. The Project

4.4. Spatial Concept

c. Function and Program

The project aims to implement a new industry into society in a literal way. Placing the facility, which usually would be located away from society, in an urban environment is an act of connection. A purposefully act against the threat of alienation. Providing a sensual experience of the produce is the way to connect. Most importantly when talking about food obviously is taste. So the program hosts a Restaurant and Cooking School to taste and learn to cook with the produce from the facility.

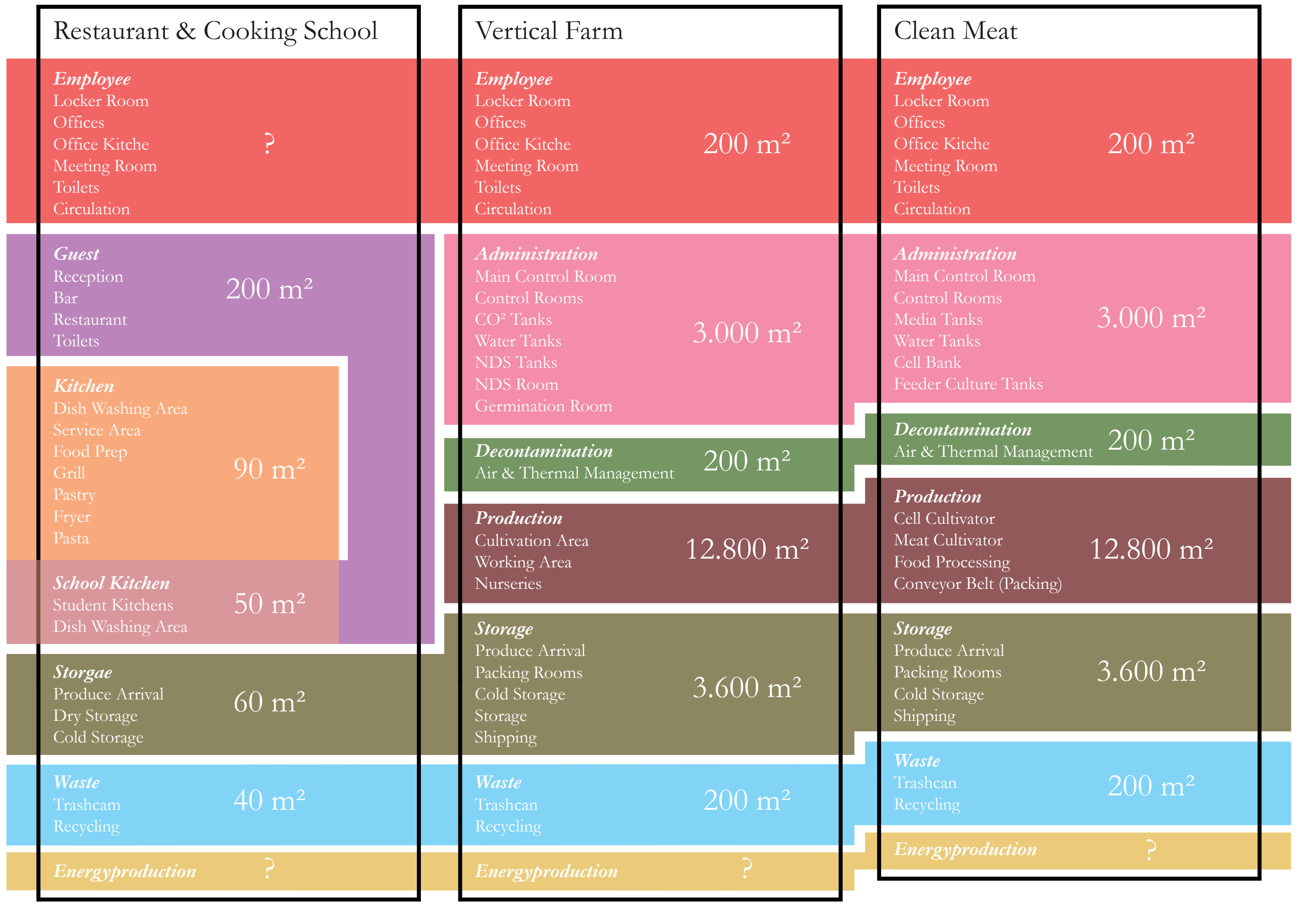
Figure 49 displays the three main facilities and their individual program which are ordered by color according to similarities. Spatial requirements have been taken from Neufert[30], Vertical Farm 2.0[31] and several sources for the Clean Meat faciliy[32,33]. Since there were no spatial requirements for these facilities, since they don't exist at the moment, I took the same spatial requirements as the Vertical Farm so proceed.

30. Ernst Neufert, *Neufert 39*, (Wiesbaden: Vieweg + Teubener, 2009).

31. Zeidler, Schubert, Vrakking, *Vertical Farm 2.0*.

32. Tuomisto, Teixeira de Mattos, "Environmental Impacts".

33. Google, "A Vision".



Program
(2019)

by the Author
figure 52

Administration & Decontamination 20% — Production 80% — 80%
80% — 20%
Employee 20% — Waste ? — Storage 80%

Typology Analysis

Architects have produced several types of architecture in thousands of years to accommodate the observer with experiencing a certain object. Thereby the emphasis on comfort, visibility, orientation etcetera. for the subject differs from purpose and object. The chosen types will be elaborated on their purpose, architectural language, function, way of accommodation and experience plus whatever else makes them unique and tailored to certain phenomenons.

Which architectural types exist that accommodate observers of a certain object, what makes them unique?

To ensure the quality and comparability four main measures are taken, which are:

Who is minority and majority, the object or the subject?

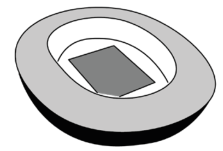
What's their hierarchical order in space?

Who is observing whom?

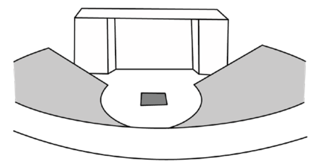
What's their spatial distance from each other?

The character of the chosen precedences of types seem to be oscillating around those measures. It became apparent for the types where object is in minority and in higher hierarchical order, that if the object would be removed the subject will be left without meaning. Vice versa the object keeps its purpose to certain degree when the subject is gone, depending whether or not there is a self purposing practice being held.
The same goes for the types which have the same hierarchical structure but the majority on the objects side, with an exception with the safari park.

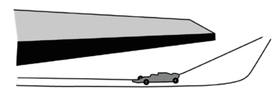
Stadium



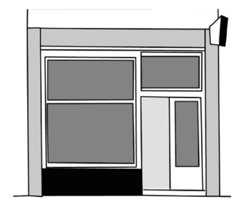
Theatre



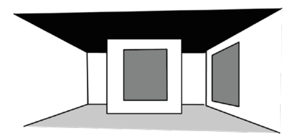
Race Track



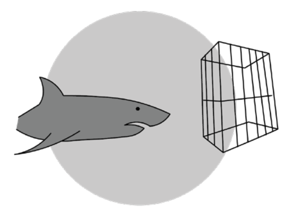
Display Window



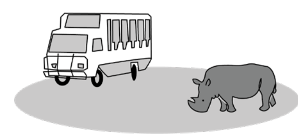
Exhibition Space



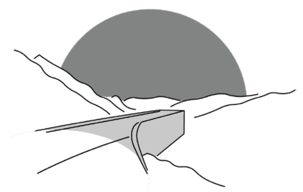
Shark Cage



Safari Park

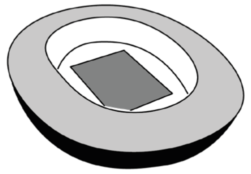


Viewing Platform



Architecture as a Mediator
(2019)

by the Author
figures 53



Stadium

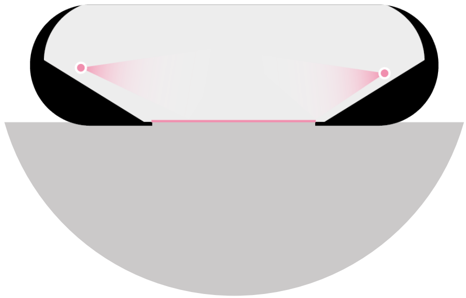
The Stadium has the purpose of protecting the visitors of the sport from the weather while watching the match. Architecturally this results mainly in two elements, the grandstand and the sports pitch. The sloped grandstand ensures high visibility from all seats. Not every stadium necessarily has to have a grandstand all around the pitch, though the typological classification will be declared as such.
Architecturally the spatial purpose is clearly defined within the two main elements as whom belongs where. The observer belongs on the grandstand, whereas the observed object or, in the case of sport, the sports event is on the pitch.
As an observer, especially during a fully visited match, one perceives the grandstands as a collective rather then individuals. The clear central orientation contributes to this experience. Both elements reinforce each other's existence and purpose, without the pitch the other element loses its purpose.

Allianz Arena
(2019)

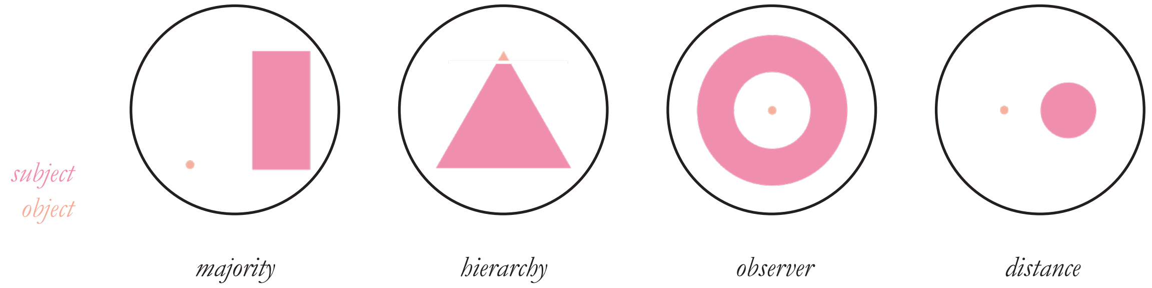
Unknown Autor,
https://allianz-arena.com/de/news/2019/05/sonderbeleuchtung-der-allianz-arena-zum-europatag, 20.08.20
figure 54

Allianz Arena

	Football stadium
Architect	Herzog & De Meuren
Year	2002 - 2005
Location	Munich, Germany

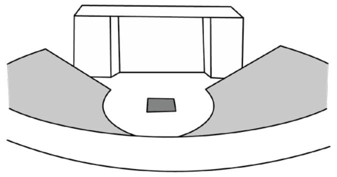


The Allianz Arena is the residence of FC Bayern München, Germany's most successful football club. It embodies every characteristic of the Stadium type. Thereby is becomes apparent that a Stadium is always an alienated structure, a landed UFO. The solitary character results from size, form and therefore obvious lack of urban context.



Allianz Arena Inside
(2019)

Unknown Author,
https://allianz-arena.com/de/news/2019/09/dfl-terminiert-die-bundesliga-spieltage-bis-zur-winterpause, 20.08.20
figure 55



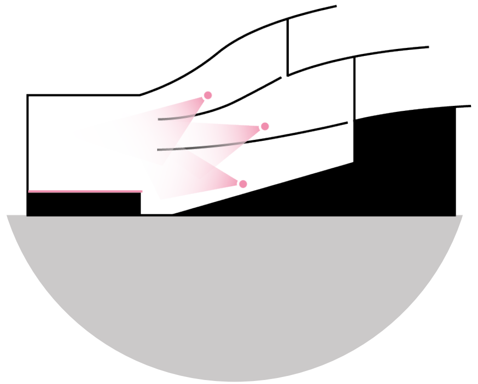
Theater

The Theater has the purpose of ensuring good visibility and acoustics for visitors of the play on stage. Thereby the stage is the central point where the semicircular grandstand is positioned around. Stage and grandstand are the main elements of the Theater type. Although there are theaters with a surrounding grandstand, the typological classification will be declared as with a semicircular one.
The central orientation of the observing seats clearly architecturally defines the purpose of the two elements. One experiences the grandstand as a collective mass with the individuals on stage. Both elements reinforce each other's existence and purpose, without the stage the other element loses its purpose.


Das Hans Otto Theater
in Potsdam, Brandenburg,
Deutschland
(2018)

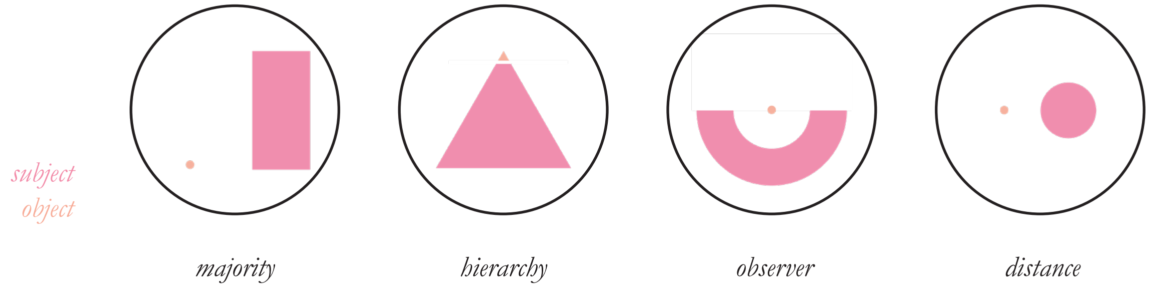
Unknown Autor,
https://uploadbeta.com/share-picture/fSl,
20.08.20
figure 56

Hans Otto Theater



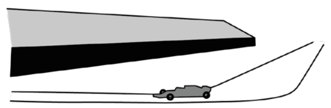
	Theater
Architect	Gottfried Böhm
Year	2003 - 2006
Location	Potsdam, Germany

The Hans Otto Theater is one of the last projects by the Pritzkerprize winner Gottfried Böhm. Theatres are not necessarily alienated elements in the urban fabric, since their size and form is depending on multiple factors.




Haus Otto Theater
Zuschauerraum
(2008)

mt/mw / DDP,
https://www.morgenpost.de/berlin/article102213798/Potsdam-bezahlt-die-bessere-Akustik-selbst.html, 20.08.20
figure 57



Race Track

The Race Track is a similar to the Theatre and Stadium though the object is in constant motion and not always visible for the subject, which makes it distinct. Eventhough the grandstand is positioned in a way to ensure a maximum of visibility, the nature of the object passing by creates an exciting momentum with the rarer occasion of visibility.
The alongside the track aligned grandstand architecturally defines the hierarchical order of the two with its orientation. One experiences the grandstand as a collective mass and depending on the occasion the object on track will be either readable as individuals or as individual groups. Thereby the object will be always distinguishable as smaller entities, whereas the subject will always be read as one mass. Both architectural elements reinforce each other's existence and purpose, without the track the other element loses its purpose.

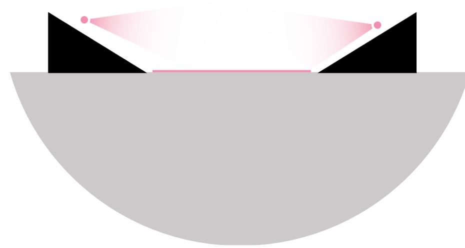
Sambódromo
(????)

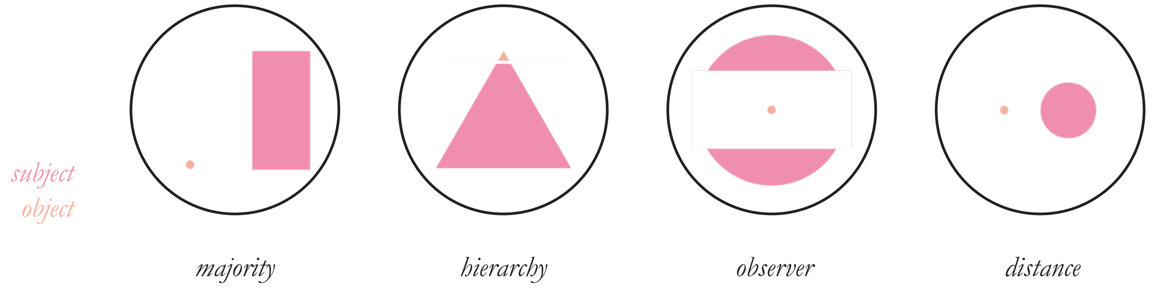
Unknown Autor,
http://upx1.meiahora.com/geral/2020/02/5871061-bombeiros-fazem-vistoria-e-liberam-sambodromo-para-o-[illegible]al.html,20.08.20
figure 58

Sambodromo

	Grandstand
Architect	Oscar Niemeyer
Year	1984
Location	Rio de Janeiro, Brazil

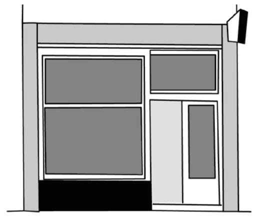
The Sambodromo is a symbol of the annual carnival in Rio de Janeiro.





carnaval_1202_018
(2012)

David Kirsch,
https://www.flickr.com/photos/k1rsch/8622563147/, 20.08.20
figure 59



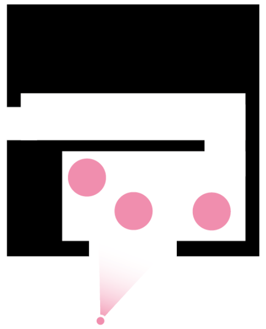
Display Window

The Display Window type is quite straightforward what its named after. It sits alongside any public pedestrian space to showcase what's behind the glass wall. Architecturally distinct is the separation of the subject an object via window, this creates an equal hierarchy between the two spaces. To a certain degree both can exist without the other without losing their individual purpose while on the other hand its clear that there is a functional symbiosis of subject and object. The loss of meaning in this scenario is highly dependent on the occupation of the object, if there is a selfsustaining practice hosted, it would not lose its purpose when removing the subject. While when the occupation is depending on the subject, obviously once the subject is removed, the meaning will be removed alongside.

Sünner Kalk
(2019)

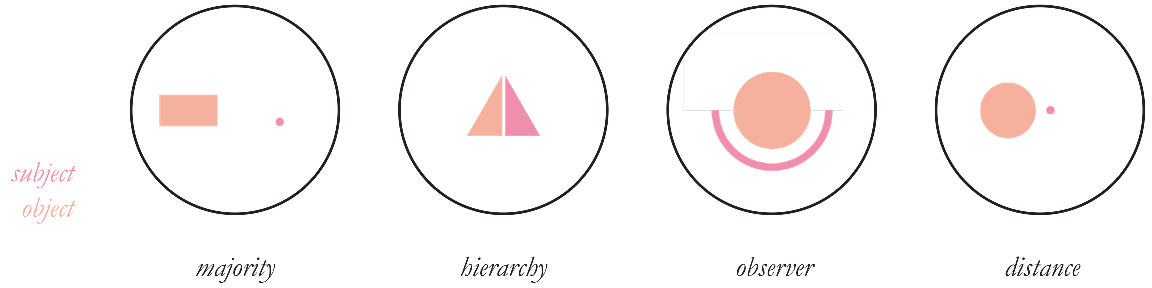
by the Author,
figure 60

Sünner Brauerei



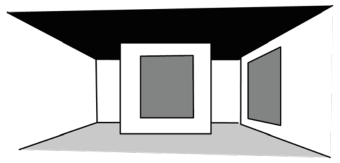
	Brewery
Architect	-
Year	1860
Location	Cologne, Germany

The Sünner brewery is an example which will keep its purpose once the subject is gone, one could state that there is an dependency on this distinct fact in order to state hierarchical equality.



Sünner Schaufenster
(2019)

by the Author
figure 61



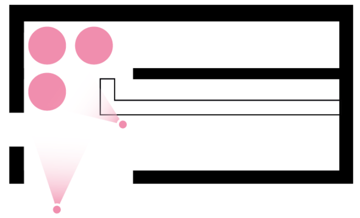
Exhibition Space

The Exhibition Space type similar to the Display Window type, its distinct because it's one space without division between subject and object. This spatial configuration creates an equal hierarchy between the two. Both reinforce each others existence, but without the subject the object loses its purpose.

Thoms
(2019)

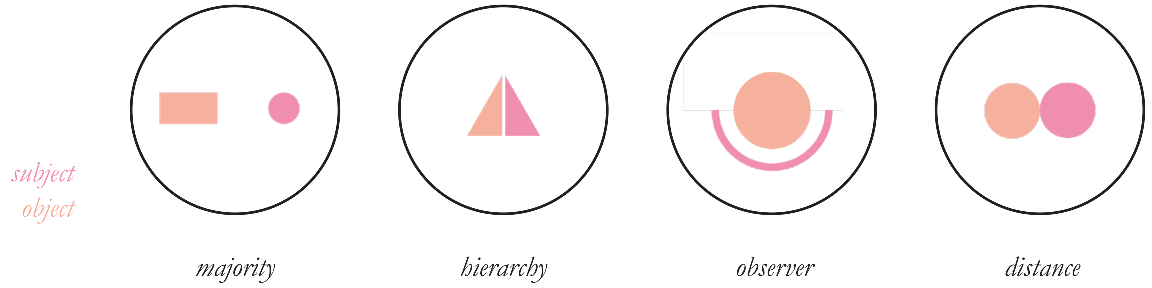
by the Author,
figure 62

Thoms Brewery



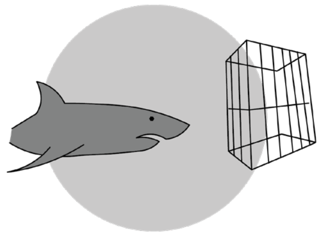
	Brewery
Architect	OMA
Year	2017
Location	Rotterdam, Netherlands

The Thoms brewery in Rotterdam is a special case, because if one considers the brewing equipment as the object, it won't lose its meaning when removing the subject. If one considers the bar as the object, then it will lose its purpose when removing the subject.



Thoms Bar
(2019)

by the Author,
figure 63



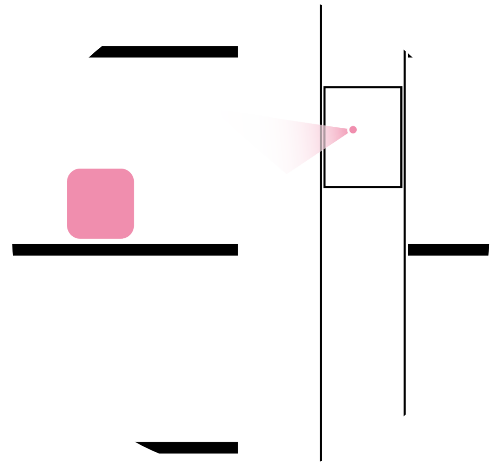
Shark Cage

The Shark Cage is distinct because of its temporality. It's a spatial intervention autonomously penetrating a space which perfectly functions without the penetrator. Architecturally this imposes a clear hierarchy where the Shark Cage is clearly on the bottom and in minority. In a way its a bubble in space which pops up for a certain amount of time until its gone. In the meantime though it creates an autonomous atmosphere a separation in space.
Hereby the object can absolutely exist with purpose without the subject, but not vice versa. The individual is more likely to be read as one in the Shark Cage, while the outside space is rather read as a mass. This perception shifts the relationship of the observer from the object to the subject. In the literal case of the shark cage one might argue the observing subject is being observed by the object as well.

Berliner Hauptbahnhof
(????)

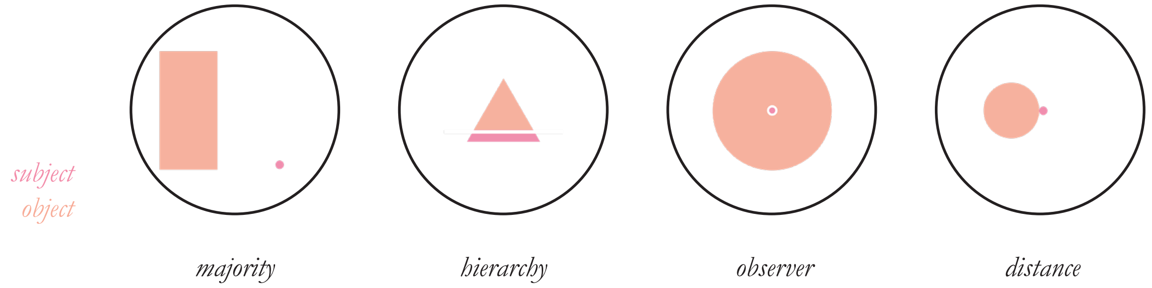
Unknown Author,
https://www.ada-amc.eu/, 20.08.20
figure 64

Berlin Hauptbahnhof



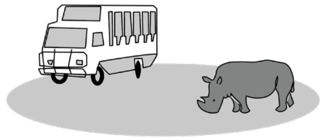
	Central Station
Architect	Meinhard von Gerkan
Year	2006
Location	Berlin, Germany

Glass elevators are the most common and known precedences of this type.



Treppe und Fahrstuhl im Hauptbahnhof Berlin
(2014)

Karl Heinz Nolden,
https://www.fotocommunity.de/photo/treppe-und-fahrstuhl-im-hauptbahn-karl-heinz-nolden/33592758, 20.08.20
figure 65



Safari Park

The Safari Park is similar to the Shark Cage in its temporality, but distinct with the opportunity of diverse objects. While the subject moves in its space its being presented to more then one objects in space. Architecturally this implies a disconnection of the object to a defined spatial arrangement. Both elements, the subjects space and the objects space, are changing independently which implies a certain autonomy of each. Both can also exist with internal meaning without the other. In this case its hard to judge on the perception of whom to be rather identified as an individual, the subject or the object. All scenarios seem possible in this case.

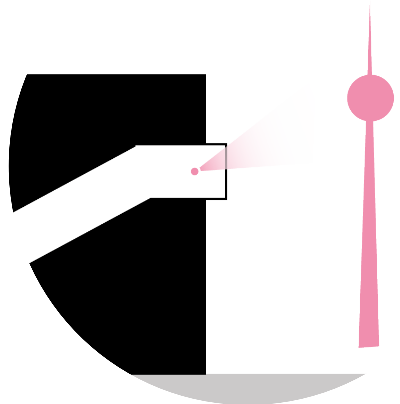
Untitled
(2019)

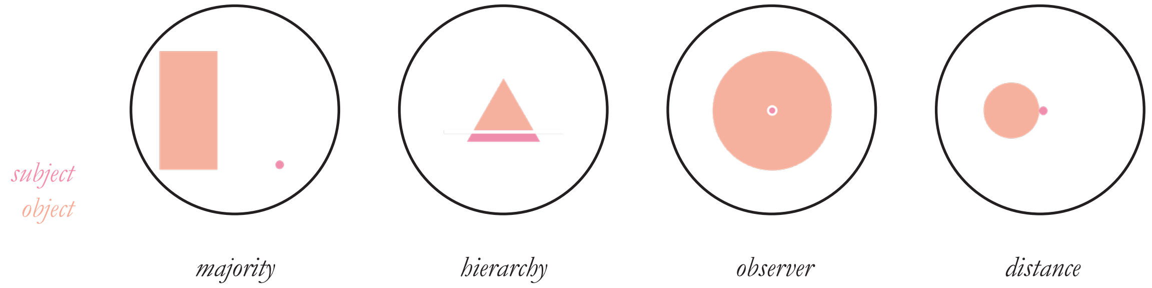
michi,
https://twitter.com/archisound/status/1210491543343120384?lang=es, 20.08.20
figure 66

Dutch Embassy Berlin

	Embassy
Architect	Oma
Year	1997 - 2003
Location	Berlin, Germany

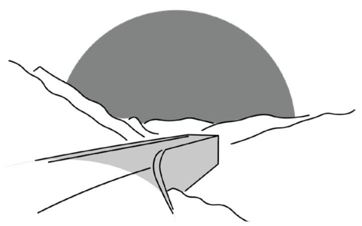
The Dutch Embassy seems to be a great built example of this type. The architectural route leading through the building exposes certain distinct moments of the city of Berlin. Its circulation is a functional Safari Park. Although it's temporality is arguable.





Untitled
(????)

Unknown Author,
https://architizer.com/idea/71204/, 20.08.20
figure 67



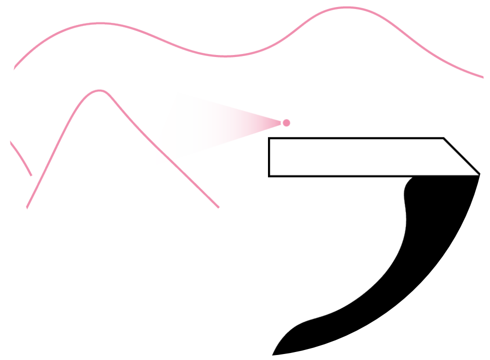
Viewing Platform

The Viewing Platform is a architectural type which is limited to the subject. It hosts outlooks onto the object inside the objects space. There is no atmospheric separation of the two. The object is higher and major on the hierarchical order and keeps is meaning once the subject is removed. Vice versa once the object is removed the subject loses its meaning.

Untitled
(2018)

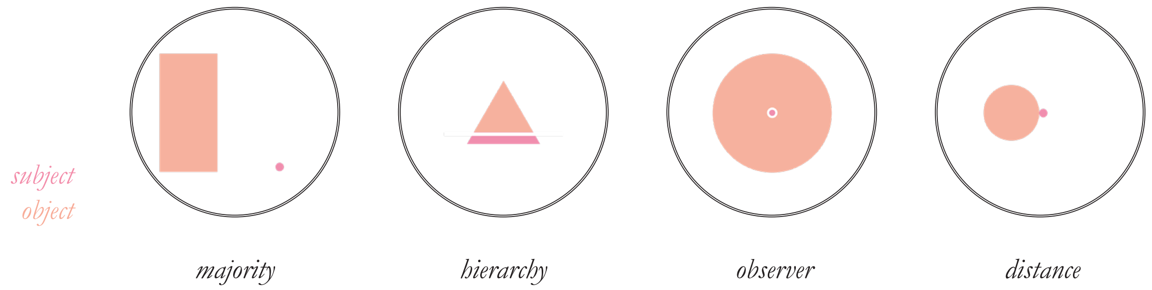
Unknown Author,
https://snohetta.com/projects/454-path-of-perspectives-perspektivenweg, 20.08.20
figure 68

Path of Perspectives



	Path / Viewing Platforms
Architect	snohetta
Year	2018
Location	Innsbruck, Austria

The Path of Perspectives is one example of many. Also the Viewing Platform only frames the view on certain angles its not creating them.



Untitled
(2018)

Unknown Author,
https://snohetta.com/projects/454-path-of-perspectives-perspektivenweg, 20.08.20
figure 69

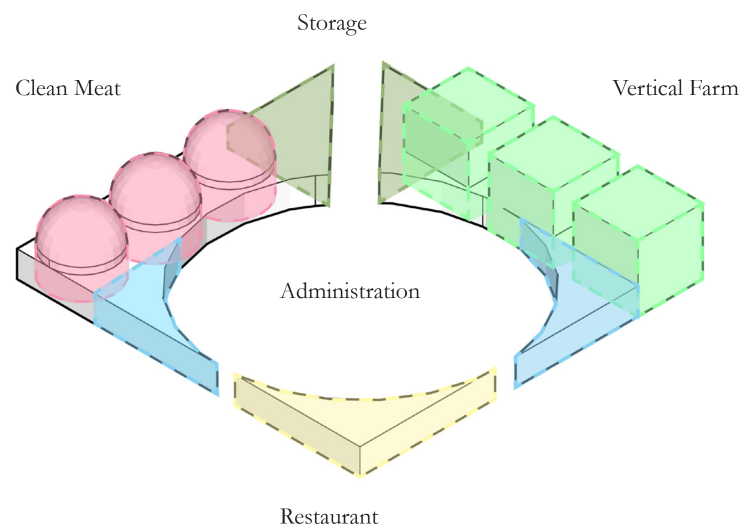
4.4. Spatial Concept

d. Massing and Shape

Architecturally program should be distinct recognizable from the far and close by. Its a volumetric approach where the volumes hosting the program, stick out of the two storey urban figure. This shape is then penetrated in order to create human scale openings and entrances where one can encounter the building. This play of the urban scale in shape and the human scale in the penetrations lives from the contrast and is a reflection of the medieval city center of Dordrecht.

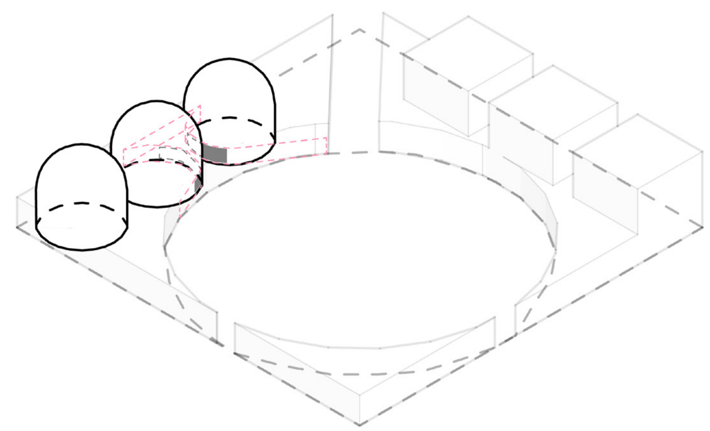
The way these volumes pop out is displayed in figure 69, the volumes are color coded for a spatial overview. Figure 71 expresses the distribution of spaces through out the stories. Orange and Pink colors are the internal spaces for the facility to function. Yellow shows the visitable spaces for pedestrians. The Turquoise colored are built public spaces and the green are not visitable spaces, both are outside.

Most public space is on the groundfloor. On -1 happens most of the work in the facility. The even below spaces are maintenance for the machine to function.



