Graduation Report

In the Msc Architecture studio of Delta Interventions

Driftwood Pier: A Cyclical Structure for Vlissingen

Karlijn Scholtens, 4133536

1st mentor: Stefano Milani
BT mentor: Sjap Holst
Delegate: Maarten Meijs

Index

1. The North Sea

1.1 Compilation of reearch topics around North Sea

The North Sea as territory; it is a vast space surrounded by densly populated and urbanized land. Clearly, the sea has many uses and meanings to these surrounding shores.
from mythical creatures for stories, to pipelines and rigs for oil extraction, the North Sea is a source for people in a wide variety of ways.
This thesis looks at the cultural meaning of the North Sea as a common denominator for the surrounding countries. The research uses buidling typologies that illustrate the relationship between people and the sea, and between people from the various surrounding countries. This way, the topics of a rising sea level and an ageing society come

This chapter introduces a variety of topics that influence the project. The hypothesis behind this approach is, that by addressing a number of important factors, the project can be imbedded more thoroughly into its context, and be useful on a number of different levels.

The sea is rising and the society is ageing. These are trends related to the North Sea, that inform this project (image 1.1). The predicted rise of sea level is related to the North Sea territory in a direct, physical way. The ageing is connected because it affects many countries specifically around this sea, due to shared societal characteritics (van Leeuwen et. al., 2014).

1.1 Ageing society

Image 2.1 shows a prediction of the population pyramid of the Netherlands, ranging 2020-2060. It shows a 'surplus' of elderly compared to younger people, peaking at 2020, levelling more around 2040 and fading around 2060.

How did this imbalance originate? The phenomenon of 'greying' of Dutch society is a process that actually already started 100 years ago. The results that are shown in the population pyramids, are actually created by multiple processes. These include a longer life expectancy, an increase of childbirths in the years after WWII, a gradual decrease of births per woman since 1970's; factors which are all caused by various factors in itself. (Beets & Fokkema, 2005)

The consequences for this trend, for society, are many. Financial pressure on a smaller working population to sustain a larger retired population is one (Wouterse et. al., 2017). A disruption in the flow of the housing market is another (PBL, 2013).

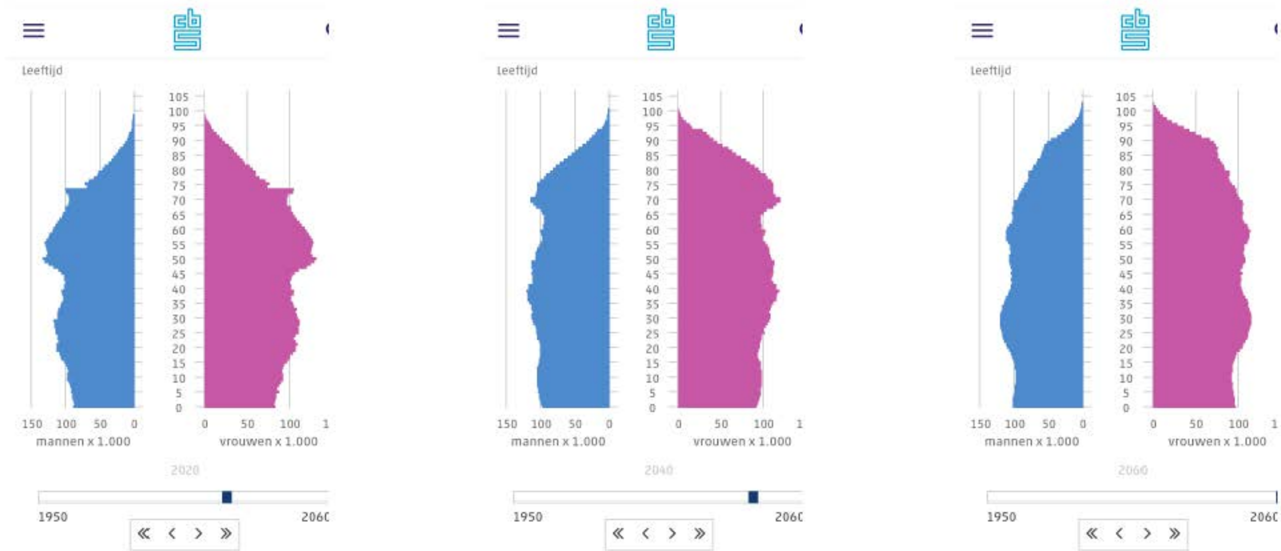
The aforementioned increase of life expectancy, will change the way we view the natural progression of life, as illustrated by the 'Lebenstreppe' of image 1.3. The peak of an active life could become more prolonged or shifted; the steps into decay from age, as illustrated by the steps going down, might take a less steep direction. How this might translate into an architectural design is addressed later on in this report.

1.2 Sea level rising

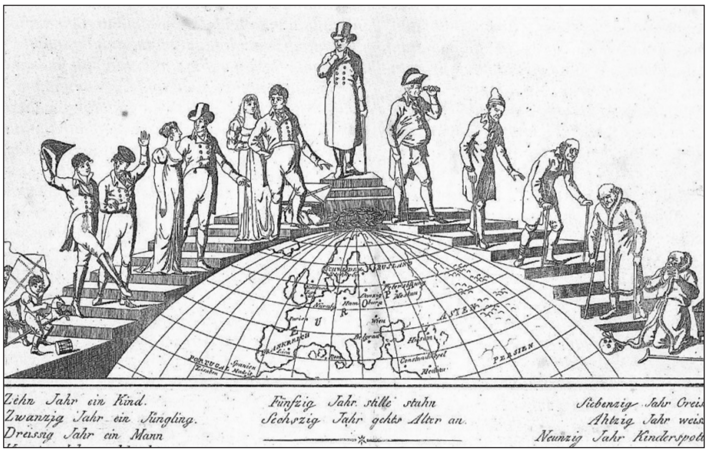
These changes are caused, by how humans interact with and influence nature. Human actions like medical advances, industrial and urban expansions that take control of the land, serve our own interests and cause significant changes to our environment. (image 1.4) These inventions become part of the fabric of our societies, while still requiring continuous maintenance to keep up that control of nature. (image 1.5)

Maintenance wll be crucial soon, as the current coastal defences will need to be updated, strengthened, to be able to deal with an increase of sea level. Current predictions that research groups and the Dutch government work with, vary between a rise of 0,65 to 1,30 m in 2100. (Dijkzeul & de Hoog, 2010)
Many coastal areas of the Netherlands are marked as 'will experience structural deterioration cause by rising sealevel' in the National Waterplan. The principle of future maintenance is 'soft where it is possible, hard where it is necessary' (Rijksoverheid, 2015).

This means that the government plans to use sand suppletion as a way of strenghthening the coastal defence, and will improve or build structures like seawalls where that is necessary; for example when there is no space available for sand suppletion. This is important in the case of this project, where a 'soft' intervention is not possible due to sea currents and sea traffic, and 'hard' intervention is necessary. This will be addressed in a further chapter.

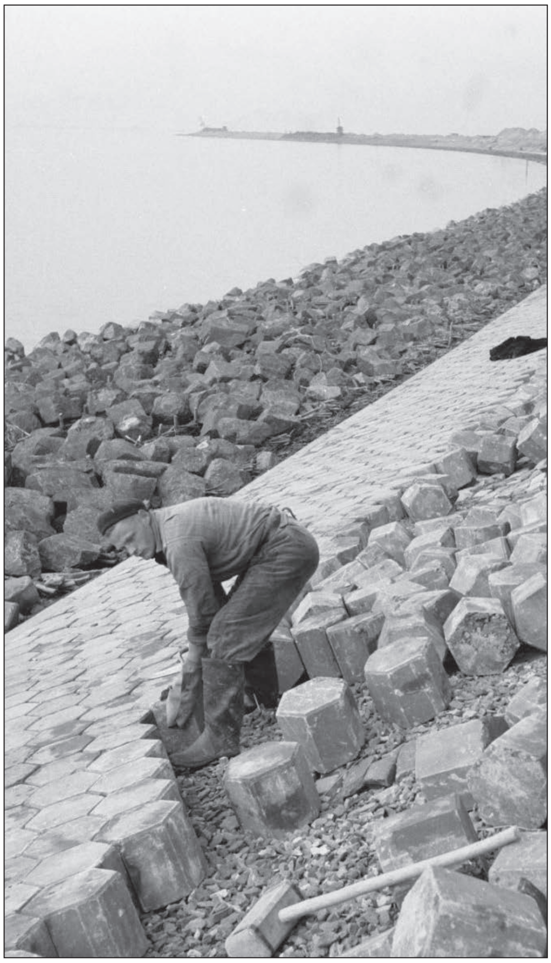


1.2



1.3 "Lebenstreppe", stairs of life

1.4 Aerial of Kleinpolderplein in 1992.



1.5 Zuidoostpolder dyke in 1950

1.3 Piers and almshouses

Besides incorporating trends or topics, this project uses a specific way of illustrating how these issues manifest: by studying building typologies. This can be seen as a method of understanding the intersection of a big 'trend' with ts consequences on a human scale. This way, the step from research towards an architectural project may become more seamless.

