The food wharf

raising awareness for the locavore movement through a floating agricultural concept

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Raising awareness for the locavore movement through a floating agricultural concept

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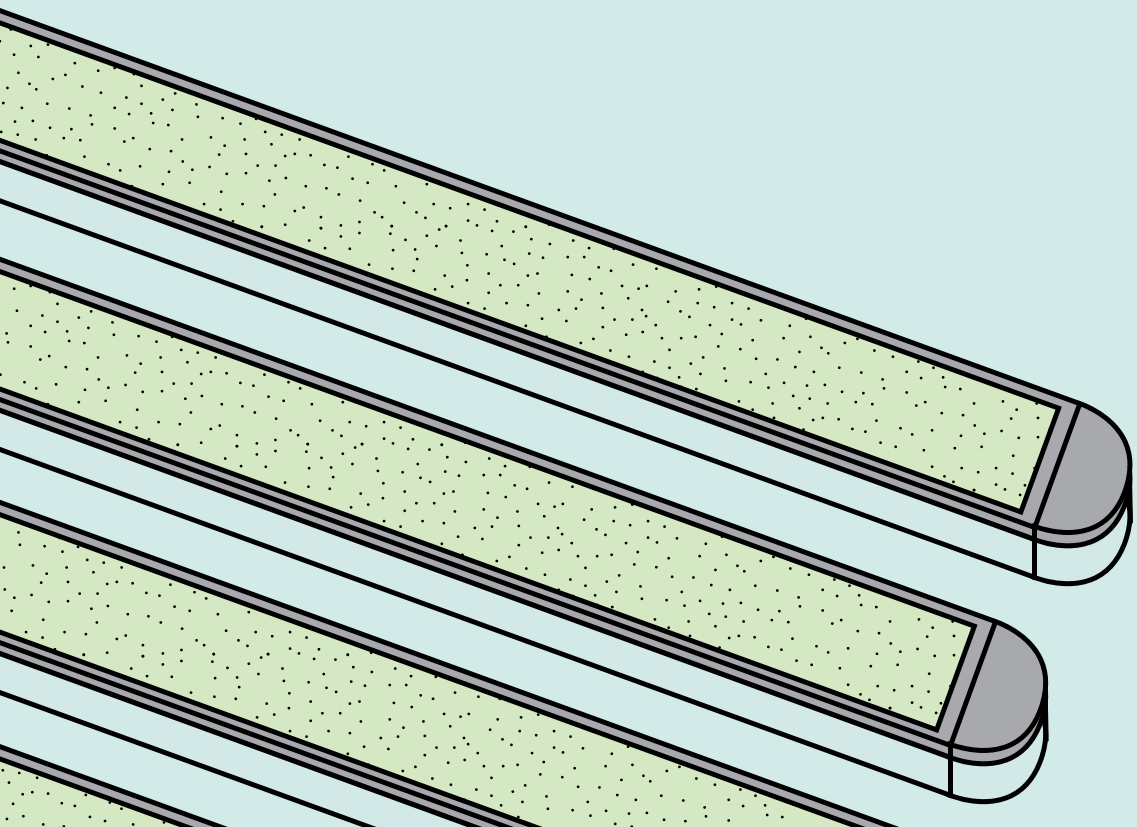

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Resilient Architecture

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Abstract

Climate change is putting pressure on Dutch flood protection systems, this forces the government to employ a new strategy which gives more room to the river. Agricultural land is attractive to use for this purpose and resilient strategies in the form of a floating agricultural concept can make sure it can retain functionality while providing room for the river. Attention raised by the floating agricultural concept can be translated into awareness for the locavore movement by creating a building which utilizes the common ground between the two. A building functioning as a food production line is found to use the floating agricultural concept to raise awareness for the locavore movement and attract visitors to the village of Alblasserdam.

Introduction

Climate change is putting pressure on the flood protection systems of the Netherlands. New insights have led to an emphasis on improving the flood protection for rivers. The Dutch government utilizes a new strategy by giving the river more room instead of only improving dikes. (Ministerie van Verkeer en Waterstaat, 2006) This strategy demands that land will be given to the river, decreasing the amount of available land for other functions. The Netherlands already has a high population density, this raises questions as to which land should be used to do this.

Since the British Industrial Revolution, Europe has seen a large increase in personal mobility due to the spreading of urban settlements and the upcoming of motorized vehicles. There has been a similar development going on for the origin of farm produce. Increased mobility and improved techniques for conserving products allowed the distance from farm to consumer to increase. In recent years there has been an increase in resistance to this phenomenon by the name of the locavore movement. (Donaghy, Rudinger, & Poppelreuter, 2004) (Anderson, 2014) (Fitzgerald, 2015)

Agriculture is a large consumer of land in the Netherlands, if part of this land can be given to the river it could help the strategy implemented by the Dutch government. This off course will create problems for the farmers who now own the land. Resilience, a concept which originates in nature, provides a solution to benefit both interests. Resilience teaches the art of adapting in changing circumstances, while retaining function. Agricultural land can retain when it is made to float on the water, a solution where both the river and agriculture can benefit. The river will get more room and the unique character of a floating agricultural concept will attract attention of the public. This attention can be used to raise awareness for the locavore movement and its goals, as well as the measures the Netherlands takes to prevent flooding.

Alblasserdam is situated on the river Noord, a tidal river in the center of the Dutch delta. The river is both prone to sea and river flooding. Along this river two areas have been designated to be given to the river, these areas are suitable for a floating agricultural concept. (Provincie Zuid-Holland, 2015) The municipality is located in the Alblasserwaard, an area with a lot of dairy farming. Alblasserdam wishes to attract more visitors to its village, a floating agricultural concept could be a tool to reach this goal. (Gemeente Alblasserdam, 2013) In the research question this notion has been linked with the creation of a building as a concrete manifestation of the concept.

How to respond to the challenges of resilience through a floating agricultural concept, thereby raising awareness for the locavore movement and increasing the amount of visitors to Alblasserdam?

The research is build up by first going deeper into what resilience is and how to utilize it for the design of a building. Afterwards a closer look is taken towards climate change and its consequences. The research continues on floating agricultural concepts and next the locavore movement is investigated. Then the chosen site is analyzed and design goals are formulated through the help of resilience, after which the design will be discussed.

Resilience

In 2010 67.2% of the total area of the Netherlands was used for agricultural purposes. (Rijksoverheid, 2013) Because there is high availability of agricultural land it is attractive to use it for giving the river more room. Because the farmers that are disadvantaged need to be compensated it is interesting to look towards resilient strategies for coping with this problem.

Resilience can be a helpful tool for designers in coping with natural threats such as flooding. Resilience is a term that comes from nature, nature has adopted the concept perfectly. It balances its complex system using resilient concepts. That is also why we often refer to nature when trying to explain resilience. Resilience can be explained using various definitions e.g.:

“The ability of a substance or object to spring back into shape; elasticity” Derived from the Latin word resiliere; meaning to jump back and rebound.” (Oxford Dictionaries, 2010)

“Resilience is defined as the capacity of a system to respond to change or disturbance without changing its basic state.” (Walker & Salt, 2006)

The definition by Walker & Salt is useful to study when applying it to new or changing conditions. These changing conditions are exactly what happens when there is a high discharge of water in the river. Water levels in the river rise and this increases the risk of flooding. The government wants to designate land to give the river more room, increasing the river's capacity to respond to change. The capacity to respond to change is now increased by spreading the water over a larger area and will thus have a smaller vertical impact, reducing the chance of flooding.

Part of the research is to see how the designated area for flooding can cope with the change it faces. Walker & Salt state resilience as the capacity of the system to respond to change without changing its basic state. A resilient approach means the basic state of the area can't change when it floods, in other words the function of the land needs to be retained while being flooded. This would be possible if the agricultural typology could be made to float, hence the basic state does not need change when responding to the changing conditions of the river.

When translating resilient principles to design decisions it can be helpful to set up maxims. "A maxim is a short, pithy statement expressing a general truth or rule of conduct." (Oxford Dictionaries, 2010) Maxims can serve as design guidelines which can help to keep focus when designing. Likewise they can serve as a tool to test a design against. For this research two maxims have been formulated which are thought to be relevant for the topic:

"Being able to foresee and adapt to possible scenarios"

"Social cooperation and awareness to deal with changing conditions"

In the chapter 'Design with maxims' the implications these maxims have on design decisions will be made concrete into design goals.

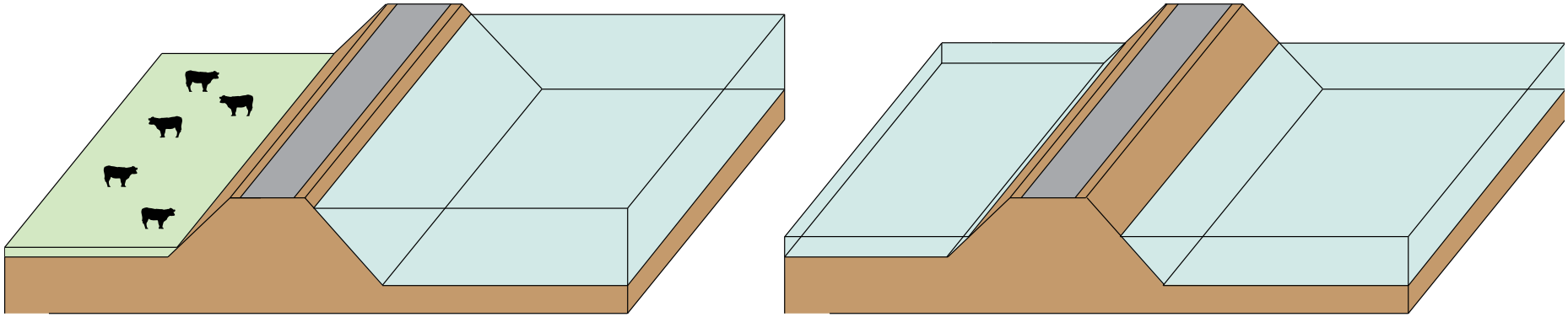


Fig 1: Room for the river diagram

Climate change

Over recent years studies have shown that greenhouse gasses are changing the earth's climate. The climate change presents itself in the form of an increase of the average temperature. (Farmer, 2015) This causes the ice of the poles and glaciers to melt which leads to an increase of the sea level. Furthermore it is likely that the increase of the average temperate has caused changes in some types of extreme climates. (Field, Barros, & Stocker, 2012) In the Netherlands this manifests itself through the rise of average precipitation levels and an increase in precipitation extremes. (Royal Netherlands Meteorological Institute, 2014) This imposes higher pressure on drainage systems, human made and natural, such as rivers and streams.

The delta works created between 1958 and 1997 were built to prevent water related disasters like the North Sea flood of 1953. The system of dikes, sea barriers and water locks was aimed at preventing sea floods. (SteenhuisMeurs, 2015) Until now there hasn't been a sea based threat which has beaten these structures. While the protection for sea floods is of a high level, river floods have gotten less attention, while the risk of river flooding is increasing due to climate change.

To address this problem the government has taken measures in the form of a core decision on country planning which is addressed to the protection for river floods. This core decision has been taken in 2006 and is called 'Room for the River' and it concerns 38 projects. The plan's vision is innovative because it neglects the traditional manner of protecting against floods. Instead of increasing the height and strength of dikes to protect against the raising water levels in rivers, the plan chooses to broaden the rivers. This increases the water capacity of the river, while not raising the water level. (Ministerie van Verkeer en Waterstaat, 2006)

Fig 2: Projects Room for the River

Land use by agriculture

The agricultural enterprise demanding the largest area is the most interesting for giving room to the river. Dairy farming contributes to 44% of the total area of agricultural land, while it contributes to only 29% of all agricultural companies. (Centraal Bureau voor de Statistiek, 2016) The amount of euros made per ha in dairy farming is lower than other sectors, the difference can be a factor 30. (Agrimatie, 2015) The low revenue and the high land use make dairy farming attractive for giving room to the river.

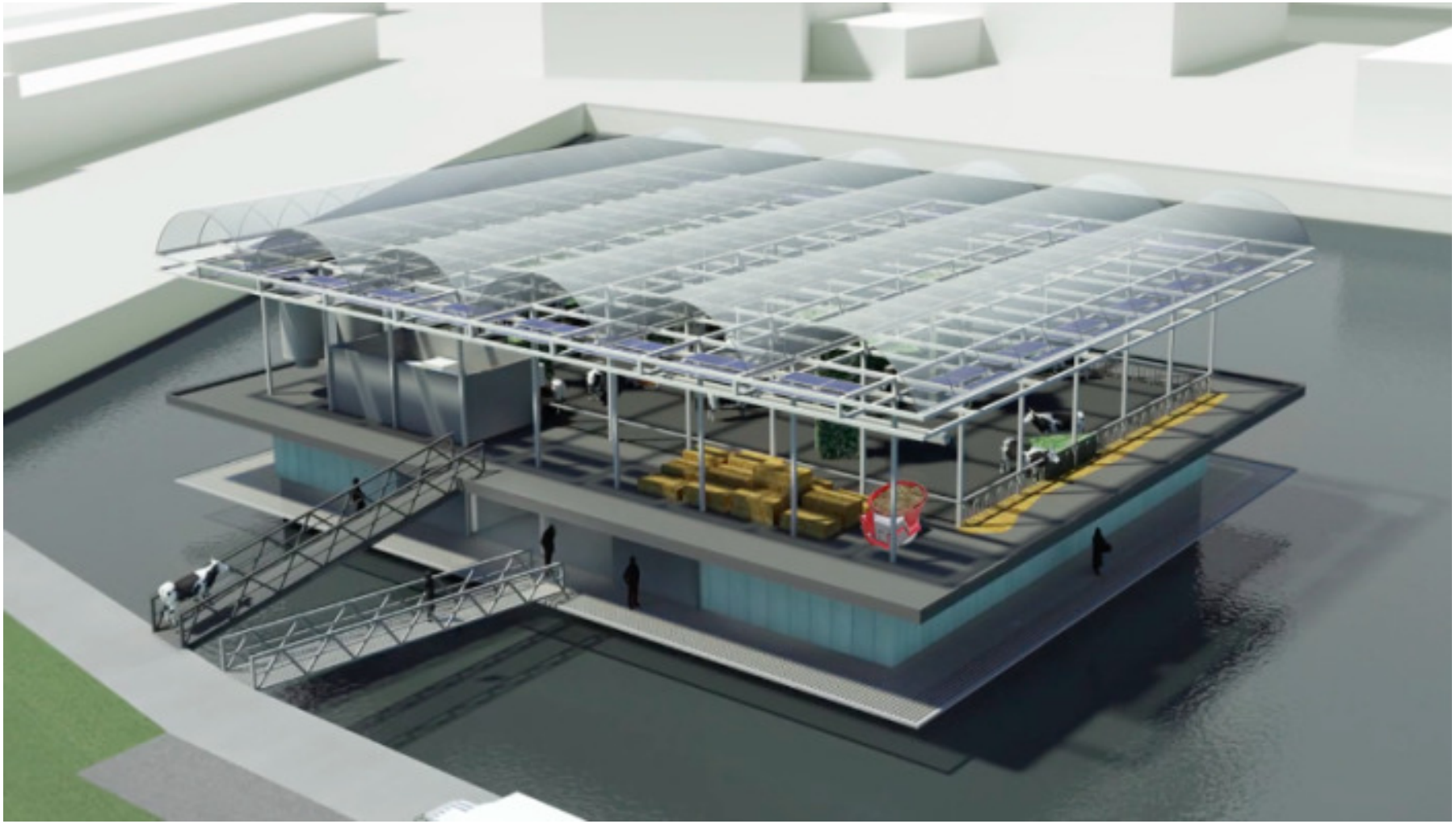


Fig 3: 'Floating Farm' reference project

Floating farm

Before researching how an agricultural typology can be made suitable for floating it is necessary to understand the requirements that the typology has. A dairy farm takes advantage of the milk that cows produce when they are fertile and give birth to calves. The average dairy farm in the Netherlands has circa 95 cows. (Agrimatie, 2015) An average cow in the Netherlands produces 8500 liters of milk a year and to do that it needs to eat 55 kilos of roughage and 5 kilos of concentrates per day. (IFCN, 2015) (Nederlandse Zuivel Organisatie, 2016) For the milk production it is necessary that the cow is fertile, a guideline is that a dairy cow gives birth to a calf approximately every year. The main diet of a cow consists of grass. Because grass grows, the same strip of grass can be grazed 2 to 4 times a year. (Stichting Weidegang, 2015) The average Dutch dairy farm has 5350m2 of grass per mature cow. (Agrimatie, 2015) A typical farm in the Netherlands therefore has an area of 50ha.