Program Shape
(2020)

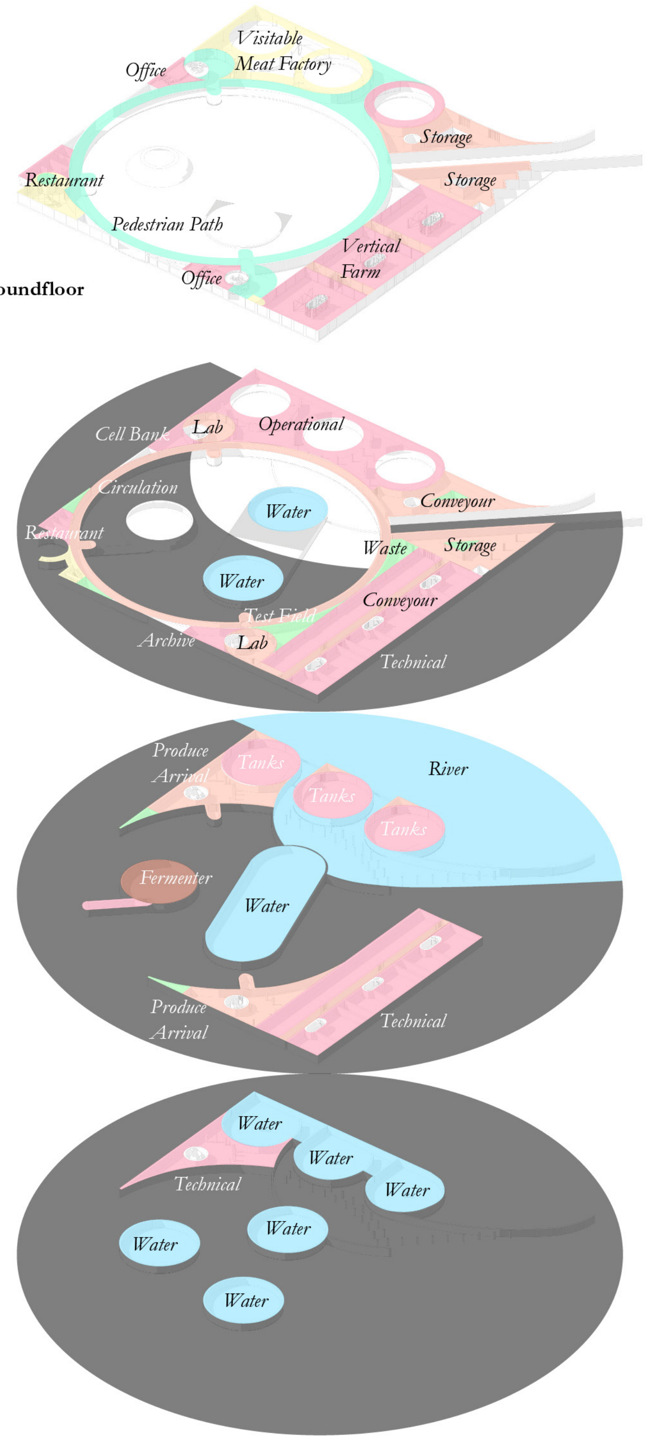
by the Author,
figure 70

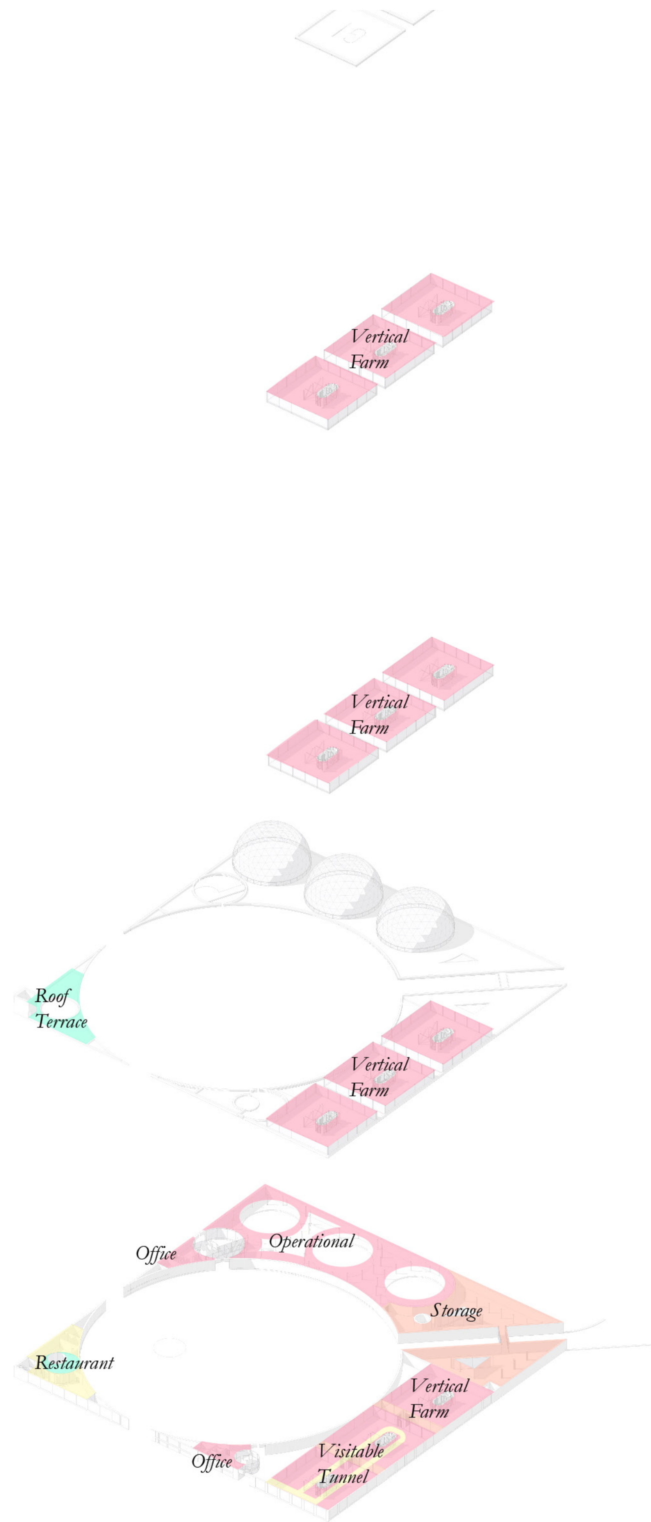


Human Scale Penetrations
(2020)

by the Author,
figure 71

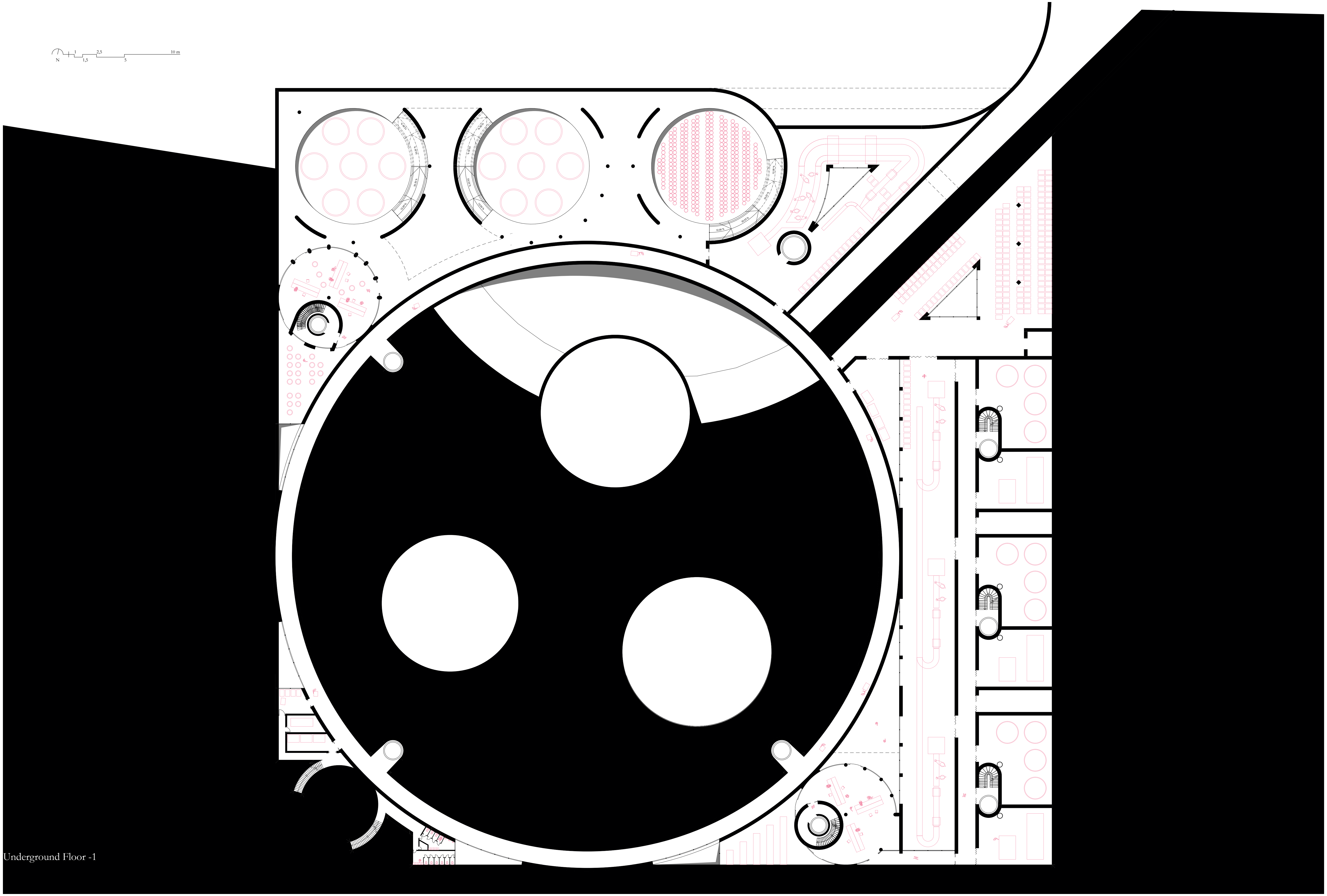
Groundfloor



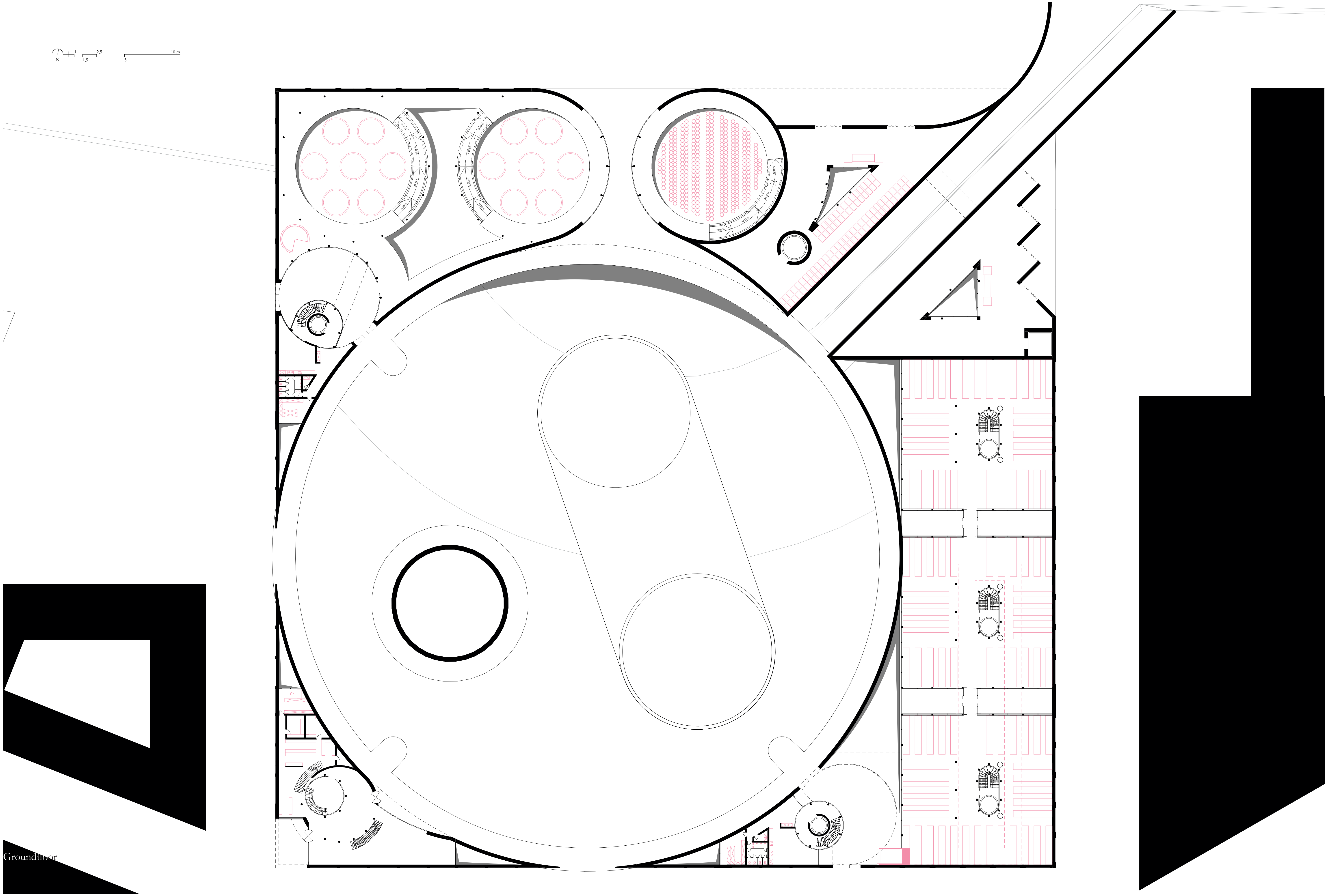


Program Stories
(2020)

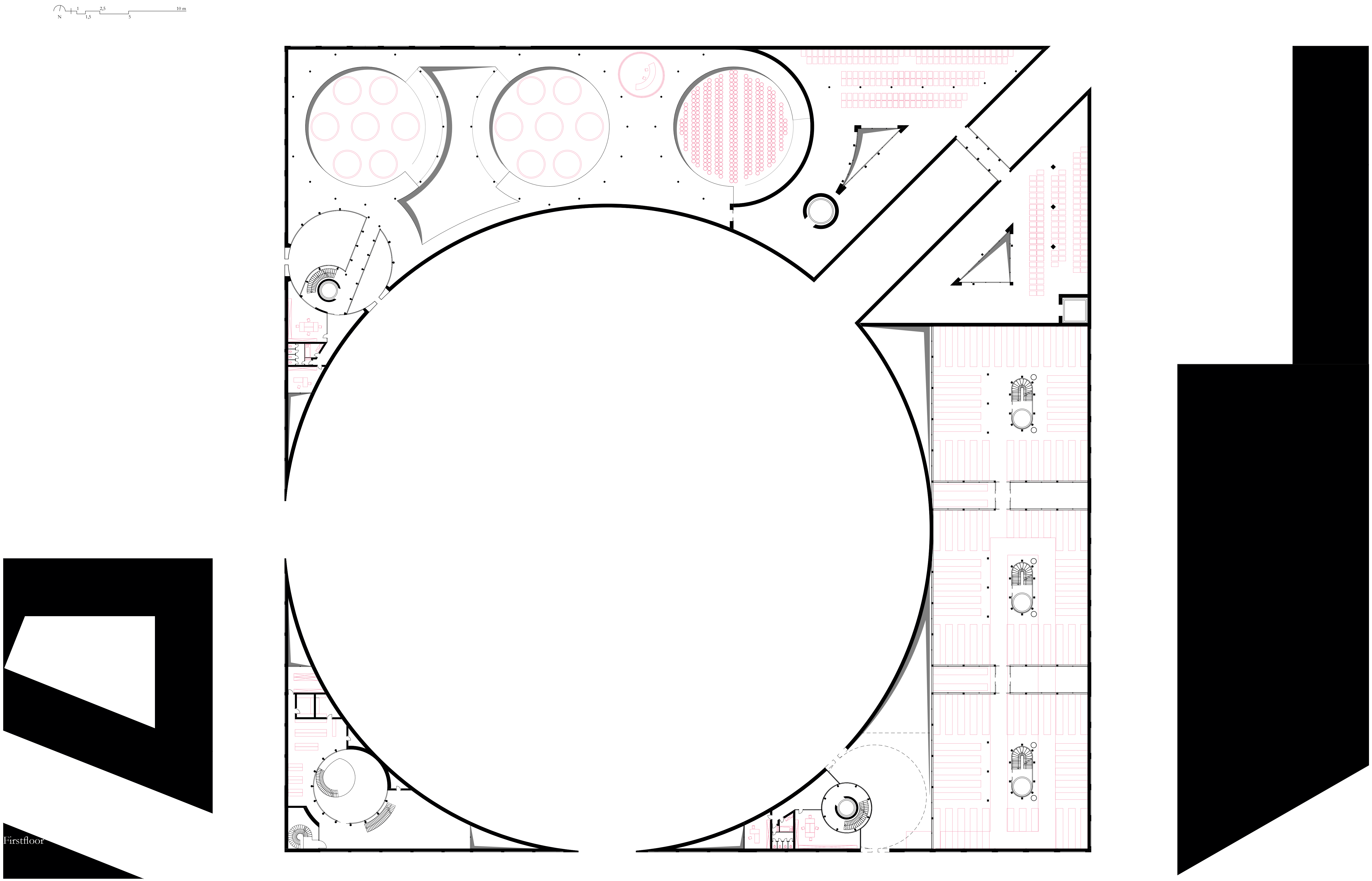
by the Author,
figures 72



Underground Floor -1



Groundfloor



Firstfloor

4.4. Spatial Concept

d. Public Squares

Courtyard

The central Courtyard is intended as a metaphor, the space which can be again nature once the machine effectively compensates for the pollution intensive traditional agricultural practice. Therefore I asked myself the question what is Dutch landscape?

Which elements is it composed of?

As a foreigner I specially want to address this properly in order to get an actual image rather then the perspective of a distorted vision. Studying landscape paintings through out the centuries seemed to be the most effective enterprise here in order to spot themes. And really it became relatively obvious what makes the Dutch landscape:

1st - Its plain grassland.

2nd - Its plain water.

3rd - Its the utilization of the landscape, meaning the Dutch had always to put in a lot of effort to gain and maintain landscape, otherwise it would flood. The relics of this are the famous windmills.

So in order to create a piece of Dutch landscape in the courtyard these three elements have to be present. With utilizing the Courtyard it also becomes a part of the machine and it compensates as a flood protection when flood events happen. (Fig. 77)

Dutch Canal Landscape im Winter
(19th century)

Lodewijk Johannes Kleijn,
http://www.artnet.com/artists/lodewijk-johannes-kleyn/dutch-canal-landscape-im-winter-LJp7y2bmKvU1GbtjIFhHXw2, 20.08.20
figure 73

Tulip Fields near The Hague
(1886)

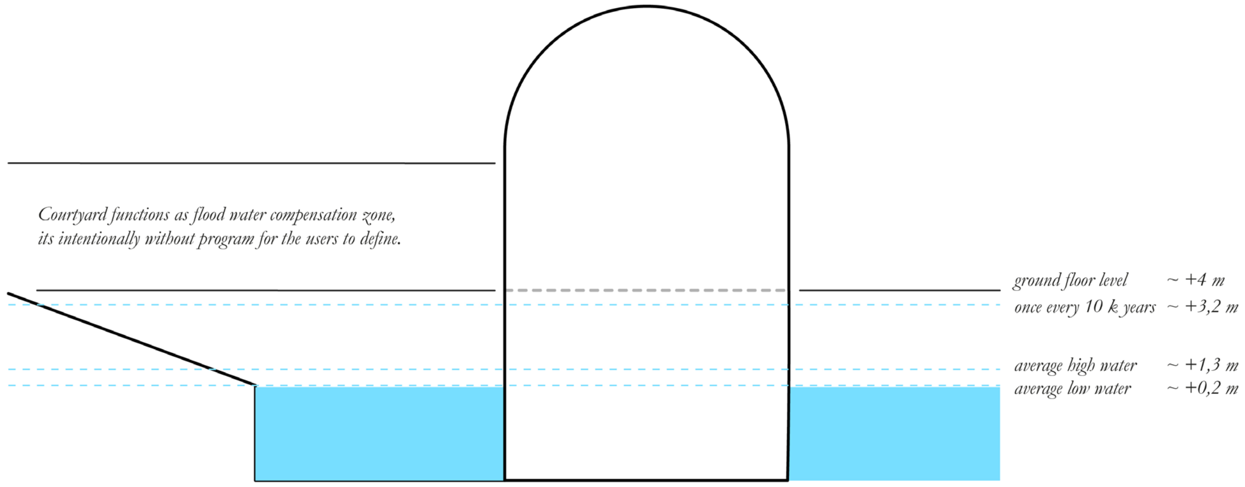
Claude Monet,
https://www.holidayme.com/explore/van-gogh-windmills-and-tulips-explore-netherlands-through-its-museums/, 20.08.20
figure 74

Allee von Middelharnis
(1689)

Meindert Hobbema,
https://en.wikipedia.org/wiki/The_Avenue_at_Middelharnis#/media/File:Meindert_Hobbema_001.jpg, 20.08.20
figure 75

Tall Dutch Trees After Hobbema
(Useful Knowledge)
(2017)

David Hockney,
https://www.newyorker.com/culture/cover-story/cover-story-2018-04-23, 20.08.20
figure 76

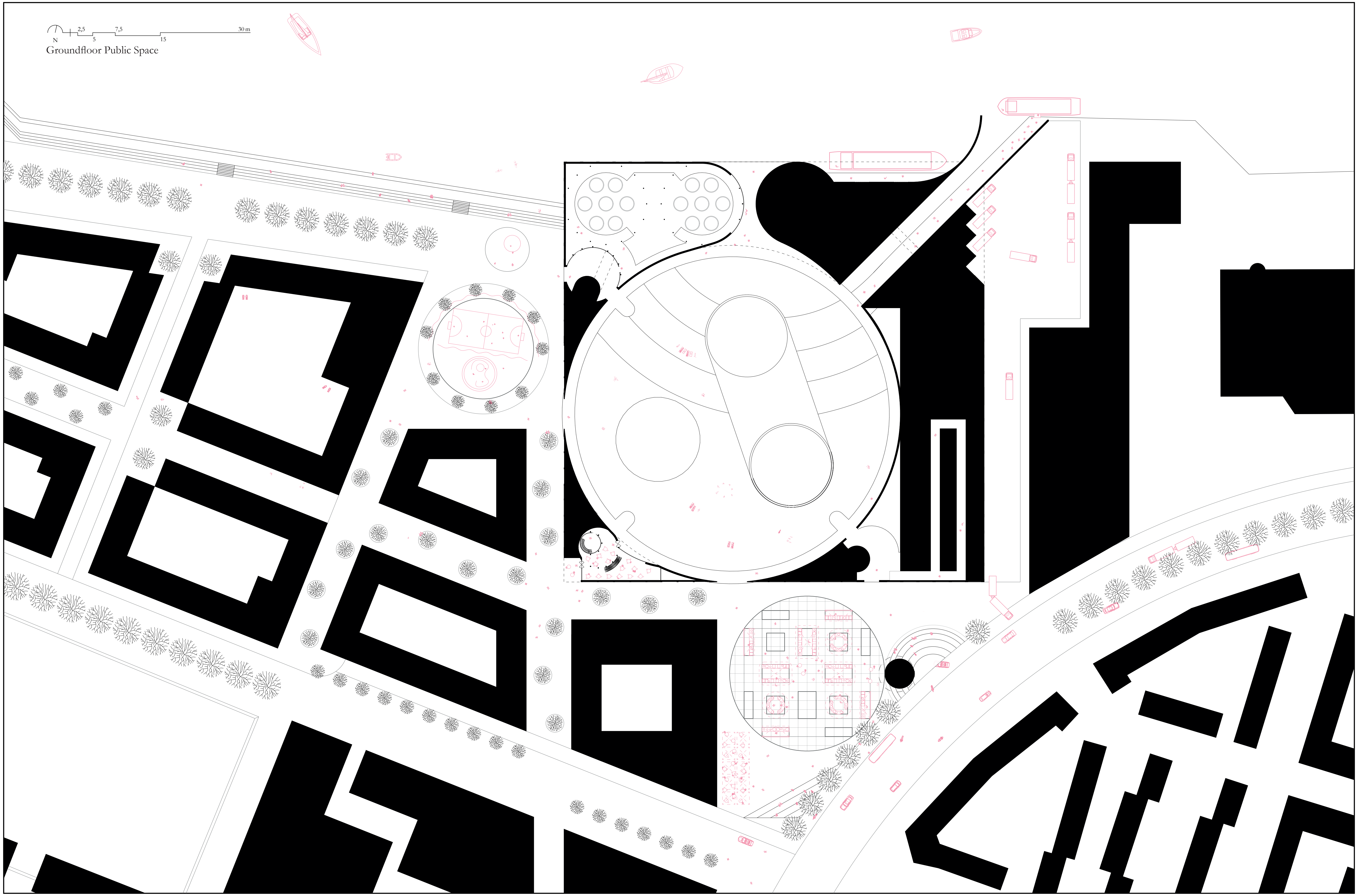


Floodprotection
(2020)

by the Author
figure 77

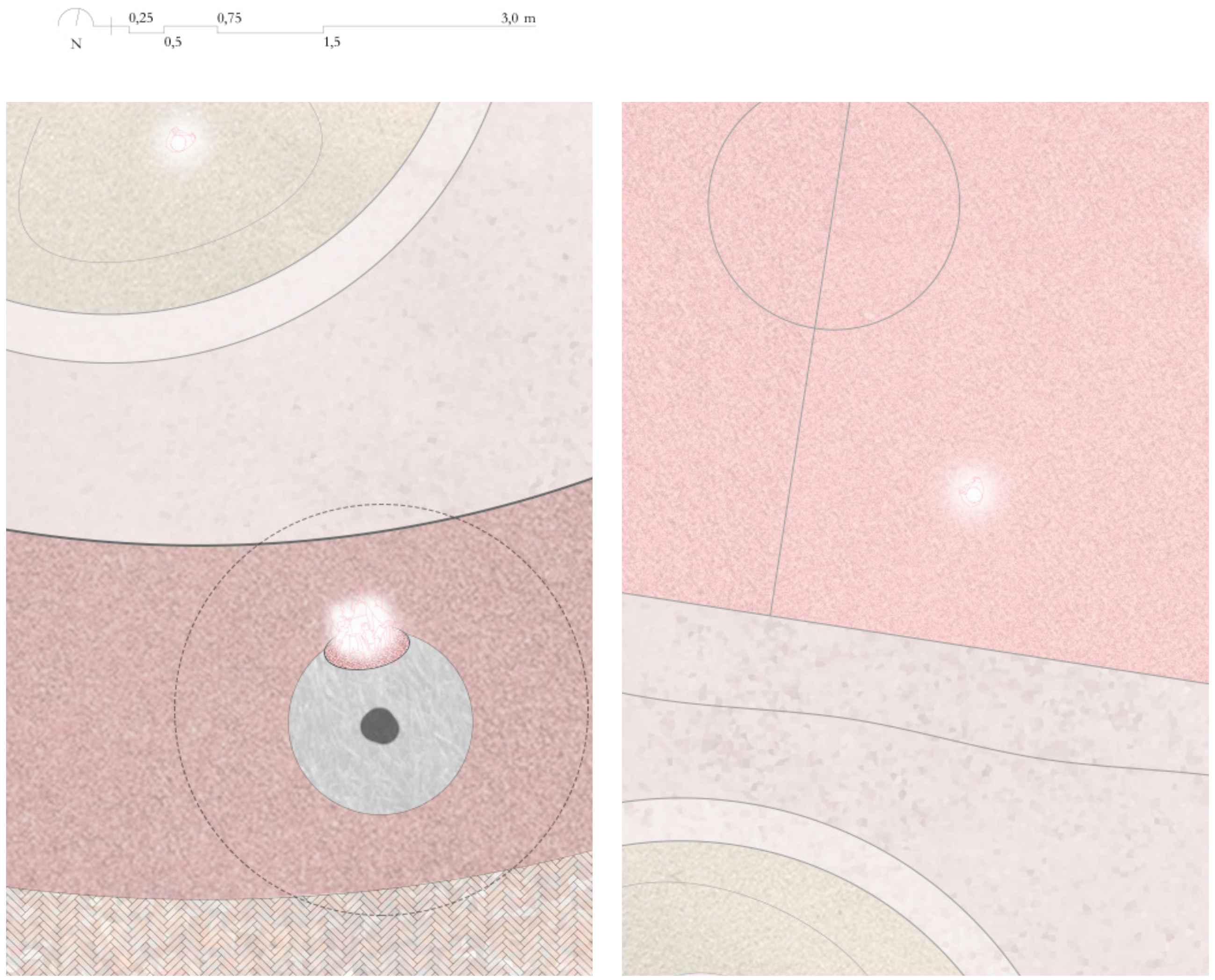
Collage
(2020)

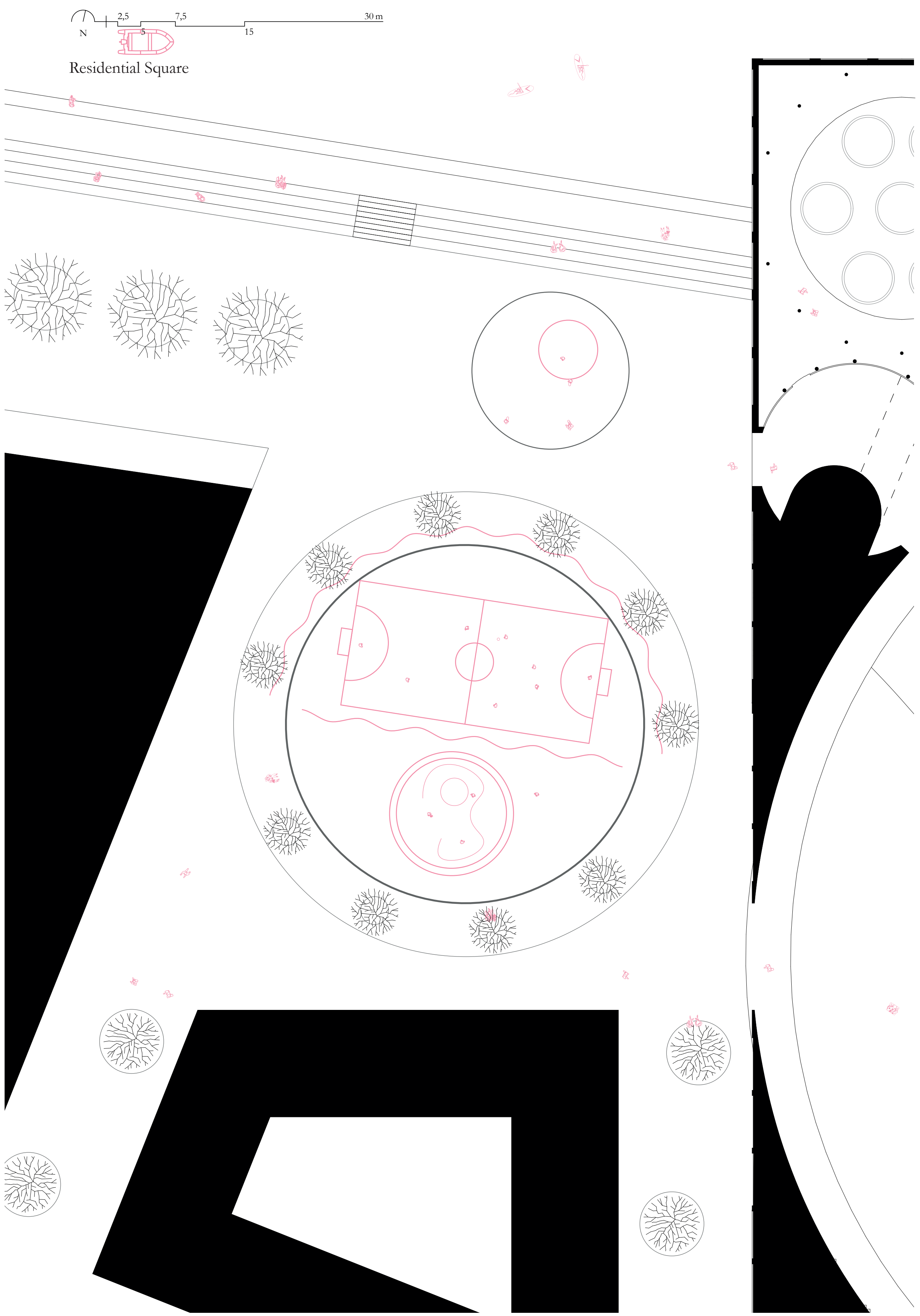
by the Author
figure 78


N
2,5
5
7,5
15
30 m
Groundfloor Public Space

Residential Square

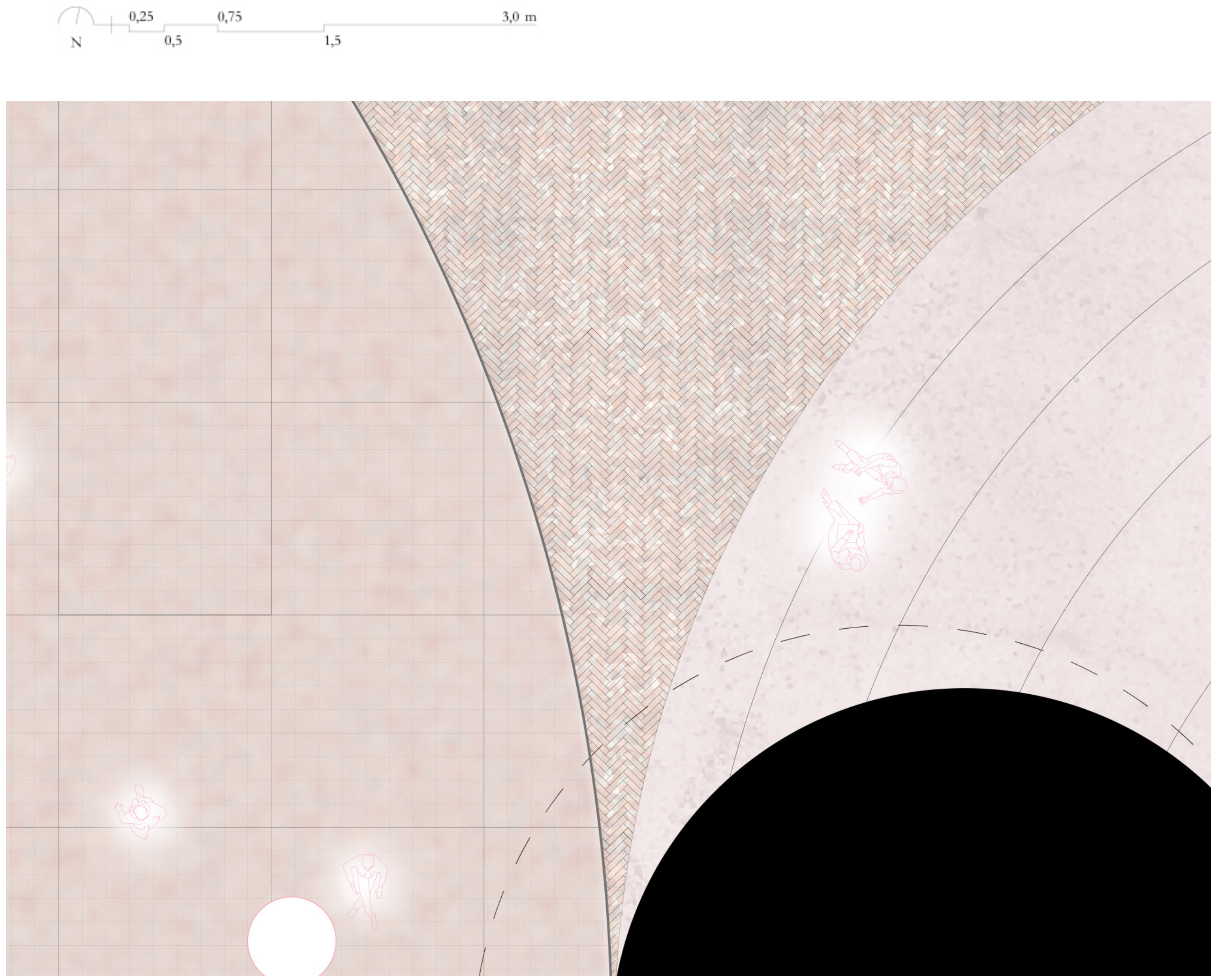
On the western side of the building the residential square is located. It hosts space for diverse activities for every demographic. Its located at the end of the river promenade where at its top the Skate pool sits. South from there is the Football field and Sandpit, both of which are hosted in a circle with a rubber flooring ring to sit and play.