The idea of using building typologies to understand the mentioned trends that concern the North Sea, was informed by the study 'Provisions for the elderly in north-western Europe: an international comparison of almshouses, sixteenth–twentieth centuries', by van Leeuwen, van Nederveen Meerkerk and Heerma van Vos (2014). This study points out that the building type of the almshouse, which houses certain fragile types of people; poor, sick or elderly, is prevalent throughout countries surrounding the North Sea.

Image 1.6 shows a small compilation of floor plans of almshouses, each represent a different country around the North Sea. The Dutch version of it is usually called 'hofje', which translates as 'courtyard', referencing its usual shape of small attached houses facing a courtyard, embedded in the urban fabric of a city.

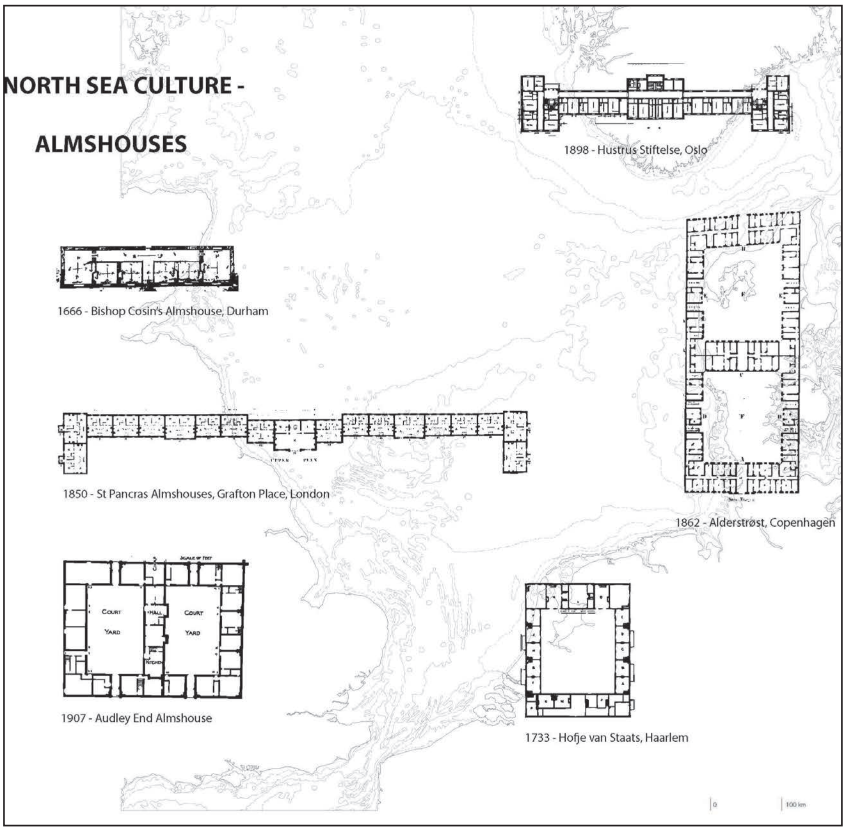
This typology of the almshouse illustrates similarities between societies around the North Sea, in the way elderly care and housing is solved, going back to 15th century and even before (image 1.7). The paper (van Leeuwen et. al., 2014) proposes that these buildings answered a need, caused by the tendency to form smaller, or nuclear, families. This tendency made these societies different from the ones further South, like Italy, France, etc, where larger families were and are more common.

The consequence of a historical inclination towards smaller families, was a lack of ability or habit to take care of the elderly of the family. The system of almshouses made it possible to still support the lives of these people, but through charity from general public instead of sole support from direct family (image 1.8). With the connection between culture, building typologies and societal trends in mind, it is clear how the almshouse typology connects to the trend of ageing societies around the North Sea.

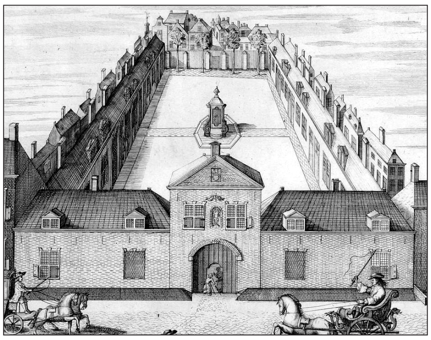
Within this approach, it might be possible to speak of a North Sea culture, which is illustrated or 'proven' through building typologies. In 'The North Sea and Culture', a 'shared culture' is understood as cultural elements that have originated in one country, have expanded and started to appear in the other North Sea countries as well, as a type of architectural pollination. The Dutch Renaissance architecture is one example (Roding, 1996), while bathing architecture is another (Dettingmeijer, 1996). According to Dettingmeijer (1996), architectural expressions of bathing culture, like seaside hotels and leisure piers, are the last example of the North Sea as a culture ground, before the sea lost its role as a cultural connector. (image 1.9) To be precise, the shores around the North Sea shared a international culture of exchange, while the hinterlands or mainlands often had different cultural routes of exchange. The rise of bathing culture, which started in England, was possible thanks to developments in train travel (image 1.10). The shores became more connected to the lands behind, and were eventually absorbed by urban expansion, with cities gaining the most of cultural importance.

The building type that illustrates best the relationship of 'land folk' and the sea, is the pier. On page 483: "*Sailors will not flirt with the waves as land folk do. [...] the farther the swimmer dares to swim away from the beach the farther from the sea he normally lives.*" (Dettingmeijer, 1996)

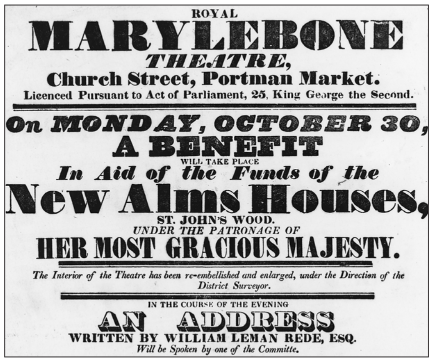
The pier expresses a certain defiance towards the sea, which historically was seen as a dangerous place and not a setting for lighthearted enjoyment, but this outlook on the sea changed as technical developments increased the power people had over the sea and its shore (image 1.11). However, with the predictions of a drastically rising sea level, the way that people feel about the sea might change again, more towards fear. This is why the pier can be relevant again as an expression of how we will deal with the serious environmental problems that we are about to face.