Research towards floating agricultural projects leads to a distinction between floating farms and floating agriculture. Floating farms are defined as structures or buildings which float on water and support agriculture. Floating agriculture are naturally assembled structures which float on water and support agricultural growth. As the research is about the design of a building it is more interesting to look at existing floating farms.

From the five reference projects which were researched, four aim at agriculture for growing crops. Only one aims at animal farming. Two out of the four projects growing crops use hydroponics, the others create floating greenhouse structures. The combination with hydroponics is logical because of the easily available water in a floating structure.

The floating animal farm project is called 'Floating Farm' and will be realized in Rotterdam in 2017. The aim is to create a dairy farm floating on the water. During the first two years of their lives the cows will graze in a rented meadow which is on a separate location. After these two years the cows will go to the floating farm where they have the possibility to graze on a small meadow and will get additional feeding. The nutrition is partially imported to the farm and partially grown through LED-grass technology. The cows basically live on the farm, which is larger than the average stable. The cows have the option to go outside onto the meadow when they want to. (Floating Farm, 2016)

The 'Floating Farm' project solves the spatial issues by only having a small meadow on location, and feeding the cows additionally on the farm. A condition is that the calves are still able to graze on a larger meadow. This makes the total area which can potentially be given to the river very limited. The food the cows get aside what they get

from grazing on the small meadow is still a grey area. The website is not very open on that subject.

A reference project that came up looking for dairy farming with limited refeeding and the ability for cows to graze as much as they want is the Polyface farm developed by Joel Salatin. The Polyface farm lies in Swoope, Virginia and is an organic dairy farm. The farms works with grass-fed animals in a rotational system. The rotational system functions more like an ecological system than the conventional farm, it keeps itself in balance. To do this it utilizes multiple types of animals: cows, chickens, pigs, turkeys and rabbits. (Pollan, 2006)

The system is based around grass. The quality of the grass is leading for the distribution of the different kinds of animals. The basic system works with a herd of cows grazing for one day on a small piece of pasture, afterwards the grass gets 2-3 days of rest. In this period the larvae in the cows droppings are allowed to hatch. Chickens are the next step, they eat the larvae and spread the droppings of the cows. The rain will make sure the droppings will enrich and fertilize the soil. This process improves the quality of the soil, thus making the grass grow quicker and in better quality. Another concept the Polyface farm utilizes is mob-grazing. They let the cows graze in a high concentration on a small pasture, making them less critical to what they eat. Just like how a mob would function in nature, if you do not eat it, your neighbor will. (Salatin, 2010) (Polyface, Inc., 2016)

This combination of concepts allows for intensive use of grass while the refeeding is limited. A cow only would need ±10m2 per day of grass, using the same patch of grass 4 times a year. This would add up to circa 900m2 needed per cow, while there is only very limited need for refeeding. The system has the advantage that it resembles nature, in its rotational system as well as in its natural feeding pattern for the animals. (Salatin, 2010) (Polyface, Inc., 2016)

To grow grass and support animals a relatively large surface is required, for an average of around 95 cows one needs a fresh pasture of ±950m2 each day. This asks for larges floating surfaces on which grass can grow. Because cows require fresh pasture each day, mobility of the floating surfaces is a key demand. These demands have led to the choice for using barges, barges are commonly used for river and canal transport of heavy goods. Barges have a large functional surface, and can easily hold the earth required for grass to properly grow in. The demand of mobility requires high flexibility of barges, the choice has been made to go for an equilibrium between size and flexibility. The choice fell for a medium size barge: 70 x 9,5m, these barges have a usable surface for growing grass of approximately 600m2.

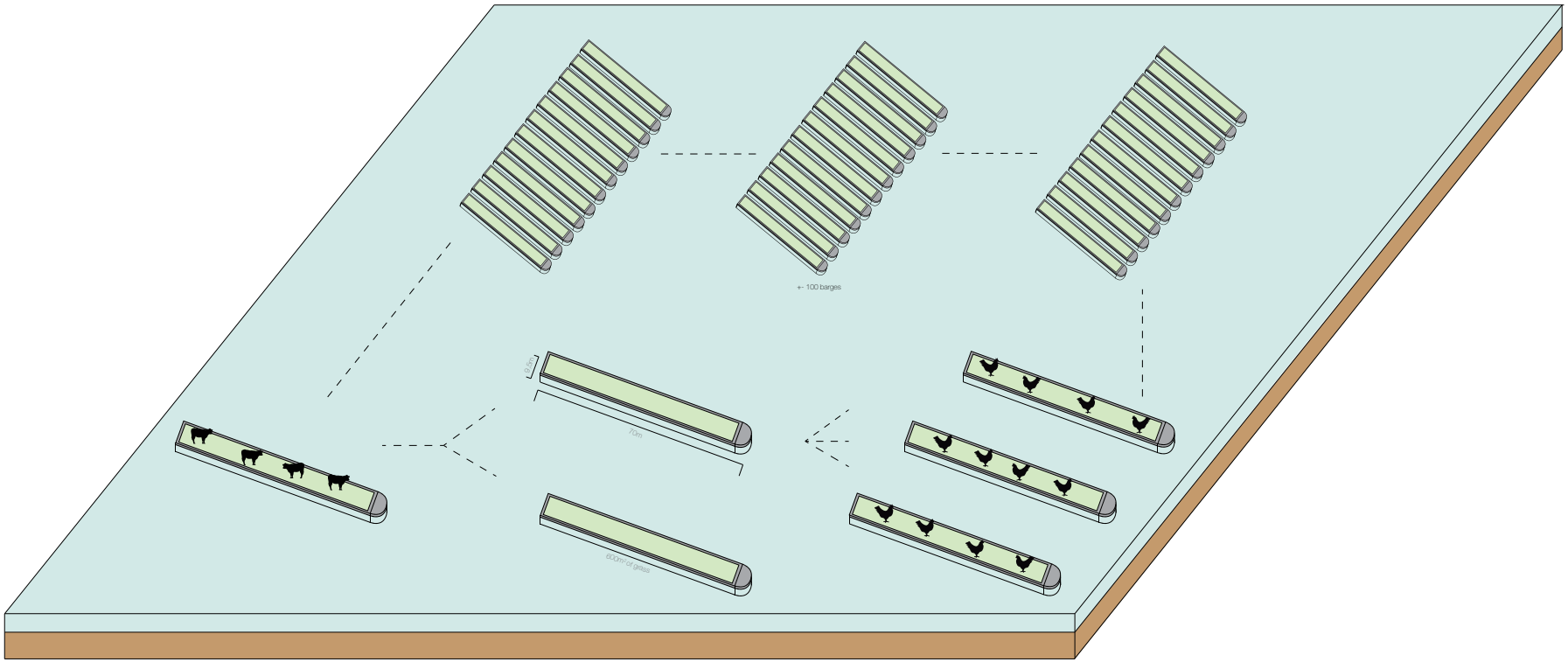


Fig 4: Salatin rotational system applied on barges

Locavore movement

During the 20th and 21st century Europe has seen the spreading of urban settlements, increasing demands for personal mobility. Over these years mobility and traveled distance has increased. (Donaghy, Rudinger, & Poppelreuter, 2004) Long-distance travel of farm produce has been common for multiple centuries but only after the Industrial Revolution large scale inter-continental trade was possible because of the invention of the steam engine. Developments which allow for longer shelf life of products have contributed to this trade. While there has been a sharp increase in food travel in the early 20th century, policy makers have tried to halt this development in the middle of the century. However due to the rapid increase of wealth in Asia, the globalization of farm products is expected to continue to rise. (Anderson, 2014) In recent years more protest has come to this phenomenon, a movement also called the locavore movement. (Fitzgerald, 2015) The movement is a way to address environmental sustainability issues as well as a reaction against late 20th century development of upscaling the food market. (Neville, 2015)

When increasing local food usage the average travel distance of produce will reduce. Decreasing the distance food travels potentially also decreases the amount of fossil fuel needed for transport and therefore the amount of pollution to the atmosphere. Possibly this could also increase freshness of products in stores and their shelf life. (Mariola, 2008) Increase in shelf life can also lead to less need for preservatives. An increase of local food usage could also lead to more seasonable use of products. This effect can decrease the carbon footprint for vegetable production. Out-of-season vegetables are grown in greenhouses which consume a lot of (fossil) energy. (Roos & Karlsson, 2013) The awareness created by using local and seasonal products could lead to larger awareness of the kind of products in people's diets. Studies in Canada suggest a link between local food consumption and a healthier diet, by purchasing directly from producers or using home or community grown produce. (McIntyre & Rondeau, 2011)

Fig 5: River Noord

Fig 6: River Noord and Delta Nature Projects

River Noord

For this research a location was chosen where the Dutch problems with water culminate. The Noord River is a tidal river which lies between the cities of Dordrecht and Rotterdam and flows from the Beneden-Merwede to the Nieuwe Maas. The area has got a high risk of flooding and it is particularly interesting because it suffers from a combination of river floods and sea floods. The last two major floods that struck the Netherlands also struck the area alongside the river Noord. The flood from 1809 was river based and struck along almost the whole Rhine – Meuse area in the Netherlands. (Couwenbergh, 2015) The last major flood was the North Sea Flood of 1953. (Stadt, 2013) The sea has quite a clear influence on the river, with normal tide differences of one meter. (Rijkswaterstaat, 2011) Additionally the river is located in the center of the delta area of the Netherlands, making it susceptible to river flooding as well. Especially this combination makes the site interesting for investigation.

Furthermore the river can be characterized by the amount of (former) shipyards lying on the water's edge. The area once was famous for its shipbuilding industry and the remainders of these times are still visible. These areas are almost always outer dike. The vision the government presented in the 'Room for the River' plan outline that these outer dike areas will get a lot more attention. (Ministerie van Verkeer en Waterstaat, 2006)

While none of the 38 projects in the 'Room for the River' plan are in the River de Noord, the province of Zuid-Holland is developing 22 Delta Nature areas. The main goal of these areas is to give more room to tidal nature, a type of nature which is specific to the delta region. Creating or regenerating this tidal nature doesn't only have an ecological benefit, it also creates sweet water buffer zones. The tidal nature is designed in such a way that during high tide a larger part of the area is flooded, this means the river will have a larger buffer capacity. Along river the Noord there are two Delta Nature projects, the Crezéepolder and the Sophiapolder. (Provincie Zuid-Holland, 2015)