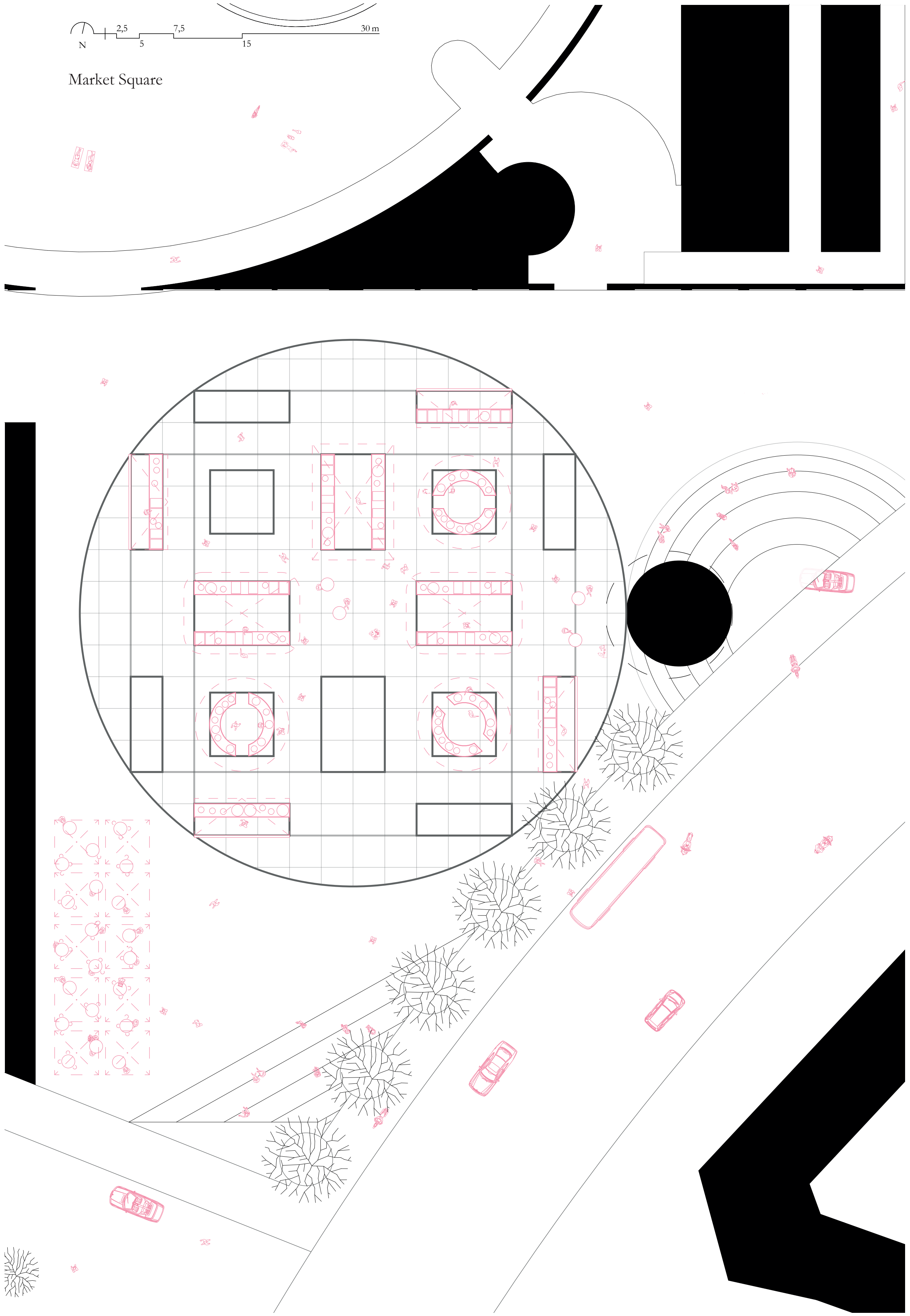


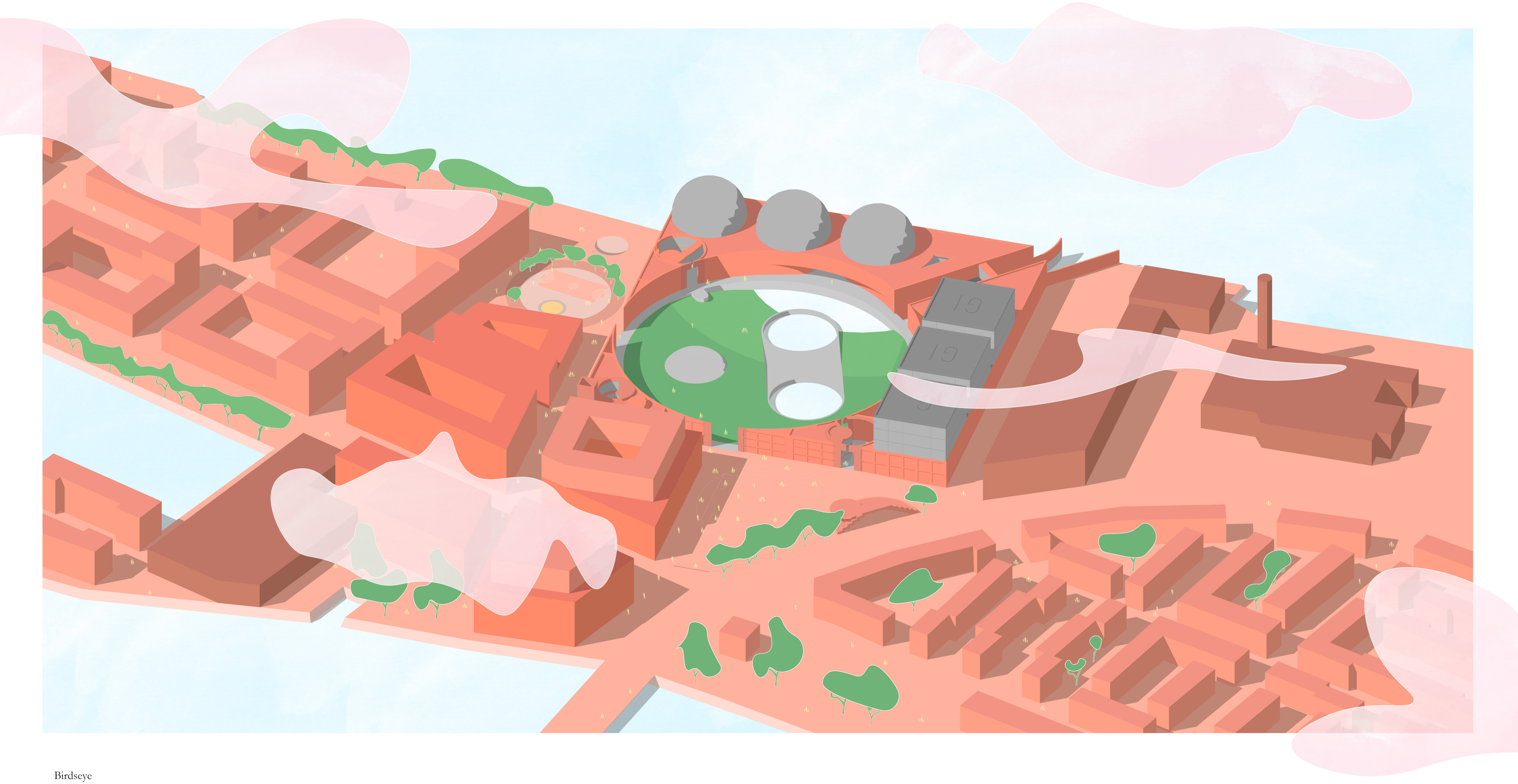


Market Square

South from the facility is the Market Square located. The circular partition of the squares indicate diverse uses. Here the central circle gives space for a daily morning market of fresh produce from the facility and local enterprices. The flooring is partitioned in 3 x 3 metre squares which are marked with embedded metal profiles. Those indicate the location of each individual booth on the square. Inbetween sit 33 x 33 cm floor tiles. The Neighbouring concrete structure hosts a bar / cafe and works as a tribune under which the entrance of the underground parking for the area is located. The circular partition is surrounded by classic herringbone flooring with wall format bricks, thereby it also refers to the flooring in city center of Dordrecht and many other Dutch cities.







Birdseye
(2020)

by the Author
figure 79

4.5. Architectural Concept

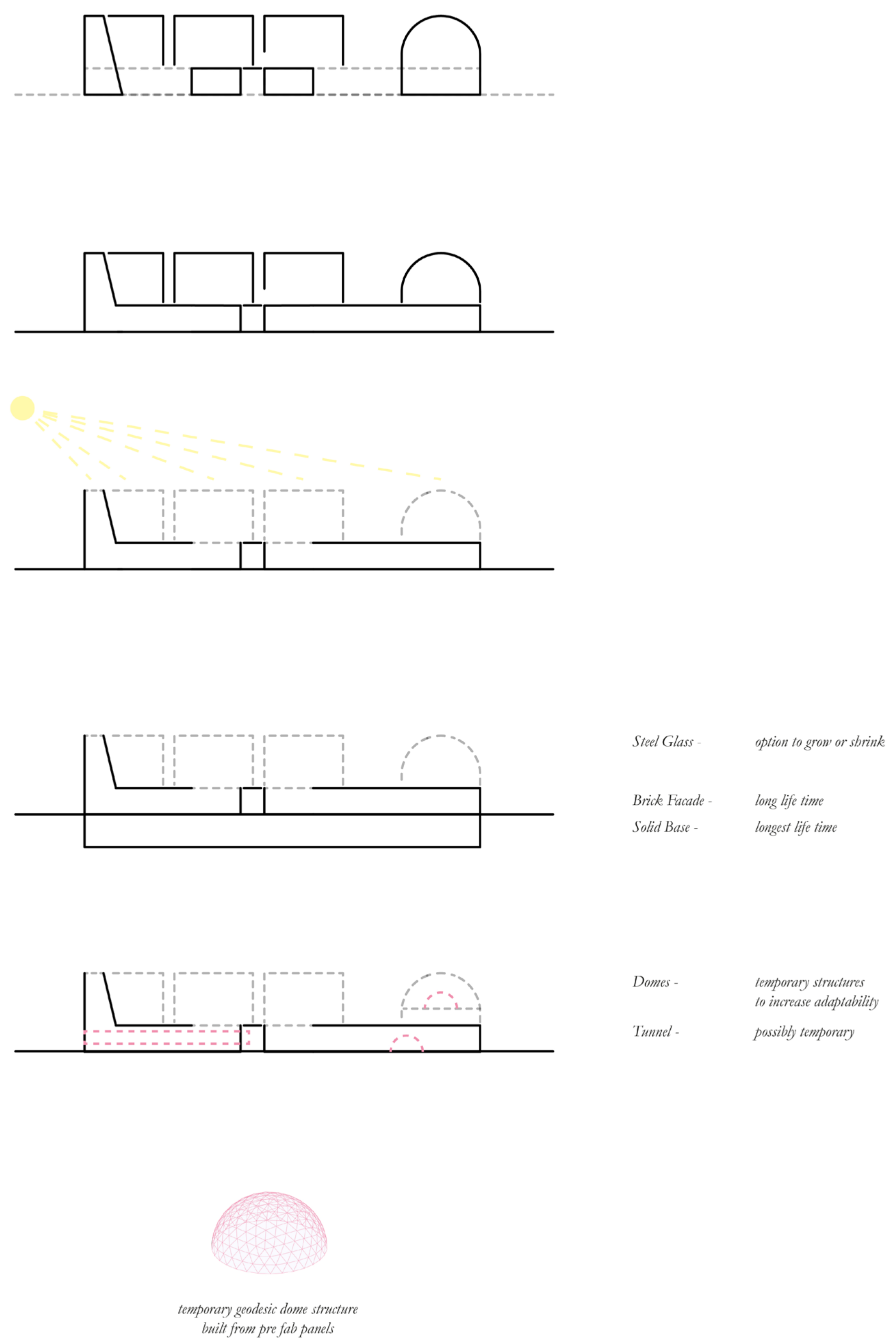
a. Layers of Flexibility

As previously touched the architectural concept is one of volumes sticking through the urban form. Both sit on top of the Solid Base which functions as a protection against the water which its most of it is almost constantly exposed to.

Since one of the primary concerns of the project is the circularity of the production metabolism, all materials should be circular materials as well. In the water purification process sediments are filtered out. Those are the basis of concrete and bricks, so the base and facade is made from a material which is a side product of the process. Unfortunately its a catch 22 situation where one can not build the building from the side products of the metabolism since the building has to be there in order to gain those sediments.

The structure of the building is made from steel profiles. At a certain moment I considered wood since it doesn't have such a high embodied energy as steel, but unfortunately the internal climates in both the clean meat factory and vertical farm would damage the wooden structure. The three volumes sticking through the urban form are clad with glass.

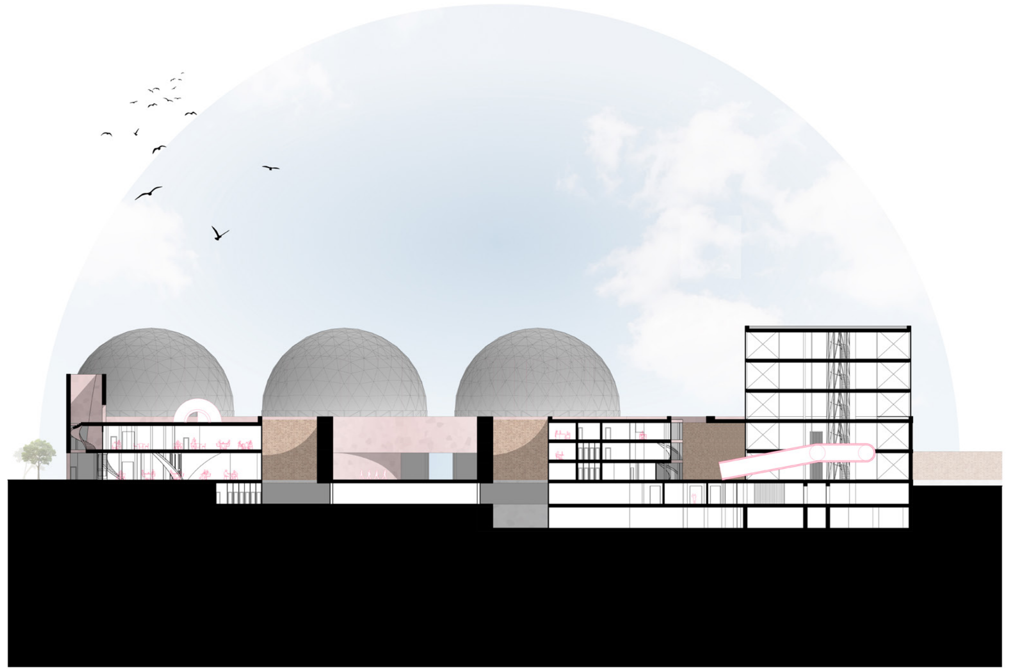
The diverse materials resemble a certain temporality. The building itself is loose fit designed for the industrial enterprice to extend and decrease to a certain degree. The concrete base which hosts the water purification, maintenance and operational space is there for the longest time. The steel structure on top which carries the facade is to a certain degree extendible or able to shrink, while the glass structures on top are meant to be the main compensation if the facilities have to grow or shrink. As a last layer of temporality there is the possibility to make pop up domes for exhibitions or to host offices. Coming back to the analysis about architecture as a mediator, the pop up domes are really the shark cages in the facility.



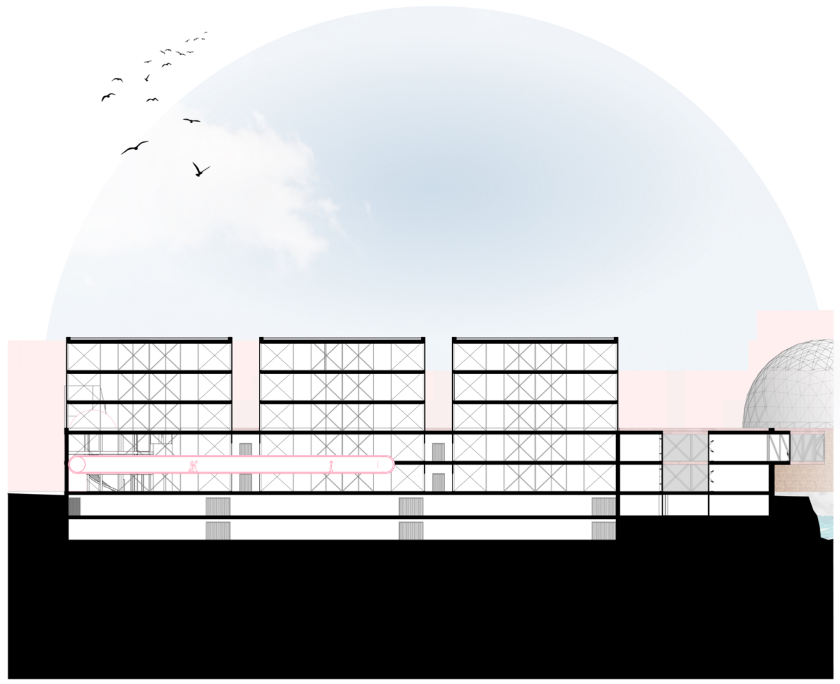
Schematic Diagrams
(2020)

by the Author
figure 80

In the Sections one can see the Tunnel structure which penetrates the Vertical Farm like a parasite. The main aim here is to give the visitor the opportunity to visualize what indoor Vertical Farming is about. Figure 81 shows the atmosphere of this rather surreal space. For the visitable parts of the building brass was chosen as a material to elevate the contrast with the industrial parts.



South Section



East Section

Tunnel of Veg
(2020)

by the Author
figure 81

4.5. Architectural Concept

b. Tectonic Expression

34. Gottfried Semper, *Die Vier Elemente der Baukunst,* (1851).

35. Semper, *Die Vier.*

36. Udo Garritzmann, "The Tectonics of Brick Architecture: Between the Tectonics of Load-bearing and the Tectonics of Dressing," in *Brick: An Exacting Material.* ed. JP Wingender., (Architectura & Natura Press, 2016), 113-132.

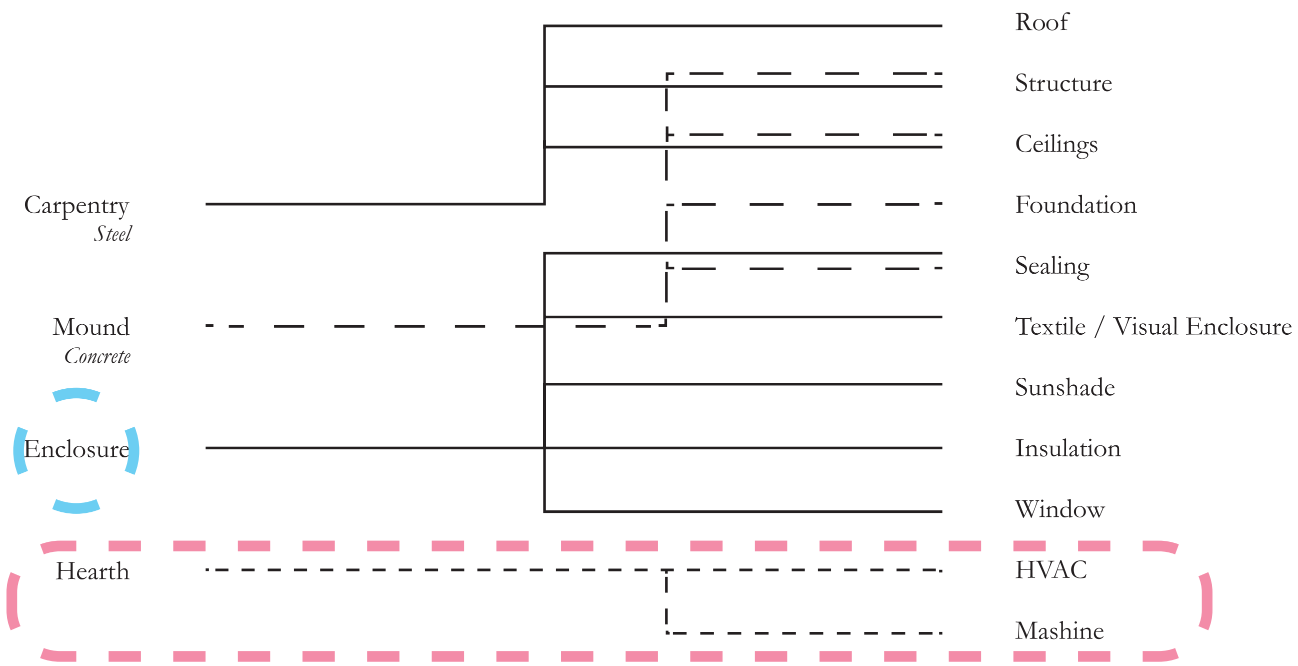
37. Semper, *Die Vier*, 104.

Gottfried Semper talks about the Barbarian hit in Die Vier Elemente der Baukunst and defines here the main four elements of Architecture. In order to address this new typology I thought it might be a good starting point to ask yourself first which elements actually compose architecture in order to define and curate them in order to find a new type.[34]

As displayed in Figure 76, the Elements are multi layered but distinguishable. The Heart, which for Semper is the fireplace, is the center of the architecture, the whole reason for the architecture to exist. In the case of the facility the Heart is clearly the machine and all its metabolism. The Mound is the concrete base and the Carpentry, the structure keeping the building up is the steel structure. Now the 4th element is the most interesting one here: Enclosure for Semper in the Barbarian Hut is made from Wickerwork. The Textile is woven and therefore Enclosure and therefore he refers to the tectonics of dressing which id represented though the art of weaving. The textile thereby is the divider of space.[35,36]

> „Wickerwork, the original space divider, retained the full Importance of its meaning, actually or ideally, when later light mat walls transformed into clay, tile, brick or stonewalls. Wickerwork was the essence of the wall." - Semper[37]

Considering the nature of brick facades being a cladding which fulfil the concept of dressing, In the following I will investigate on the textile expression of brick.



Semper Scheme
(2020)

by the Author
figure 82

How can a Brick Facade be textile?

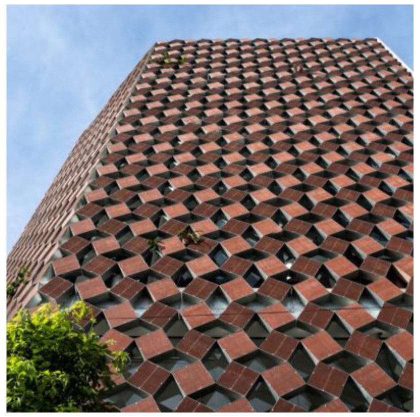
When considering different techniques for a textile brick appearance I decided to go for actual bricks not any ceramic tiles. So rather then producing a textile from ceramics the facade should have a light textile appearance while being masonry.

There were three main techniques to built such a facade with several nuances in execution with each of them. Its either built on site by either a mason or a robot, here one can say that the robot can lay bricks up to a millimetre exact. Or one can use prefabricated panels, but those would be then actually mostly concrete-panels with a thin layer of brick.

Since the building is meant to be implemented in the community of Dordrecht it seems to be the right decision to let local masons do the work to be an actual product of the local craftsmanship.

Textilverband Münster, Münster
(????)

behet bodzino lin architeckten,
https://www.zi-online.info/imgs/1/2/4/2/0/7/5/AF_800_533-476a7b05e3c12349.jpg, 20.08.20
figure 83

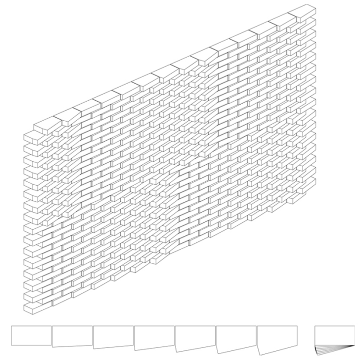


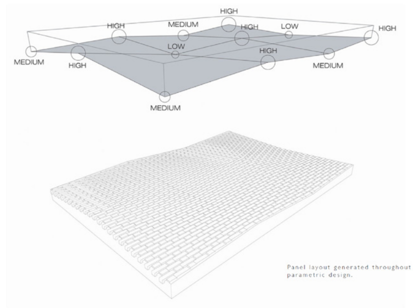
Office Building, Hanoi
(????)

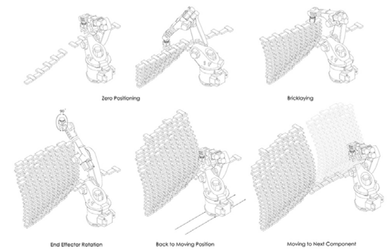
H&P Architects,
https://materialdistrict.com/article/properly-breathing-house-recycled-ceramic-bricks/, 20.08.20
figure 84

Stan Pau Reserach Institute, Barcelona
(????)

PICH Architects,
https://www.flexbrick.net/en/portfolio/sant-pau-research-institute-in-barcelona/, 20.08.20
figure 85

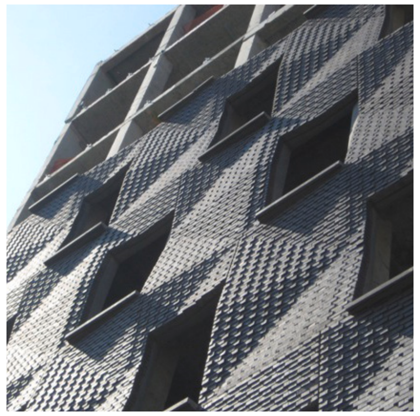






Textilverband Münster, Münster
(????)

behet bodzino lin architeckten,
https://www.zi-online.info/imgs/1/2/4/2/0/7/5/AF_800_533-476a7b05e3c12349.jpg, 20.08.20



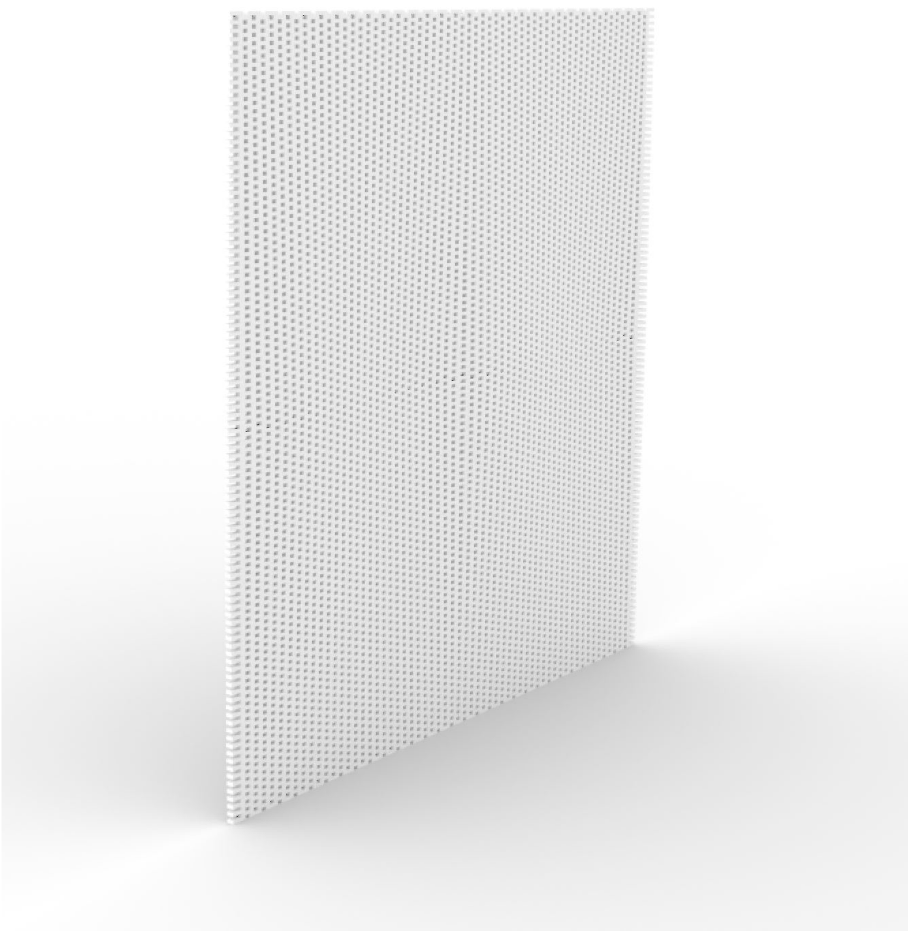
290 Mulberry
(????)

ShoP Architects,
https://www.archdaily.com/9028/in-progress-290-mulberry-shop-architects, 20.08.20
figure 86

Art Gallery, Shanghai
(????)

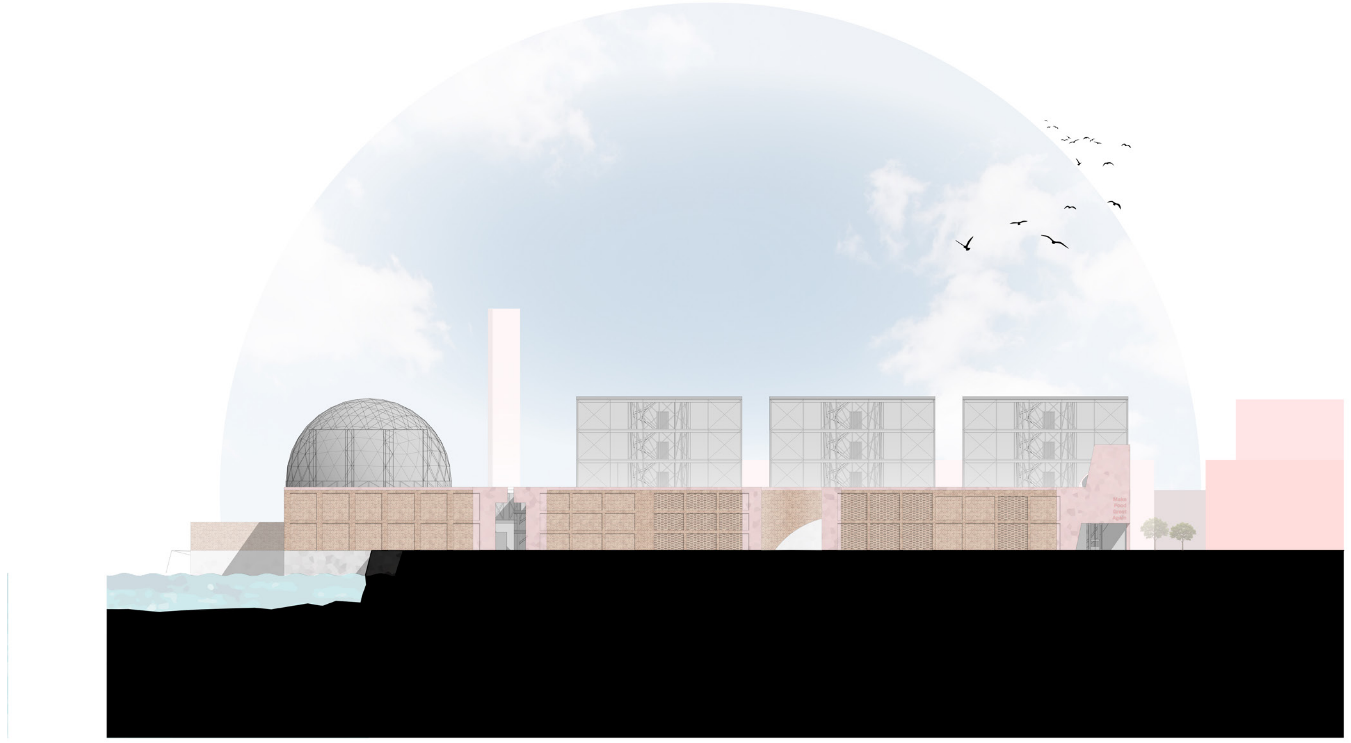
Archi-Union Architects
http://www.archi-union.com/Homes/Projectshow/index/pageid/6/id/40, 20.08.20
figure 87

The tectonic expression in the facade is a mix of the tectonics of load bearing and the tectonics of dressing. The grid in front represents the load bearing tectonics, which means behind the recessed part with the textile brick expression is no load bearing structure. While the beams and columns are expressed via prefabricated heavy appearing brick elements. Also the entrances and penetrations in the structure are differently expressed. Red tinted concrete elements indicate these.