1.6 Plans of historic almshouses around the North Sea

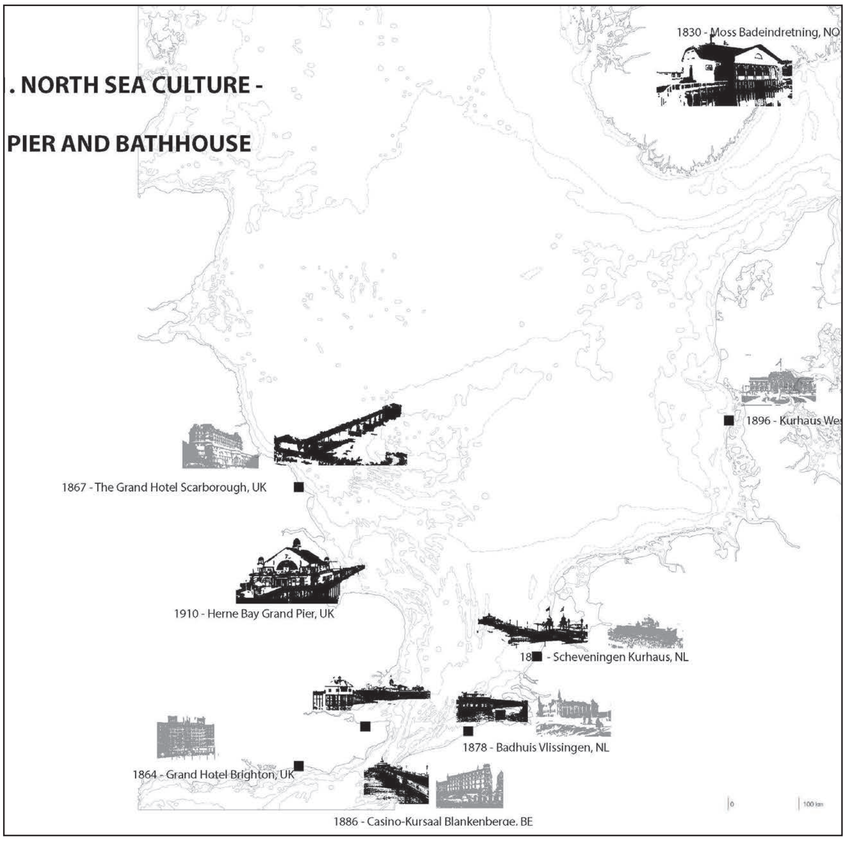


1.7 Hofje van Hoogelande was completed in 1699.

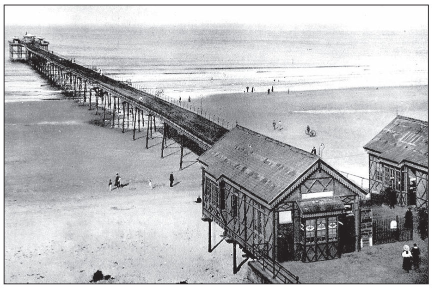


ROYAL
MARYLEBONE
THEATRE,
Church Street, Portman Market.
Licenced Pursuant to Act of Parliament, 25, King George the Second.
On MONDAY, OCTOBER 30,
A BENEFIT
WILL TAKE PLACE
In Aid of the Funds of the
New Alms Houses,
ST. JOHN'S WOOD.
UNDER THE PATRONAGE OF
HER MOST GRACIOUS MAJESTY.
The Interior of the Theatre has been re-embellished and enlarged, under the Direction of the District Surveyor.
IN THE COURSE OF THE EVENING
AN ADDRESS
WRITTEN BY WILLIAM LEMAN REDE, ESQ.
Will be Spoken by one of the Committe.

1.8 Announcement of charity event to benefit almshouses in 1837.



1.9 Historic pier and seaside hotels along the North Sea



1.10 Saltburn pier opened in 1869 and was 457m long.

1.11 Margate Jetty opened in 1855.

1.4 Design location

These topics all combine into a design goal or proposal: to design a pier that responds to a rising sea level and an ageing society. To narrow down the project, I chose Vlissingen as location. I chose this location because it is a point of special interest in the case of both trends, or where they overlap with extra significance. Vlissingen is already a popular destination with the older visitor, even to the point it was called 'Miami of the Netherlands' (ARCADIS, 2009). In terms of coastal defence of the Netherlands, Vlissingen as part of the southwest coast of Walcheren, was highlighted as a weak link in the system and in need of intervention in order to resist future climate related threats (Elias et al., 2014).

In conclusion, the design challenge is formulated: ***to design a pier that responds to rising sea level and ageing society in Vlissingen.***

1.5 Design intentions

The proposed design challenge needs to be fleshed out with a specific goal or interest that it aims to achieve. For this I chose the topic of loneliness; something that relates back to the previous research but also ties in with current news: in 2018 the UK installed a 'minister of loneliness' (image 1.12), which was quite a dystopian move. But as is illustrated with the piers and almshouses, a cultural product might expand and settle in the surrounding countries, meaning a minister of loneliness could be in the near future of the Netherlands as well.

With that said I an add to the challenge: *a main goal of the design should be to reduce loneliness*.

The topic of circularity is, within architecture, a strategy for designing and building that aims to reduce the negative impact of our sector upon the environment (image 1.13). Kristinsson (2002) phrases sustainable building in a broad but essential way: to create buildings that future generations want to inherit and are able to maintain and use. This excludes the production of buildings that hand over pollution and unusable structures to future generations. I include circularity as a goal within the design challenge, because when the rising sea level caused by climate change is a main starting point of the design, this has to be a consequence of the awareness of this problem, an understanding of environmental problems and causes has to be reflected in the design choices.

Sources

ARCADIS. (2009). *Pilot Waterfronten Walcheren - Kustversterking als Gebiedsontwikkeling.* (n.p.) Retrieved at https://ruimtelijkeadaptatie.nl/voorbeelden/overzicht-projecten/@160304/waterfronten/

Beets, G., & Fokkema, T. (2005). Misverstanden over Vergrijzing. *Demos, 21*(50, 37-40) Retrieved at WUR

Dettingmeijer, R. (1996) The emergence of the bathing culture marks the end of the North Sea as a common culture ground. In J. Roding & L. Heerma van Voss (Ed.), *The North Sea and Culture 1550-1800* (pp. 96-106). Hilversum: Verloren Publishers

Dijkzeul, D., & De Hoog, M. (2010). *De Kust in Ontwikkeling. Inventarisatie en Inspiratie.* Delft: Delft Infrastructures & Mobility Initiative

Elias, E., Vermaas, T., Vonhögen-Peeters, L., & Bruens, A. (2014). *Ontwikkeling Zwakke-Schakel suppletie Westkapelle.* Delft:Deltares

Kristinsson, J. (2002). *Integraal ontwerpen : Vitale architectuur.* Deventer: Kristinsson-Reitsema.

PBL (2013). *Vergrijzing en Ruimte. Gevolgen voor de woningmarkt, vrijetijdsbesteding, mobiliteit en regionale economie.* Den Haag: Uitgeverij PBL.

Rijksoverheid. (2015). *Nationaal Waterplan 2016-2021.* Den Haag: Ministerie van Infrastructuur en Milieu en Ministerie van Economische zaken

Roding, J. G. (1996) The North Sea coasts, an architectural unity? In J. Roding & L. Heerma van Voss (Ed.), *The North Sea and Culture 1550-1800* (pp. 96-106). Hilversum: Verloren Publishers

Van Leeuwen, M. H. D., van Nederveen Meerkerk, E., & Heerma van Voss, L. (2014). Provisions for the elderly in north-western Europe: an international comparison of almshouses, sixteenth-twentieth centuries. *Scandinavian Economic History Review, 62*(1), 1-16. DOI: 10.1080/03585522.2013.872181

Wouterse, B., & Smid, B. (2017). How to finance the Rising Costs of Long-Term Care: Four Alternatives for the Netherlands. *Fiscal Studies, 38*(3) 369-391. https://doi.org/10.1111/j.1475-5890.2017.12137

In a sad reflection of modern Britain where 9 MILLION live in isolation and 200,000 elderly go weeks without talking to a friend or relative, PM appoints a . . .

MINISTER FOR THE LONELY

Tracey Crouch, Minister for loneliness

A MINISTER was appointed yesterday to help tackle the loneliness suffered by an estimated nine million adults.

Tracey Crouch will lead a drive

By Jason Groves
Political Editor

new brief, Theresa May said isolation was a sad reality of modern life for too many people.

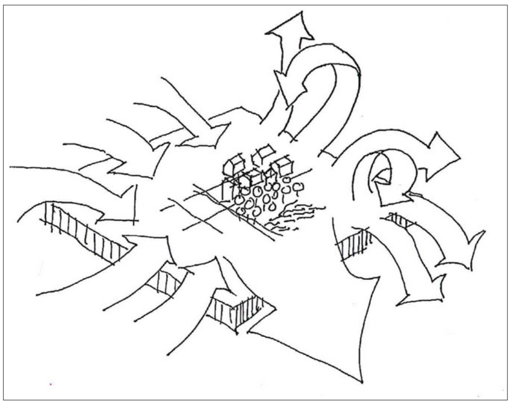
The Prime Minister added: 'I want to confront this challenge and for

lost loved ones, people who have one to talk to or share their thoug and experiences with.'