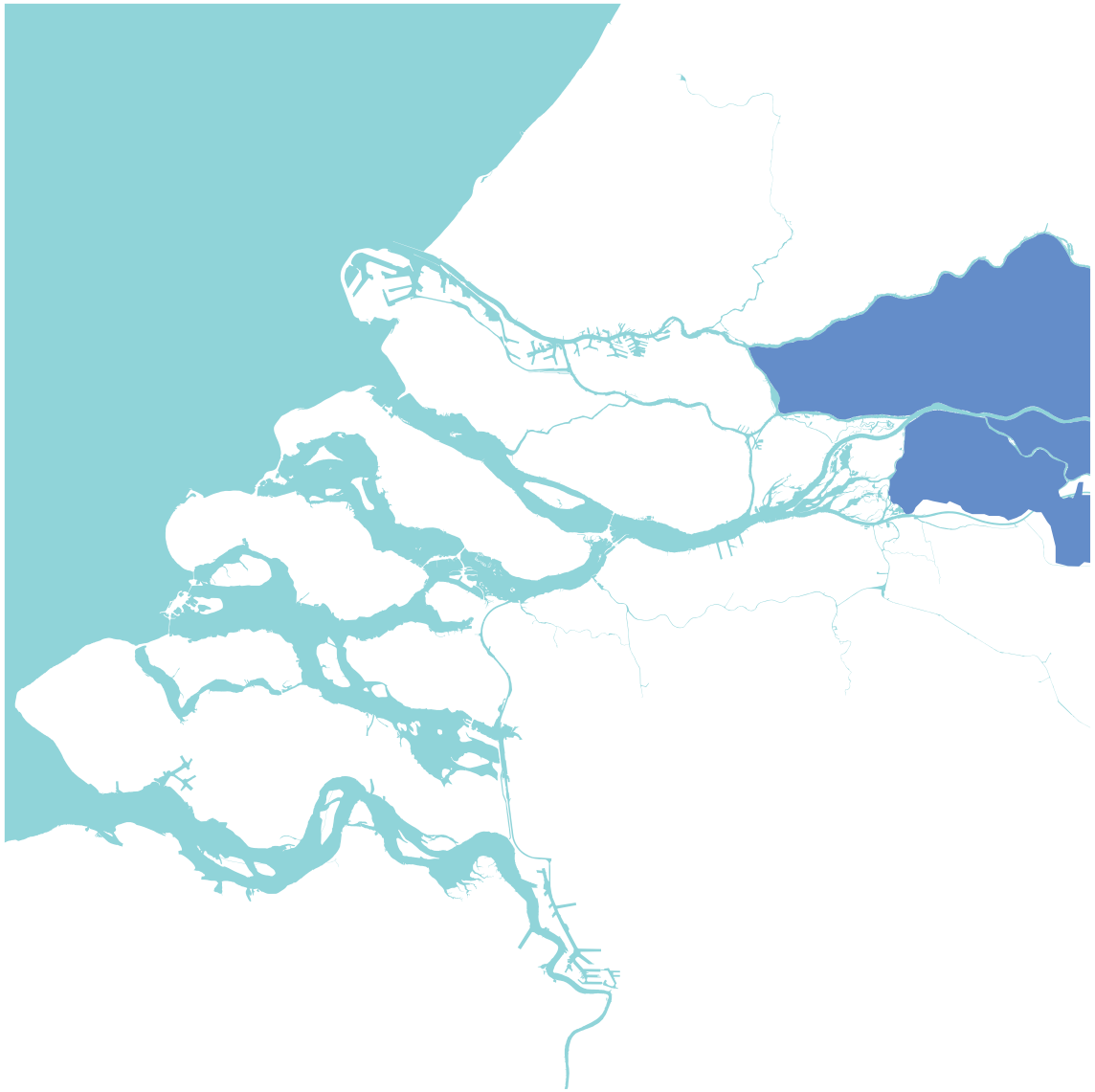


Fig 7:1809 flood

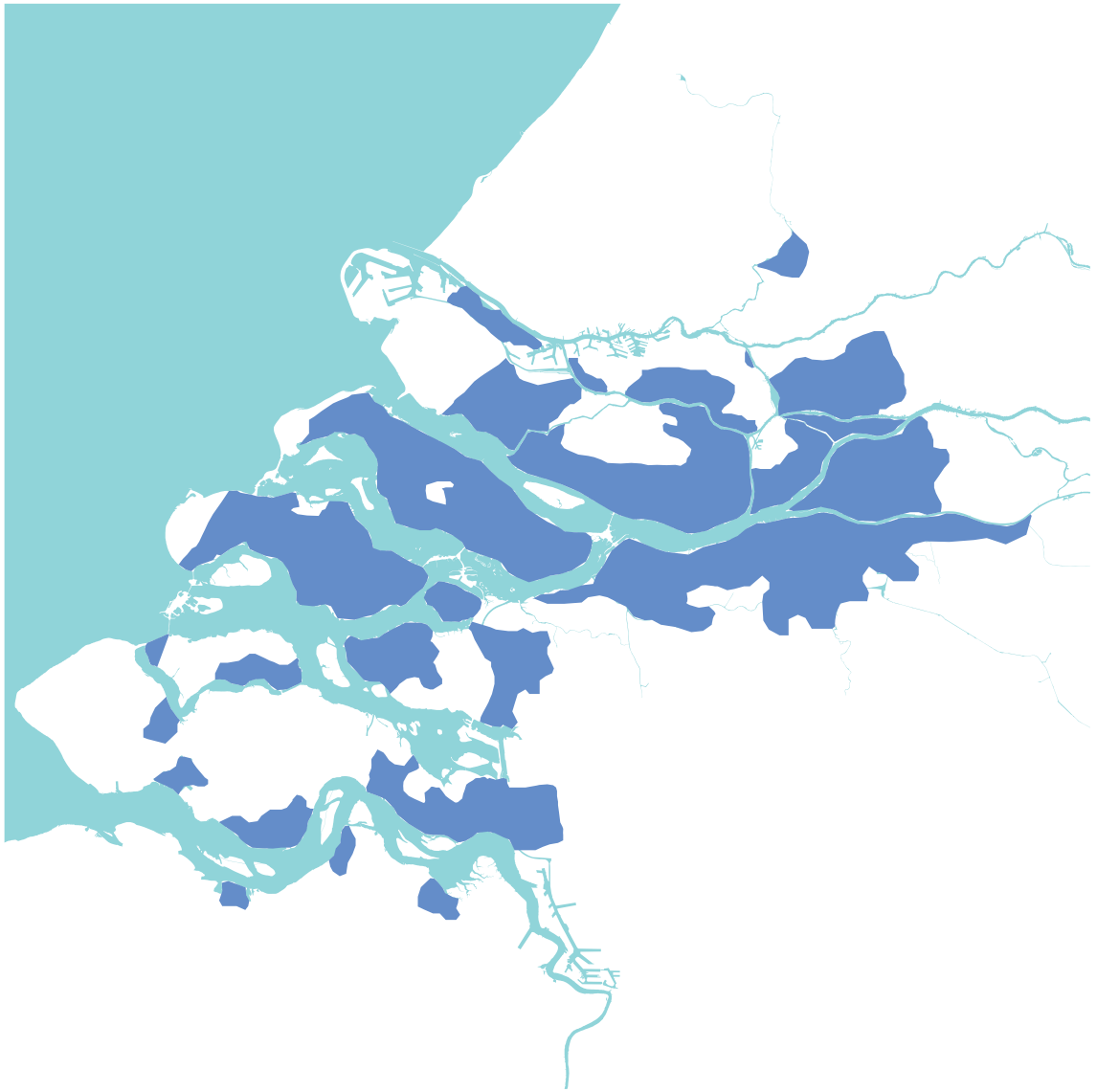


Fig 8:1953 flood

Fig 9: View on Dordrecht

Fig 10: Ship being built at Royal IHC

Fig 11: Industry next to the river

Fig 12: Large steel factory in Alblasserdam

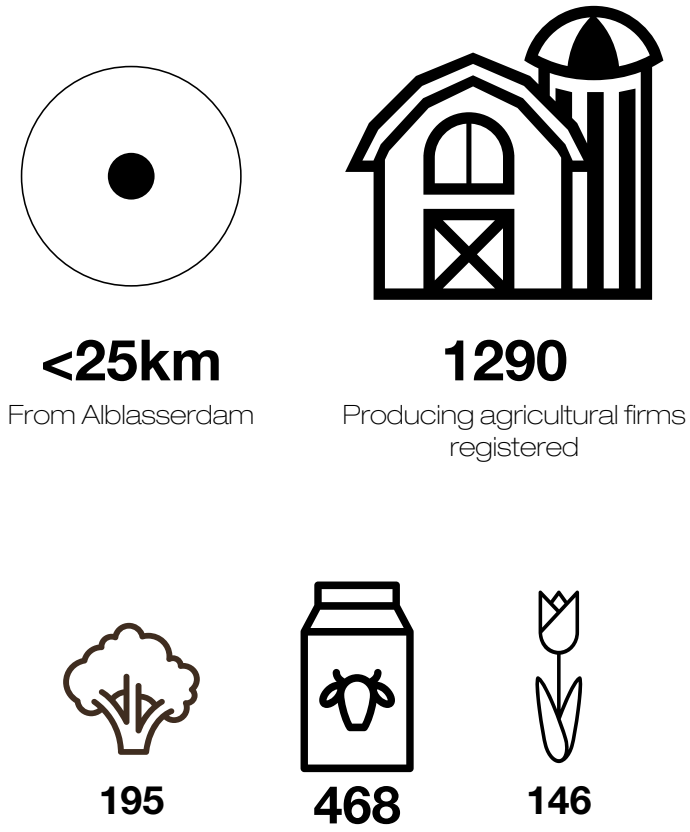


Fig 13: Most common agriculture surrounding river Noord

Agriculture surroundings river Noord

In 2015 The Netherlands was the 2nd largest exporter of agricultural products in the world. (LEI Wageningen UR, 2014) Within a range of 25km from Alblasserdam (in the middle of the River Noord) there are 1290 registered agricultural enterprises. When looking to the most common agricultural enterprises in a 25km radius of Alblasserdam, the top 3 are: Dairy, vegetables and flowers. (Drimble, 2016) Relative to the rest of the Netherlands there are a lot of dairy farms and enterprises that grow flowers and vegetables. (Centraal Bureau voor de Statistiek, 2016) There is a significant difference in the types of agricultural enterprises on the west and east sides of the river. The west, more urban side, has got a higher percentage of flower and vegetables enterprises, the east side is mainly dominated by dairy enterprises. This difference originates in the type of soil that can be found on both sides of the river. The west side's soil is much richer and more fertile for growing crops. The east side's peat soil contains a lot of water and has subsided because of attempts from farmers to get rid of the water. (Stol, 1993) (Lola Architects, 2016) The types of soil found on the east and west side explain the differences in the types of agriculture that are most common on both sides.

Design with maxims

To make a translation from resilience to building design maxims have been formulated. The chosen maxims will help to define the design by making a conversion from problem statement to solution. The maxims contain resilient strategies which can be used to make design decisions and test a design against. In the following paragraphs the chosen maxims are noted and design guidelines have been formulated.

Both design guidelines provided by the maxim's relation to the problem analysis have been combined into one main design goal. The building translates the attention raised by a floating farm, to provide for context and incentive for putting knowledge on the locavore movement into action. The design guidelines have been used as sub goals in the design.

"Being able to foresee and adapt to possible scenarios"

The possible scenarios which we can foresee are: additional room needed by the river to prevent flooding, desired increase of eating more local thereby lessening pressure on the environment. A floating farm provides a resilient way to adapt to a scenario where more room is needed by the river. Jon Naustdalslid names climate change a modern environmental problem, as is it as much an environmental problem as it is a societal problem. The solution might not be found in a lack of knowledge of society but a lack of context and incentive for putting this knowledge into action. (Naustdalslid, 2011) While risks such as flooding can be solved at a large scale, the using of local products is largely based on decisions of individual members of society. To be able to adapt to eating more local, context and incentive for putting knowledge about eating locally should be provided. This maxim leads to the following design guideline: The building utilizes a floating farm to provide context and incentive for putting knowledge on the locavore movement into action.

"Social cooperation and awareness to deal with changing conditions"

The changing conditions described in this maxim are similar to the scenarios which were used in the last maxim: need for more room for the river and a desired increase in use of local products. The floating farm is a resilient tool to deal with agricultural land that is pressured by giving more room to the river. The innovative nature of this concept will likely attract attention, this attention can be put into benefit by raising awareness for the use of local products. This results in the following design guideline: The building translates the attention raised by the floating farm into attention for the locavore movement.

Design guideline 1

The building utilizes a floating farm to provide context and incentive for putting knowledge on the locavore movement into action.

Design guideline 2

The building translates the attention raised by the floating farm into attention for the locavore movement.

Main design goal

The building translates the attention raised by a floating farm, to provide for context and incentive for putting knowledge on the locavore movement into action.

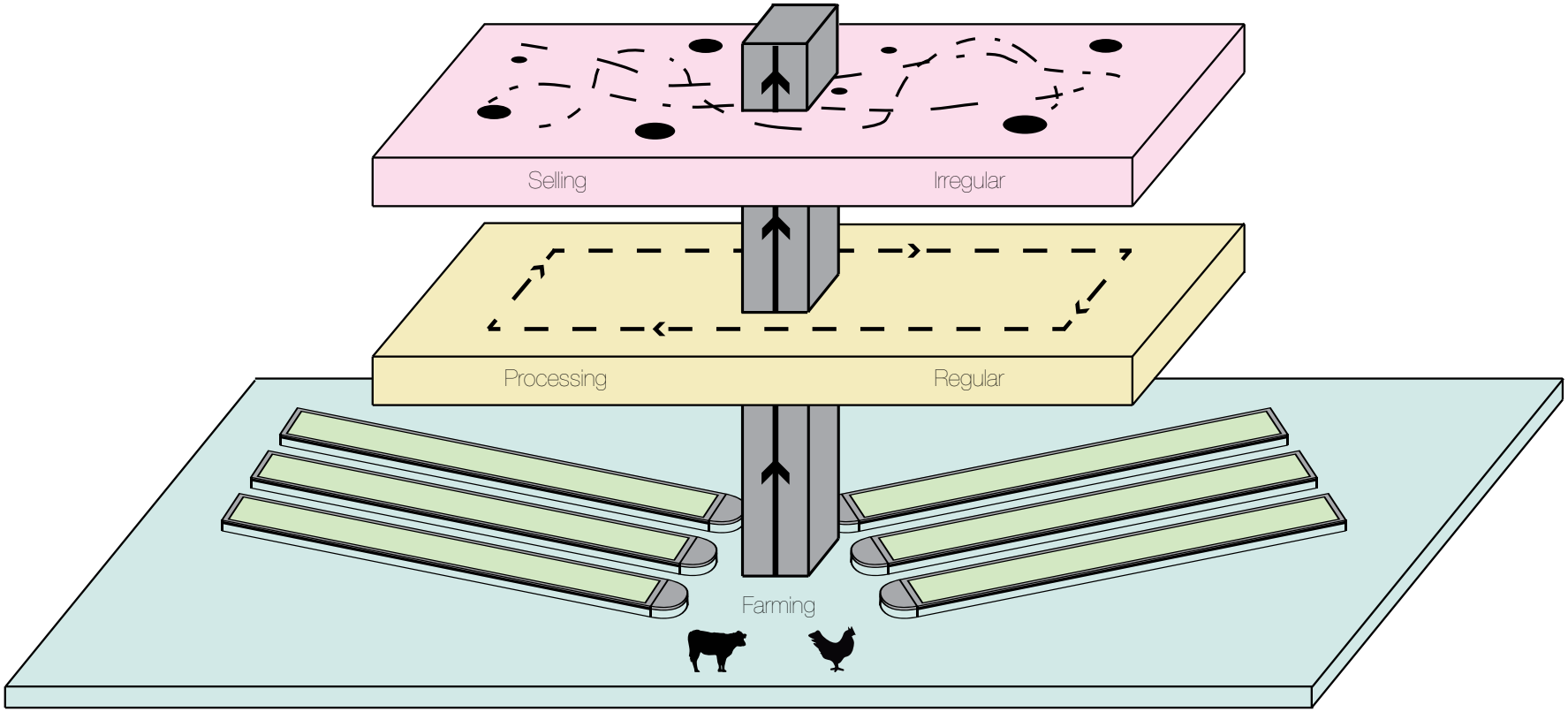


Fig 14: Building concept diagram

Building concept

To answer the first design guideline, context and incentive for putting knowledge on the locavore movement into action should be provided. Providing context simply means showing how it is done. Incentive can be provided by showing the benefits of eating local and providing the means to do so. Through utilizing the floating farm, the building's program can be used to explain the goals of the locavore moment, thereby providing context and incentive.

To answer the design goal it is important to find out what the relationship is between agriculture and the locavore movement. Essential to this relationship is the common ground between both. This common ground is food: agriculture produces food for consumption, the locavore movement calls for an increase in local food usage. Food will be a key component in the design because it links agriculture to the locavore movement. For the second design guideline food serves as a mutual theme to translate the attention from the floating farm to the locavore movement.

Combining both answers to the design guidelines provides a concept for answering the design goal. A building program which utilizes the floating farm's relation with food to provide context and incentive for putting knowledge on the locavore movement into action.

For the building program to utilize the relation with food, the building will be built around the concept of the (food) production line. From floating farm to a food market. This concept envelops three layers. A base level which contains the floating farm, a middle layer in which produce gets processed and a top layer with a food market where products get sold. The layers emphasize the food production process as to provide visitors with context and incentive for the locavore movement.

Gastronomic tourism is currently growing and is aimed at exploring and enjoying meals and beverages to explore local cultures. A food market reflects local culture and traditions because it functions as the social center of a community. (Crespi-Vallbona & Dimitrovski, 2016) A food market can attract gastronomic tourists which will be confronted with the food production process and the floating farm. This will increase the attention that can be generated by the building and which can be put into benefit for raising the awareness for the locavore movement.

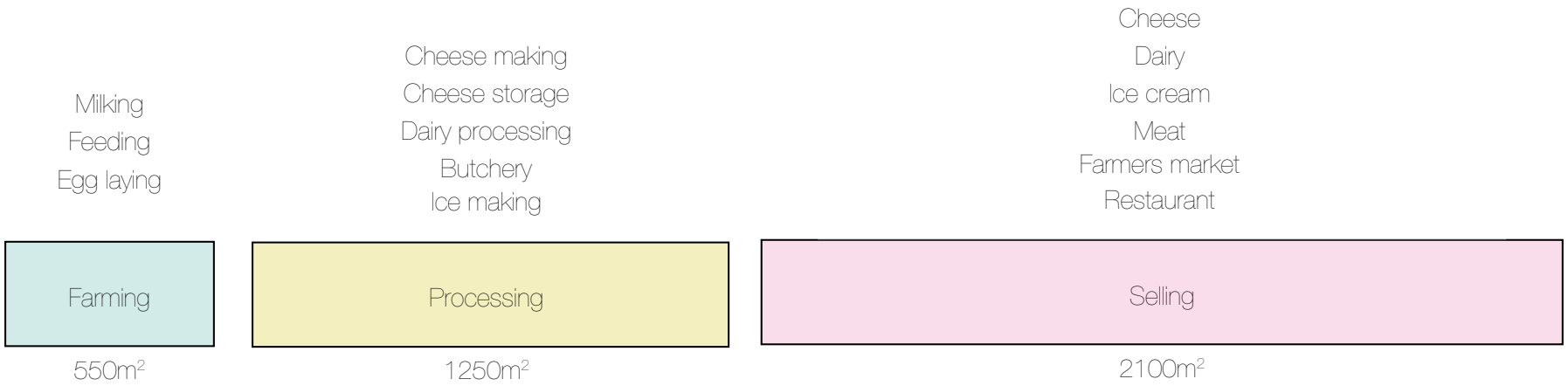


Fig 15: Building program

Layout of the building

The base level will float on the river, cows and chickens will graze here. Produce from the animals will be gathered. Produce will go upwards from this layer towards the middle layer. The middle layer contains the facilities for turning produce into products. There are spaces for dairy processing, cheese making and meat processing. Products from the middle layer will go up to the top layer where they will get sold. The top layer will contain a food market selling products produced in the base layer and products from local farms. The market will have fixed market stalls and there will be a restaurant.

Fig 16: Location

Location

The suggested program leads to a set of demands for the location. The location should be able to attract enough visitors for the market to function properly. Because the building will be located in the water, a location with high visibility and accessibility will be required. Close to the location a large patch of land must be available to give room to the river and allow for the growth of grass on barges.

The location that was chosen for this research lies in Alblasserdam on a former shipyard that has been redeveloped into a residential neighborhood. Alblasserdam is located along the middle of the river Noord. The Crezéepolder, a Delta Nature project, is designated to be given back to the river to create tidal nature. (Provincie Zuid-Holland, 2015) The polder lies on the other side of the river, opposite to Alblasserdam. This polder would be ideal for the storing of barges to grow grass, as it has a large area and is very close to the site for the building in Alblasserdam. The only thing that lies in between is the river. Alblasserdam lies in the Alblasserwaard, an area famous for measures taken to keep the land dry. Exactly this fact makes the land less suitable for growing crops and more suitable for keeping animals. The area has thus had a long history in dairy farming.

The chosen site is close to the village center and lies on the water's edge. It can be characterized as a transitional zone. It lies on the river quay of Alblasserdam in front of an introvert residential neighborhood. Towards the south there are larger industrial buildings and a large residential building and towards the north there is a more natural remainder of a former shipyard. This natural zone is a remainder of a former shipyard, the layout can still be recognized in the nature. (Belder, 2005) The remainder has a very open and natural appearance, as it is under influence of the tides. Alblasserdam's waterbus stop is at the quay, directly behind the residential neighborhood and close to a road which leads towards the city center.