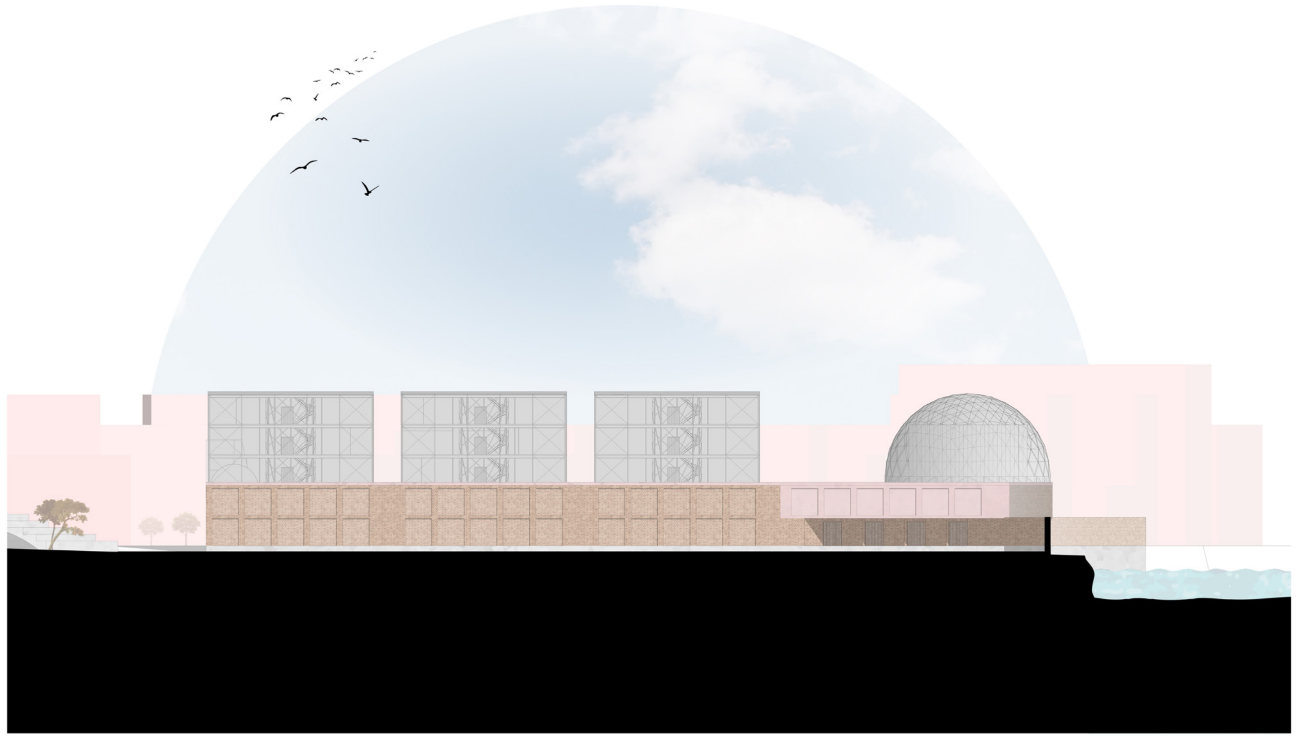


Brick Curtain Grasshopper
(2020)

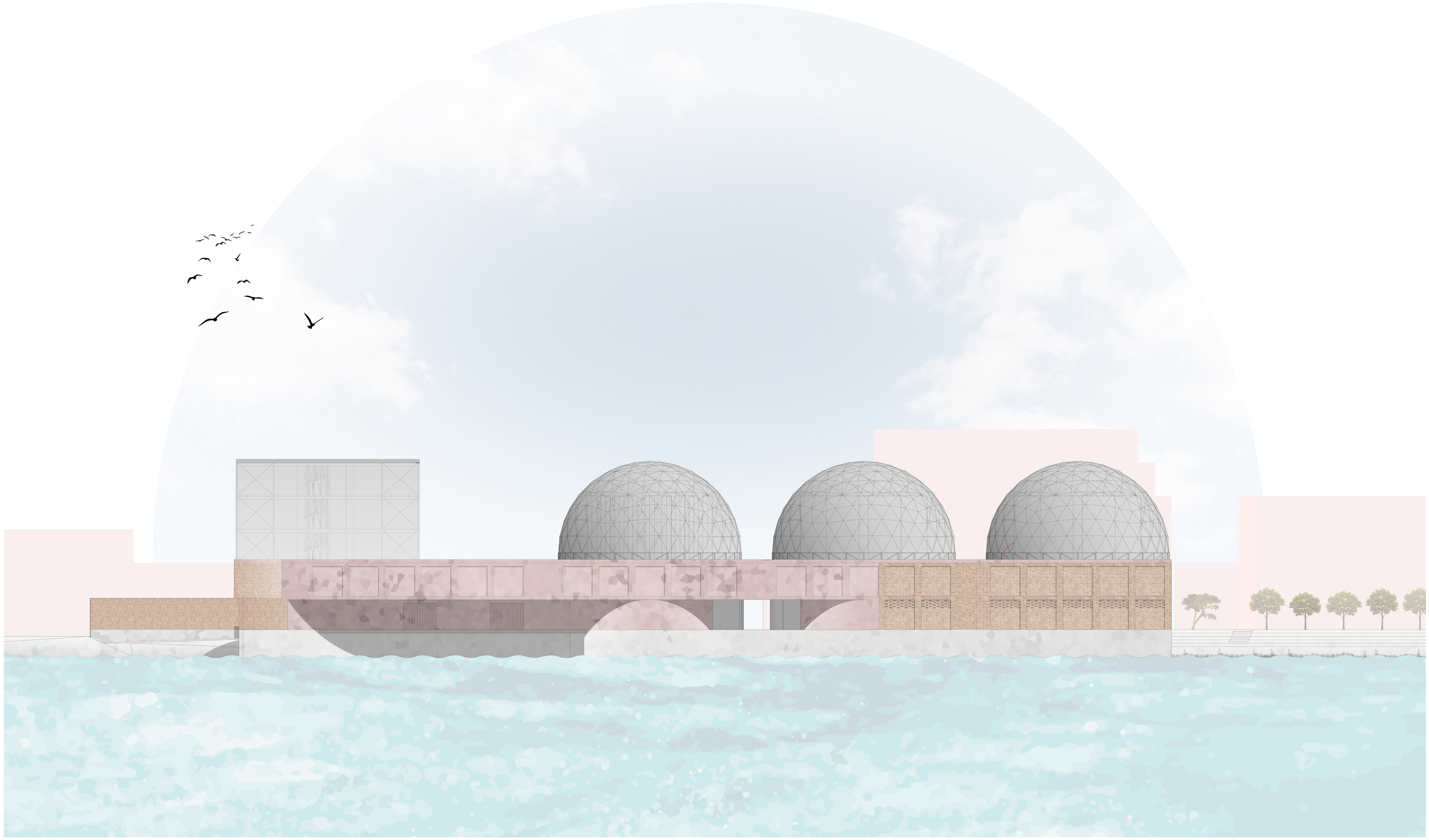
by the Author
figure 88



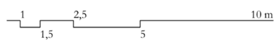
West Elevation

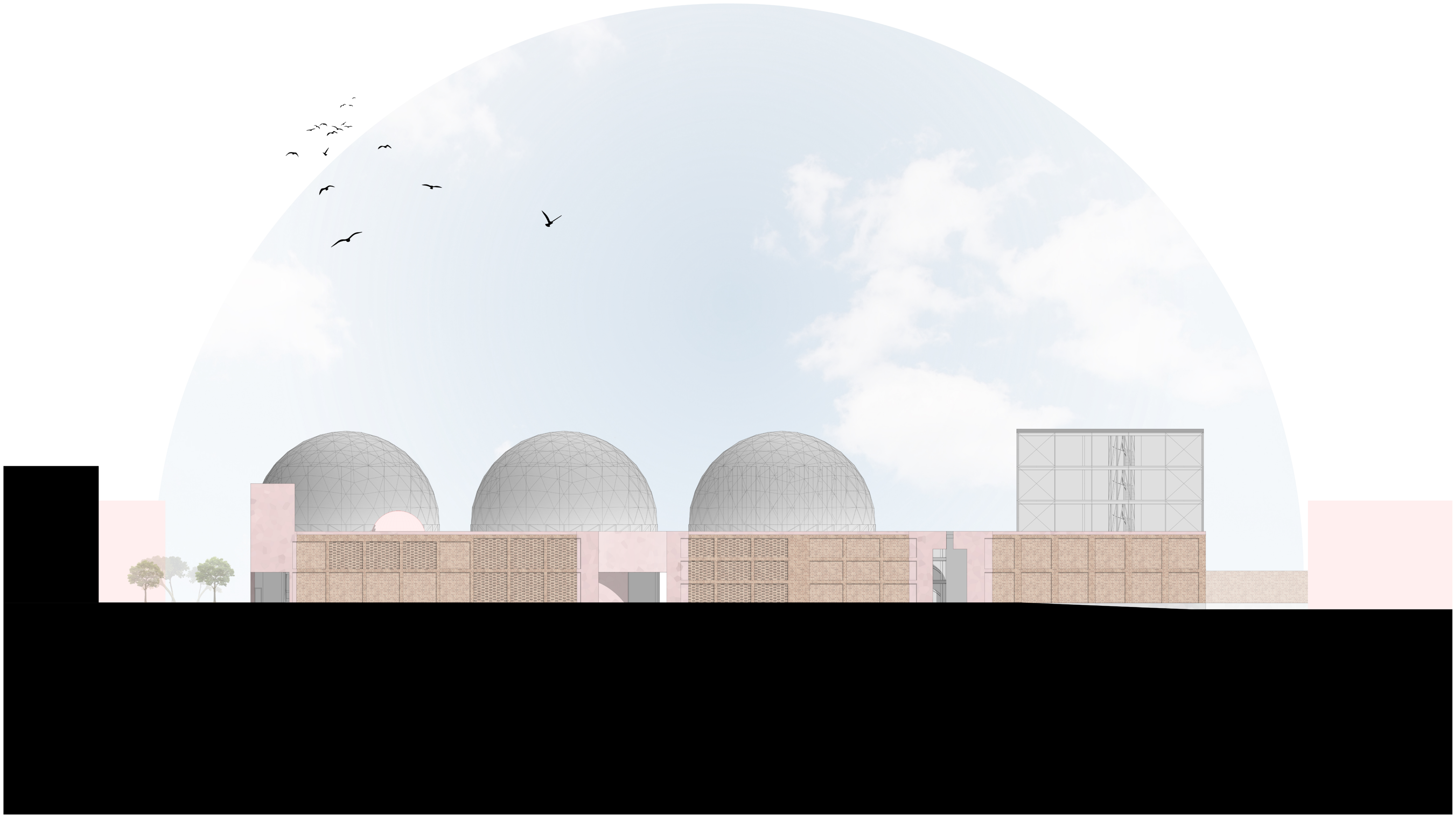


East Elevation

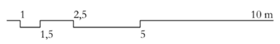


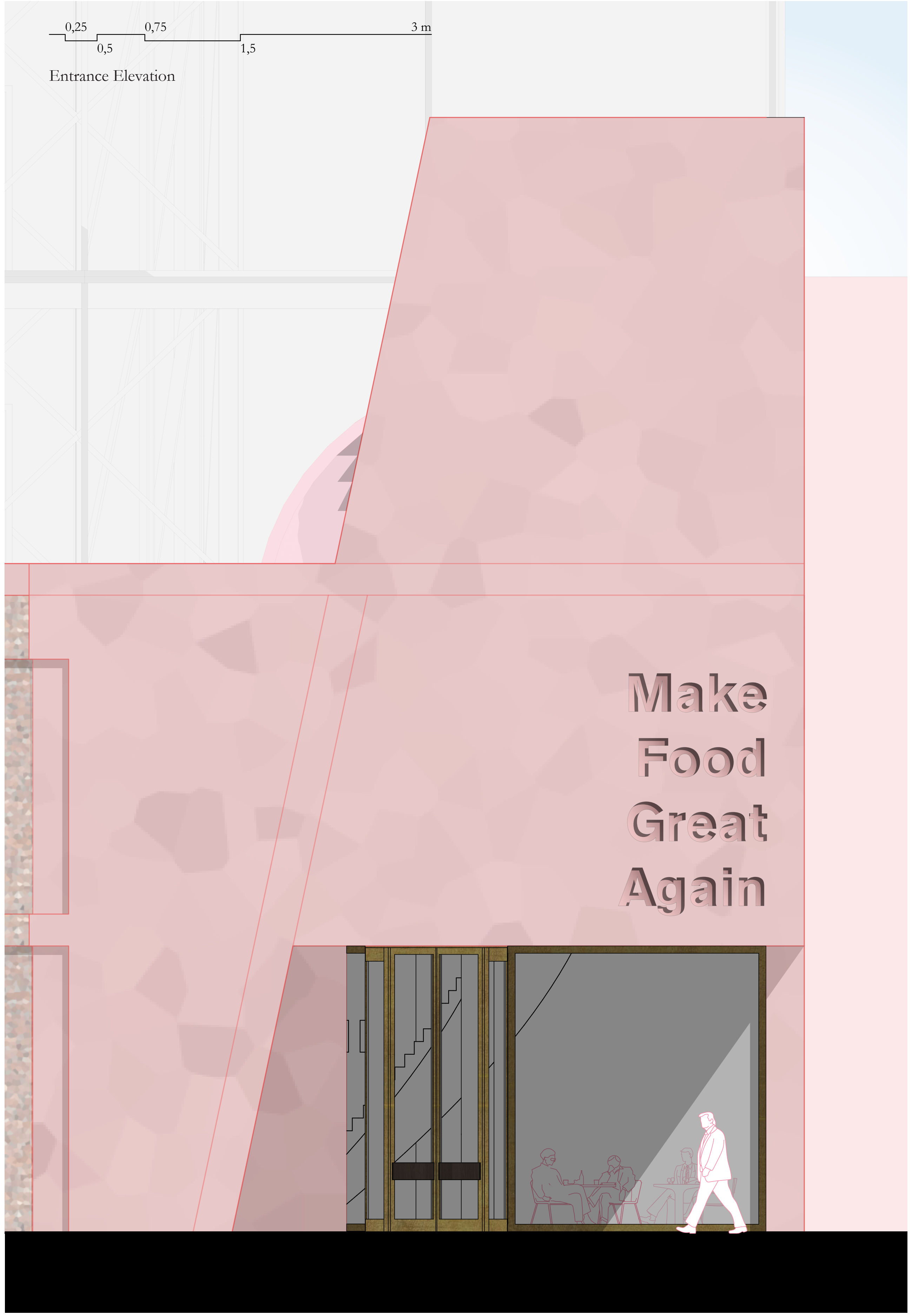
North Elevation





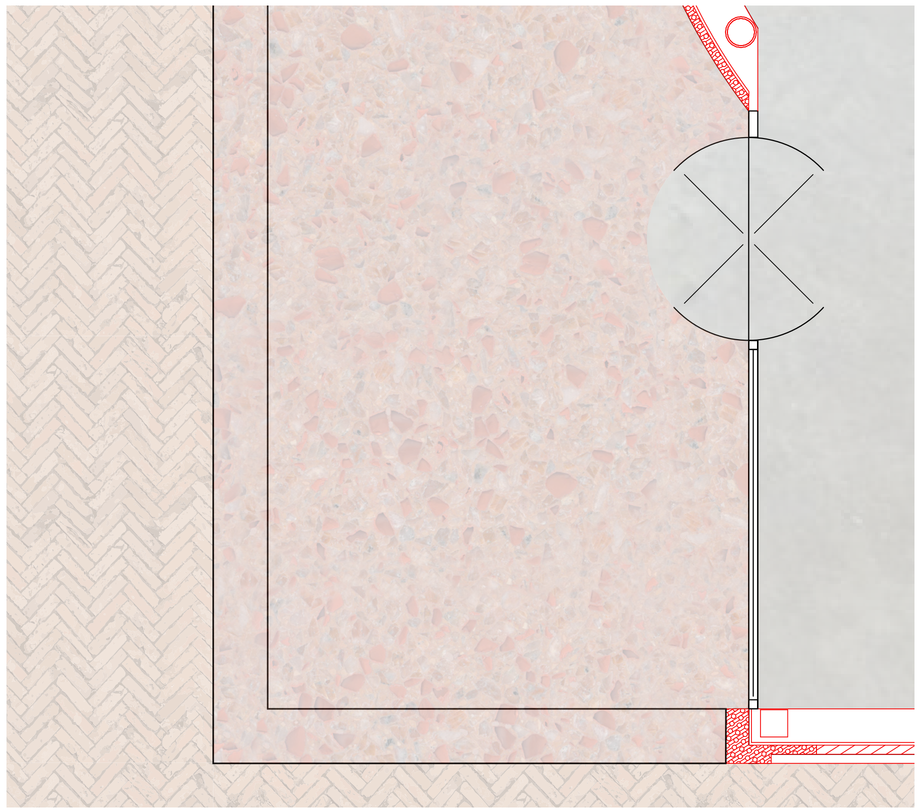
South Elevation




0,25
0,5
0,75
1,5
3 m
Entrance Elevation
Make
Food
Great
Again

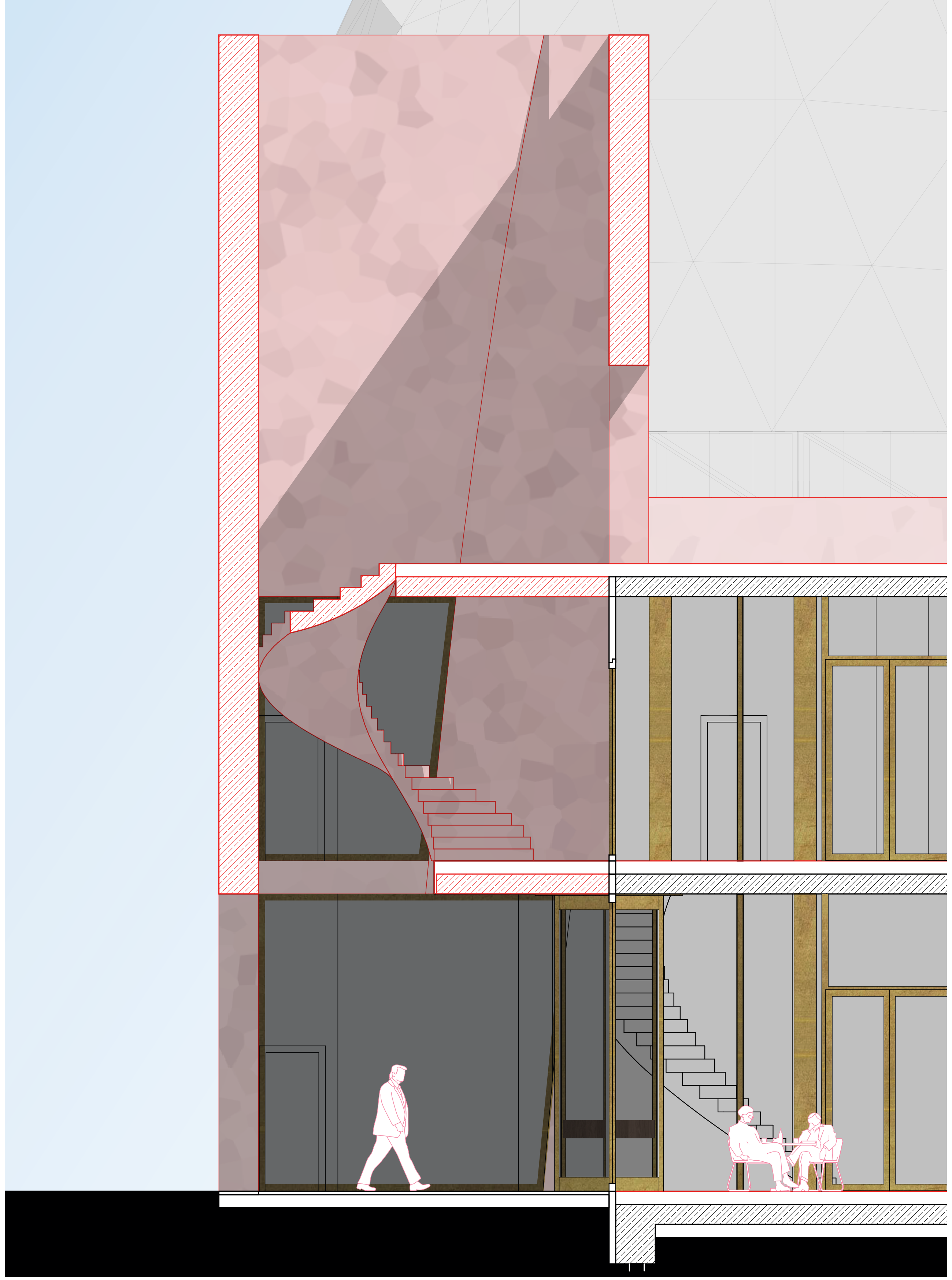
0,25 0,75 3 m
0,5 1,5

Entrance Plan



0,25 0,75 3 m
0,5 1,5

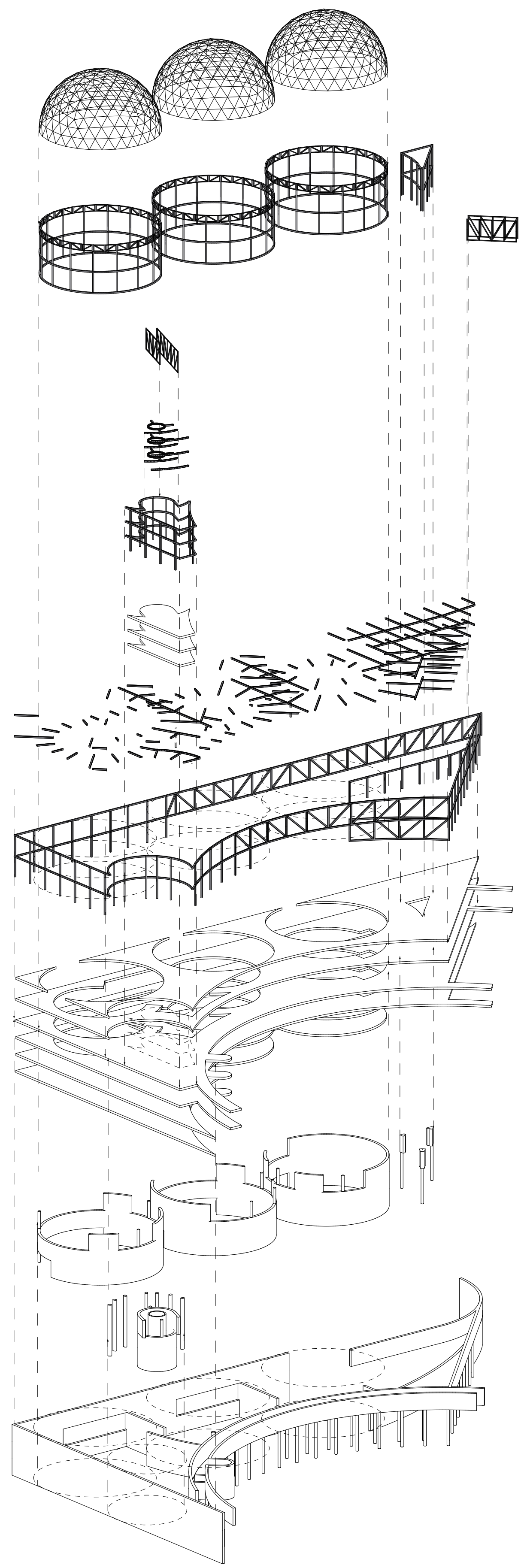
Entrance Section



4.5. Architectural Concept

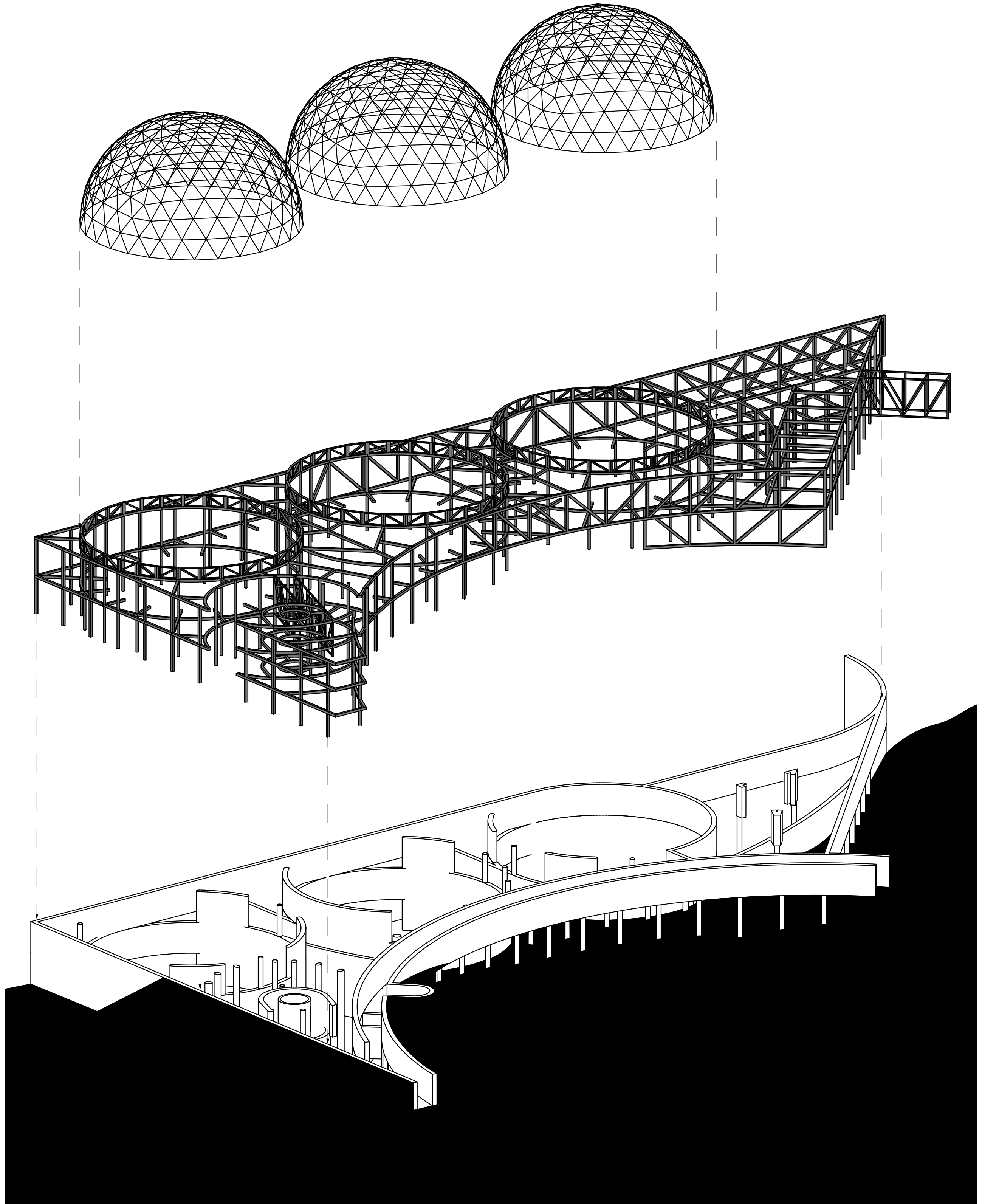
c. Structure

As previously mentioned the structure is composed from bottom to top, with a solid thermo concrete base, steel structure and light domes on top. The Clean Meat Factory was chosen in further detailing since its the major novelty in type and therefore most interesting in exploring in further detail for me.



Structure 1
(2020)

by the Author
figure 89



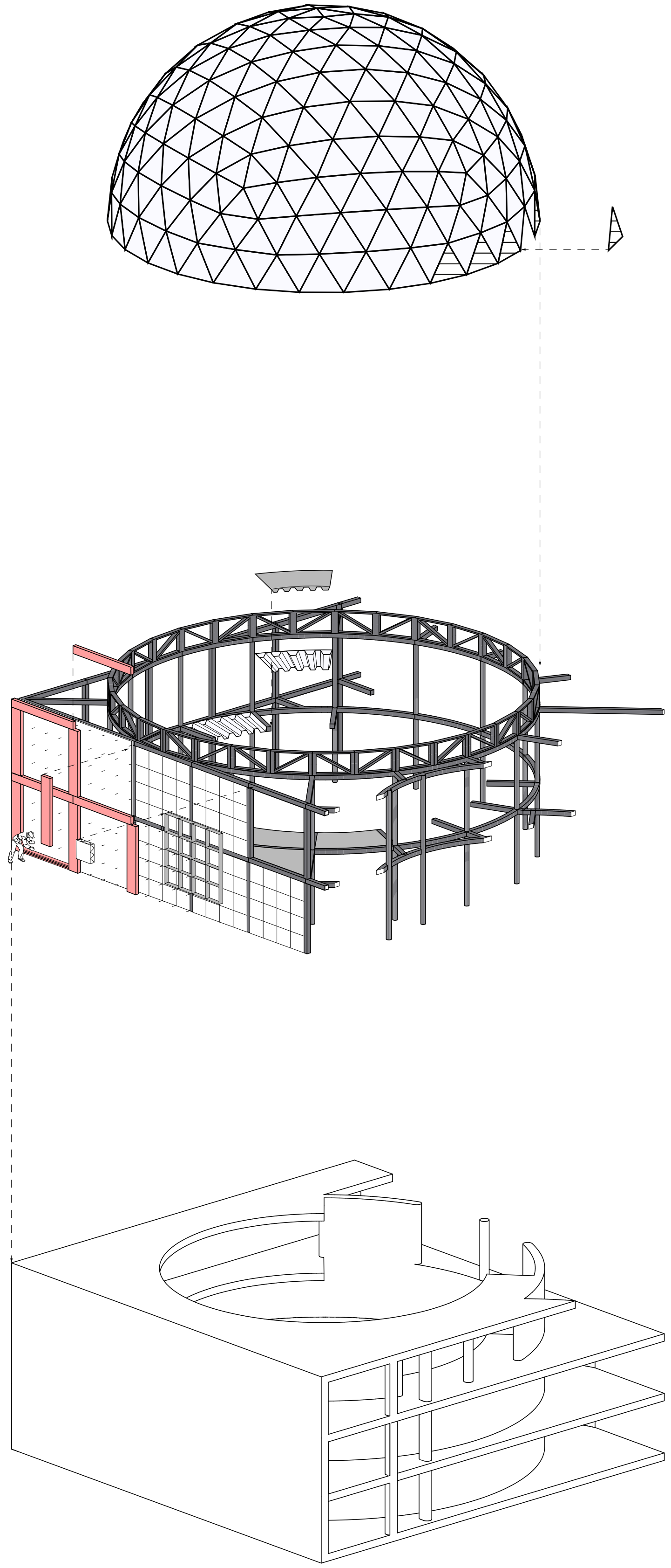
Structure 2
(2020)

by the Author
figure 90

The facade bricks are made in Amsterdam from the Stone Cycling company, their bricks are at least 60% recycled material. This contribution to the circularity of their building materials also adds local value. The chosen format is the Waal format since the river is a side arm of the Waal which means that the by-product sediments of the facility are the same then the ones the original Waal bricks were used to be made with. Even though the Waal format is nowadays a common format all over.