The move was recommended i report from the Jo Cox Commissi on Loneliness. The Labour MP, w was murdered by a far-Right fanat had campaigned on the issue.

Mrs May, who will host a Downi

1.12 Dailymail article on Tracey Crouch



1.13 Odum System by Kristinsson, interexchange of environmental system and technical components.

Image credits

1.1 Compilation image, own work

1.2 Screenshots of infographic by CBS at https://www.cbs.nl/nl-nl/visualisaties/bevolkingspiramide

1.3 By Bart van Eyck for Rijkswaterstaat, 1992. Retrieved at beeldbank.rws.nl

1.4 Lebenstreppe, anonymous copy of work from F. Campe, Nürnberg, dated 1800-1850. Retrieved at commons.wikimedia.org

1.5. Public domain image from Nationaal Archief, Fotocollectie Anefo, retrieved at gahetna.nl

1.6 Compilation image, own work

1.7 Anoymus copy of work by Gerrit van Giessen, 1730, retrieved from Municipal archive of Den Haag at http://www.haagsebeeldbank.nl

1.8 Poster of Wellcome Collection retrieved at wellcomecollection.org

1.9 Compilation image, own work

1.10 Image from National Piers Society UK retrieved at https://piers.org.uk

1.11 Image from National Piers Society UK retrieved at https://piers.org.uk

1.12 Daily Mail january 16, 2018

1.13 Kristinsson taken from Sustainable Integrated Design, p. 19

2. Vlissingen

2.1 Vlissingen historic centre and harbor

Vlissingen is situated in Zeeland, Netherlands, north of where the Westerschelde enters the North Sea. It is a city of about 30.000 inhabitants and received its ‘city rights’ in 1313. It is home of both famous and notorious sea captain Michiel de Ruyter and the city’s reputation as a base for regular trade and piracy dates back to the 13th century. (Van Druenen, 2015)

2.1 The edge condition

The aerial (image 2.1) shows the old harbor of Vlissingen with the touristic boulevard to the left. This boulevard, consisting of housing, apartments, restaurants, shops, hotels and other venues (image 2.2), is part of the mentioned ‘weak link’ in the Dutch sea barrier of the coastline.

Along this boulevard there used to be a leisure pier (image 2.3), on the location marked on the map of image 2.7. The pier, organized by local entrepreneurs related to tourism and built in 1936, was destroyed in 1943 by German occupation to prevent military use of the structure by allied forces.

The south-west facing boulevard of Vlissingen has more economic importance and activity than the market place area in the old center. Currently, the essence of Vlissingen is the boulevard, the border between land and sea, the ‘edge condition’. Such an edge is an interesting condition for architecture, creating possibility for expressive and poetic spaces. (Cheng, 1992)

It is along this stretch of boulevard that the urban fabric changes in character; from old, historic, to a more modern plan with a larger grain. The old map shows the cause of this: the center of Vlissingen was based around the harbor, and towards the north a large amount of space was dedicated to a ‘spuigat’, basically a buffer zone for water. This buffer became unnecessary when the harbor activities moved to a terrain outside of the center to find more space. The former Spuigat is still a terrain where space is available for future development.

Where the old part of the city connects with the emptier terrain, boulevard Bankert becomes boulevard de Ruyter, and there is a ‘lull’ in the boulevard, in-between locations that pull activity, namely the city center in the south and the swimming beach in the north. This spot has some empty space where a possible pier would connect to the boulevard; there is width to work with, as opposed to the location of the original pier, which location I discarded for that reason. Because of those factors, I selected the project location outlined on image 2.8.

2.2 History and future of urban fabric

On maps 2.7 and 2.8, the effects of WOII on the urban fabric of Vlissingen are visible. The map of 2.7 was made in 1939 and used during WOII to mark locations of bombs and plane crashes. Bombs were not sole reasons for physical changes in the plan of Vlissingen; during the rebuilding stage after 1945, the municipality used that opportunity to improve living conditions in some areas. This meant that a whole neighborhood was demolished and rebuilt; the area around the almshouse for retired seamen as marked on map 2.7. This neighborhood was considered derelict, with insufficient maintenance and amenities. Photo 2.4 shows this historical almshouse, which survived conflicts and demolishings, in its current context: surrounded by high rise apartments.

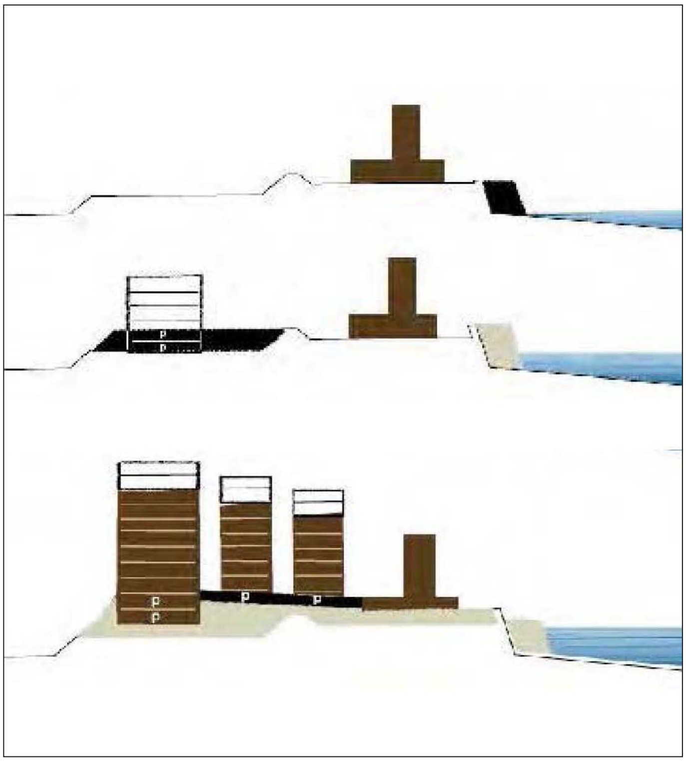
High rise apartments play a large part in the environment of Vlissingen. This is a characteristic often seen in seaside settlements that have tourism as an important source of income. The view of the sea becomes such a valuable amenity, it gives incentive to build higher. (Durydiwka & Duda-Gromada, 2014) Image 2.5 shows that high rise building could be part of the future of the boulevard as well: these sections of boulevard de Ruyter propose a way that Vlissingen could respond to the rising sea level and was published in a research document by ARCADIS (2009). It proposes to basically build a wall that is high and thick enough to resist the waves. The final step is to create a boulevard of gigantic width, with buildings that are high rise but overlook each other in a stairs pattern, in order to maintain the view of the sea as an amenity.

As mentioned in chapter one, sustainable building means to hand over structures to the next generation which they will want, and be able to, maintain. The design proposal of image 2.5 would keep Vlissingen safe from flooding for another century, but it would impact the urban fabric drastically. It is a trend towards vertical planning, which I suspect will not be the most sustainable strategy. As Rob Krier (1991, p.81) pointed out, ‘erosion of urban space’ is where our cities are made up of a jumble of buildings surrounded by space without meaningful activity, high rise planning is especially sensitive to this effect. (image 2.6) This is where the design of a pier could contribute to an urban fabric that invites horizontal, sprawled movement that can help create meaningful activity in the public space.