Alblasserdam lies in a touristic region: Dordrecht, Rotterdam and the world famous Kinderdijk are close. Alblasserdam itself does not have a lot to offer to visitors though. The city wants to develop a more attractive city center and facilities to attract visitors. (Gemeente Alblasserdam, 2013) The municipality of Alblasserdam wishes to develop the city center, one of the strategies to do this is improve the relationship with the water. Visitors should be able to walk around the harbor and the link with the river needs to be stronger. (Gemeente Alblasserdam, 2015) A food market combined with a floating farm will likely attract visitors to Alblasserdam. Because of the placement in the river the building can help to improve the relationship of the city center with the river.

Fig 17: Developments wanted by municipality of Alblasserdam

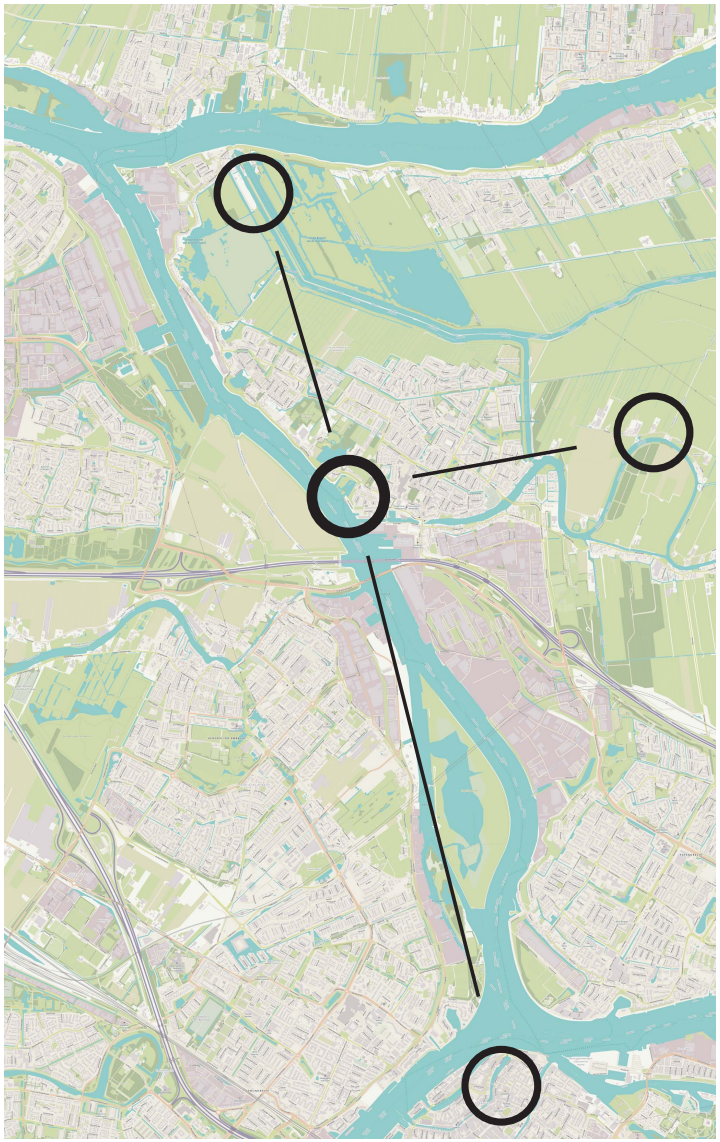


Fig 18: Recreation in relation to Alblasserdam

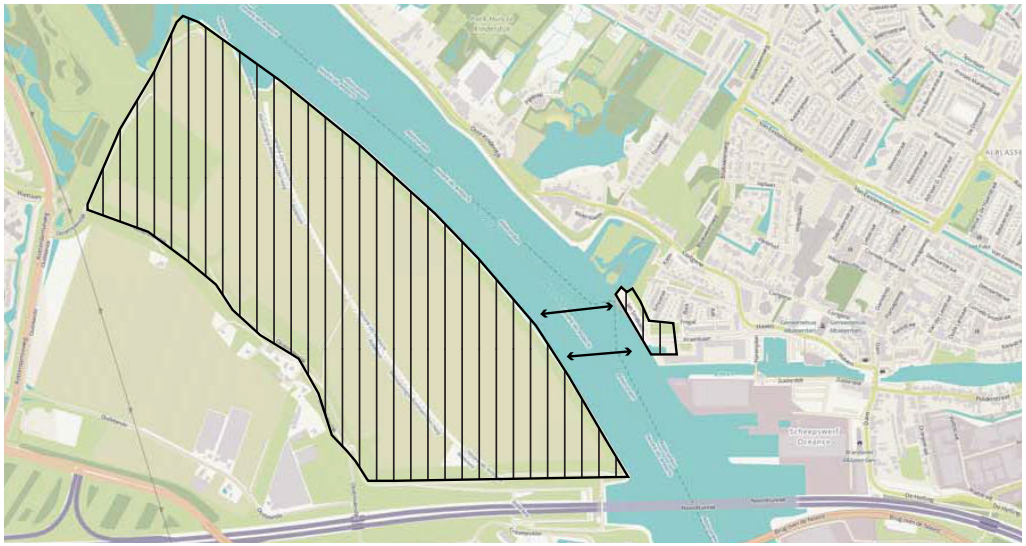


Fig 19: Relation site and Crezéepolder meant for giving river more room

Fig 20: Entrance to city center via water and industrial building

Fig 21: Large residential building very close to the site

Fig 22: Natural area; remainder of a former shipyard

Fig 23: Residential neighborhood

Fig 24: Urban Intervention

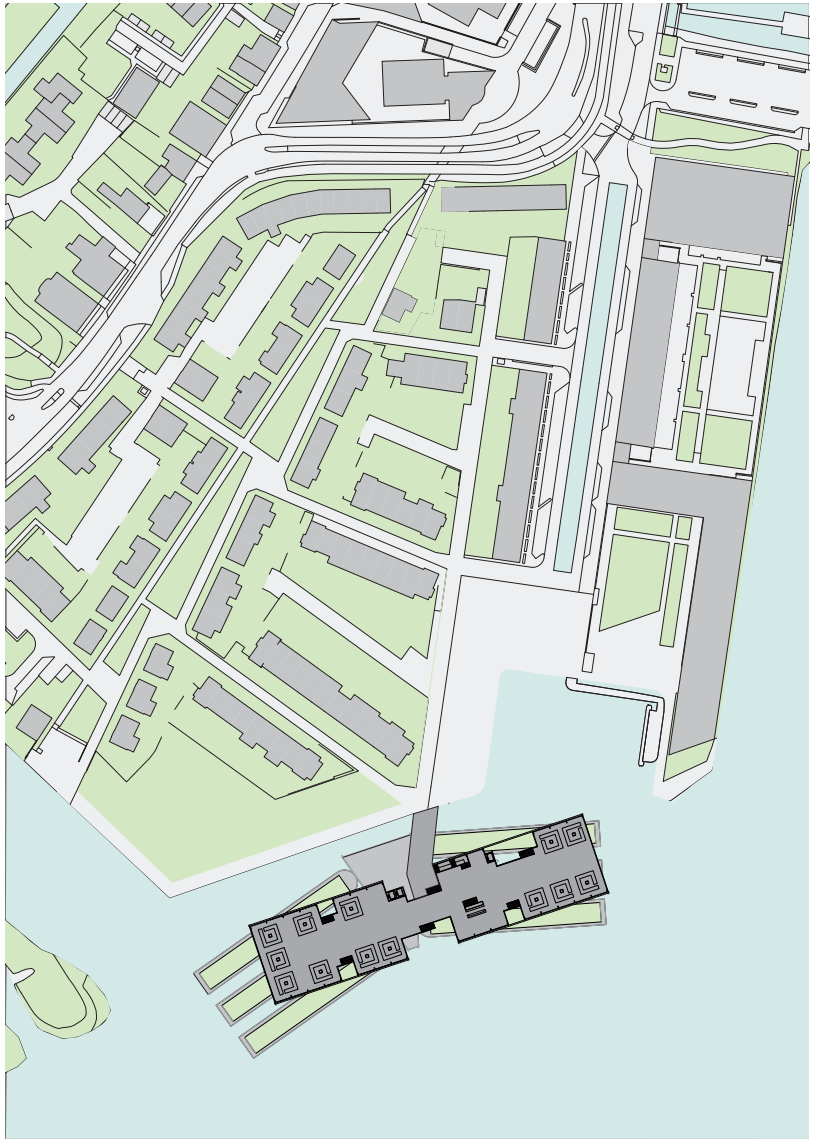


Fig 25: Urban integration

Urban integration

To create space for the building and give the river more room the quay will be set back towards the residential neighborhood. A small cove will be created at the end of the street leading up to the city center, this will create space for the waterbus stop. This street will be reorganized with water running in the middle, this will form a connection between the harbor and the newly created cove in the river. The municipality wants to improve the relationship with the river and this an approach to emphasize the relationship to the quay and the river. (Gemeente Alblasserdam, 2015)

Around the cove a square will be created, which will lead up to the building. The square serves as a public space surrounding the cove and it provides a view towards the cove, the building and the river. The building which is situated in the river is connected with the square via a bridge. This bridge is meant for both pedestrians and motorized vehicles.

The building (130*30m) manifests itself as an independent object standing in the water. The scale is comparable to the larger buildings on the south side of the quay. The height was chosen to form a transition between the higher industrial buildings and the lower height of the residential buildings. The building is designed in such a way that you can look from the quay underneath the building and see the river and the floating farm. The angle of the barges is based on the angle of the flow of the river. The river makes a slight bend at the location which explains that not all six barges are aligned in the same direction. Three barges lie in line with the current, the other three lie countercurrent. The building itself is independent of that angle and follows the line of the quay. This gives a playful image between the barges and the building, at some points the barges are under the building, in others they are in the open air.

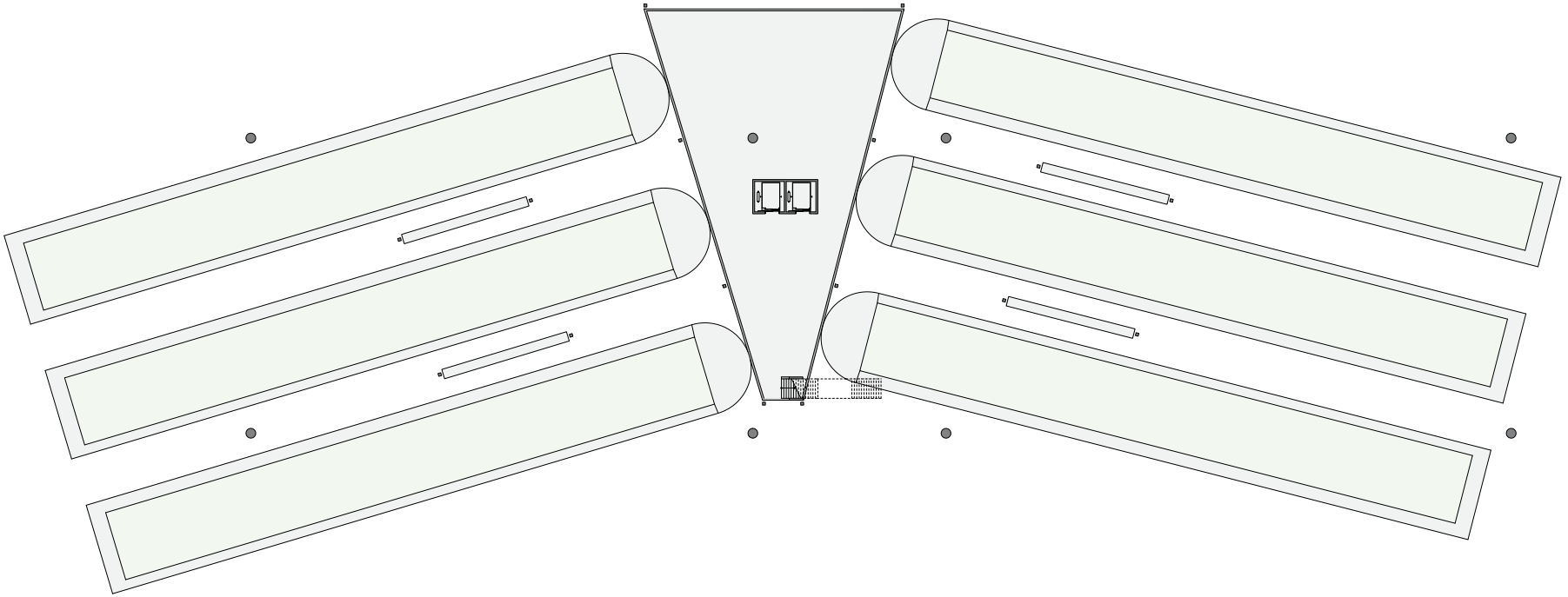


Fig 26: Floor plan of agricultural layer

Agricultural layer

The agricultural layer contains six barges. One for the cows, two barges on which the grass is resting and three barges with chickens. Each barge is 70 x 9,5m. The three northern barges lie countercurrent, the three southern barges lie in line with the current. The northern barges will be used for the cows, the chickens will use the southern barges. The pasture will go through a rotational cycle based on the Polyface model. (Polyface, Inc., 2016) The base level has a pontoon floor in between the barges. This pontoon floor floats on the water and its position thus changes with the tides, in this way it will remain aligned with the barges. There are two points of connection with the upper levels, two elevators and one set of stairs.

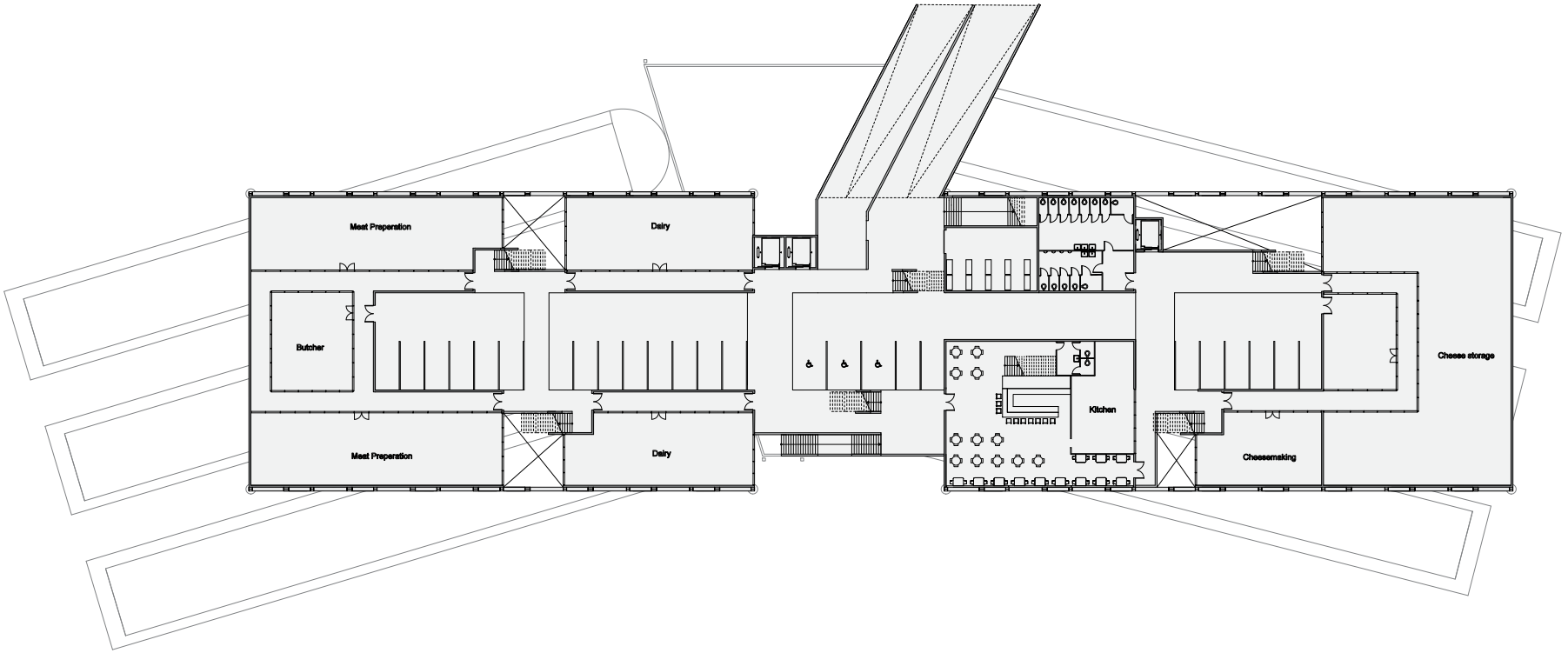


Fig 27: Floor plan of processing layer

Processing layer

There are three main product categories that can be created from the produce gathered in the base level: dairy, meat and cheese. The milk the cows produce can be processed into all kinds of dairy products. Additionally cheese can be produced, this is a separate process and asks for a lot of space because cheese needs to age. This can take up to 2 years depending on the type of cheese you are making. Cows which are not fertile anymore and don't provide enough milk can be slaughtered for their meat. Male calves will be slaughtered for their veal, female calves will grow on to be dairy cows. The chickens provide for eggs, which don't need any additional processing, eventually they can also be slaughtered for their meat.