Materials
(2020)

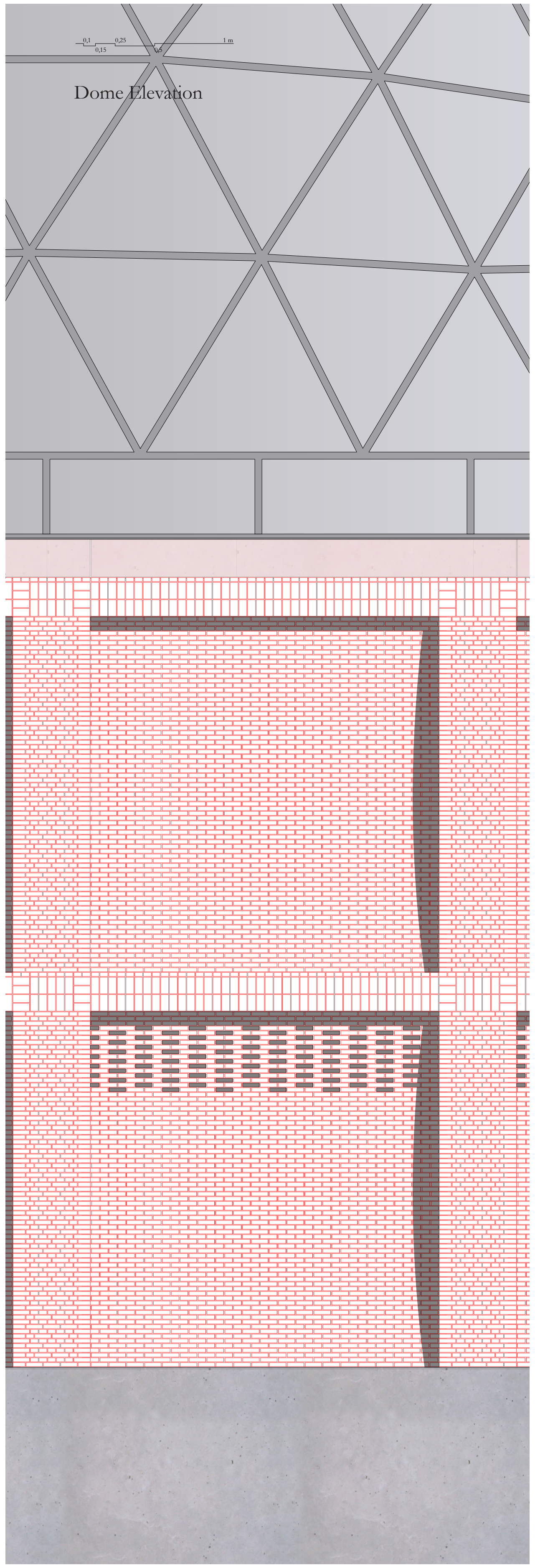
StoneCycling
https://www.stonecycling.com/, 20.08.20
figures 91

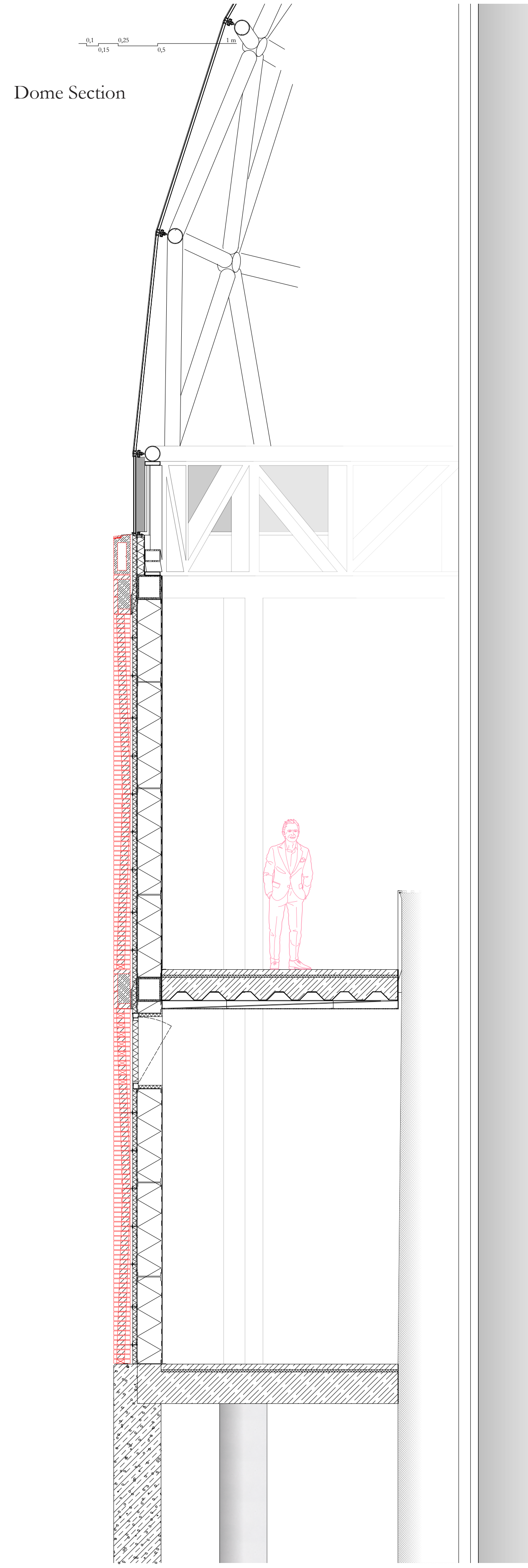


Structure 3
(2020)

by the Author
figure 92

Brick Waal Format,	210 mm
Cavity,	30 mm
Mineralwool water-repellent,	70 mm
Moisture diffusing windproof layer,	
Gypsum impregnated plasterboard,	9 mm
Sheet-steel sections with minderal wool,	280 mm
Vapor barrier,	
Perforated steel finish White,	5 mm





Ceiling

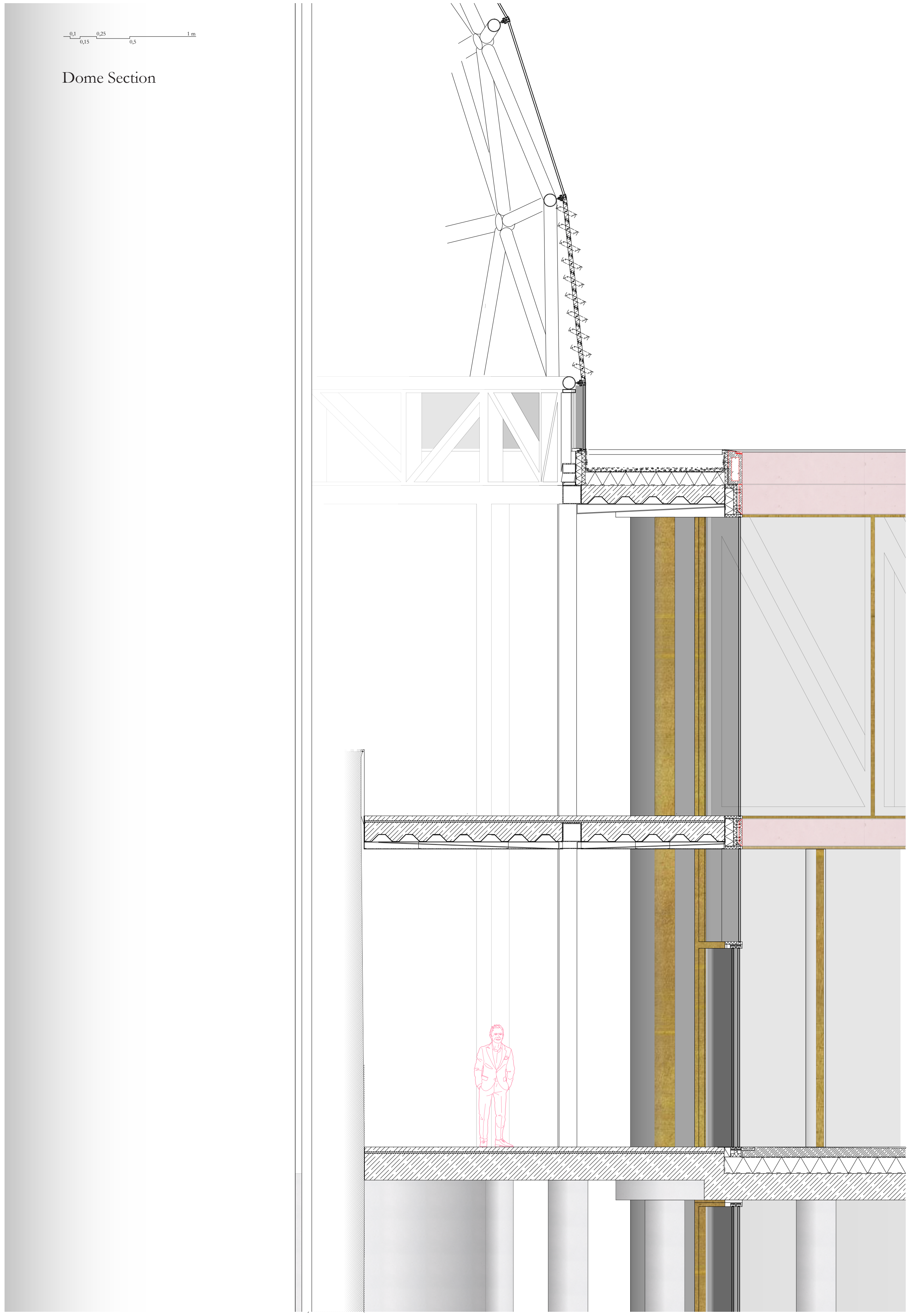
Honed screed,	70 mm
Impact sound insulation,	30 mm
Reinforced concrete on trapeziodal-section steel,	170-270 mm
Suspended ceiling,	205 mm
Brass finish,	5 mm

Roof

Gravel,	50 mm
Bituminous roof sealing double layer,	
Mineralwool to falls,	170 - 270 mm
Vapor barrier,	
Reinforced concrete on trapeziodal-section steel,	170 - 270 mm

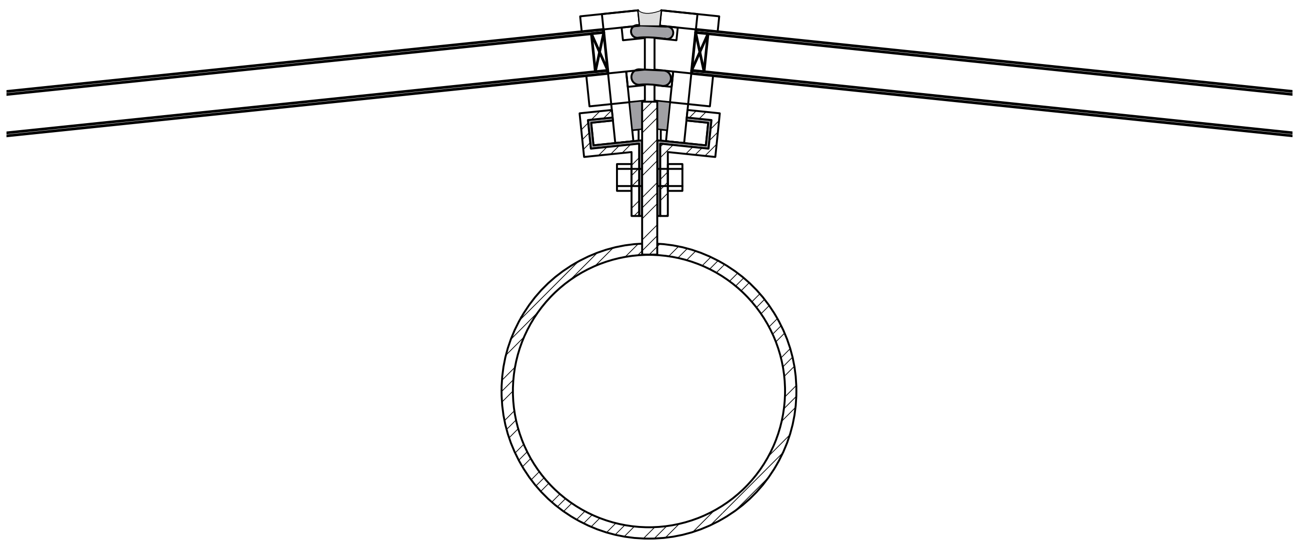
Floor

Honed screed to falls,	80 - 150 mm
Sealing layer,	
Hard mineralwoll,	250 mm
Vapor barrier,	
Reinforced concrete	400 mm



Dome Section

The windows in the dome are also prefabricated panels. They come in diverse options in order to increase later adaptability. Even though in the original design only the ventilation and glass panels are used, blinded or PV panels are imagineable.

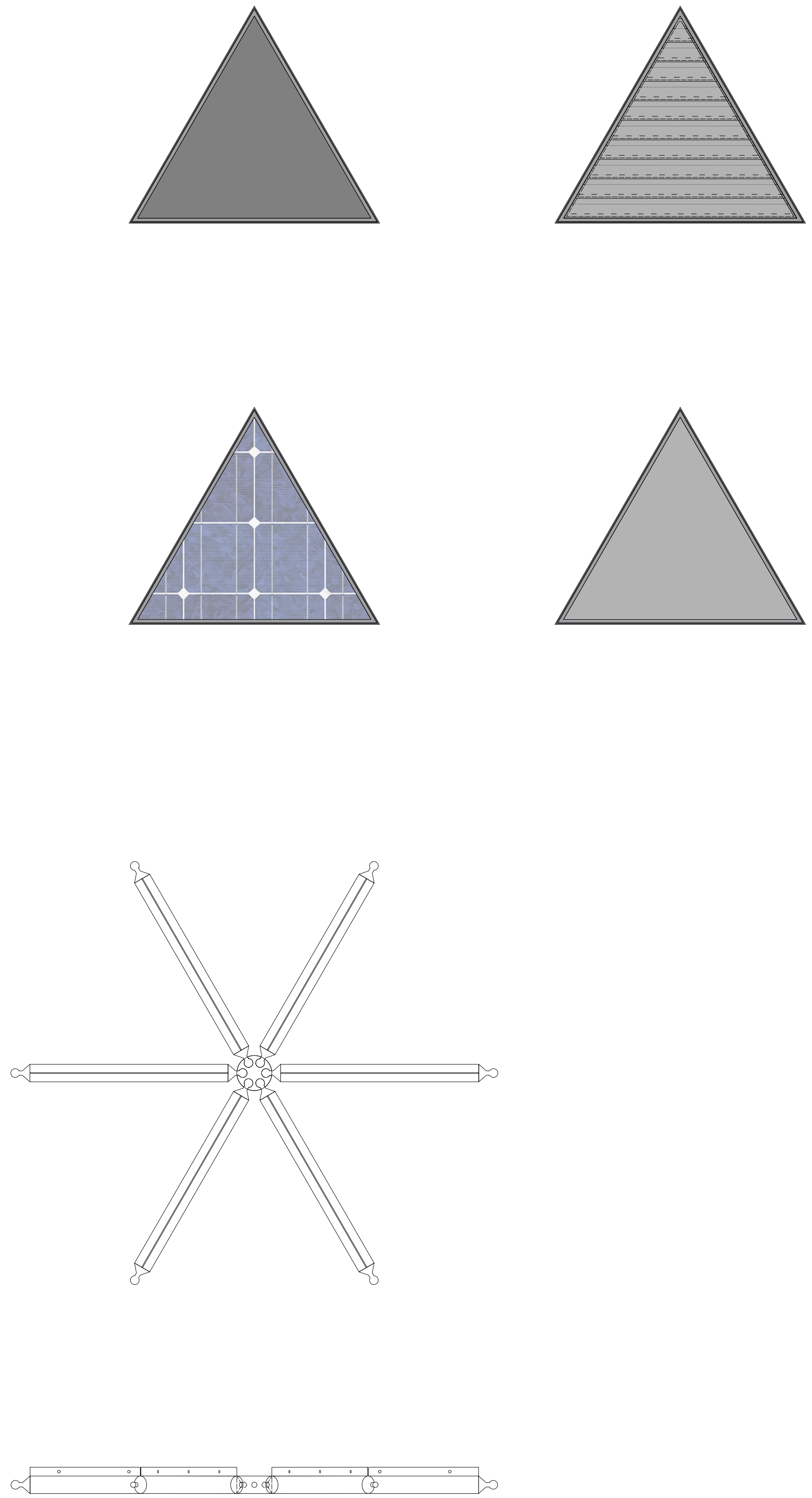


1 2,5 10 cm
1,5 5

Dome Structure Detail

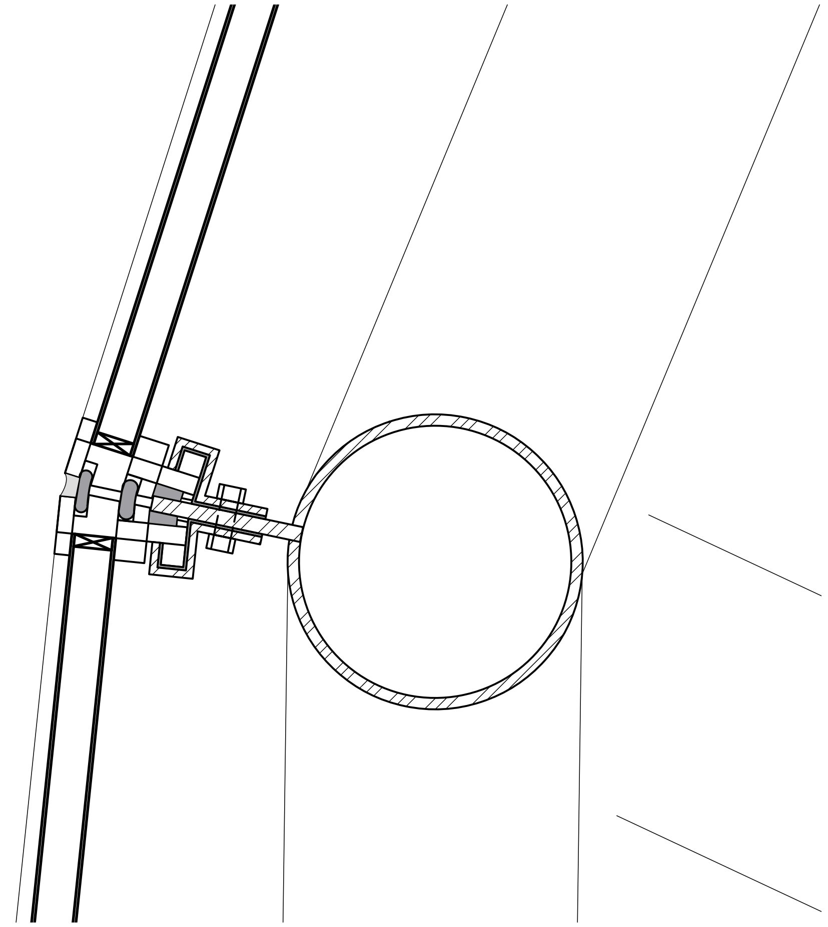
0,1 0,25 1 m
0,15 0,5

Dome Panels



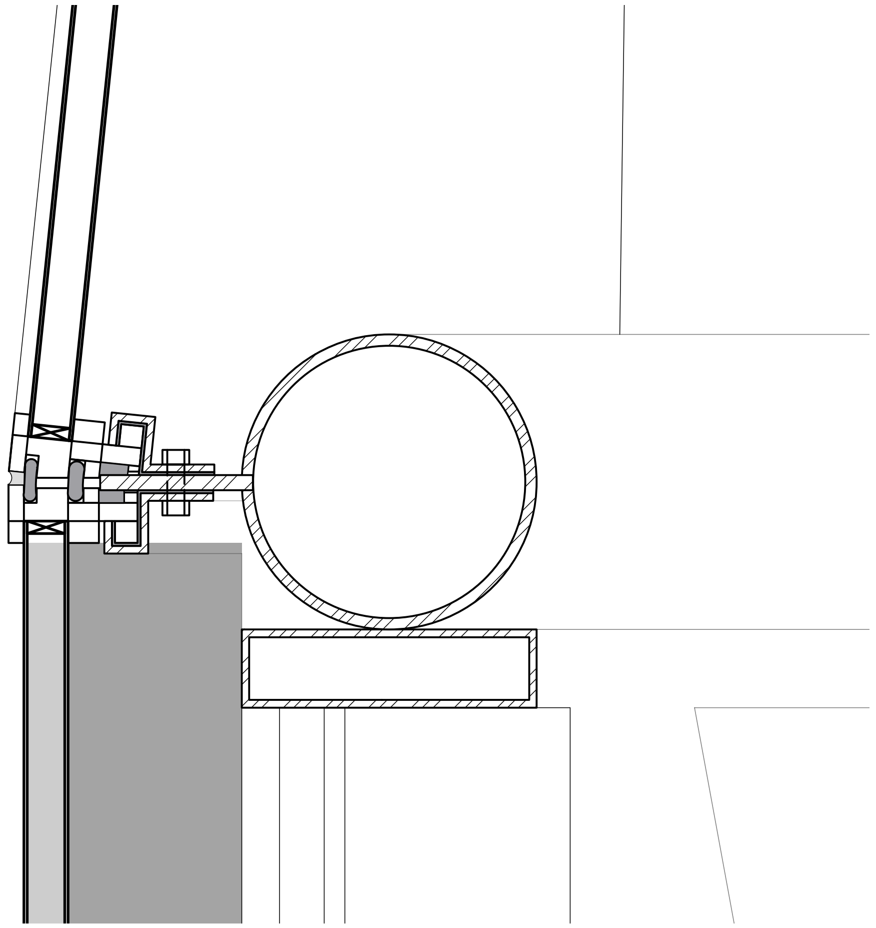
1 2,5 10 cm
1,5 5

Dome Structure Detail



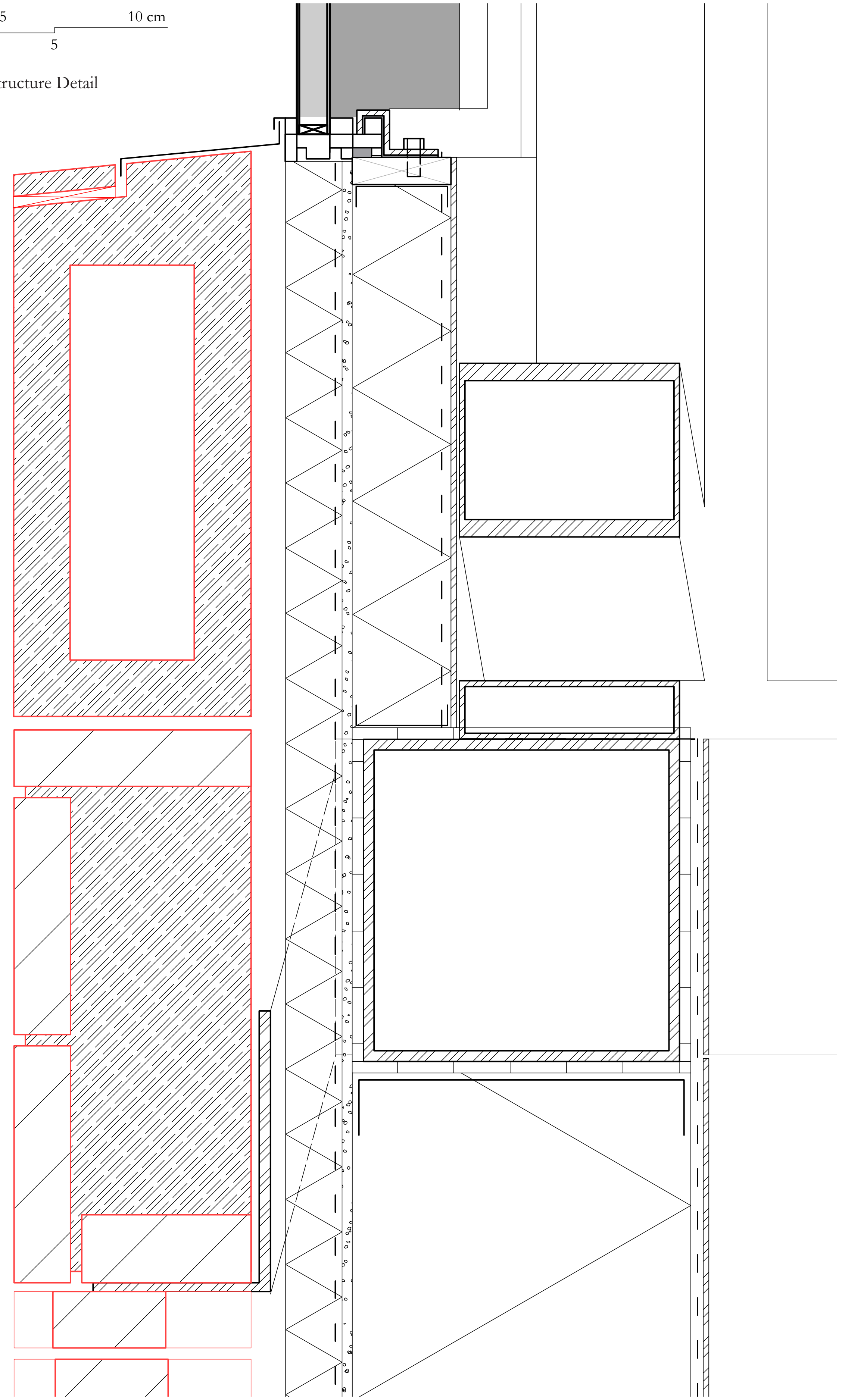
1 2,5 10 cm
1,5 5

Dome Structure Detail

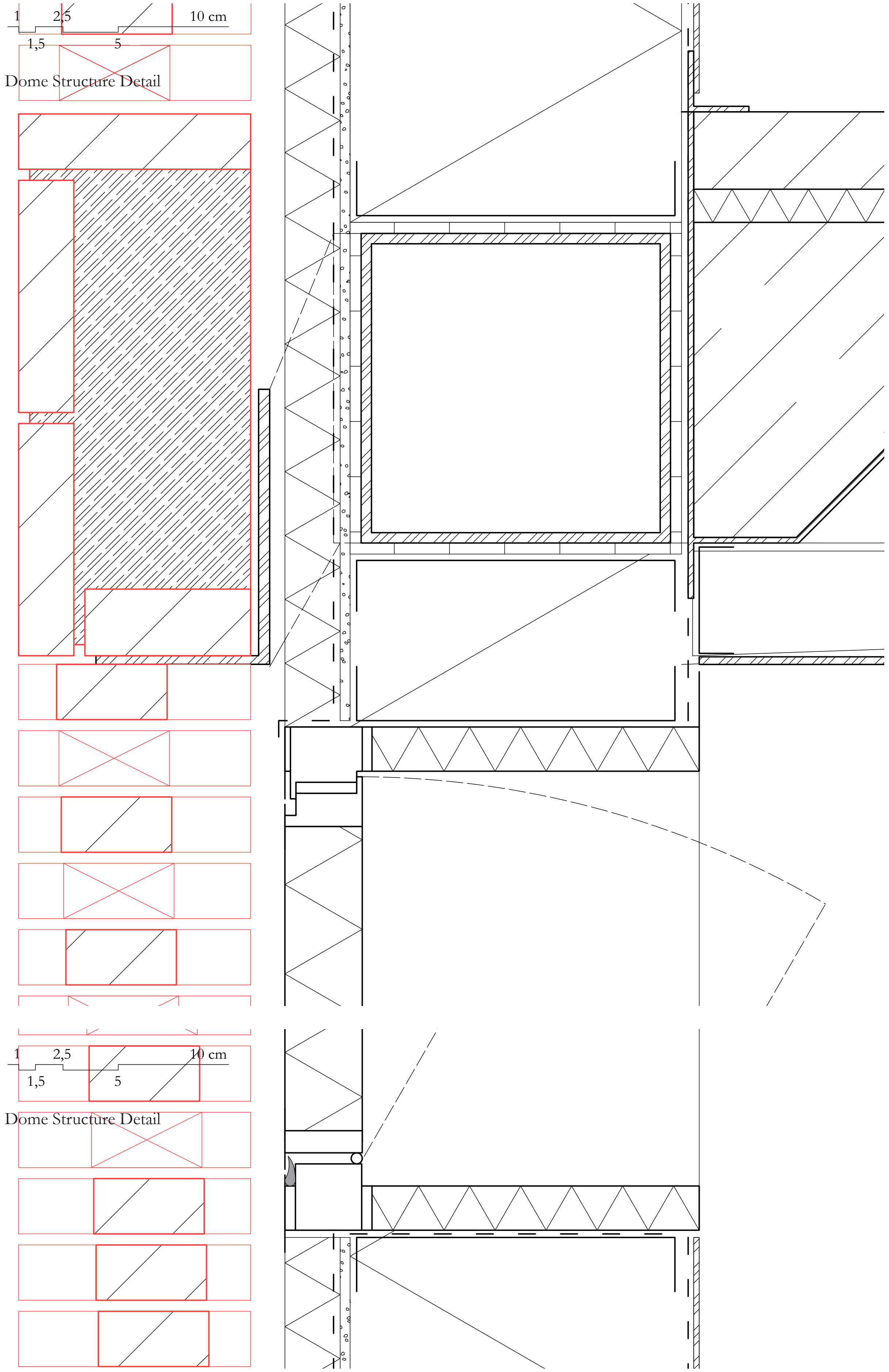


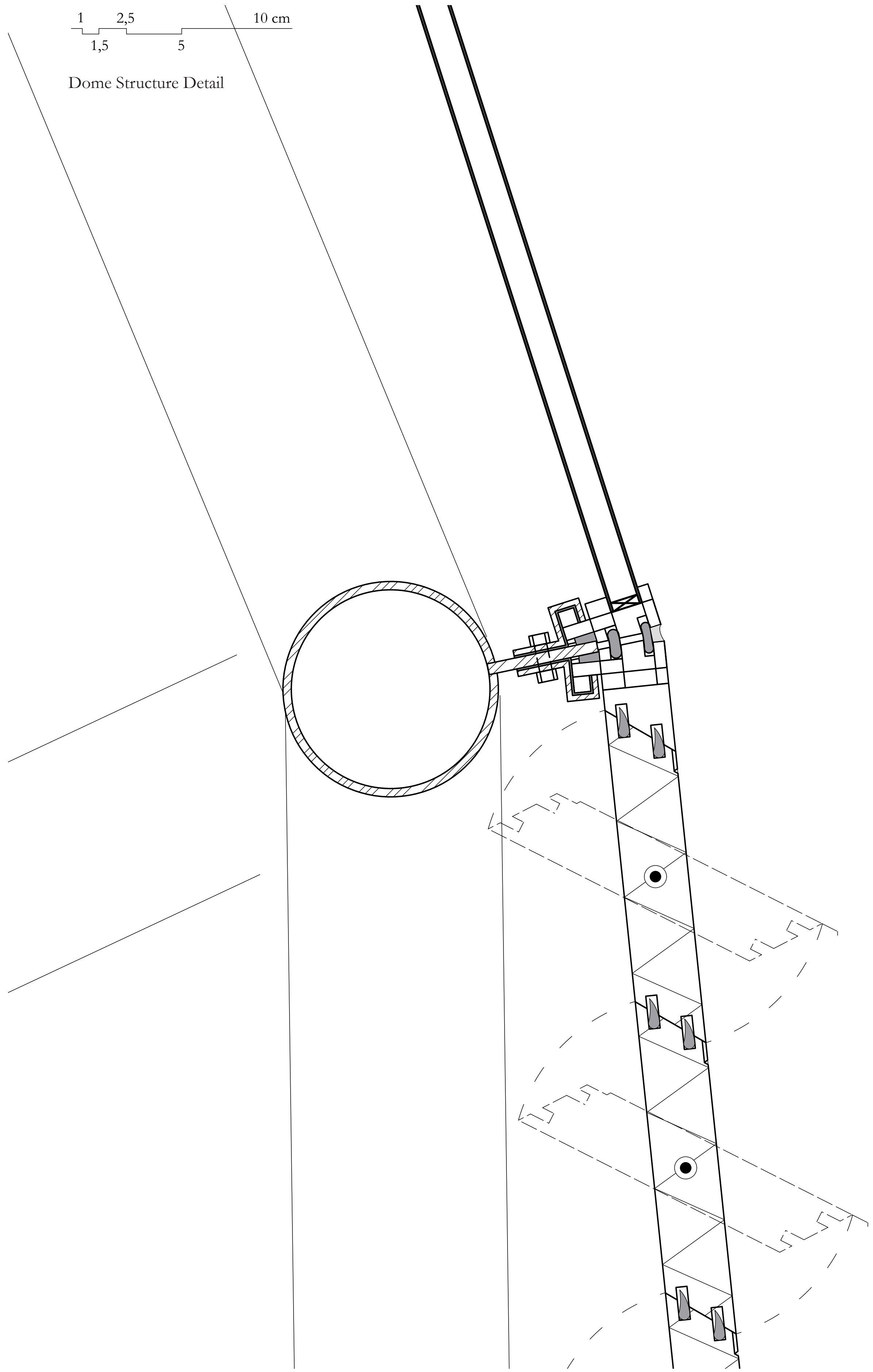
1 2,5 10 cm
1,5 5

Dome Structure Detail

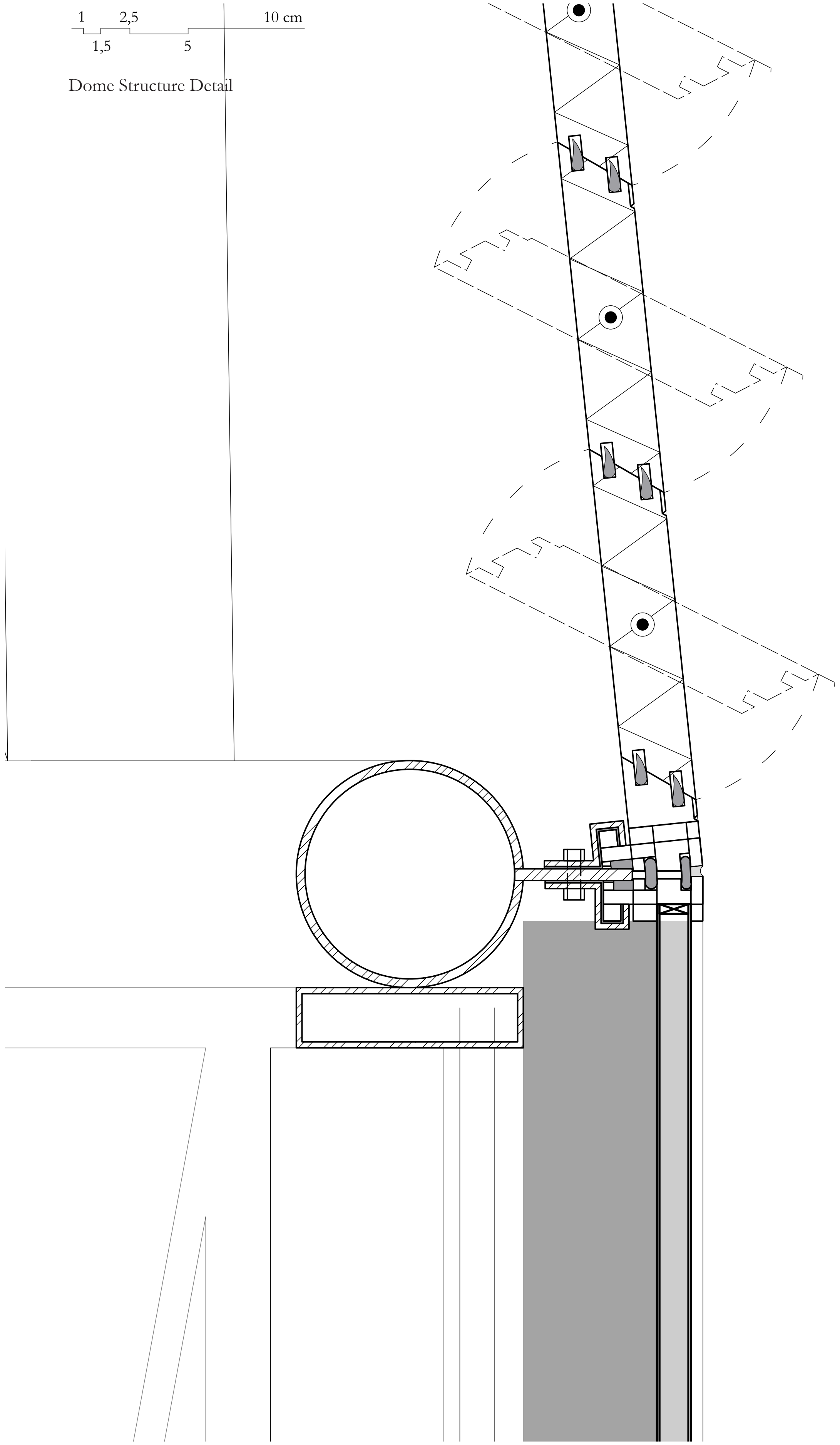


Brick Waal Format,	210 mm
Cavity,	30 mm
Mineralwool	70 mm
water-repellent,	
Moisture diffusing	
windproof layer,	
Gypsum	9 mm
impregnated plasterboard,	
Sheet-steel sections	280 mm
with minderal wool,	
Vapor barrier,	
Perforated steel finish	5 mm
White,	