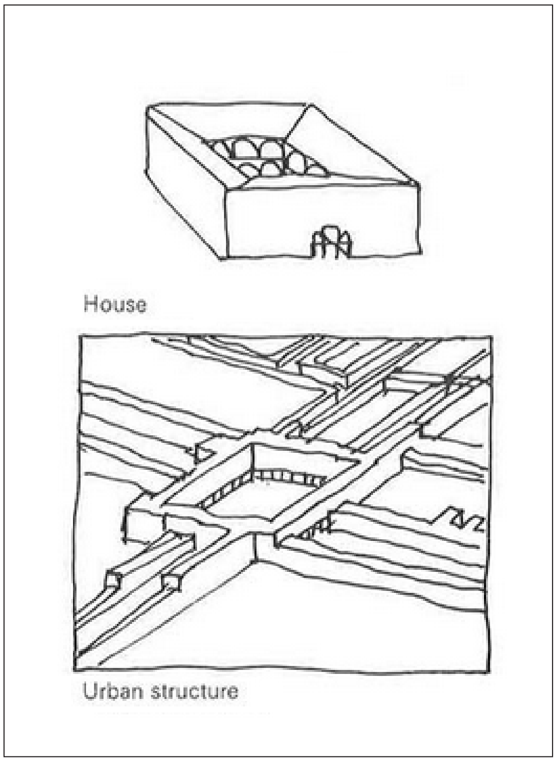
2.2 View from boulevard Bankert towards boulevard Michiel de Ruyter

2.3 Wandelpier, the previous pier of Vlissingen

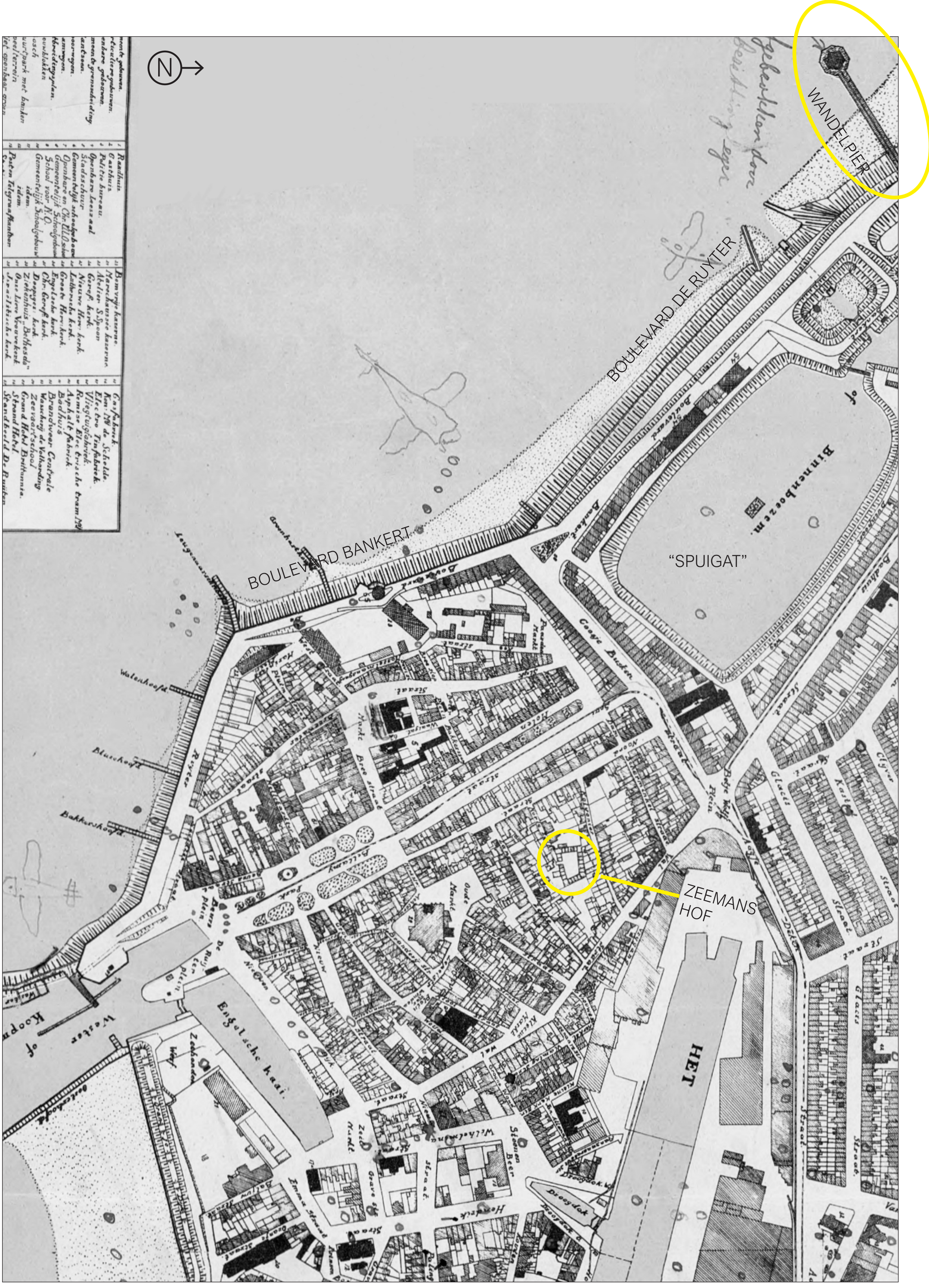
2.4 Zeemanserve, remaining hofje in Vlissingen



2.5 Vision of seabarrier and boulevard adjustments,



2.6 Parts of the principle of urban space by Rob Krier



2.7 Map from 1939

2.8 Current map

2.3 Environmental conditions

From the 1939 map (image 2.7) and photo material (image 2.3) we know that a pier structure was built before, in Vlissingen. This is proof that it is at least possible. With this project I want to address the feasibility of a pier structure in Vlissingen, to a certain extent. The specific environmental conditions of the location can provide quit a challenge to any building. Image 2.9 shows how Vlissingen is positioned just at the entrance of the Westerschelde, leading to Antwerp. The boulevards Bankert and Michiel de Ruyter are at a curve where North Sea and delta waters meet; this causes very strong currents. Besides, these waters are an important route for ship traffic and any loss of space for ships would not be acceptable.

In order to approach feasibility concerning these factors, I consulted with prof. Z.B. Wang of Deltares and TU Delft. His estimation to the question 'what is the coastal morphological consequence of putting an intervention in the coastline?', was that any intervention structure simply can not be solid, must be constructed on pillars to not interfere too much with currents and sedimentation. Apparently, a relatively small addition to a shore can cause a drastic change in the shape of an entire coastline. Thankfully, a theoretical pier structure built on stilts was effectively greenlighted by him.

Besides this specific design project, prof. Wang also explained the general coastal defence tactic of the government, which he supports, of 'soft where possible, hard when necessary', and underlined that the location of Vlissingen counts as a case where 'hard defence' will be necessary, for the aforementioned reasons of shipping routes, currents and danger of coastal change through sedimentation.

Image 2.10 and 2.11 address the tidal situation of Vlissingen, which is unique. From low tide to high tide, in Vlissingen, is a height difference of 4 meters. Image 2.10 shows how the physical configuration of the boulevard reacts to that; with a wall that enables a view of the sea and a sloped 'talud' of concrete which prevents waves from crashing too hard unto the wall. If the sea level rise mentioned in chapter 1 is incorporated, the future high tide could go , in 100 years, from +2m to +3.2m. For this project, I will rather anticipate a maximum sea level rise of 2m, which would set the new high tide at +4. I am rounding up the prediction, because it is still very unsure what the actual rise will be, predictions fluctuate a lot and researchers acknowledge that the changes could still be much worse than anticipated.

Sources

ARCADIS. (2009). *Pilot Waterfronten Walcheren - Kustversterking als Gebiedsontwikkeling.* (n.p.) Retrieved at https://ruimtelijkeadaptatie.nl/voorbeelden/overzicht-projecten/@160304/waterfronten/

Cheng, G. W. (1994). *Phenomena and Form at the Water's Edge: A scenario for Boston* (master's thesis) Retrieved from MIT Department of Architecture.