The processing layer has been designed in such a way that the processing facilities all lie on the outside of the building, the middle of the layer will be occupied by a parking facility for employees and the disabled. Directly at the entrance there is storage for goods brought in from local farms. For visitors it is possible to circle the whole building, thus seeing all processing facilities. The route for visitors constantly switches between inside and outside, inside are all the processing facilities. Outside visitors walk next to gaps which have been made in the footprint of the building, these gaps allow for viewing downwards towards the water and the floating farm. Visitors can also look upwards and they will see the top layer. In the middle of the route there will be a restaurant. The restaurant with its glass facade offers beautiful views of the river and the base level.

For visitors processing will be a transparent activity. The actual facilities will be parted from the visitors by large glass walls, allowing visitors to take a look at what is going on inside. The hallways can be equipped with information panels which will give information about the processes going on inside. The butchery has a box-in-box construction to prevent sound leaks towards other parts of the building. It is possible to walk around the butchery and glass windows will allow for peeking inside. Because there is only a limited amount of moments when there will be activity in this room, it has been decided to keep this process transparent because it is an essential part of the process.

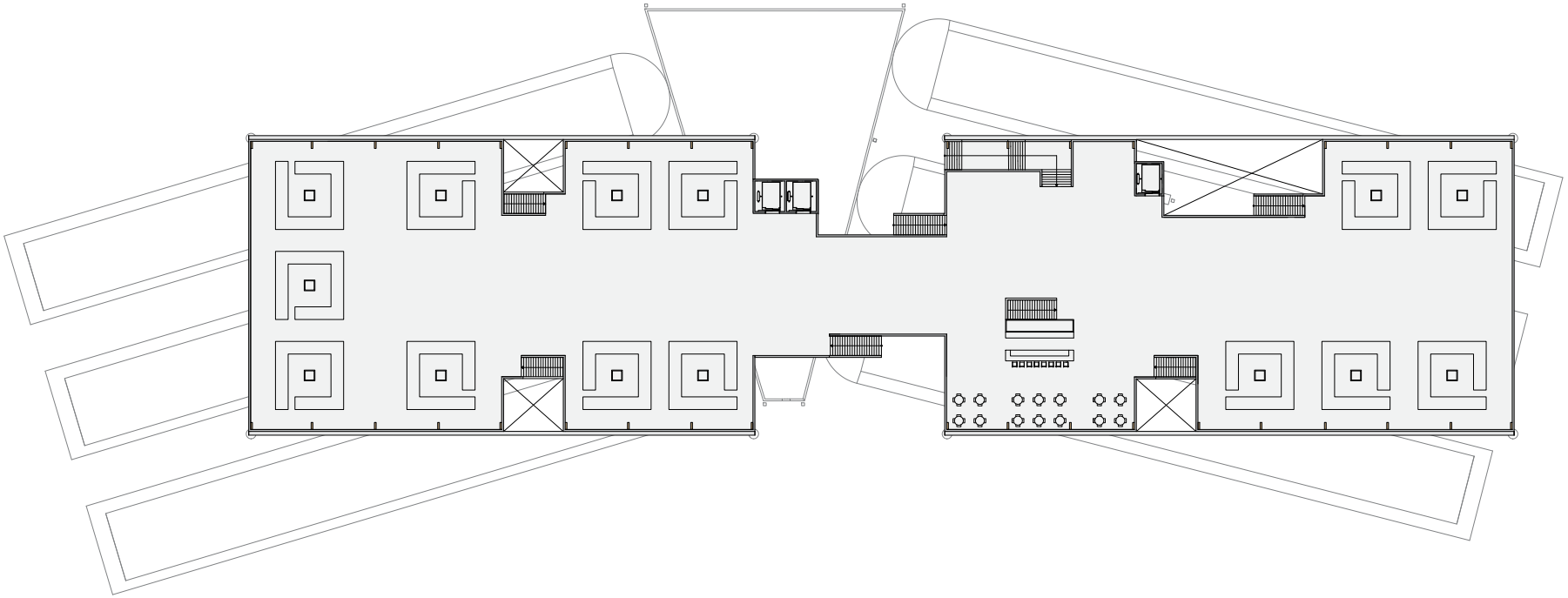


Fig 28: Floor plan of market layer

Market layer

For the design of the market research has been done to different types of markets in buildings around the world and how they function. Logistics is a very important aspect of markets: there are products coming in every single day and this process needs to be streamlined. It is thus logical to arrange markets rationally, making transport easy and efficient. Though markets do not always appear so rational and streamlined to the eye of the visitor.

An analysis of reference market projects leads to the conclusion that markets in most cases are indeed arranged rationally. Usually markets consist of a few pathways surrounded by market stalls. Most of the analyzed markets have market stalls which allow visitors to walk around them, maximizing selling space. The idea that markets do not always appear rational and streamlined is presumed to be caused by a few different factors. One factor is the amount of visitors: when a space is full of people it quickly looks chaotic. Another is that most of the markets have central alleyways and are placed in a large hall, this allows visitors to get an overview of the offer, chances are they might be overwhelmed by the amount of people and the products they see.

Using the conclusions of the research, the top level containing the market is set up very rationally with regard to the placement of the market stalls. There is a central 'avenue' which allows visitors an overview over the market, this overview will result in the effect of abundance when the market is busy. The market stalls have been categorized in a few sections: meat, dairy, vegetables, cereals and cheese. The design of the market stalls was done in such a way that there is maximum space for selling products: people can walk around the stalls and on all sides there are items being sold. In the middle of the building lies a restaurant with a terrace looking out on the river, the restaurant has inside spaces on the processing layer.

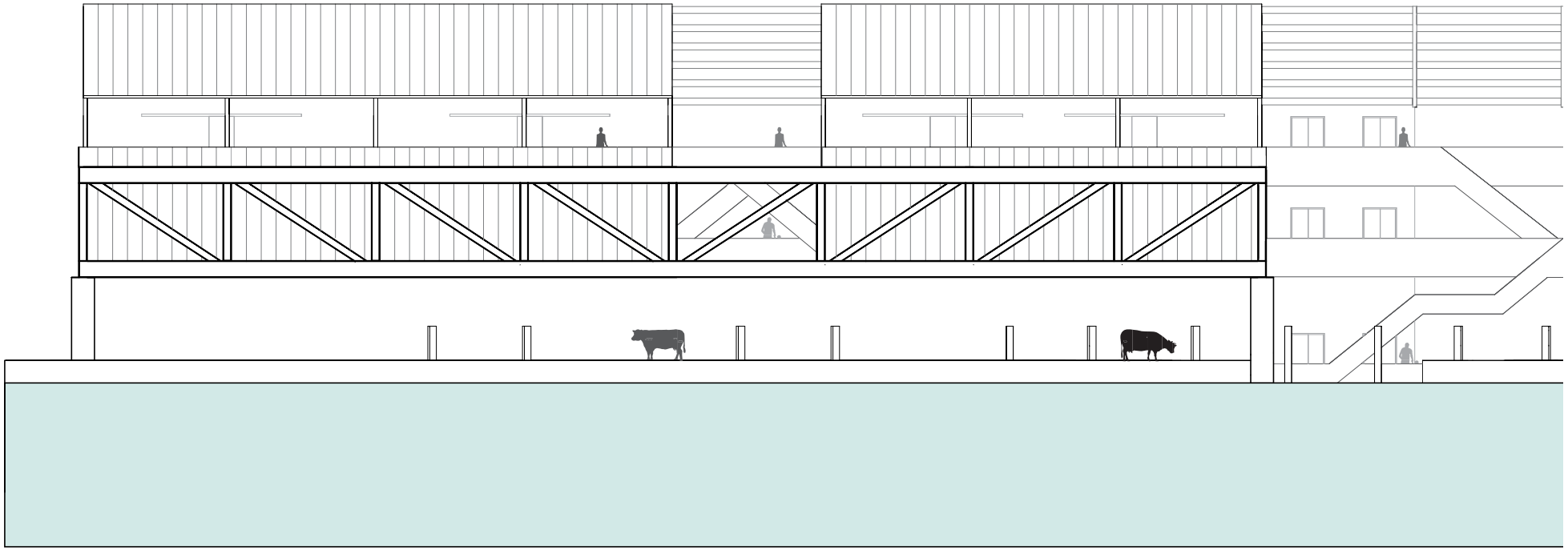
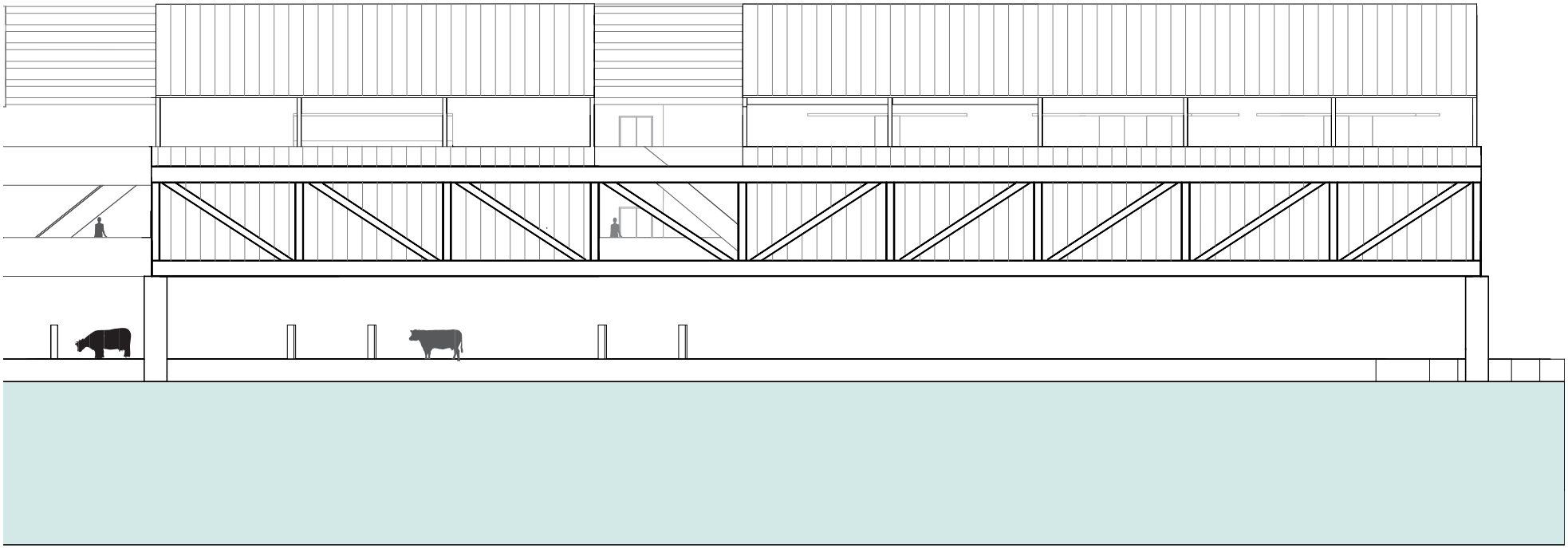


Fig 29: Southwest Elevation



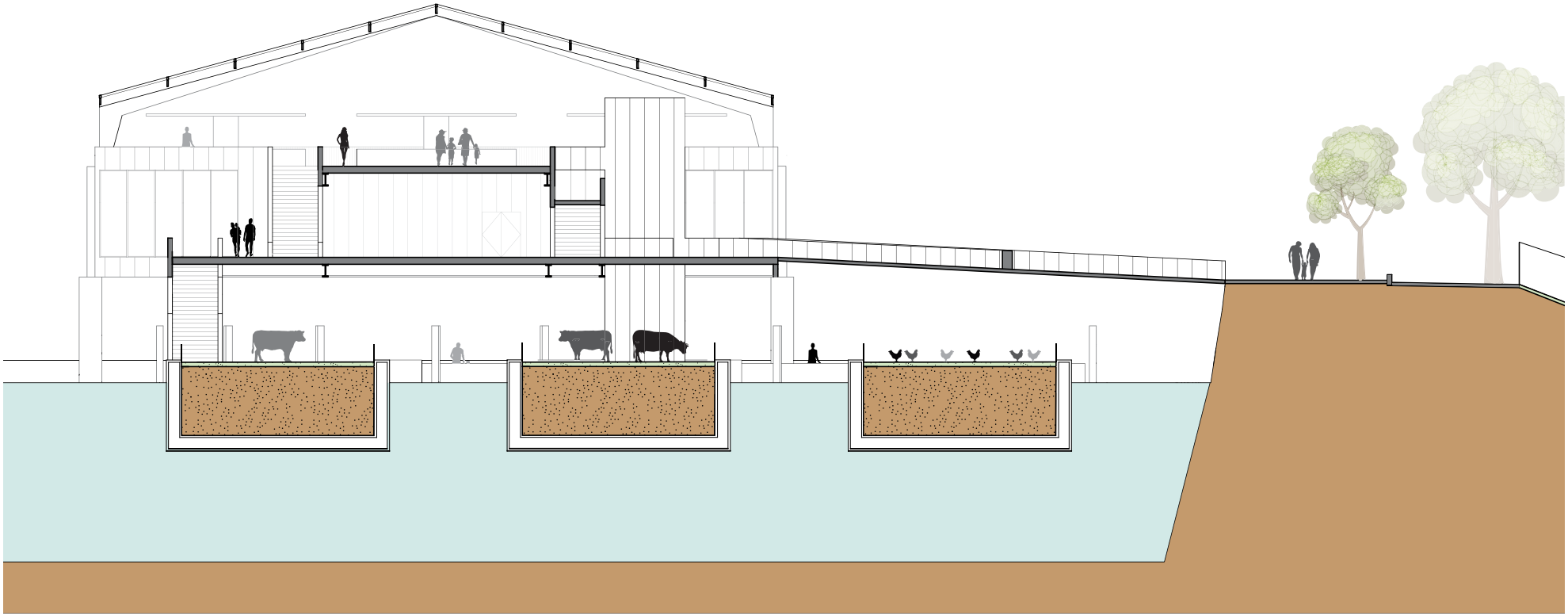
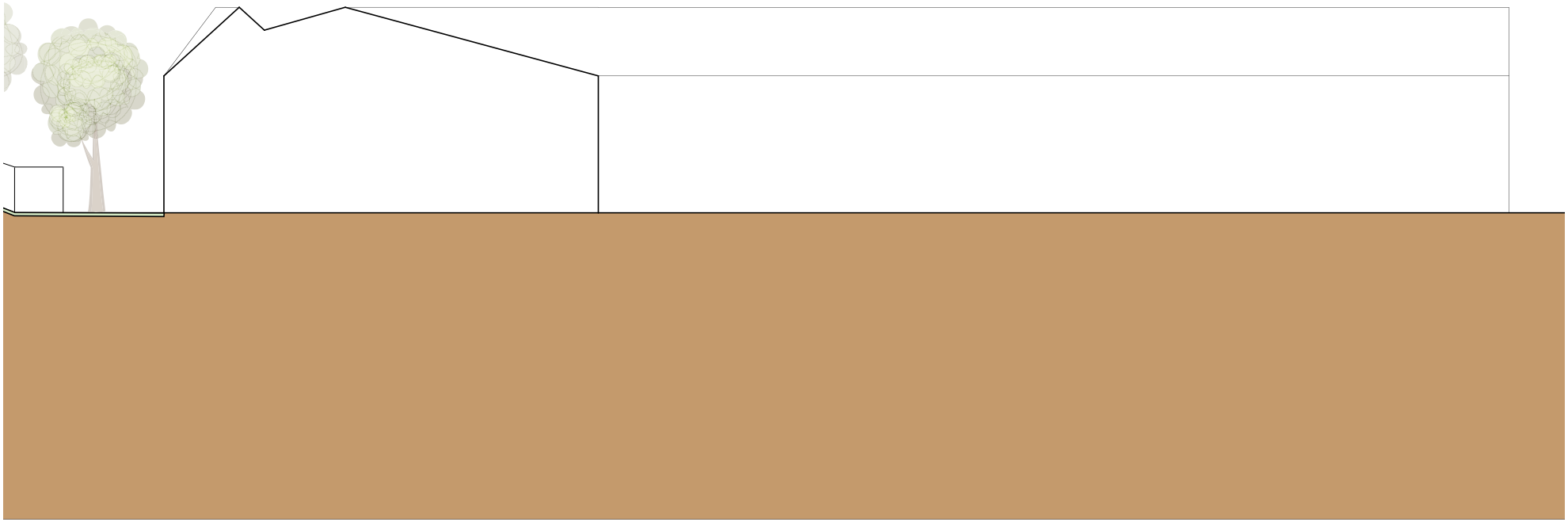