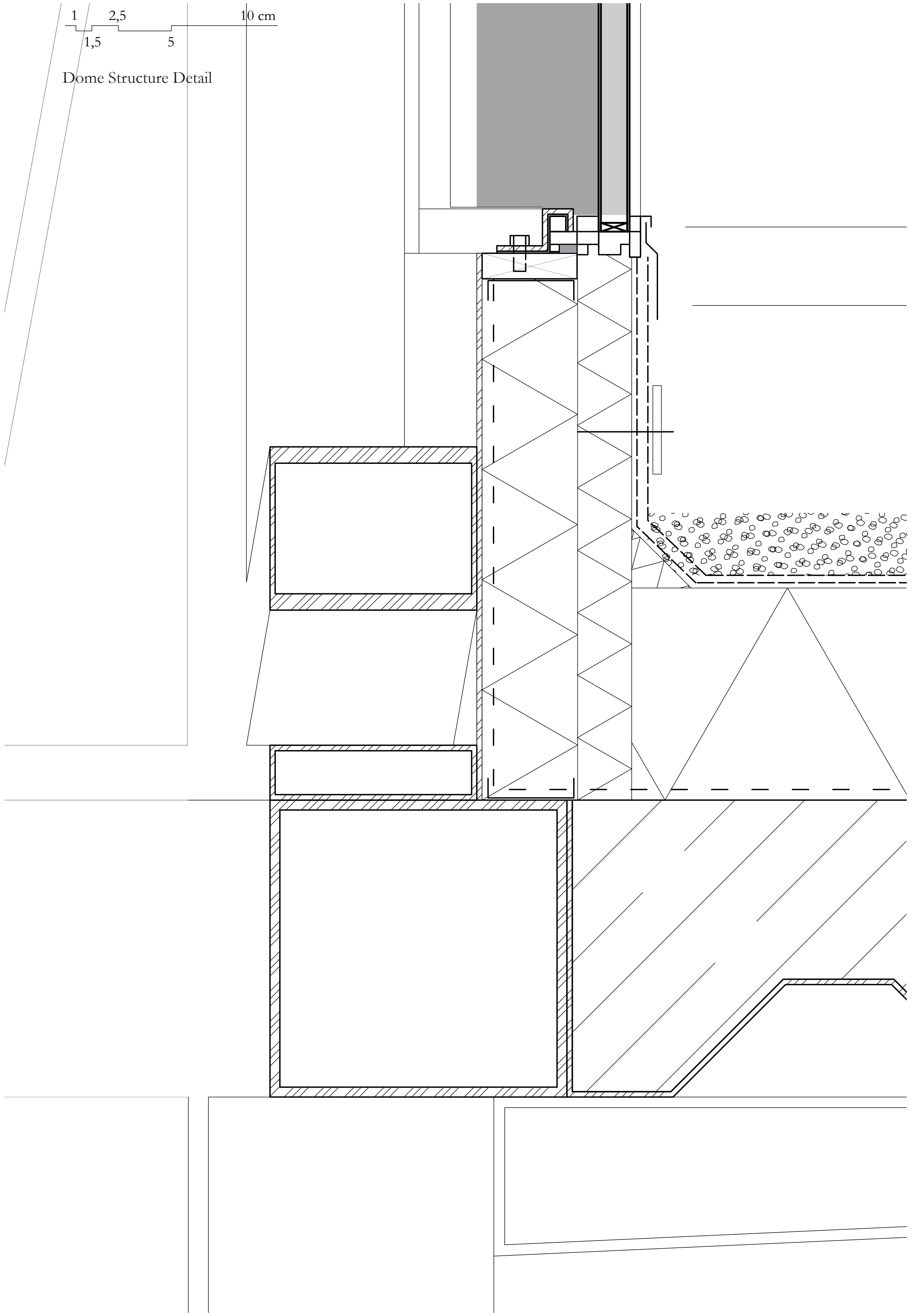




Dome Structure Detail

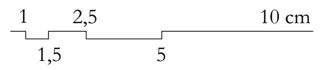


Dome Structure Detail

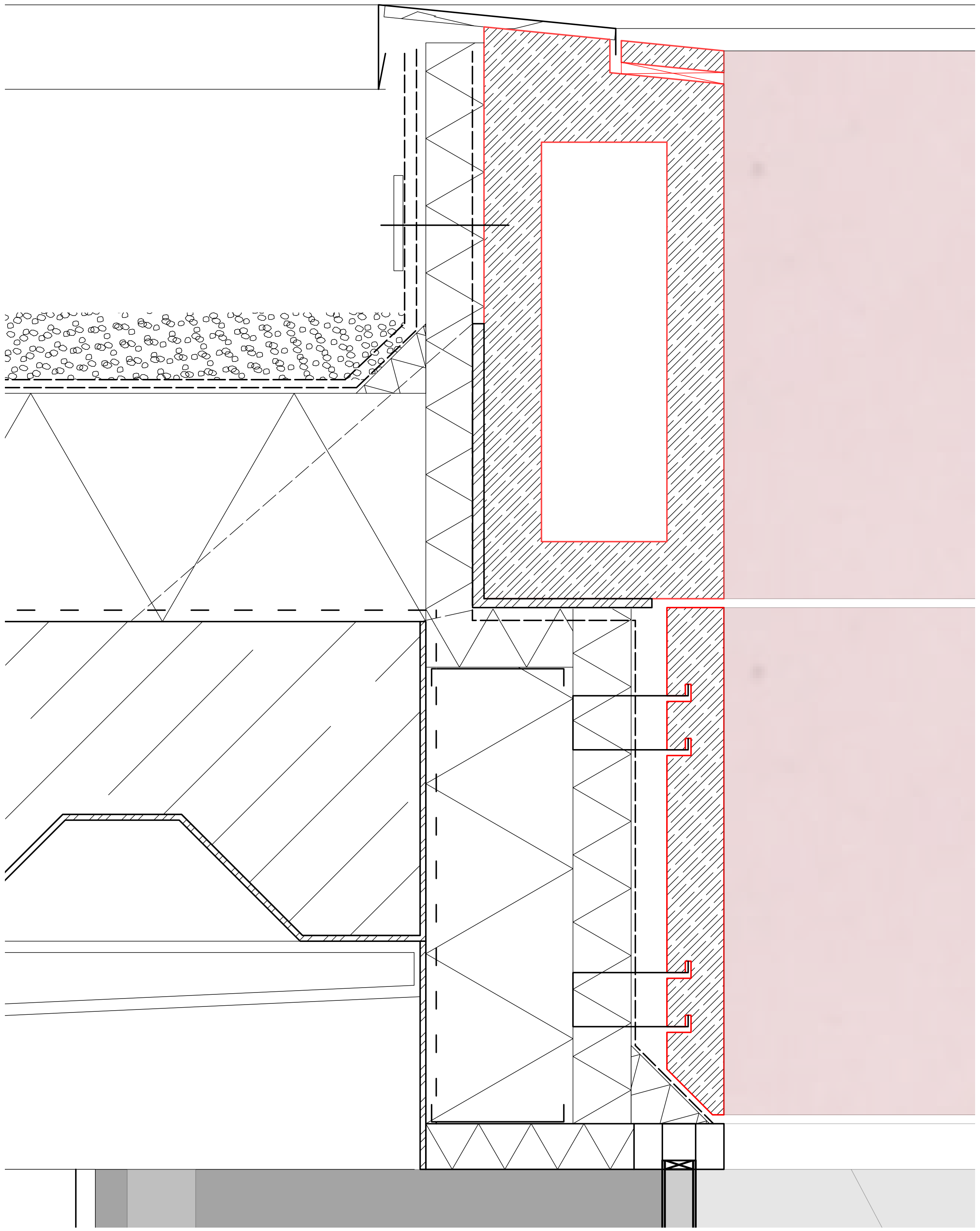


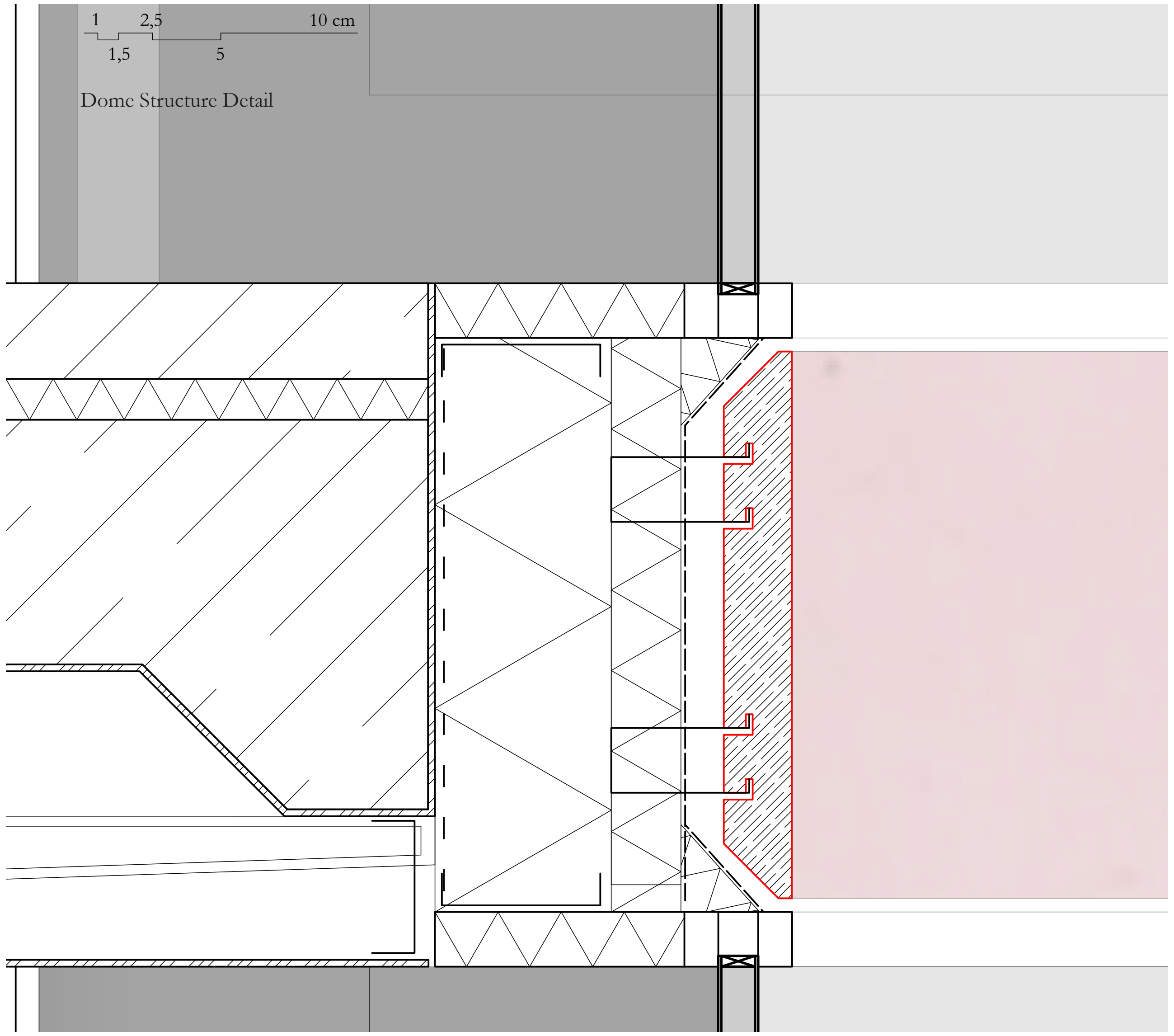
Dome Structure Detail

Gravel,	50 mm
Bituminous roof sealing double layer,	
Mineralwool to falls,	170 - 270 mm
Vapor barrier,	
Reinforced concrete on trapeziodal-section steel,	170 - 270 mm

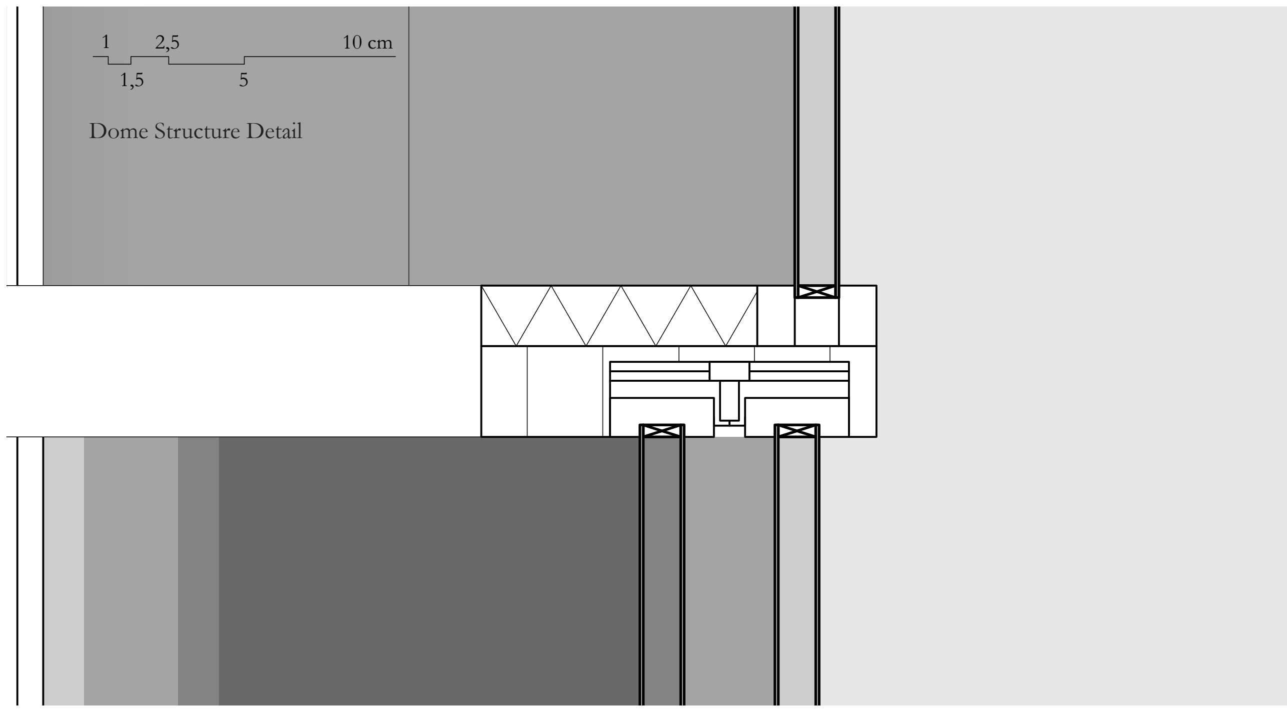


Dome Structure Detail



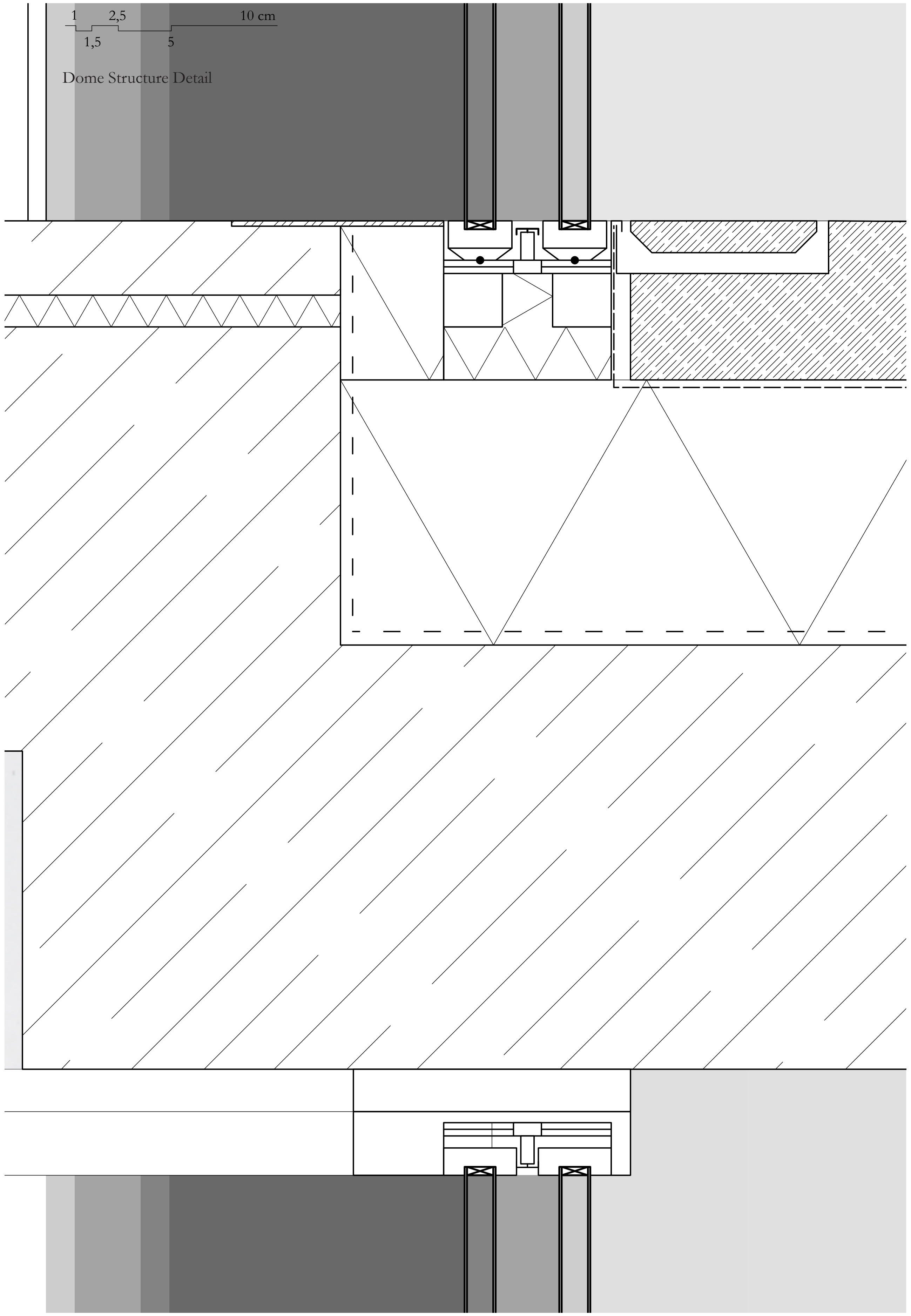


Dome Structure Detail



Dome Structure Detail

Honed screed	80 - 150 mm
to falls,	
Sealing layer,	
Hard mineralwoll,	250 mm
Vapor barrier,	
Reinforced concrete	400 mm



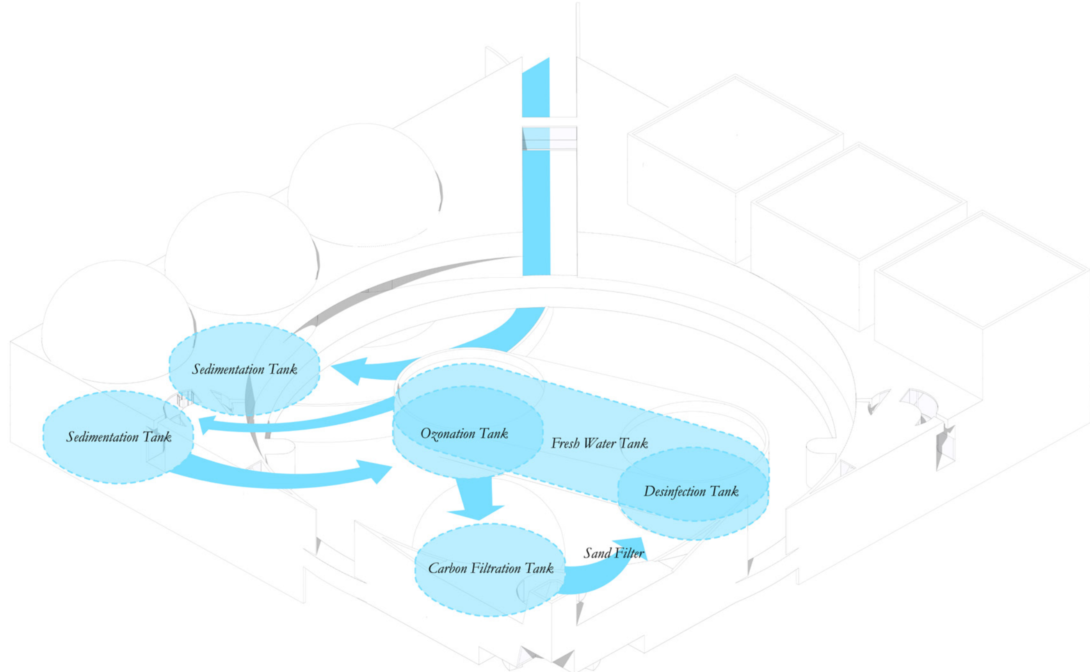
4.6. Metabolism

a. Water

Figure 93 displays the water purification process from the river water. Different basins serve individual purposes until the water eventually is stored in the freshwater tank.

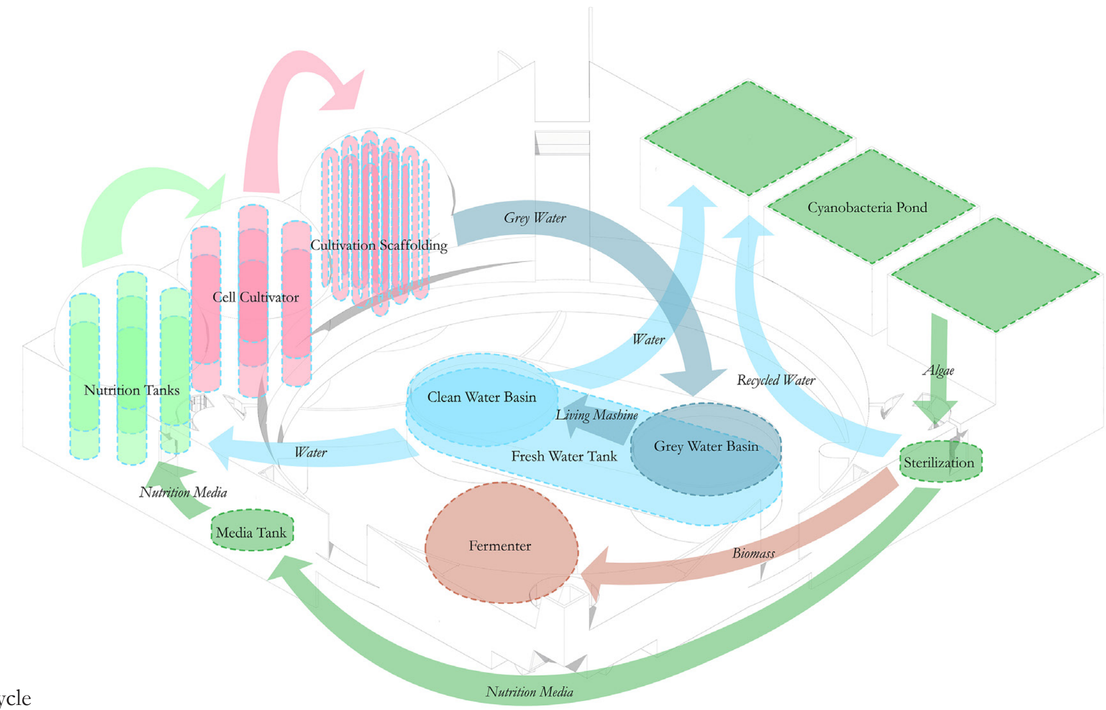
The Purification starts with the Sedimentation Tank where all sediments sink to the bottom. In the Ozonation Tank the organic chemicals are breaking down. Afterwards, organic matter and dissolved chemicals are filtrated though Granular Activated Carbon. Once Sand filtrated the water is disinfected by Ultraviolet light so it eventually gets to the Fresh Water Tank.

The water cycle shown in Figure 94 is rather complex and also already involves the Clean Meat production. As previously explained the Clean Meat production needs a medium to grow the muscle cells with, in this case Algae or Cyanobacteria. The Cyanobacteria ponds are on the roof of the vertical farm, keeping them in direct sunlight to grow and maximize yields. Once sterilized and separated from the waste, the base media is enriched with water in order to fuel the cultivation Tanks. Gray water gets recycled together with the rainwater through an living machine.



Water Purification
(2020)

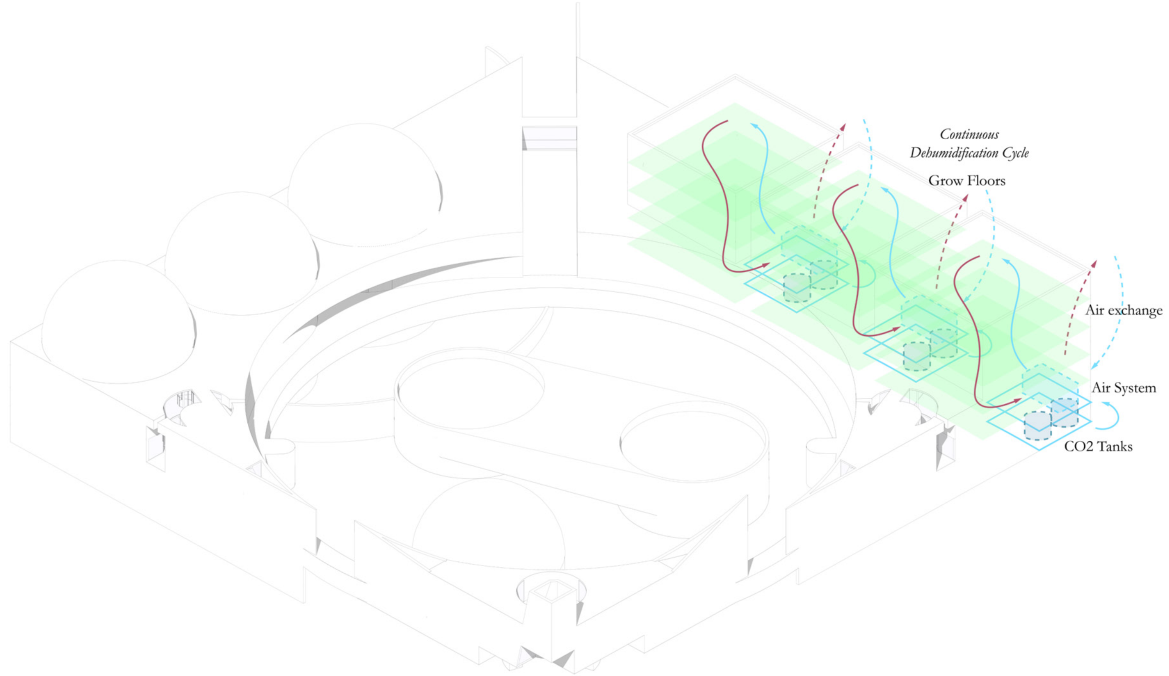
by the Author
figure 93



Water Cycle
(2020)

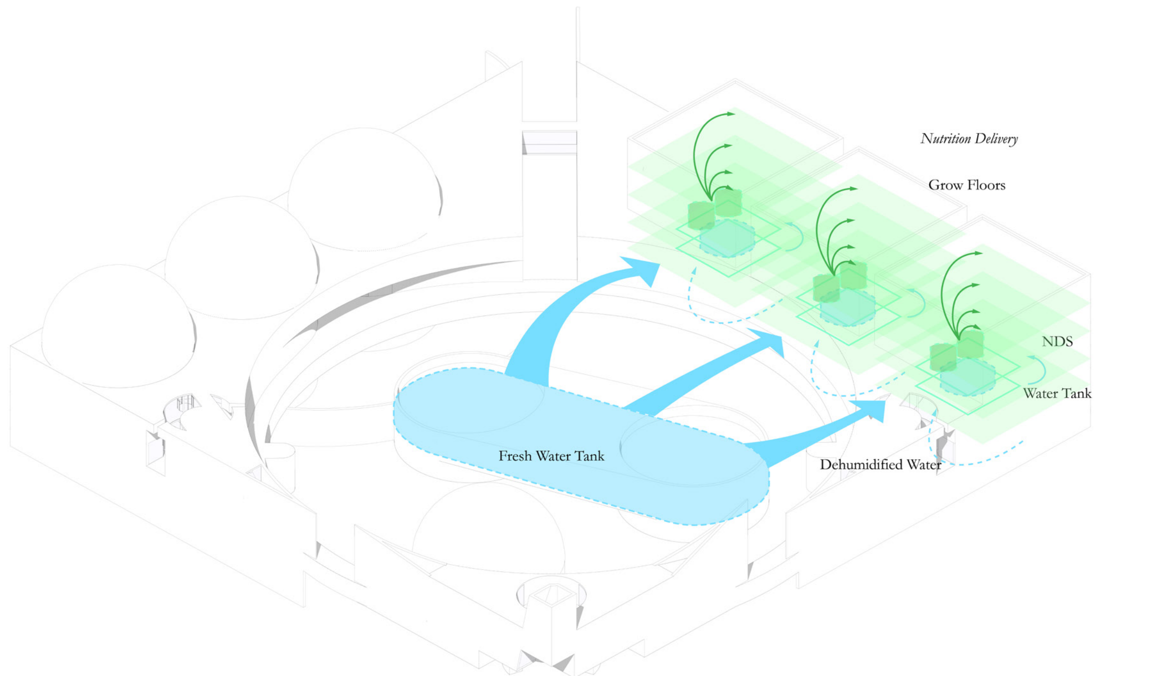
by the Author
figure 94

In Figure 95 and 96 one can see the water cycle in the Vertical Farm. The water supply is entirely controlled by the Air Management system. During the growing process the crops humidify the air so the air management keeps the humidity on a constant optimum for the plants to grow.



Air Management
(2020)

by the Author
figure 95



Nutrition Delivery
(2020)

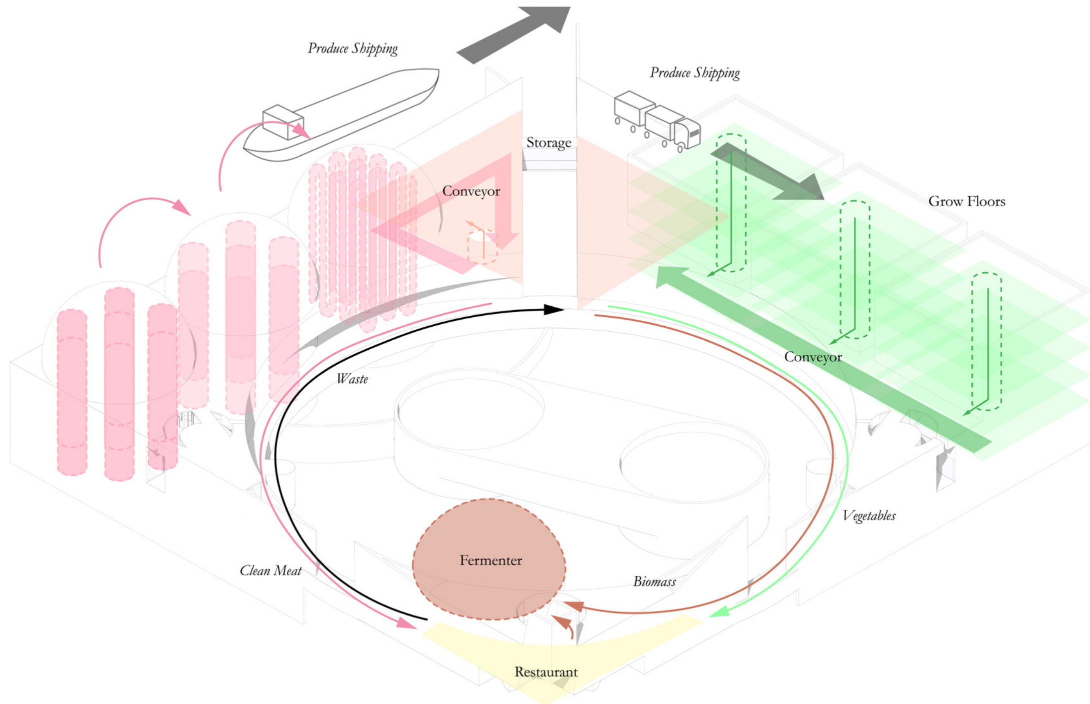
by the Author
figure 96

4.6. Metabolism

b. Matter

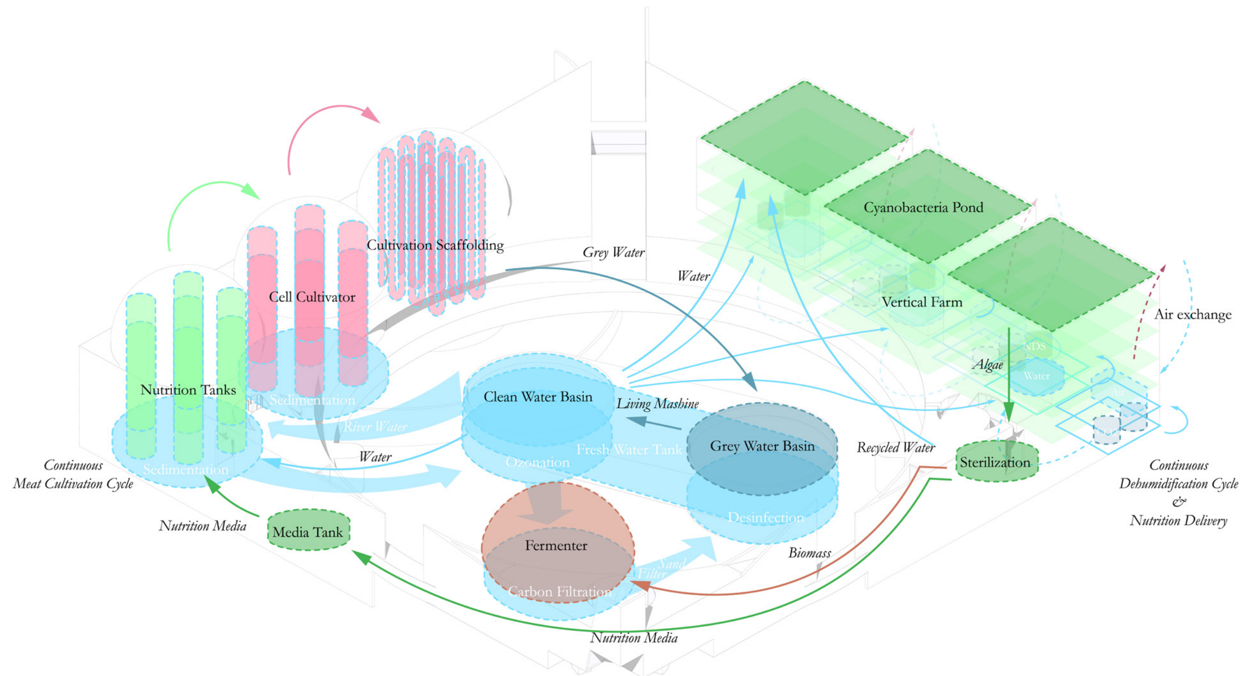
The Matter Cycle displayed in Figure 92 gives a functional reason to the circular Courtyard. In order to transport the produce and waste around the facility the circle is implemented as the optimal form of circulation. At the rear end where the Storage is located, the produce shipping takes place. Both Conveyor are processing the produce while transporting it from the harvest to the Storage.