Durydiwka, M., & Duda-Gromada, K. (2014). Influence of tourism on the spatial development of seaside resorts: selected aspects. *Tourism, 24*(1) (n.p.) DOI: 10.2478/tour-2014-0007

Krier, R. (1991) *Urban Space*. London: Academy editions. (Original work published in 1979) Open access book retrieved at http://robkrier.de

Van Druenen, P. (2015). *Vissers, kapers, arbeiders : Vlissingen 700 jaar stadsrechten.* Vlissingen: Stichting Historische Publicaties Schelde-estuarium

Image credits

2.1 Rijkswaterstaat 1999.

2.2 Photo by Hermanus Es accessed through Wikimedia Commons

2.3 Uncredited photo, retrieved at https://www.wandelpiervlissingen.nl/fotoarchief/

2.4 Retrieved at maps.google.com

2.5. From page 18 of 'Pilot Waterfronten Walcheren - Kustversterking als Gebiedsontwikkeling' by ARCADIS

2.6 From Urban Space by Rob Krier, page 17

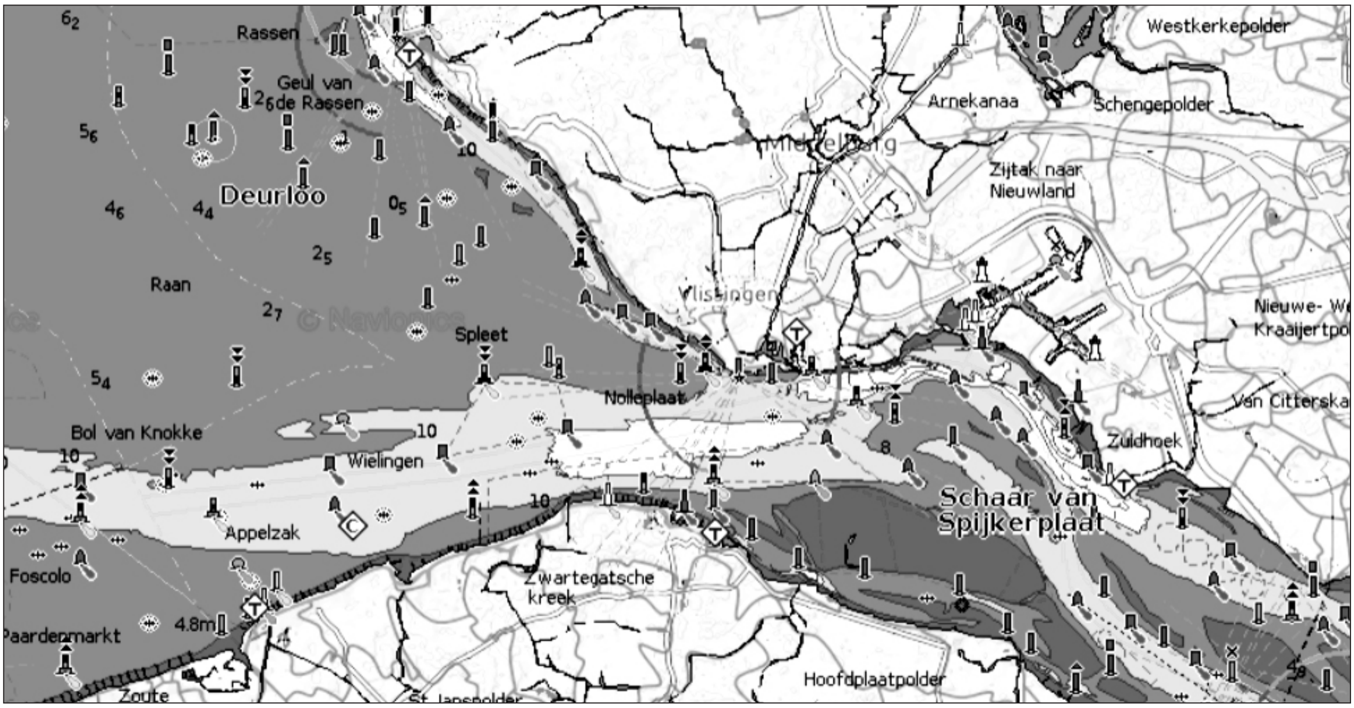
2.7 "Bommenkaart" Retrieved from Gemeentearchief Vlissingen at http://www.archieven.nl. Map is dated as 1939 with notes from 1942-1945. Digitalised in 2015.

2.8 Retrieved at maps.google.com

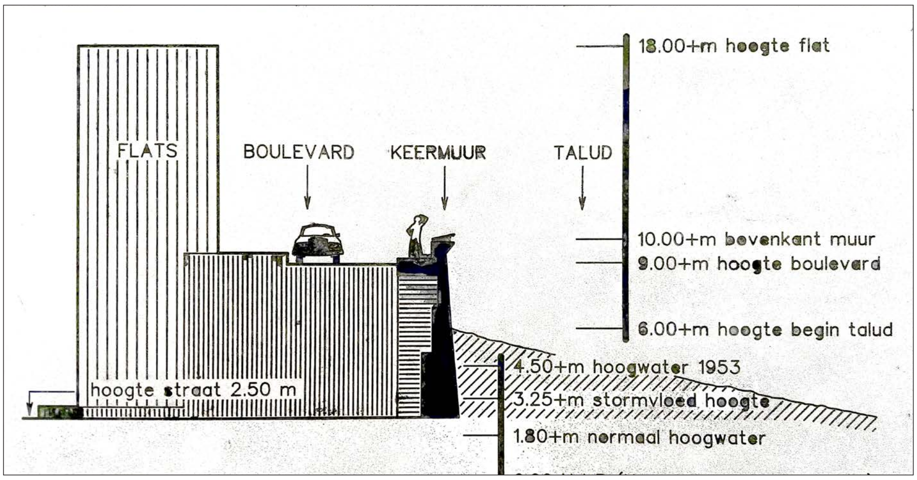
2.9 Retrieved at www.navionics.org

2.10 Photo of plaque found in Vlissingen, own work

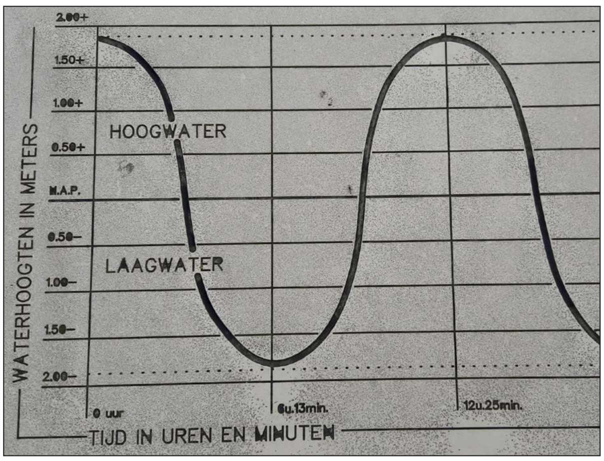
2.11 Photo of plaque found in Vlissingen, own work



2.9 Map of waterways around Vlissingen



2.10 Section of boulevard including various tide heigths and meaurements



2.11 General tidal flux of Vlissingen

3. The hofje displaced

3.1 Displacement exercise

How to learn from history through architecture, how to handle building typologies in a design project? The Dutch variant of an almshouse is called Hofje and is a predecessor of the current elderly homes system. In this chapter I study the typology and make an exercise of transplanting a hofje from it's inner city context to the context of the project location: the seashore.

3.1 Teyler's Hof in Haarlem

For this typology, the 'case study' is Teylers Hof in Haarlem, founded in 1787 by the wealthy merchant Pieter Teyler van der Hulst. The hofje still operates, its demographic consists of 24 single women.

The hofje offered a solution for fragile citizens, but operated with strict rules. (image 3.2) The inhabitants of Haarlems Teylers Hof (image 3.3) were reprimanded or fined, for crossing the rules. To live in the hofje, the inhabitants sign a contract stating that they agree with the rules and will follow them. One important rule is that the inhabitant's heritance belongs fully to the hofje. Another essential rule is the duty to help out neighbours in case of sickness, called 'liefdesplicht'; love obligation. In exchange for the obedience and the contract, the hofje provides protection, surveillance, counselling in case of arguments, free food and easily accessible medical attention. And it comes with a number of close neighbors who share some duties and some outside space, who are in a similar life situation.

Some hofjes were a way to use leftover space, inside an urban block, on cheap 'unregistered' ground. It was because of the cheap ground an effective financial model. However, some hofjes were not built on leftover space, hidden behind the 'normal' city, but were actually built with prestige, their entrance not a small gate but a proud facade that sits on the edge of an urban block, clearly visible. This means that a substantial investment is made at the beginning of the hofje's operation. This investment was usually part of the testament of a wealthy character. The prestigious character of the hofje, named after this benefactor, was a way to affirm and ensure the good name of this patron until well after their passing. This private charity system explains as well the need for strict rules of occupants: the 'good name' of the patron is what they should protect, by living their lives in a grateful and respectful way. The system of a wealthy patron, an overseeer or matron who mediates, and the inhabitants of the hofje themselves, formed a social hierarchy (image3.4) that allowed the typology to function well.

I chose the typology because it seems a small-scale, friendly, hopeful alternative for the impersonal agglomerates which are modern nursing homes. But when it is put into historical context, the element of dispassionate practical organization explains the shape of the courtyard housing better than a need for neighborly support. Maintaining the patron's good name motivated the detailed house rules.