Fig 30: Cross section



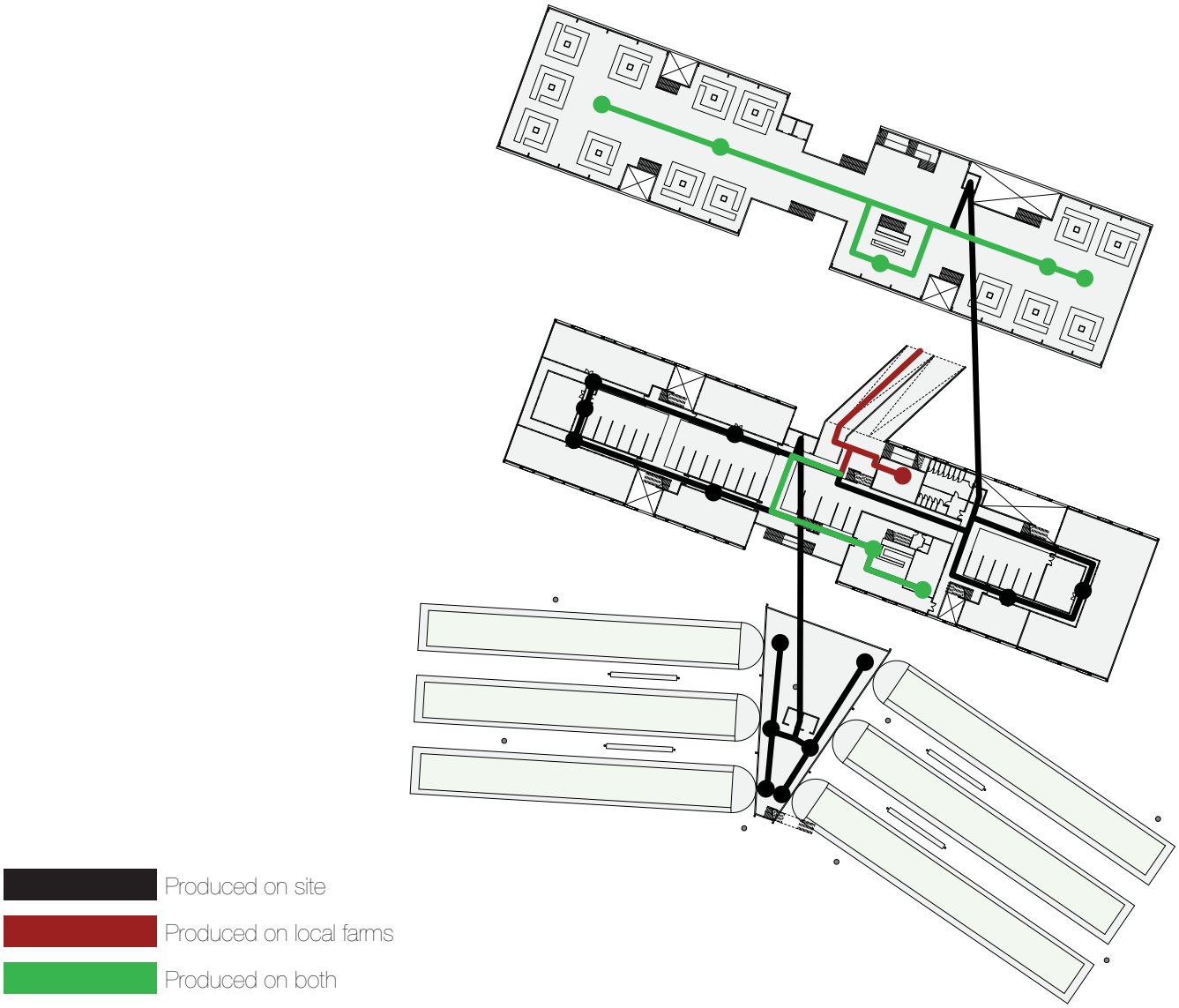


Fig 31: Routing of produce

Routing

Visitors enter the building on the middle layer using a bridge coming from the quay. From the entrance point most visitors will go up the stairs or take the elevator towards the top level. The other option is to go down to the base level. The top level will attract most visitors and is the most approachable. Here visitors can explore the market, or enjoy the scenery from the restaurant. The relationship with the middle and base layer is done using elevators and multiple stairs. The stairs are located in gaps created in the volume of the building. These gaps allow visitors a visual relationship with the middle layer, base layer and the river.

In the middle layer visitors walk alternatingly around the inside and the outside of the building. This way they get to experience the processing facilities as well as the relationship the building has with the water. The stairs or elevators to the base level are near the entrance and allow visitors to reach the floating pontoon. Here they can view the animals on the barges and experience the river.

Produce coming from the base level will go to the middle level via the elevator, where it will go to the designated department for processing. After processing it will go up to the top level or the restaurant where it can be sold or used in products. Products from local farms will come in via the bridge on the middle floor, where they can temporarily go in storage. From here they either go directly to the market or they can get further processing and afterwards go up to the market or the restaurant to be sold.

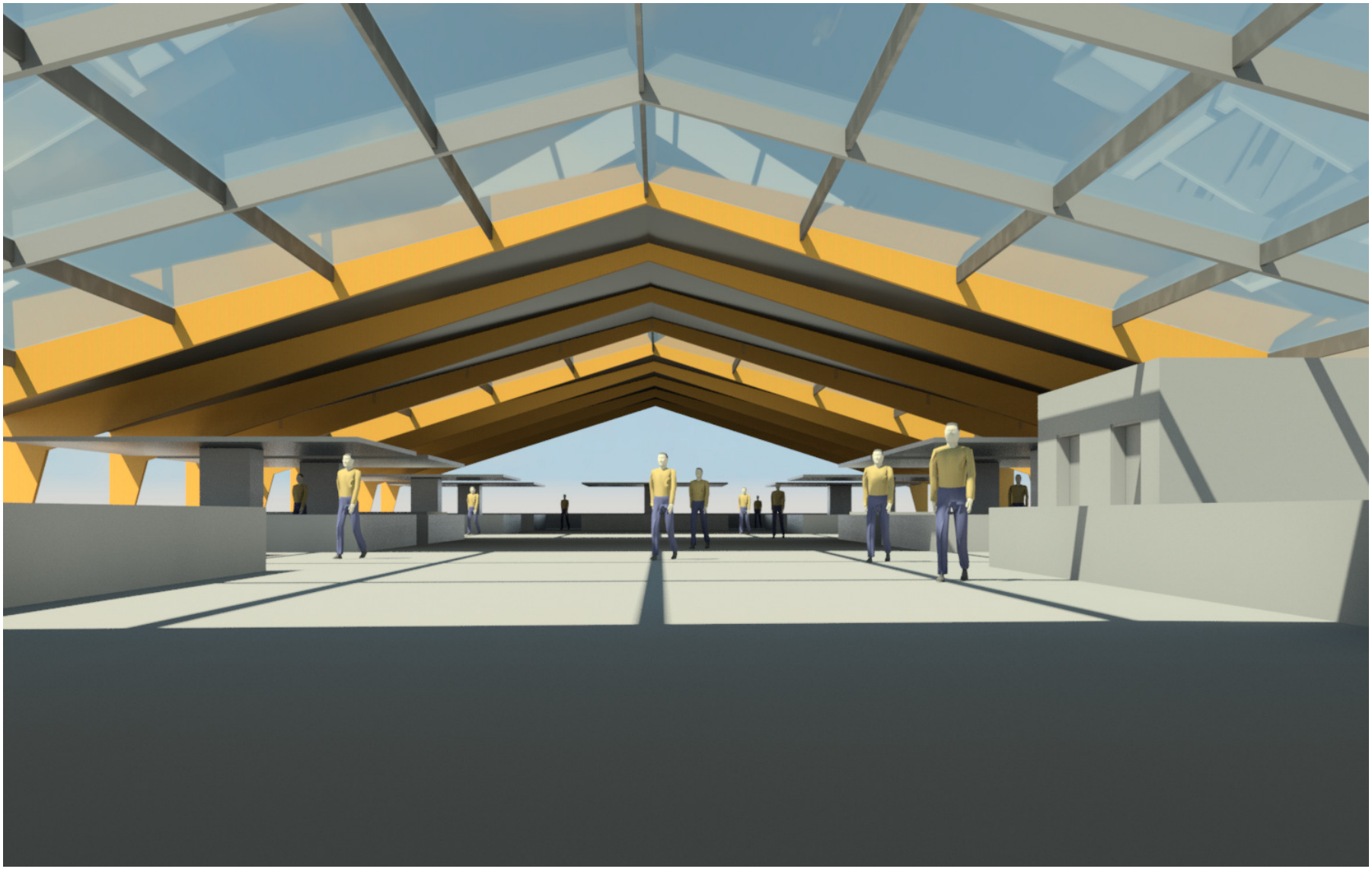


Fig 32: Impression of market level

Architectural expression

In the architectural expression a clear distinction should be made between the construction and the rest of the building. The construction has been solved in a style resembling civil engineering projects on water. The construction has been dimensioned in such a way that it appears sturdy. The truss configuration is based on the well-known Pratt truss. (Chen & Duan, 2000) The cladding for the facade and the roof is made of zinc and should remind of the cheap metal profiled sheets often used to clad dairy stables. (Provincie West-Vlaanderen, 2006) The inside of the balustrade on the market is made from a material which been researched to be perceived warmer than other common materials. (Wastiels, Schifferstein, & Heylighen, 2012) The wooden planks should give a warmer feeling to the market, making it more attractive to stay here for a longer period of time. That is also why the construction of the roof is made from laminated wooden portal frames. The chosen roof pitch is relatively low, because of the length of the roof it reminds of typical dairy stables.

The top layer has an open layout, providing views over the river and the surroundings. To still create an enclosed space the roof with warm materials was created as a unifying element. The roof runs over the complete market, uniting the two halves created by the construction. The roof is made from glass in the locations where there are gaps made in the volume, this highlights those cuts and allows more light to enter the market.

The middle layer is much more enclosed. The volumes where the processing facilities are located are closed and they surround the parking spots in the middle. The volumes are alternated with gaps in the volume, emphasizing the location of the processing and the market stalls on the higher level. The walls separating the processing facilities and the gaps are made of glass, as to provide an insight into what is happening. The idea is that visitors on all three layers can view inwards to see what happens in these spaces, making the process more transparent. The cuts made into the volume are used to emphasize the relationship between the layers and provide a visual connection. People can also take the stairs here as the vertical transportation is located in the gaps.

The base level has a very open layout. The space is only interrupted by the eight columns which supports the steel trusses. The barges define the space and determine where the columns stand. The floating pontoon in the middle follows the left-over space by the barges.