To set the Matter Cycle in relation to the Water Cycle one can compare the Complete Water Cycle in Figure 97 with Figure 98. Together its a complex machine which performs like an orchestra alongside of each other in order to complete the whole.



Matter Cycle
(2020)

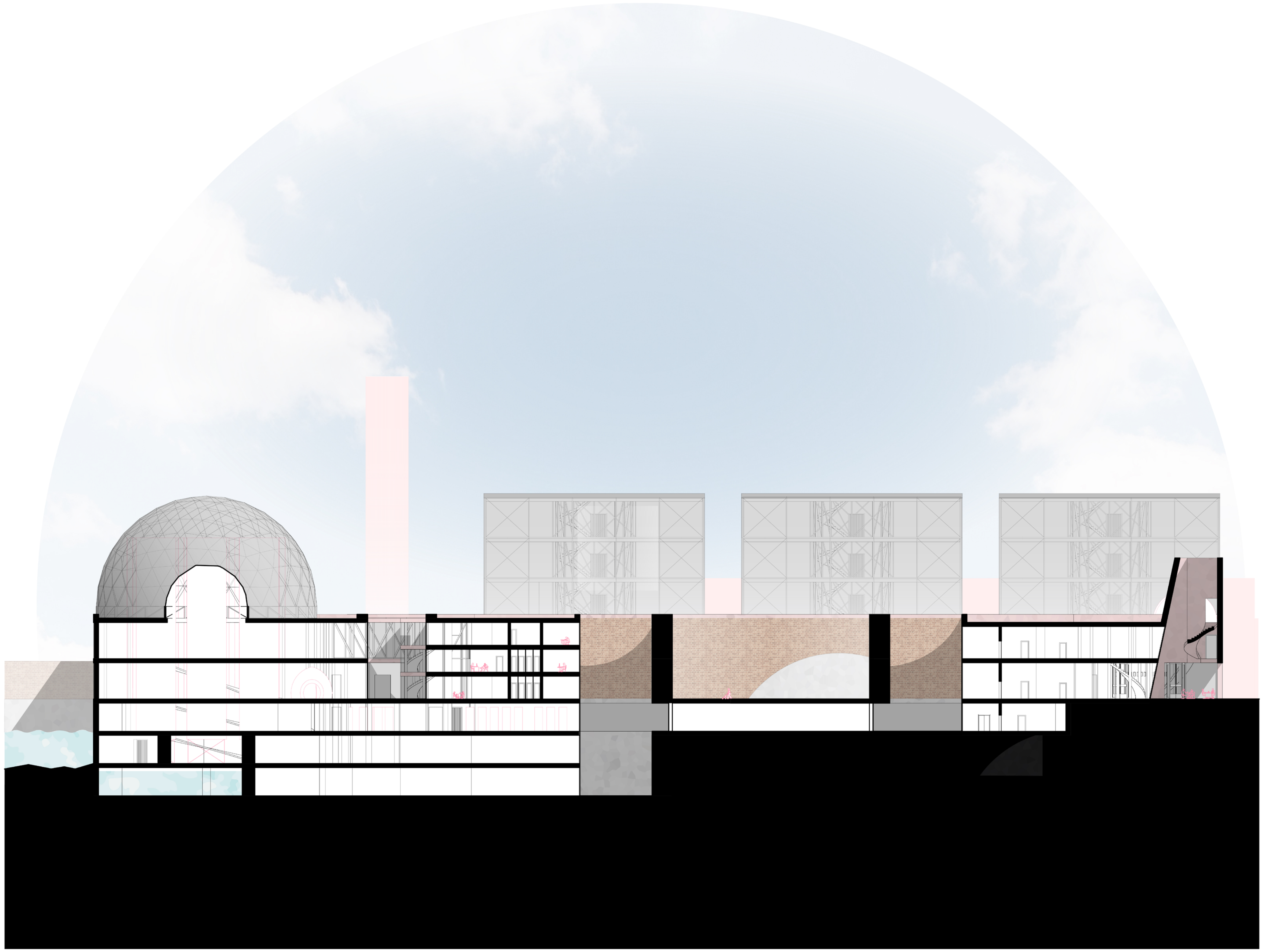
by the Author
figure 97



Complete Water Cycle
(2020)

by the Author
figure 98

North Section



West Section

4.6. Metabolism

c. Vertical Farming in Numbers

1 km^2 produces 250g vegetables/day for 10 mil. people/year[37]
741,4 mil. European citizens

74,14 km^2 to feed all Europeans

~2700 kWh/m^2/year[38]

200.178.000.000 kWh/year

6 mil. kWh/year average 2,5-3 MW Windturbine[39]
200.178 mil. kWh/year to feed all Europeans

33.363 Windturbines

main energy demand:

Illumination	69,9%
Air Management	27,9%

2-4 liter water per kg vegetables[40]
1 km^2 produces 250g vegetables/day for 10 mil. people/year

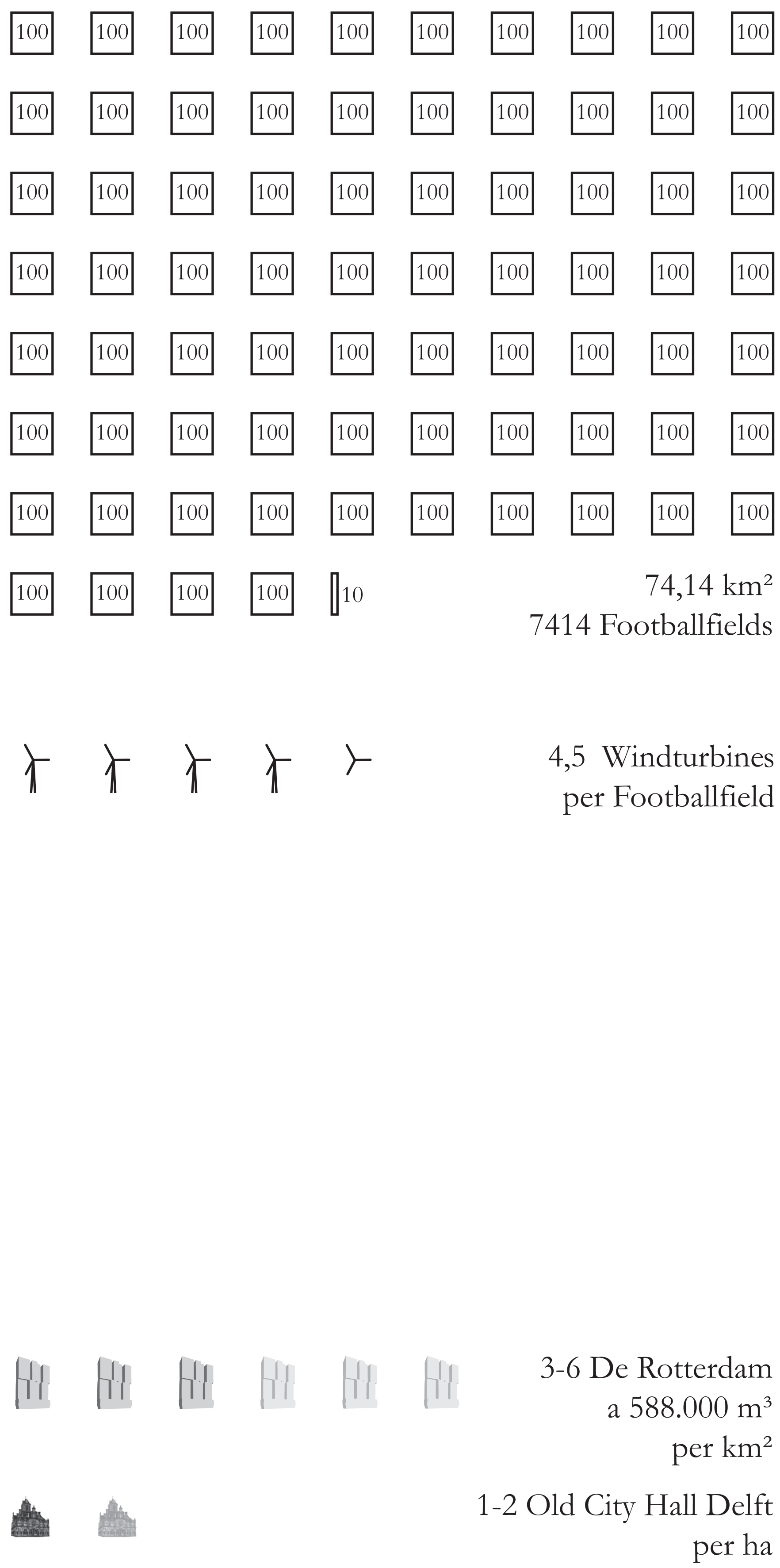
1,78-3,56 mil. m^3 water/year/km^2
17.800 - 35.600 m^3 water/year/ha

37. Prof. Leo Marcelis, "A tomato flat: growing vegetables in the city." *Wageningen University* (blog). January 10, 2020. Accessed August 20, 2020. https://weblog.wur.eu/spotlight/a-tomato-flat-growing-vegetables-in-the-city/?utm_source=Measuremail&utm_medium=email&utm_campaign=Wageningen+Newsletter+(EN).

38. Zeidler, Schubert, Vrakking, *Vertical Farm 2.0*

39. "Wind energy's frequently asked questions," Euopean Wind Energy Association, last modified date unknown. Accessed August 20, 2020. https://www.ewea.org/wind-energy-basics/faq/.

40. Prof. Leo Marcelis, "A tomato".



Vertical Farm Metabolism (2019)

by the Author
figures 99

4.6. Metabolism

d. Clean Meat in Numbers

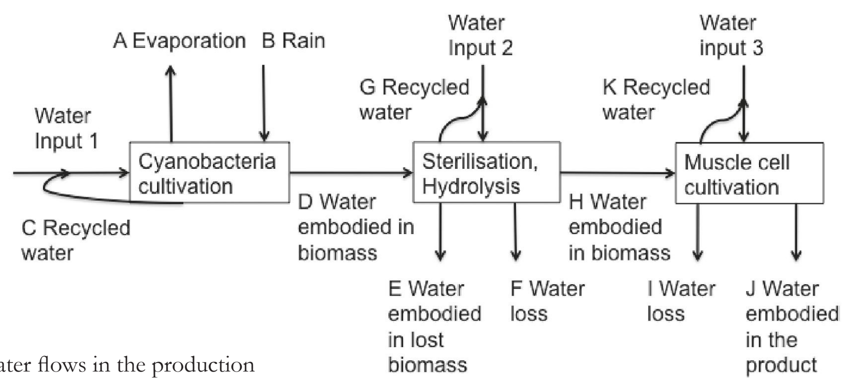
The process of Clean Meat production is rather complex in comparison to the Vertical Farming. In H. L. Tuomisto and M. J. Teixeira de Mattos[41] study from 2011 a yield of 10 kg per m³ tank was assumed in 60 days. According to C. Gasteratos[42] by 2040 the expected yields will be somewhere at 30 kg per m³, he even adds that a few optimistic scientists in the field even prophecy 40 kg. In the further I will work with the conservative 30 kg/m³ in 90 days. The process requires 8,8 kWh/kg energy and 0,521 m³/kg water.[43] In the process 40% of the water is lost in biomass and 80% of the other water can be recycled without treatment.[44]

41. Tuomisto, Teixeira de Mattos, "Environmental Impacts".

42. Talks to Google, "A Vision".

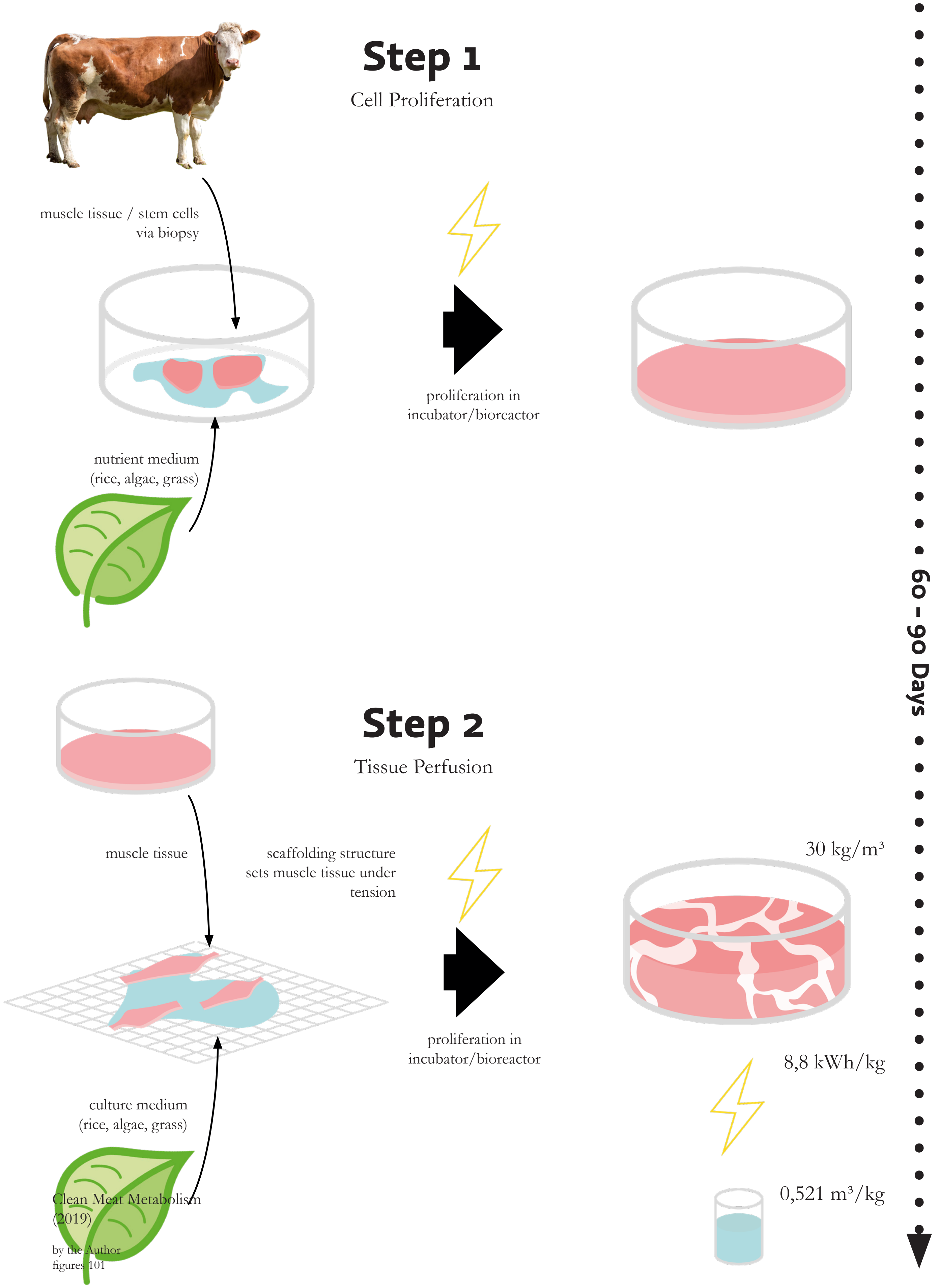
43. Tuomisto, Teixeira de Mattos, "Environmental Impacts".

44. Tuomisto, Teixeira de Mattos, "Environmental Impacts".



Water flows in the production chain of cultured meat (2011)

H. L. Tuomisto, M. J. Teixeira de Mattos,
20.08.20
figure 100

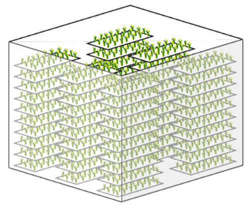


Clean Meat Metabolism (2019)

by the Author
figures 101

Water

Energy



12.000 m^2 Cultivation Space

91.250.000 kg/km^2 (annual)

91.250.000 kg/km^2 * 0,012 km^2
= 1.095.000 kg (annual)

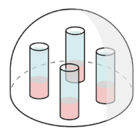
12.000 m^2 = 0,012 km^2

1,78-3,56 mil. m^3 /km^2 (annual)
middle ~ 2,7 mil. m^3/km^2

2.700.000.000 l/km^2 * 0,012 km^2
= 32.400.000 l (annual)

~2700 kWh/m^2 (annual)

2700 kWh/m^2 * 12.000 m^2
= 32.400.000 kWh (annual)



7x
400.000 l Proliferation Tanks

400.000 l = 400 m^3

400 m^3 * 30 kg/m^3
= 12.000 kg (every 3 months)

12.000 kg * 4 annual periods
= 48.000 kg (annual)

72.000 kg * 7 tanks
= 336.000 kg (annual)

0,521 m^3/kg

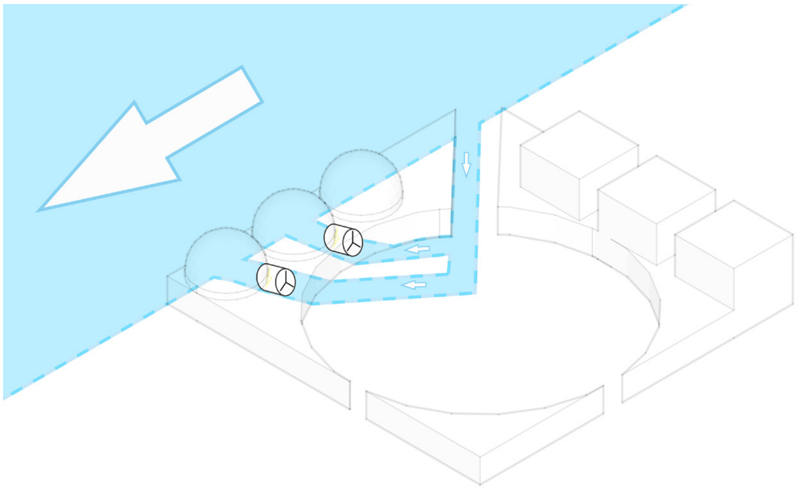
0,521 m^3/kg * 336.000 kg
= 175.056 m^3 (annual)
= 175.056.000 l (annual)

8,8 kWh/kg

8,8 kWh/kg * 336.000 kg
= 2.956.800 kWh (annual)

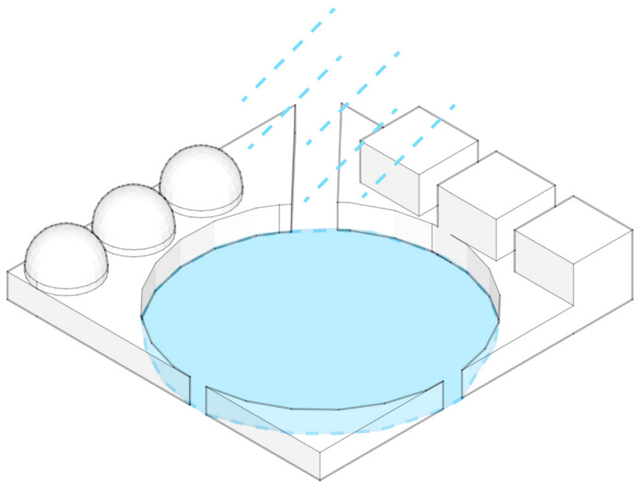
45. Juha Schweighofer, *Technical evaluation report on pilot test case energy-efficient navigation*, (ResearchGate, 2018), Accessed August 20, 2020, https://www.researchgate.net/publication/326231835_D513_Technical_evaluation_report_on_pilot_test_case_energy-efficient_navigation.

46. "Dordrecht Climate," Climate-Data, last modified date unknown, Accessed August 25, 2020. https://en.climate-data.org/europe/the-netherlands/south-holland/dordrecht-2104/.



River Energy
(2020)

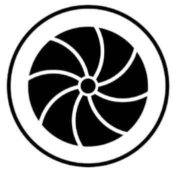
by the Author
figure 102



Rainwater Collection
(2020)

by the Author
figure 103

Energy



Pmax = $\frac{1}{2}\, \eta\, \varrho\, A\, v^3$

η = 80 %
efficiency of the turbine

$\varrho = 10^3$ kg/m³
water density

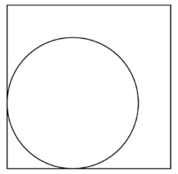
v = 1,6667 m/s
velocity of the Rhine[45]

A = 12,5 m²
turbine size ~ r = 2 m

$\frac{1}{2} * 0{,}8 * 10^3\ \text{kg/m}^3 * 12{,}5\ \text{m}^2 * 1{,}6^3\ \text{m}^3/\text{s}^3$
= 20.480 kg m²/s³
= 20.480 W
= 20,48 kW

20,48 kW * 365 days * 24 h
= 179.404,8 kWh (annual)

Water



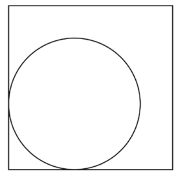
Courtyard Size
A = 9.850 m²

Dordrecht rainfall
789 mm (annual)[46]
789 l/m²

789 l/m² * 9.850 m²
= 7.771.650 l (annual)

Water

Energy



Vertical Farm
32.400.000 l (annual)

Clean Meat
175.056.000 l (annual)

207.456.000 l (annual)

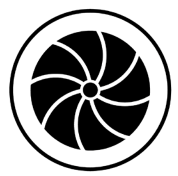
Vertical Farm
32.400.000 kWh (annual)

Clean Meat
2.956.800 kWh (annual)

35.356.800 kWh (annual)

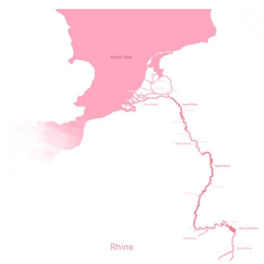
207.456.000 l (annual)
- 7.771.650 l (annual)

199.684.350 l (annual)

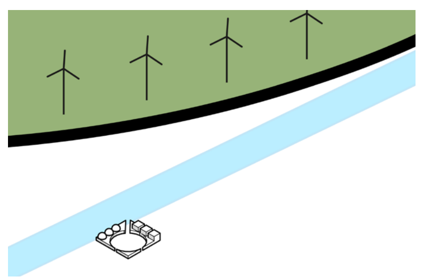


35.356.800 kWh (annual)
- 179.404,8 kWh (annual)

35.177.395,2 kWh (annual)



199.684.350 l (annual)



35.177.395,2 kWh (annual)

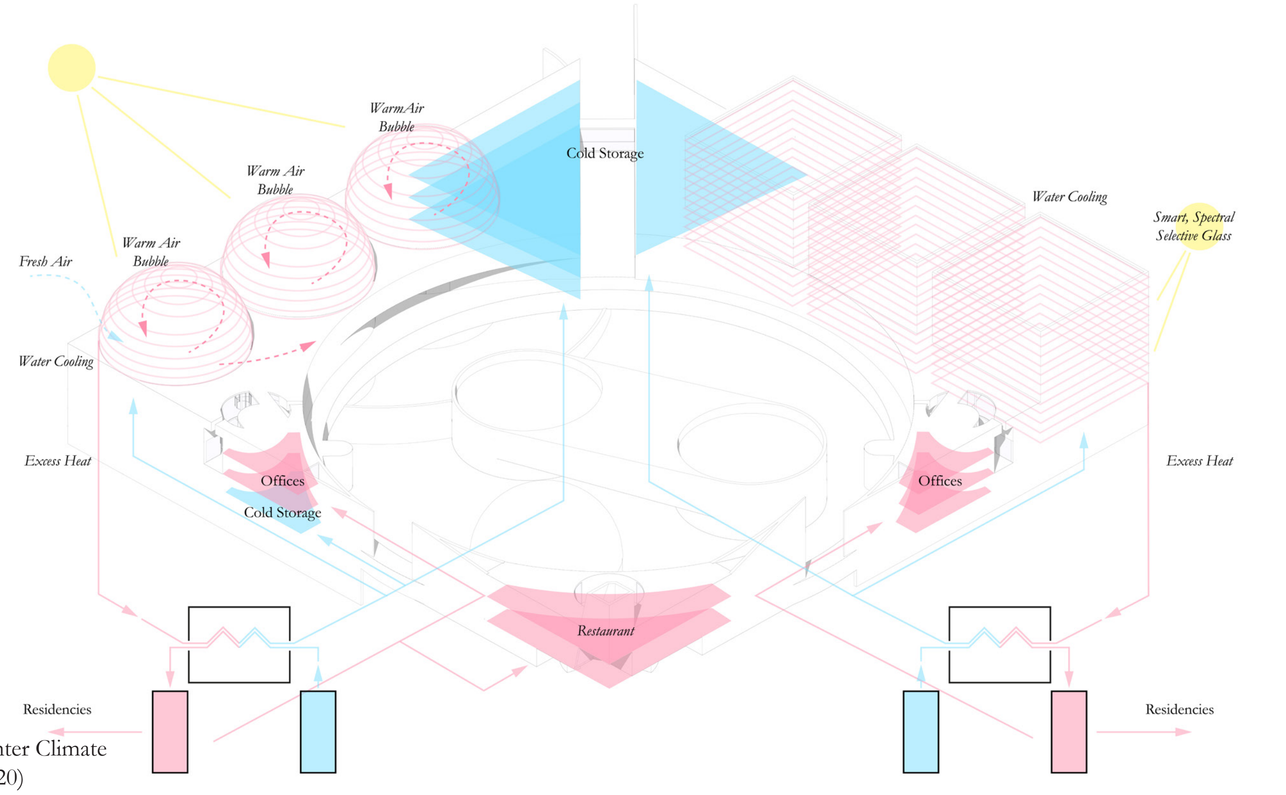
6.000.000 kWh (annual)
per 2,5-3 MW Turbine

6x 2,5-3 MW Turbines
36.000.000 kWh (annual)

4.6. Metabolism

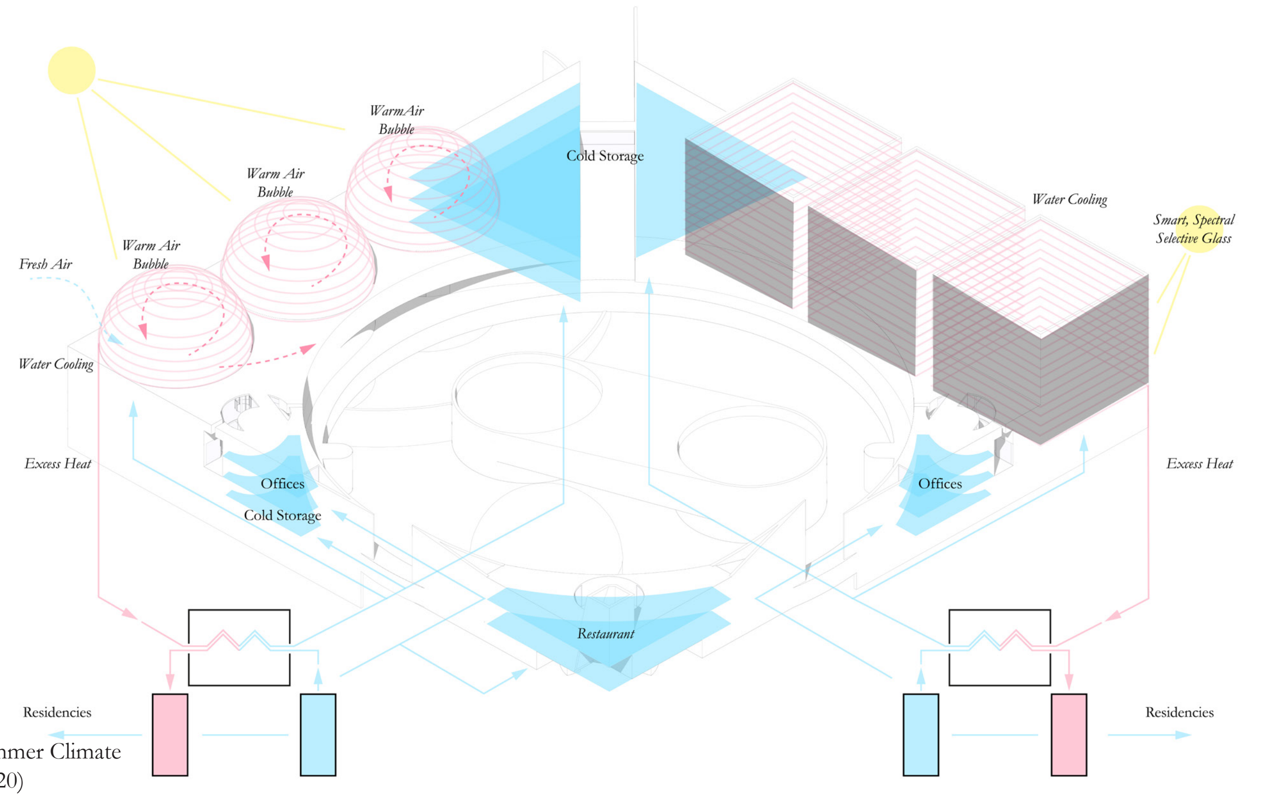
e. Climate

The facility needs diverse climatic conditions in certain spaces. Due to the machine there is always a surplus of heat. As earlier explained I'll further detail the domes due to their distinct climatic conditions. One can see in the following Climate Schemes how the tanks of the machine radiate heat at a constant 38,5 C°. This radiation is used and stored in an Aquifier System to fuel the neighbouring buildings with heating or cooling.