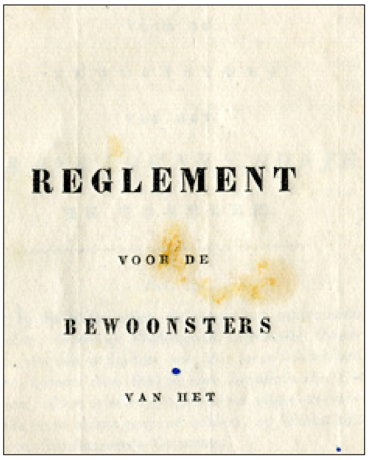
3.2 Translating the hofje to current times

Image 3.5 serves as a summary of the specific elemants that define the hofje. Shape, configuration of program and configuration of inhabitants - these ingredients create this urban solution for a social situation. The hofje is a confined shape, it invites for more closeness and contact, but also asks for an adjustment of personal boundaries. To address the problem of loneliness, that sacrifice might be worth it.

Then, how does the hofje translate to recent and future times? Who could be for example the new patron? Perhaps the Netherlands will have a minister for loneliness in the near future, like UK, and this minister could found the hofjes as part of a new policy. This system however does not match with the current political direction in the Netherlands, since the welfare state is being dismantled and transformed into a 'participation society'. According to the government, citizens have become smarter and stronger and need less help and meddling. This ideology is a money-saver for the state, but if the 'less meddling' rule truly applies, citizens should be able to self-organize in a resolute way. In that setting, perhaps the hofje should be formed by the citizens, for the citizens. This would mean that, although the specific building shape of separate samll houses gathered around an enclosed area, could be relevant, but the original social hierarchy is not relevant for current times.

3.3 Translating the hofje to the seaside

Besides the social context, there is the environmental context. To grab the hofje and put it 'at sea', is quite a strong movement. This movement is already shown in image 3.1, where a side by side comparison of Haarlem and Vlissingen is shown. Where there used to be urban fabric, now are waves of the sea. Where there used to be steps down onto the street, to public life, now is a bridge, a strange connection or disconnection. This is what we can

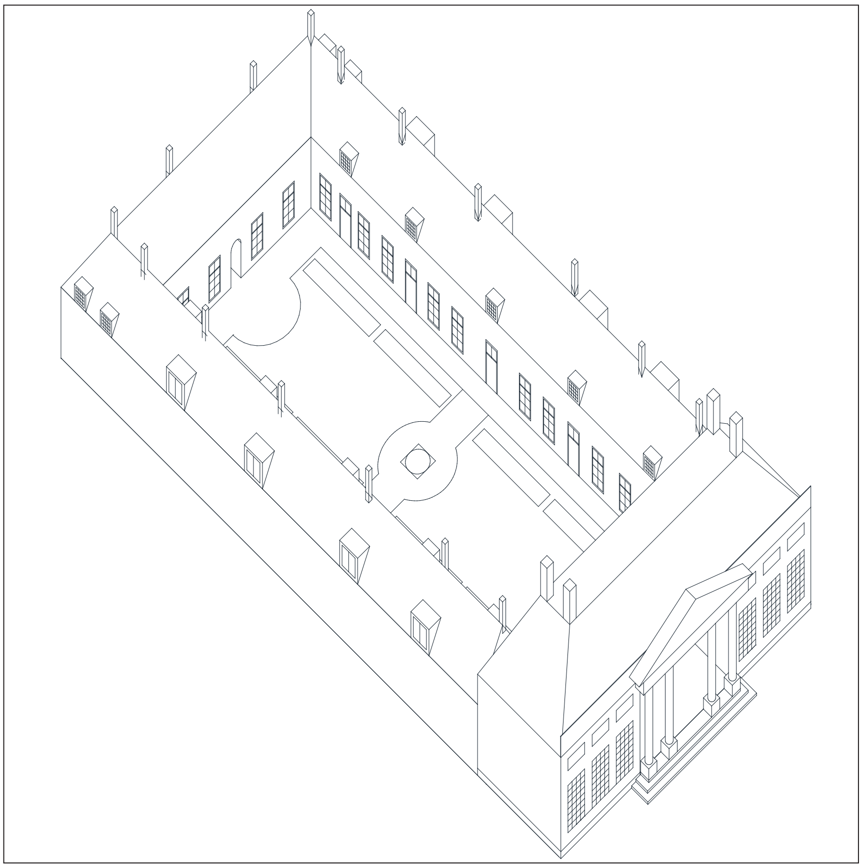

REGLEMENT

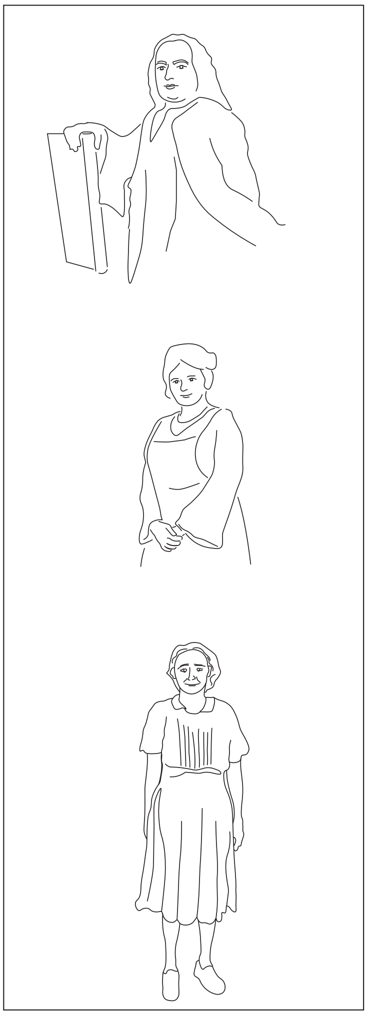
VOOR DE

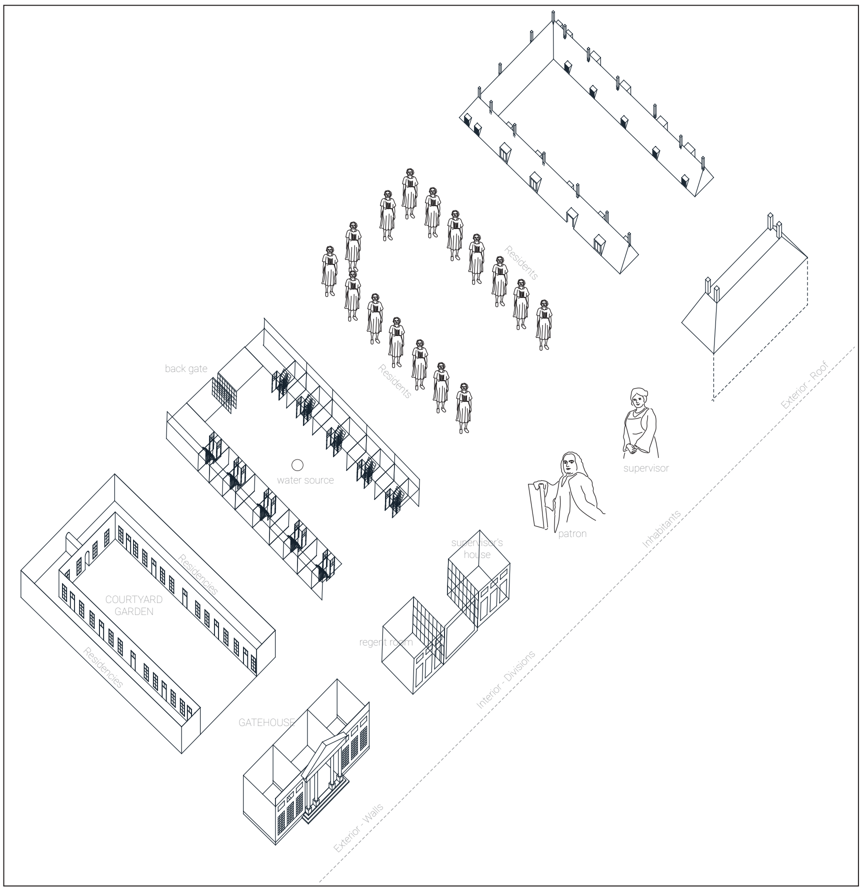
BEWOONSTERS

VAN HET

3.2 rules of Teylers Hof


3.3 Teylers Hof in Haarlem


3.4 Hierarchy at Teylers Hof



3.5 Teylers Hof dissection

see when looking at the hofje and how it relates to the outside. The inside of the hofje however, the confined space, is difficult to define. I have tried to approach the consequences with image 3.6. Yellow, blue and red are used to mark built area, emtpy space and inhabited space. Artistic expression is used to represent a significant feeling that happens around the hofje when it is placed at the seaside - freedom, a change of ways, departure from known structures, movement. Within the hofje, the red color intesifies - it is now even mroe enclosed, a dead end, like a ship at sea. The interior becomes more intimate.