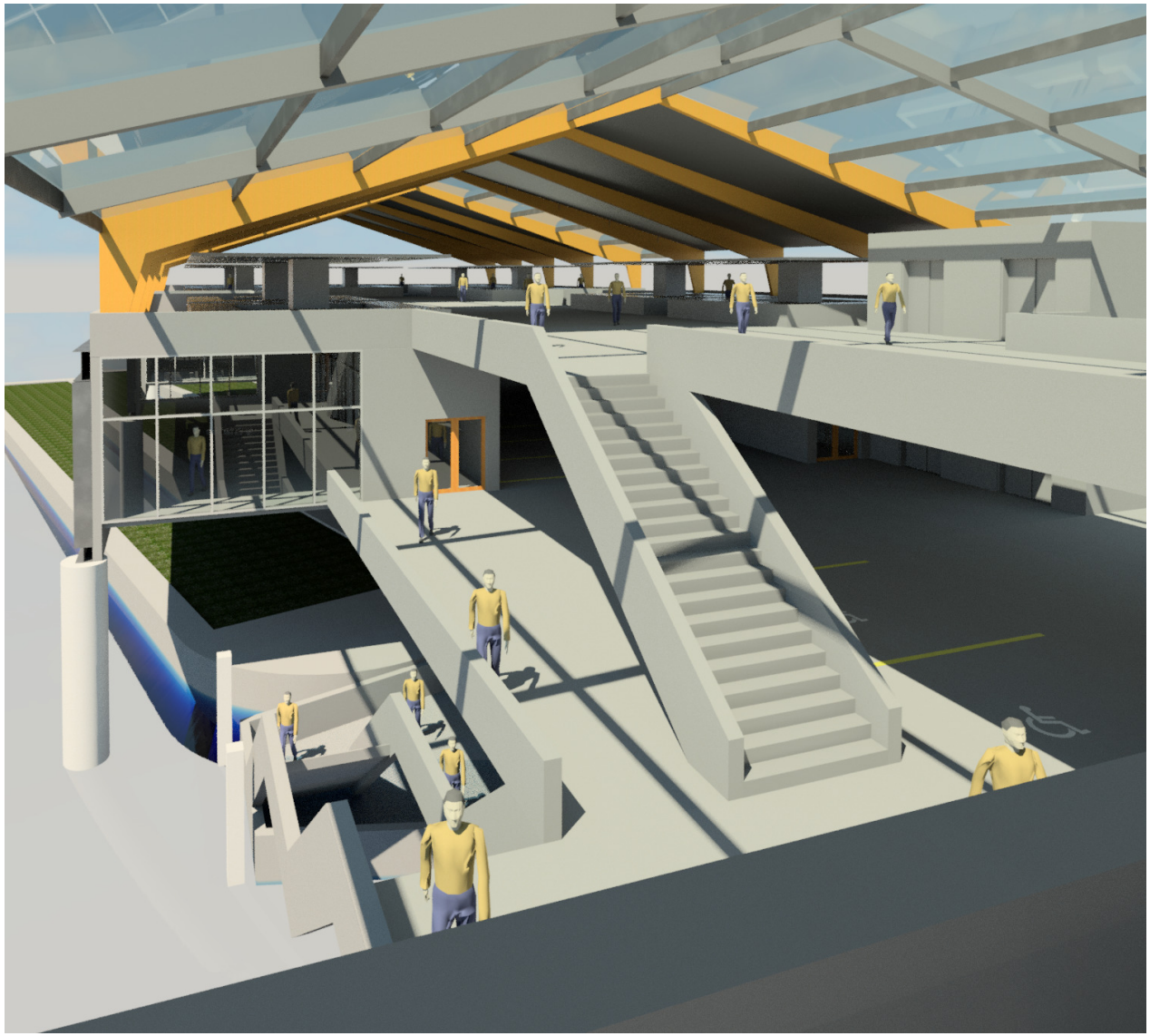


Fig 33: Vertical transport in the gaps

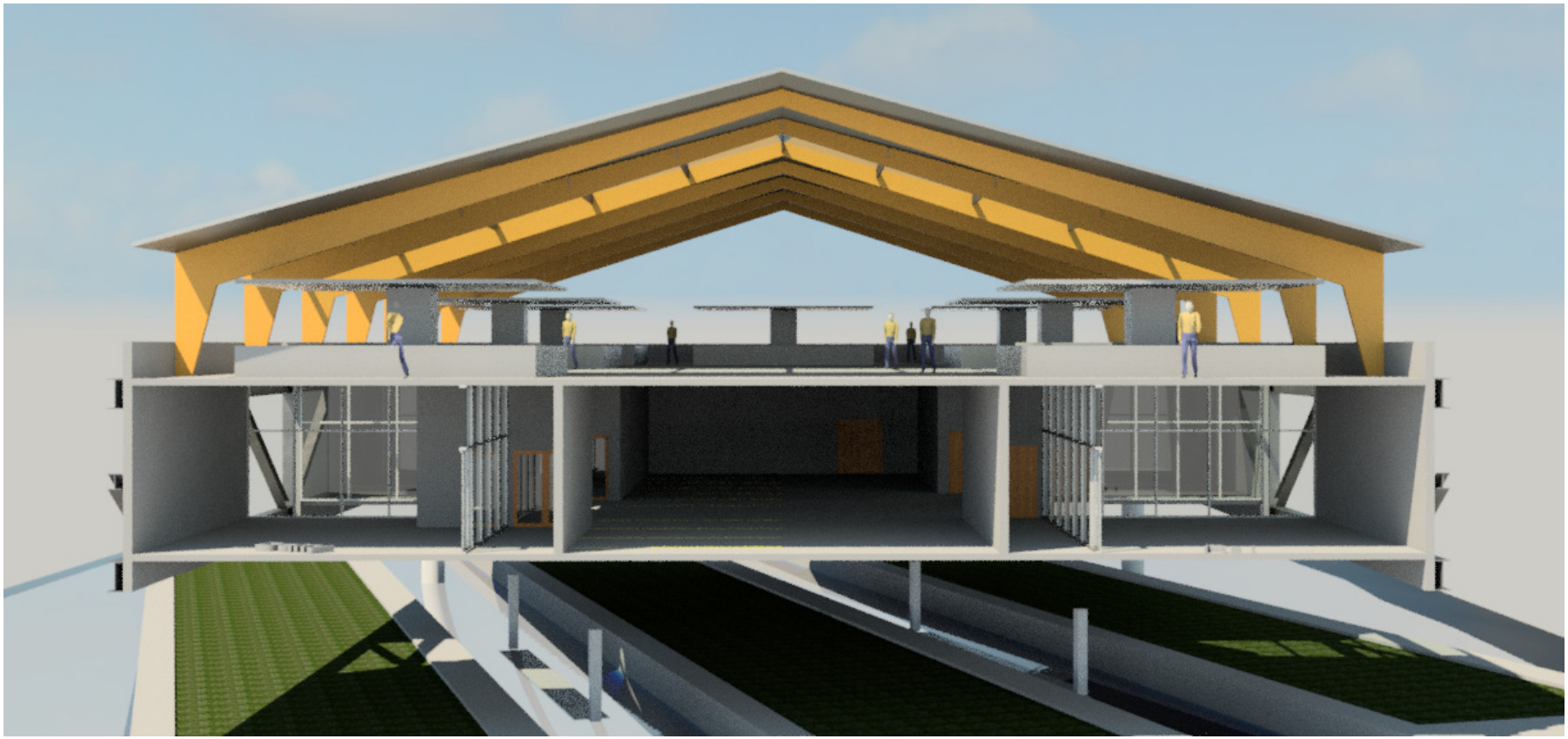


Fig 34: 3d short section, showing relationship between the different layers.

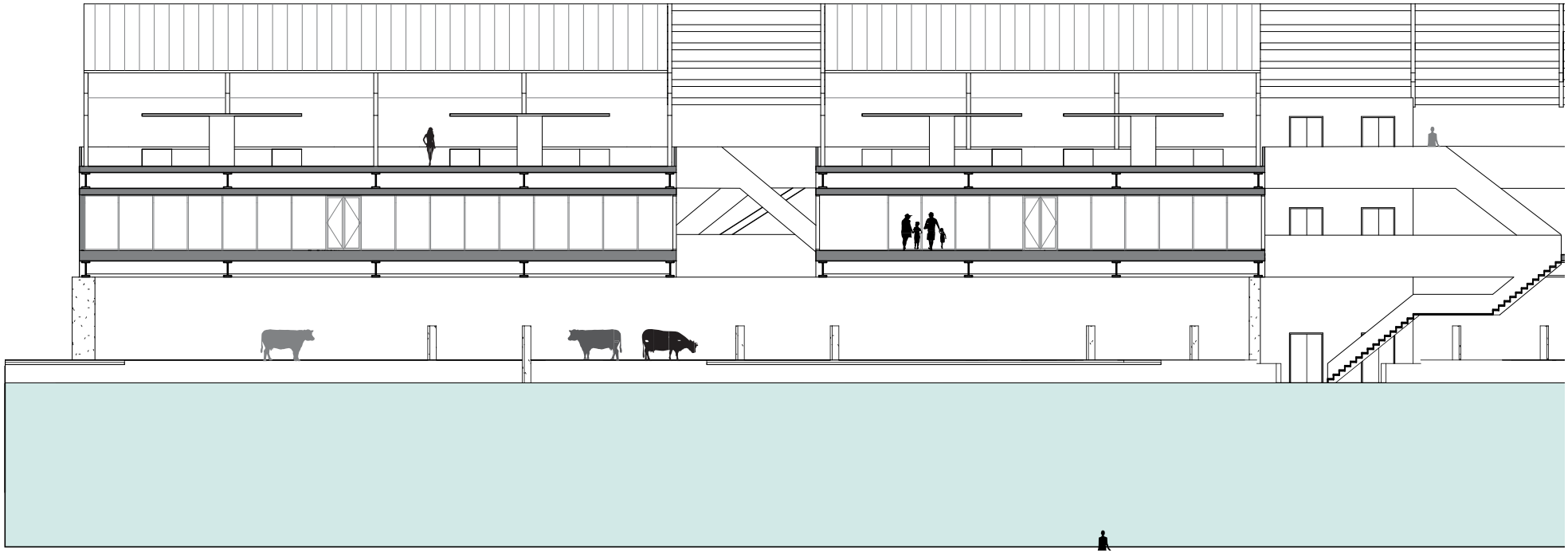
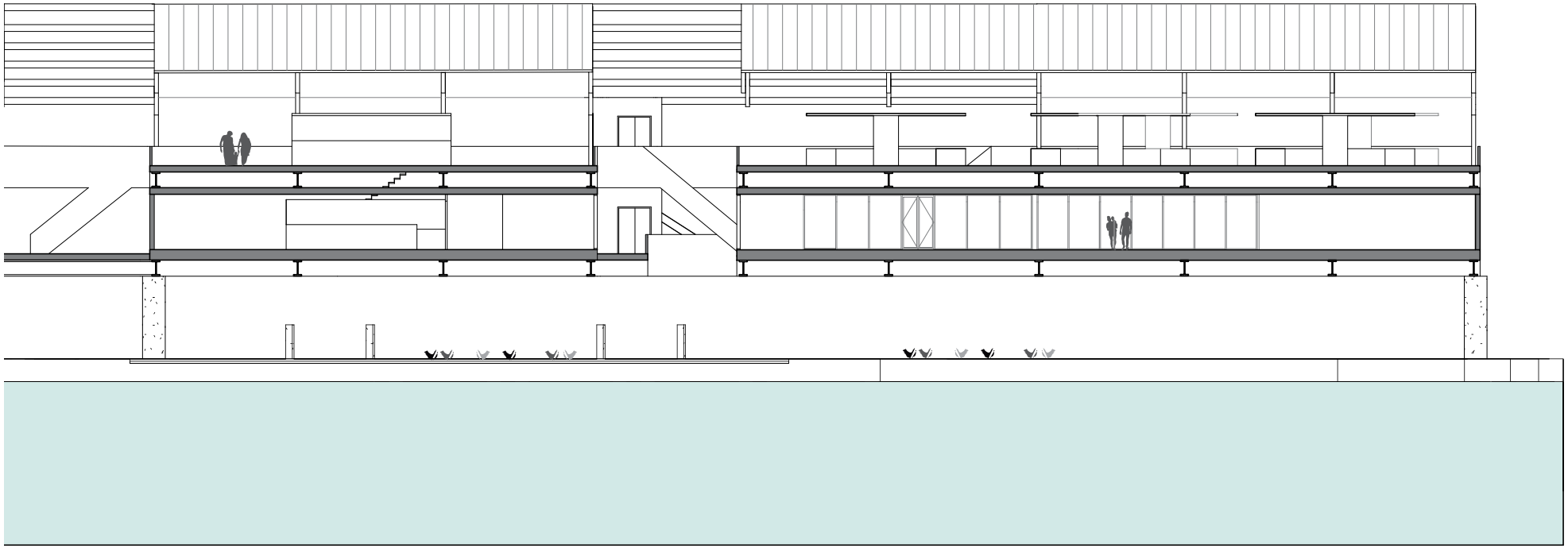
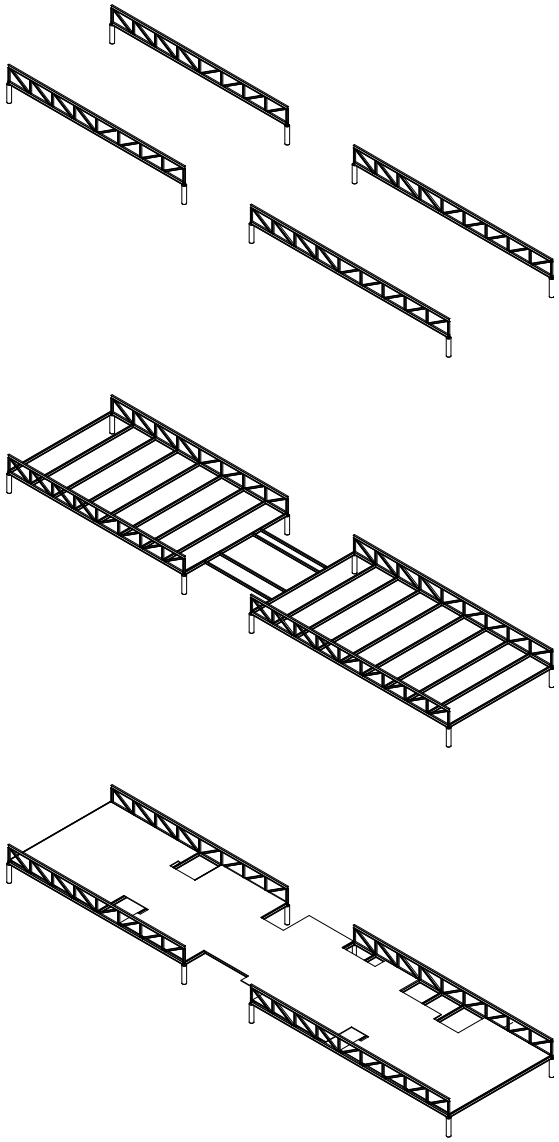


Fig 35: Long section





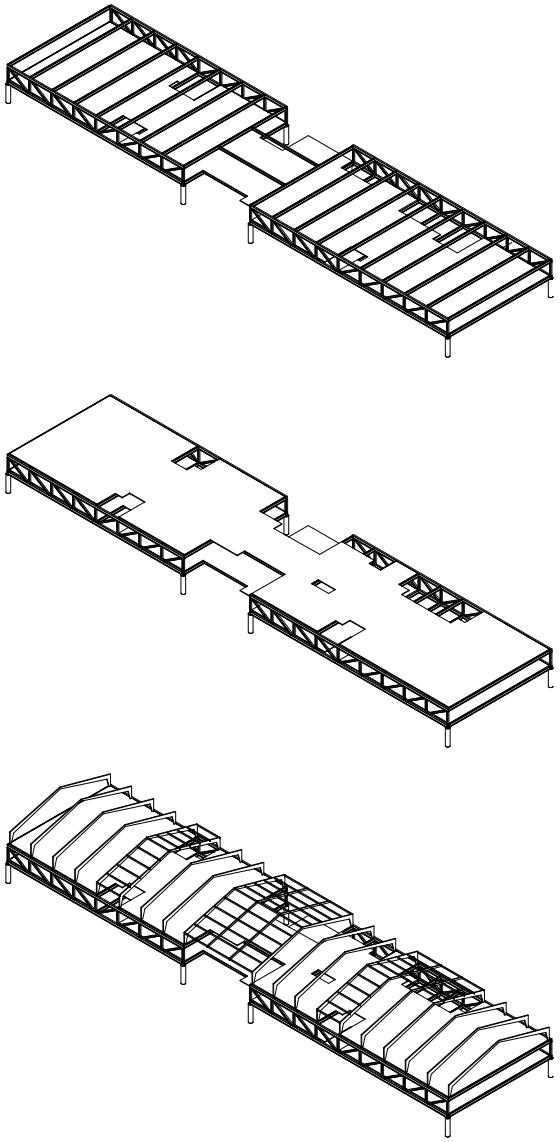


Fig 36: Buildup of construction

Makeability

The construction has been heavily influenced by the barges which need to float under the building. The optimal direction in which the barges need to be docked conflicts with the angle the building has. The consequence of this difference is that the locations where supports can be placed are very limited. This leads to big spans. Big spans are common when building over water, e.g. in the building of bridges. Typical types of construction used in this discipline are trusses. (Chen & Duan, 2000) The main construction for the building has been divided in two parts, each supported by a truss on each facade. The height of the trusses is based on the height between the beams supporting both floors in the building. These beams must apply their forces in the nodes of the truss, as to make sure they aren't loaded with a momentum. The trusses support all of the loads in the building. The trusses are supported on eight spots by steel columns encased by a thick layer of concrete. These columns make a connection in the water with the foundation.

Beams span between the trusses, these beams support the hollow core floor slabs. These floors span 6.5m between each beam. This system is applied for both the middle level floors as well as the top level floors. The roof is constructed out of wooden portal frames. The roof itself spans 6,5m with a standard wooden roof construction. The glass parts of the roof have a steel construction.

For the dimensions of the profiles used in the trusses two reference projects were consulted. The Unilever building in Rotterdam and distribution center the Greenery in Barendrecht. (Henkens & Lagendijk, 2007) (Deelen, 2009) The used profiles in the reference projects were analyzed and based on their ability to handle tension and compression new profiles were chosen. The advantage of using trusses is that the individual members only handle tensile or compressive loads. (Janssen, 2010) The ability to handle tension and compression is largely determined by the sectional area, as the average force in the steel decreases when the area increases. This follows out of the equation: Tension = Force/Area. (Verburg, Barendsz, & Eldik, 2004)

Profiles were sought out which have sectional areas that are based on the profiles in the reference projects. There were some conditions towards the size of these profiles, the height of the top and bottom chord should correspond with that of the beams supporting the floors, allowing the connection to be neat. This height is approximately 700m and width can be a maximum of 400mm. For the diagonal and vertical profiles it is possible to have a smaller area since the forces they need to handle are smaller. (Verburg, Barendsz, & Eldik, 2004) Profiles were chosen which have approximately the same width as the top and bottom chord, so they connect neatly and appear as they have the same size. The height is much lower as to represent the forces the profiles need to bare, which are also much lower.

The size of the wooden portal was based on the rules of thumb offered for constructions in wood. (Herwijnen, Blok, & Martens, 2007) These rules of thumb are often conservative estimates. (Hollander, 2011) This estimate will suffice in most cases and probably the dimension can be more slim in practice. The height of the portal will be 7000mm, the width of the laminated wood is 180mm and the height of the profile varies between 400mm and 1250mm. On the apexes the height is the largest as the bending loads are the highest in these spots.

The middle level is the only level which will contain rooms which need to be insulated, the rest of the building can be cold. These rooms are the processing facilities, the storage, toilets and the restaurant. Because the construction lies on the outside of the building and is thus cold the choice has been made to insulate on the inside. This means the floors and ceilings will also be cold, resulting in insulation only for the necessary parts. Alblasserdam is in wind area II for the Netherlands which makes the chance of strong winds more likely than a location more in land. (NEN, 2011) That is why there will be glass panels beneath the roof in line with the facade, they can lower when the weather is good allowing for views over the river.