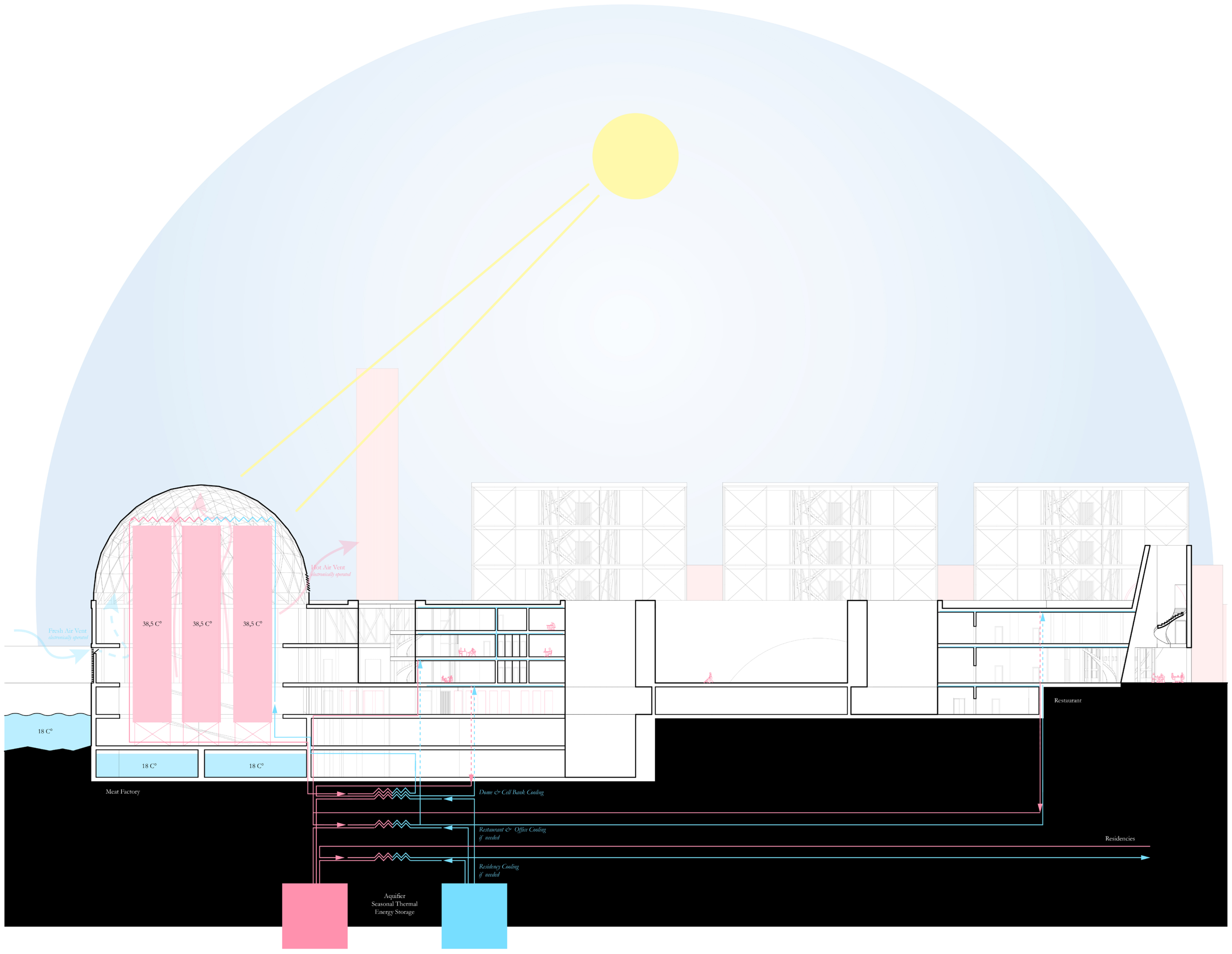
Winter Climate (2020)

by the Author
figure 104

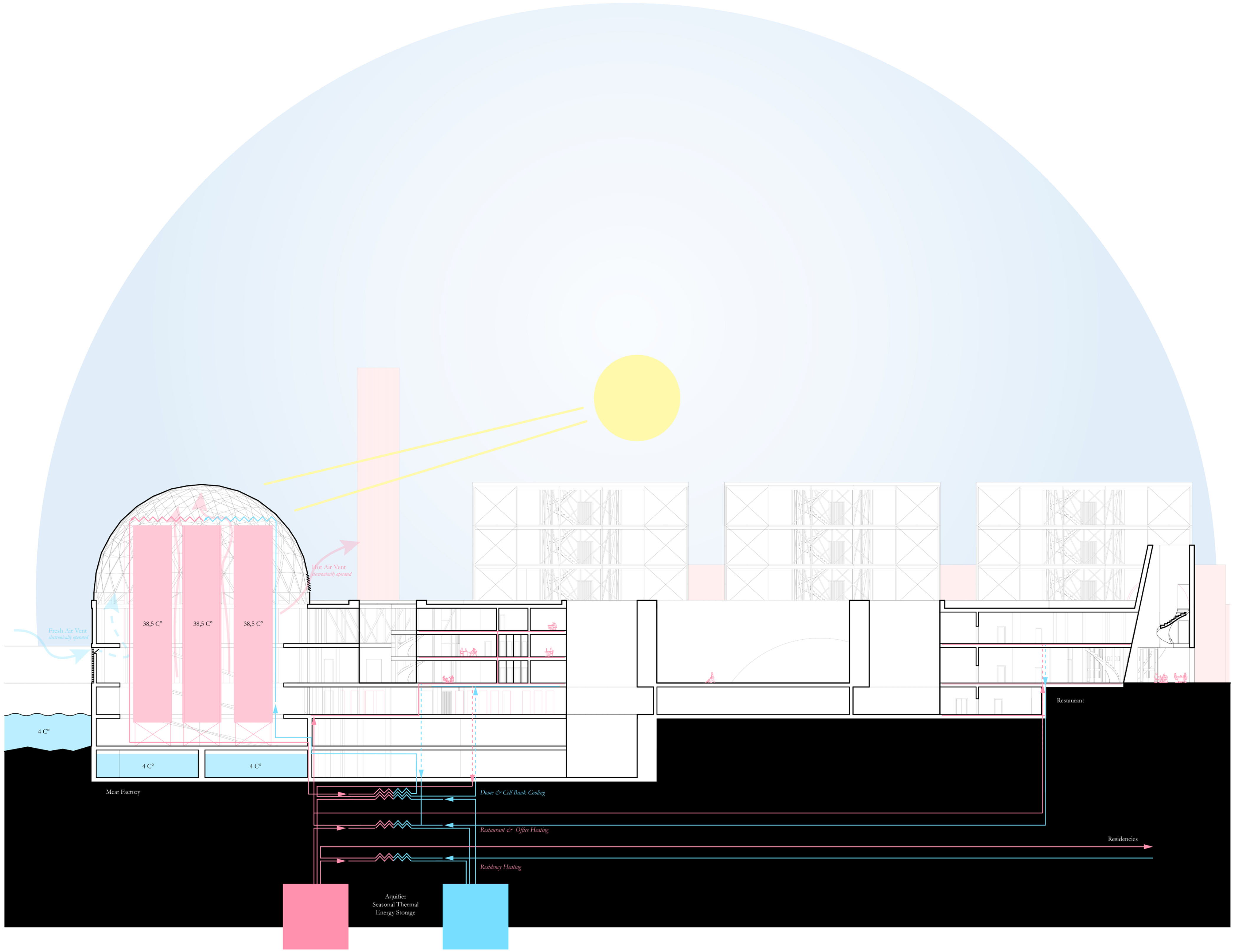


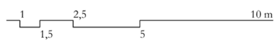
Summer Climate (2020)

by the Author
figure 105



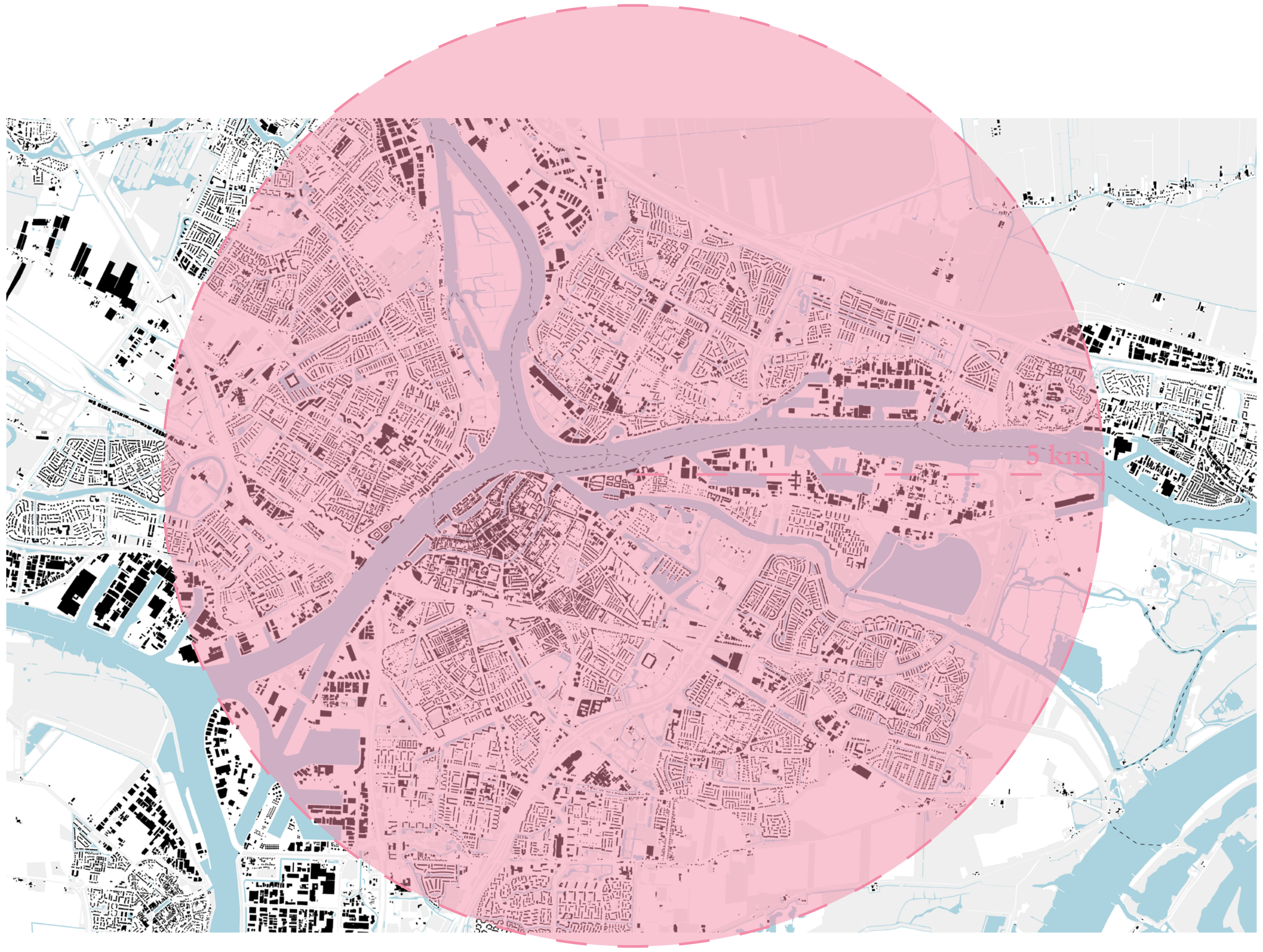
Climate Scheme Summer





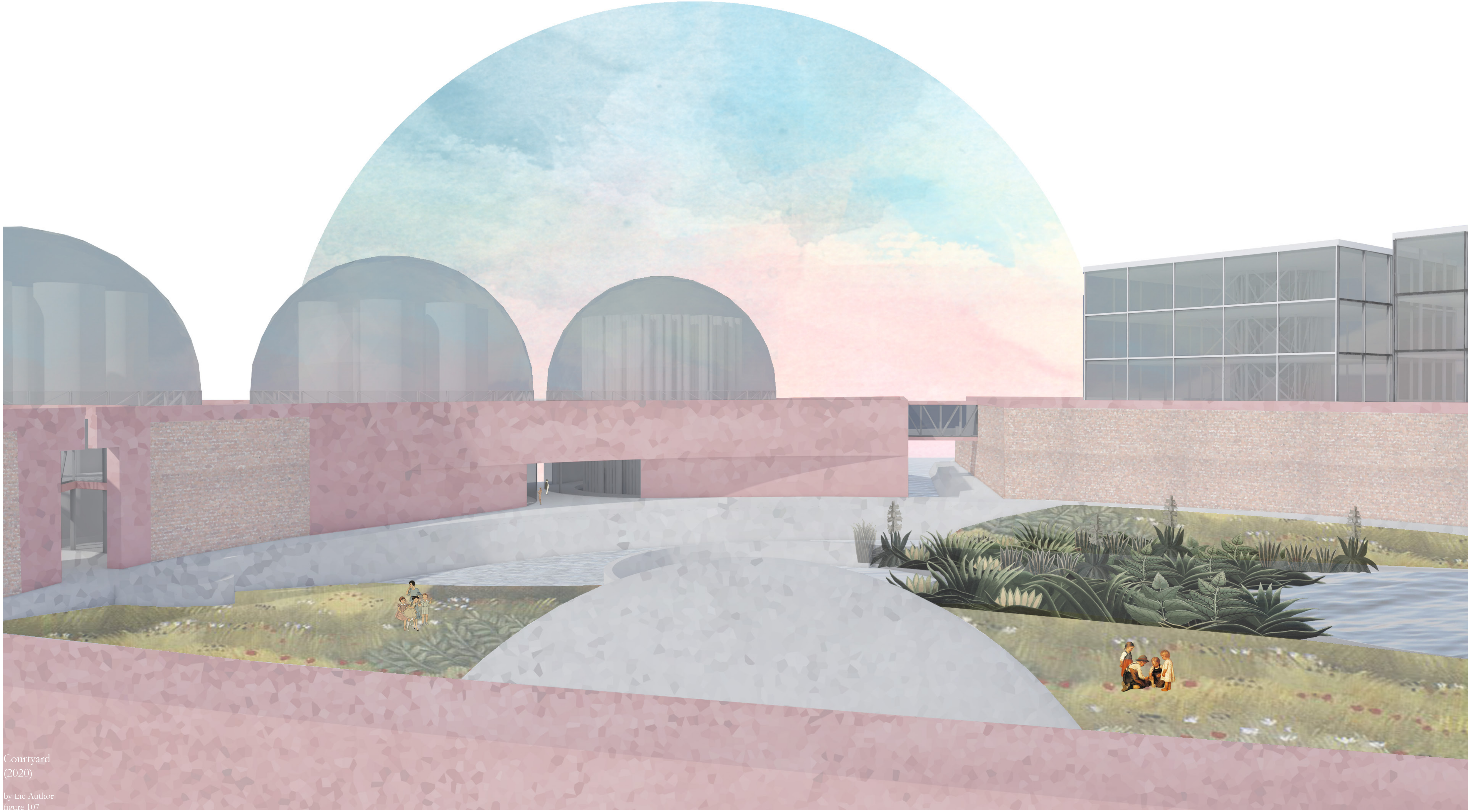
Climate Scheme Winter

Figure 101 shows the capacity of a close range heating network of 5 km. The facility is therefore theoretically able to heat the whole city of Dordrecht and beyond.



Industrial Ecology Heat
(2020)

by the Author
figure 106



Courtyard
(2020)

by the Author
figure 107

4.7 Make Food Great Again Short Film

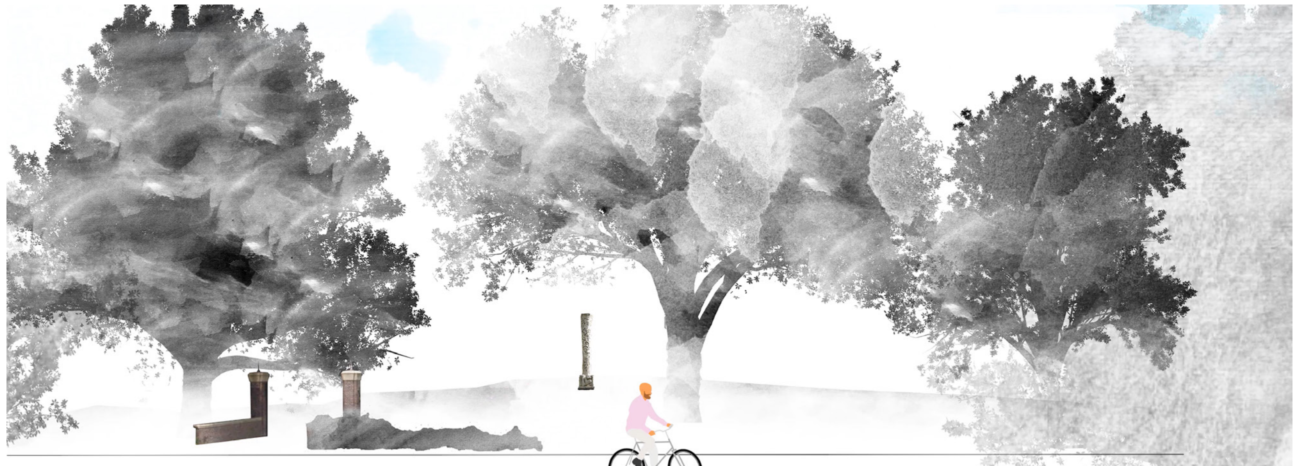
The film is made to show the connection of the layered city of Dordrecht with the building. The short plot is a guy cycling through the city. Thereby he passes the central station, small traditional row houses, a park and Dordrechts suburbia. Finally he arrives in the rather industrial area where the building is located. after crossing the bridge he passes the market square and the courtyard. After the visit of the meat facility he takes a walk to the restaurant where he has some food ate the table. afterwards he leaves the facility by water bus passing by the skyline of the city.

Film Scene 1
(2020)

by the Author,
Make Food Great Again Film, 26.08.20
figure 108

Film Scene 2
(2020)

by the Author,
Make Food Great Again Film, 26.08.20
figure 109



Film Scene 3
(2020)

by the Author,
Make Food Great Again Film, 26.08.20
figure 110

Film Scene 4
(2020)

by the Author,
Make Food Great Again Film, 26.08.20
figure 111

Film Scene 5
(2020)

by the Author,
Make Food Great Again Film, 26.08.20
figure 112

Film Scene 6
(2020)

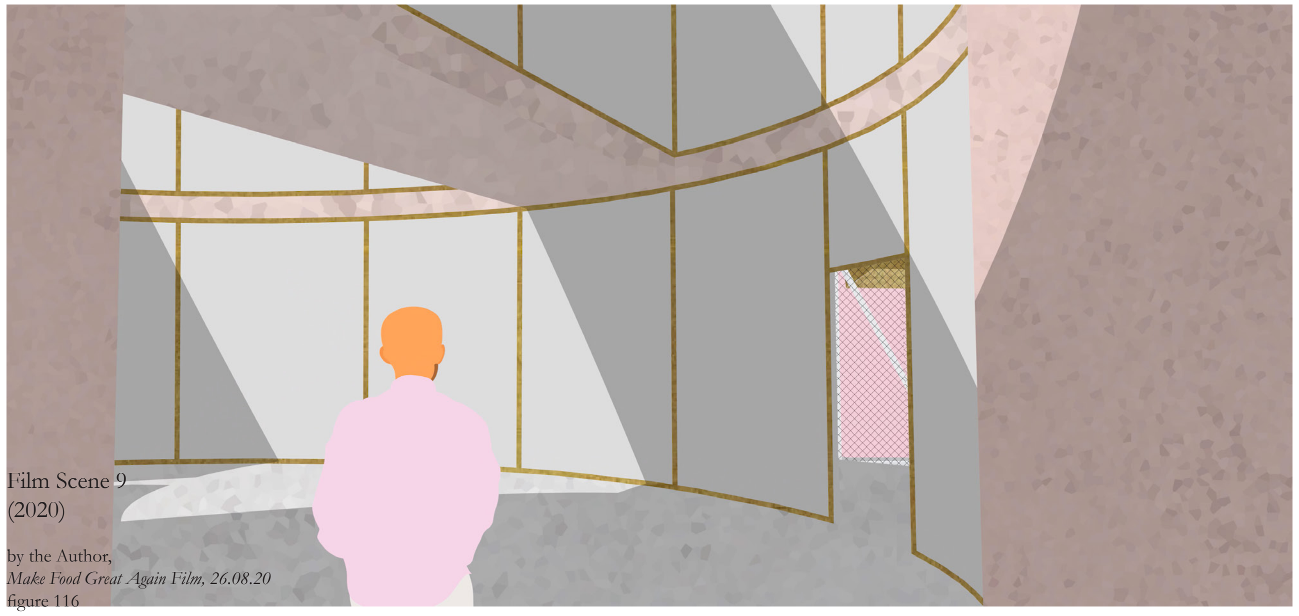
by the Author,
Make Food Great Again Film, 26.08.20
figure 113

Film Scene 7
(2020)

by the Author,
Make Food Great Again Film, 26.08.20.
figure 114

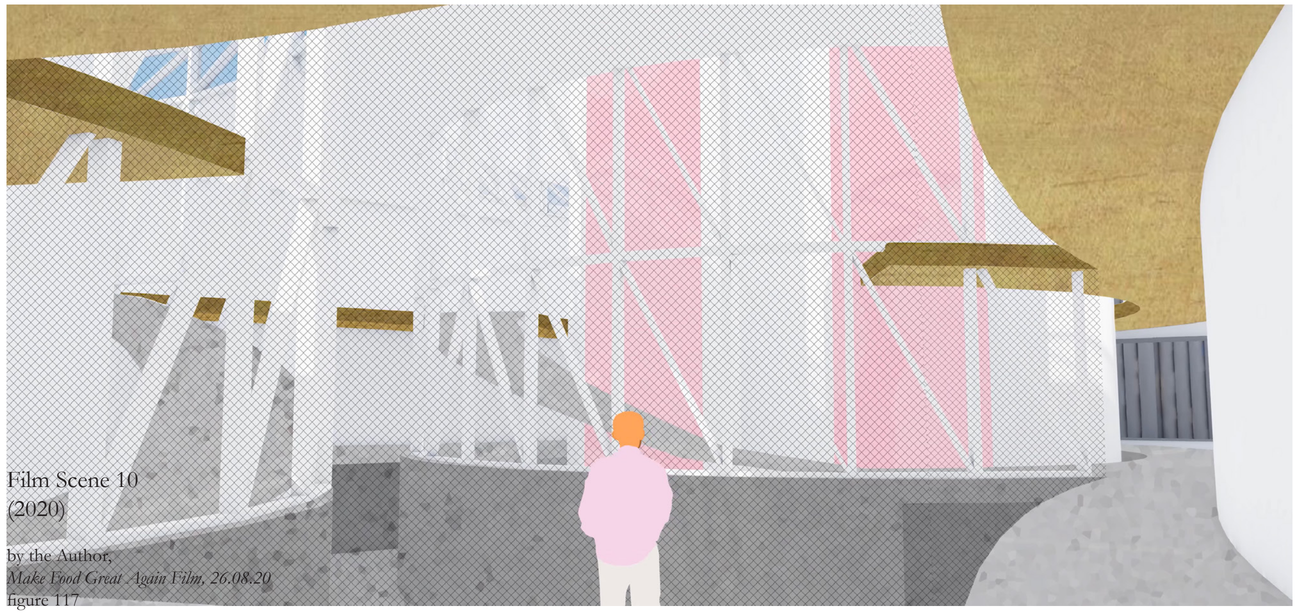
Film Scene 8
(2020)

by the Author,
Make Food Great Again Film, 26.08.20
figure 115



Film Scene 9
(2020)

by the Author,
Make Food Great Again Film, 26.08.20
figure 116



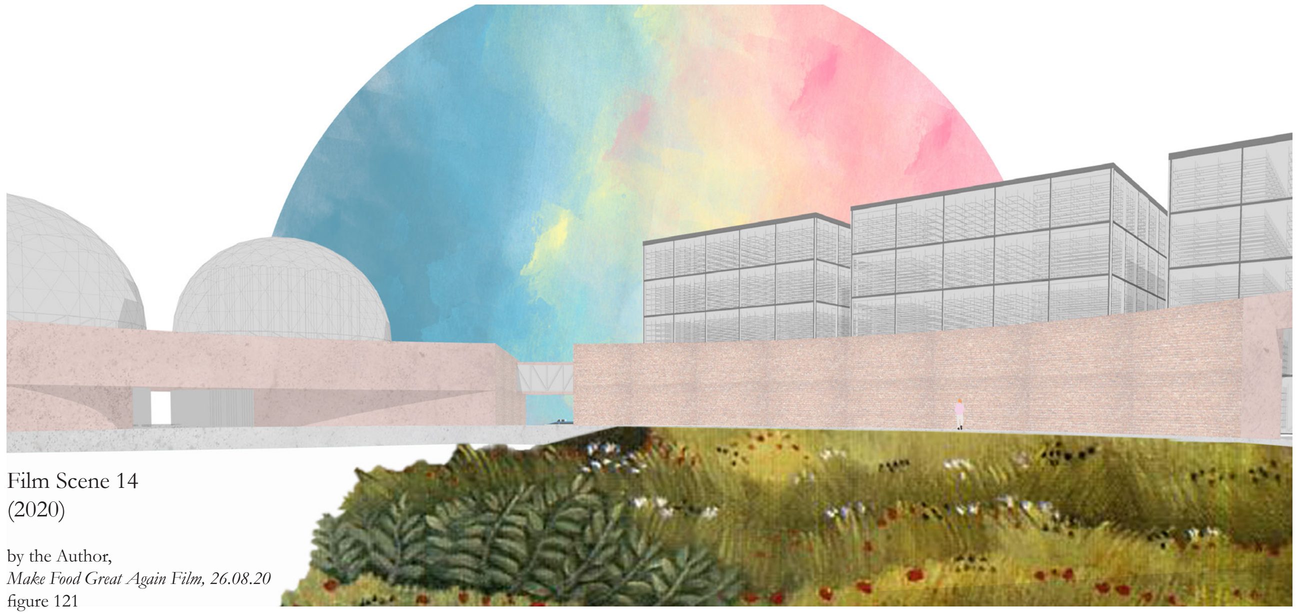
Film Scene 10
(2020)
by the Author,
Make Food Great Again Film, 26.08.20
figure 117

Film Scene 11
(2020)
by the Author,
Make Food Great Again Film, 26.08.20
figure 118

Film Scene 12
(2020)
by the Author,
Make Food Great Again Film, 26.08.20
figure 119

Film Scene 13
(2020)

by the Author,
Make Food Great Again Film, 26.08.20
figure 120



Film Scene 14
(2020)

by the Author,
Make Food Great Again Film, 26.08.20
figure 121

Film Scene 15
(2020)

by the Author,
Make Food Great Again Film, 26.08.20
figure 122

Film Scene 16
(2020)

by the Author,
Make Food Great Again Film, 26.08.20
figure 123

Film Scene 17
(2020)

by the Author,
Make Food Great Again Film, 26.08.20
figure 124

Film Scene 18
(2020)

by the Author,
Make Food Great Again Film, 26.08.20
figure 125

Conclusion

5. Conclusion

A Strategy for the implementation of Food Production 4.0

The proposed project is a fitted facility in the urbanity of Dordrecht. Though it all started with a strategic analysis about the odds of this new technology, and which factors when choosing a site would be beneficial, or even necessary. In this conclusion I would like to zoom out again and shift the perspective a bit away from the architecture to the more strategic values of the project. Therefore I will briefly explain the main strategic factors to consider when looking for a potential site.

First its important to consider a certain resilience of the site to SLR since the discussed technology is about to be implementable in 2040, as the scientists project. Therefore its important to cope with the future threats of climate change.

Second to implement this facility there is a high demand on renewable energy and fresh water supply. In the case of Dordrecht wind made sense as the main energy resource for the facility since the Netherlands always experience certain North Sea wind.

Third its important to weave the facility in the urbanfabric to encounter the alienating tendency of this technology from the start. Also its redefines the whole idea about locally produces produce in an actual efficient manner.

Since the facility brings new jobs and infrastructure decommissioned harbour areas close to city centers are ideal locations. Locations with a rather cold climate also benefit from the facilities heat production while at the same time the facility benefits from a naturally cooler climate since the efforts of chilling down the machine don't apply as much.

On the map one can see some of those areas where these factors apply. Certainly the Netherlands, North of France and the South of England are mostly fitted to these strategic benefits.

Strategical Places for this new Industry

1:10.000.000

Atlas 18/19

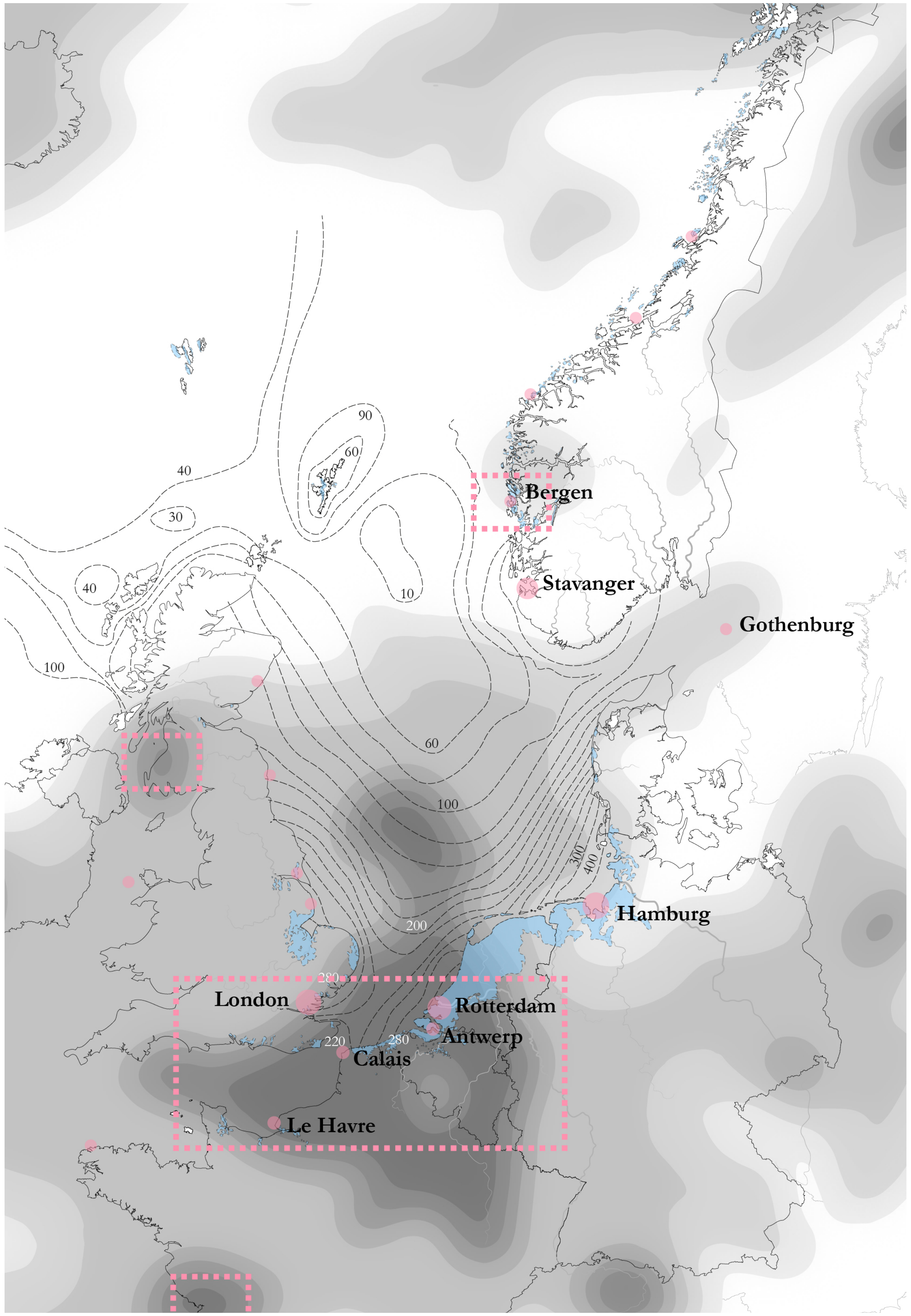
Future daily maximum wind speed

-20 -10 -5 -2.5 +2.5 +5 +10 +20

Long term extreme surge prediction

60 Surge height and the uniform winf/ pressure field

SLR 2100 RCP 8.5



5. Conclusion

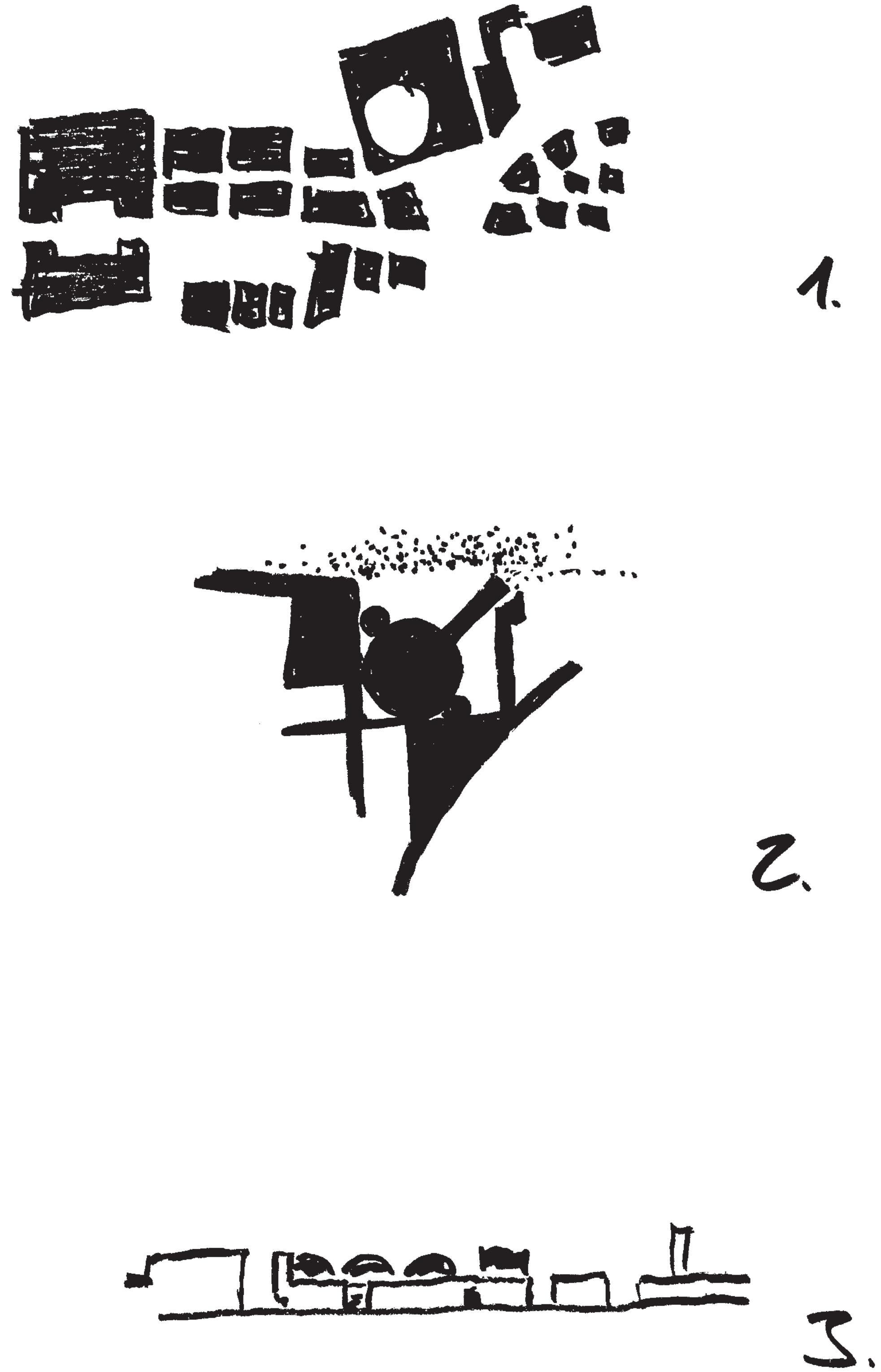
Site specific qualities

There is also a part of the project which is very site specific and tailor fitted. Those parts are mainly architectural. The ensemble is carefully placed in its urban surrounding in order to bridge between the industrial and urban part. Thereby its a purposeful decision to place this facility in the urban environment rather then in any industrial area, the reasons for that have been also discussed in the former paragraph.

The building refers in shape, size and type to the block type context of Dordrecht. It layers itself in a introverted manner as the city of Dordrecht has the same characteristics. Thereby a new piece of not just industrial but also urban infrastructure is created. The public realm is enriched with a serious of distinct new squares which are designed to accommodate diverse users at any time through out the day.

The size of the ensemble also adds a new interesting piece to the skyline of Dordrecht. Its an attraction not just for its internal values or products. It really celebrates the idea of a new form if food production, in almost cathedraleske way.

Metaphorically speaking, the project imports a the spatial idea of the Dutch landscape into the city. A plea for a conscious use of progressive technology in a circular manner in order to be able to reduce the spatial and environmental impact of the agricultural industry.



Quality Diagrams
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