In fig. 38 you can see a detail of the floor on the middle level and the truss one can see how the cold floor works. The truss is on the outside, it supports the beam, which in line supports the hollow core floor slab. This construction is all cold. Then a layer of insulation follows and a layer of screed. The facade cladding is made out of zinc and is hung from the sandwich panel walls. The underside of the building is also clad with zinc, this is hung from small beam which run between the larger beams that support the floor.

Fig. 37 shows a detail of the floor of the top level being supported by the truss. The floor is cold because it lies directly in contact with the outside space of the food market. This means the inside room on the middle layer needs to be insulated from the inside, under the floor. On top you can see the wooden portal's connection with the steel beam. The steel beam transfers the forces to the truss. The sandwich panel in the ceiling is hung from the steel beam on top of it. The zinc cladding continues over the edges of the truss but leaves an opening for the beam. This way it seems as if the zinc cladding is continuous over the whole facade.

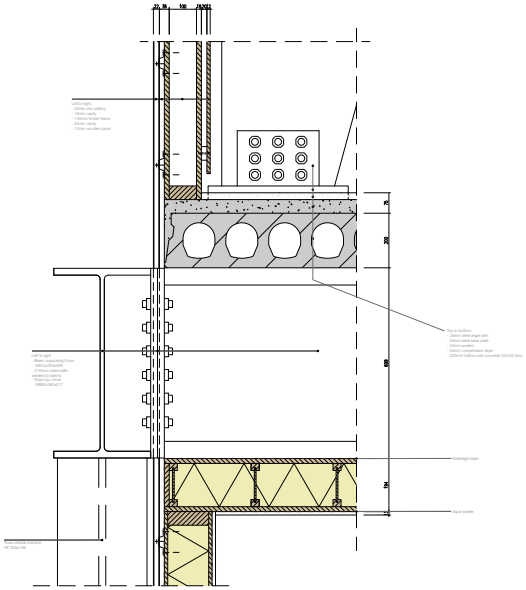


Fig 37: Buildup of construction

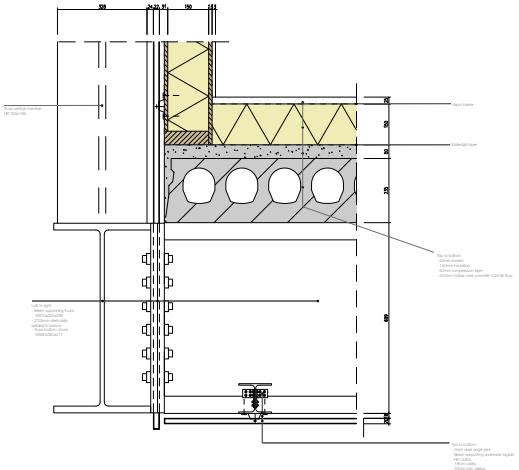


Fig 38: Buildup of construction

Fig 39: Roof in model

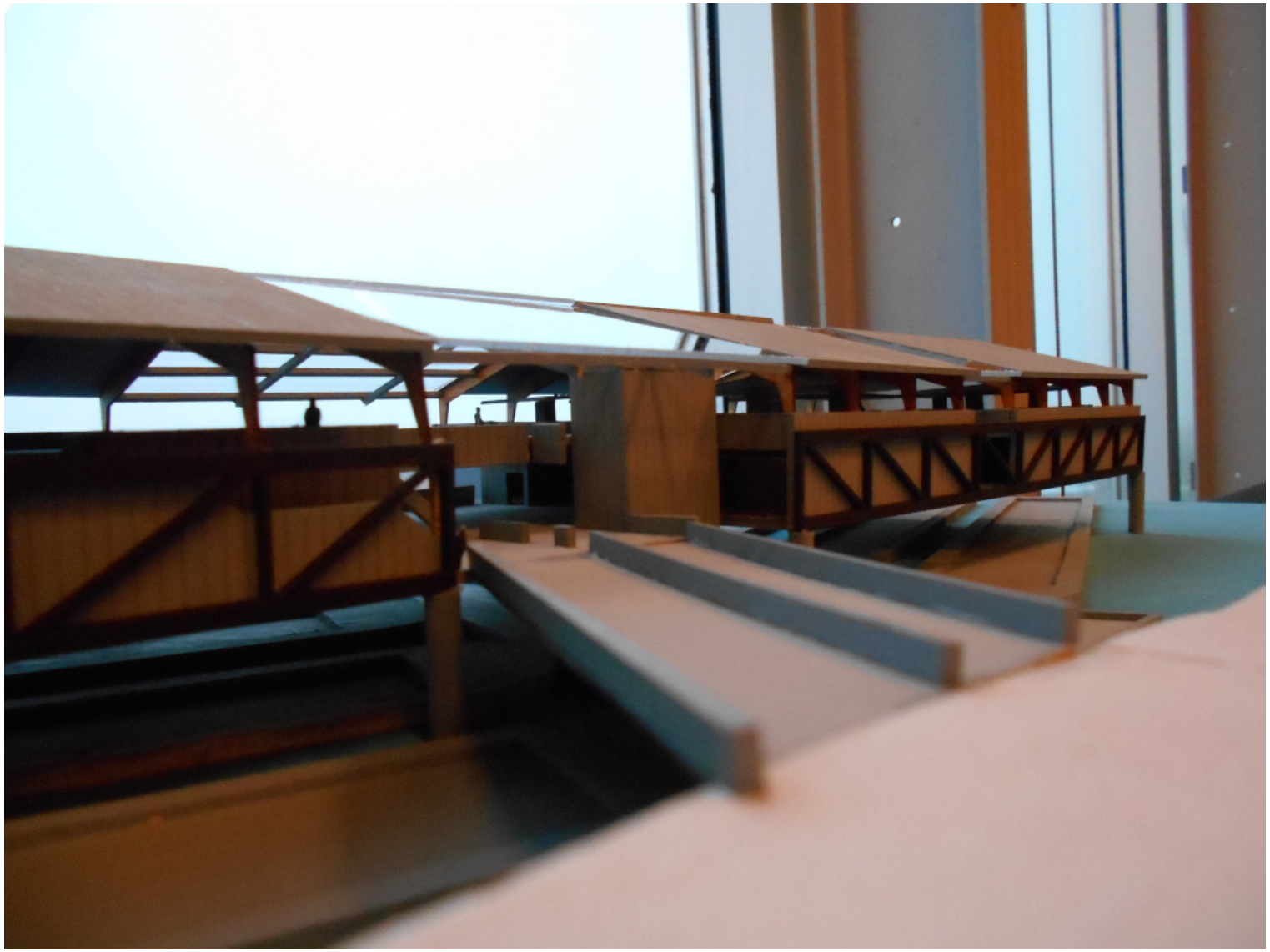


Fig 40: Entrance of building

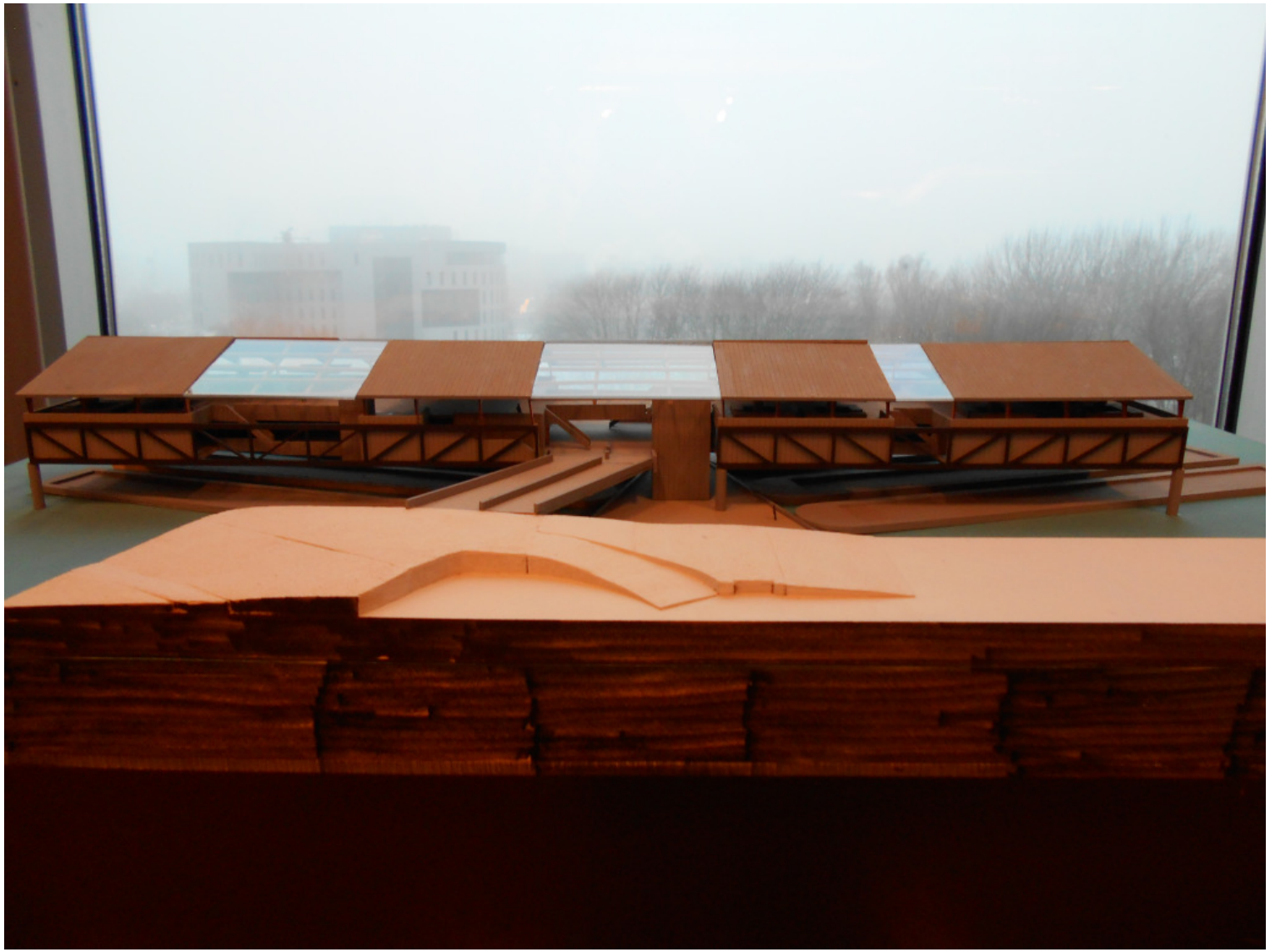


Fig 41: Facade from quay

Fig 42: Market layer

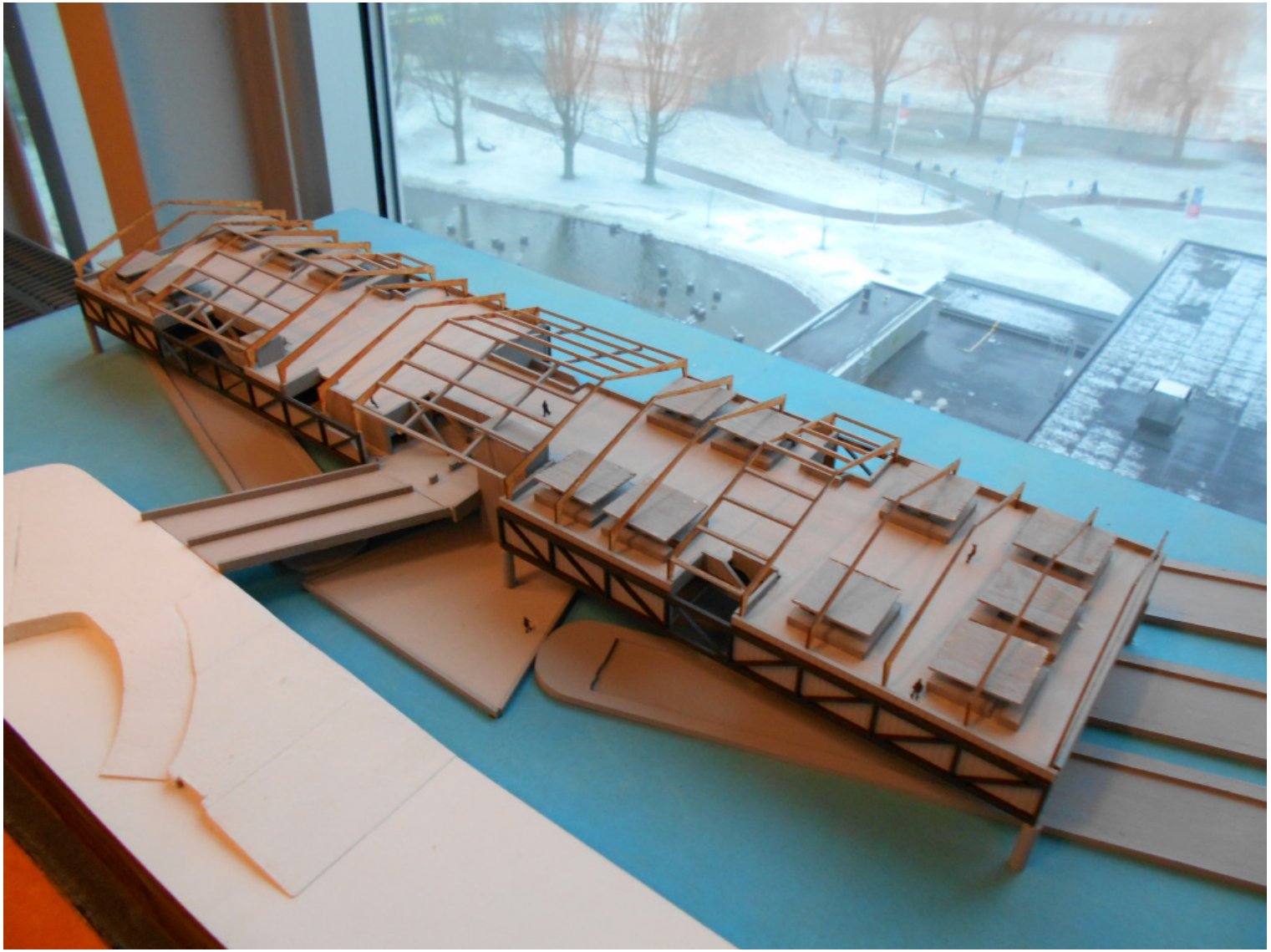


Fig 43: Overview without roof

Conclusion

A floating farm provides a resilient manner of dealing with the Dutch government policy of giving more room to the rivers to prevent flooding. The floating farm depicted in this research is a new step in floating agricultural concepts. A fixed location for animals in relation with moving pasture is an addition to the existing examples of floating farms. The floating farm requires further research, as this is the first time the concept has been used. Most urgently the concept needs be researched on the topics of energy consumption, animal welfare and yield. The resistance of animals and reliance on grass during winter months is another issue which demands attention, winter proof species should be sought out.

The main design goal: The building translates the attention raised by a floating farm, to provide for context and incentive for putting knowledge on the locavore movement into action, has been fulfilled largely. The building makes a successful translation by using the food production process as a similarity between the floating farm and the locavore movement. The building concept does an excellent job of answering the main design goal. The three layer build-up helps to make the internal process from animal to product clear to the visitor, thereby providing context for the locavore movement. The translation from the design goal to the architectural elaboration was harder. Further research would be required on how to efficiently make the translation from design goal or maxim to architectural expression and detailing.

The ability of the building to attract visitors to Alblasserdam is probable, though this isn't supported in numbers, further research would be needed to evaluate whether it can attract the number of visitors the municipality wants. Two unique features of the building, the floating farm and the integration of agriculture, processing and selling at one site, make it difficult to compare to other markets. It is expected these unique features will have a positive influence on the number of visitors. While being part of the research question, attracting visitors to Alblasserdam was only a small part of the research. More attention could have gone to the influence of the urban design of the building and the influence it has on how Alblasserdam's city center functions and its ability to attract visitors.

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