3.4 Input for the design

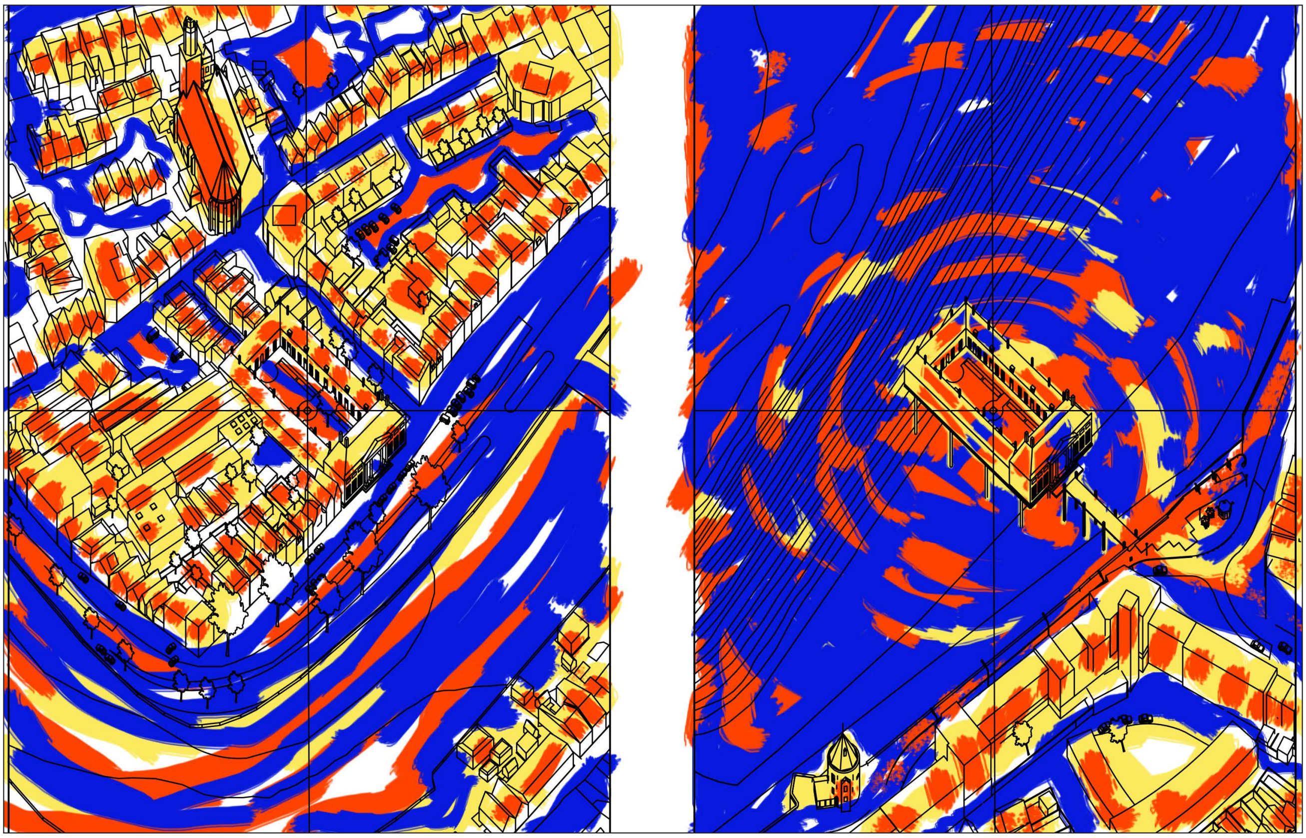
Wit this exploration at hand, I return to the design proposal: ***to design a pier that responds to rising sea level and ageing society in Vlissingen.***

Image 3.7 represents the ideas that arise from the displacement. Firstly, the passage of ships is very close to the proposed construction and both should stay protected. The second point, is that when the hof is placed at the location or territory of a pier, it needs to react as well to the public function that a pier has. There needs to be a space or configuration that allows a stream of vistors. Third, the introduction of windows to the outside, since this could give a view of the sea, while still keeping the interior private, due to the secluded location of being out at sea. Fourth, the hof typology already tackles one environmental isseu: the wind. Wind gusts become so strong in this location, that measures are necessary to make it inhabitable. A enclosed space can give some of that necessary shelter. Number five, the connection to the shore: is it a bridge, does it merge with the street? This needs to be solved. And finally, how does the structure respond to future frotification of the seawall and boulevard? Finally, there is a long, stretched area available for the project, taking cues from a pier. How will this space be used?

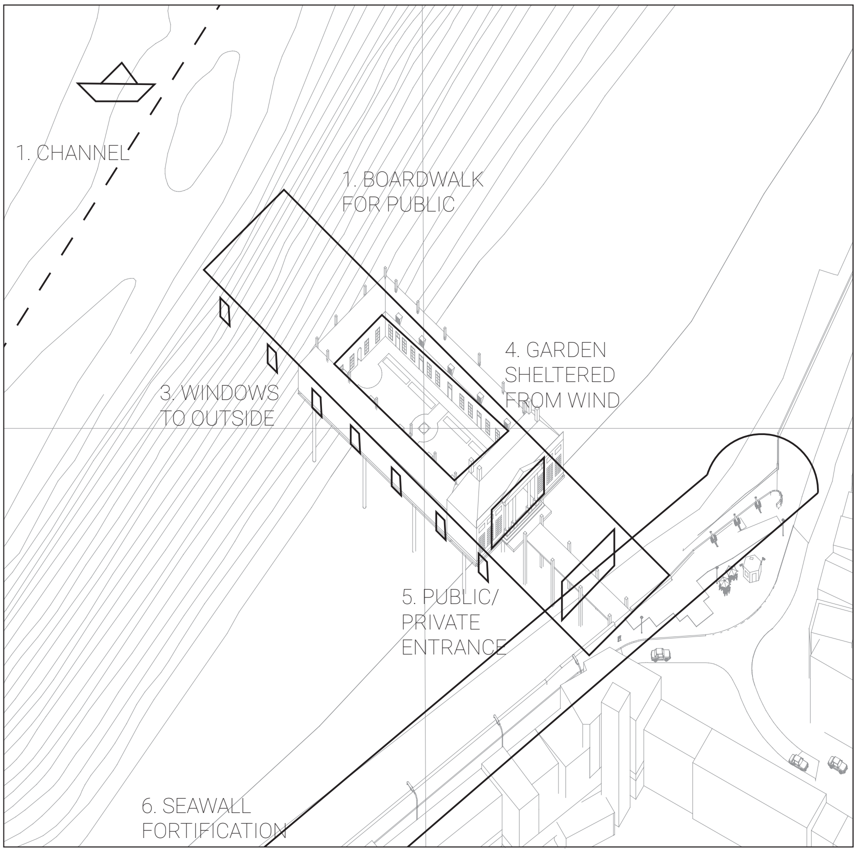
With image 3.8-3.10 a number of these questions are addressed. The typology of the hofje is incorporated into a concept for the entire pier, in image 3.8. It formulates that a hofje consists of individual physical shelters, that are arranged in a way that provides social shelter. This principle is duplicated to fill the long, stretched area designated for the pier. By doing so, we can host multiple hofjes 'on deck'. This program of housing needs to be combined with the public function of the pier (image 3.9). Image 3.10 shows how the pier can consist of two elements: the deck, that hosts a public program, and housing on top, which would consist of a sequence of hofjes interspersed with space for activities, as the final part of image 3.8 proposes. The yellow arrows signify that movement of visitors can be guided around the edge of the pier, past housing and public functions.

Image credits

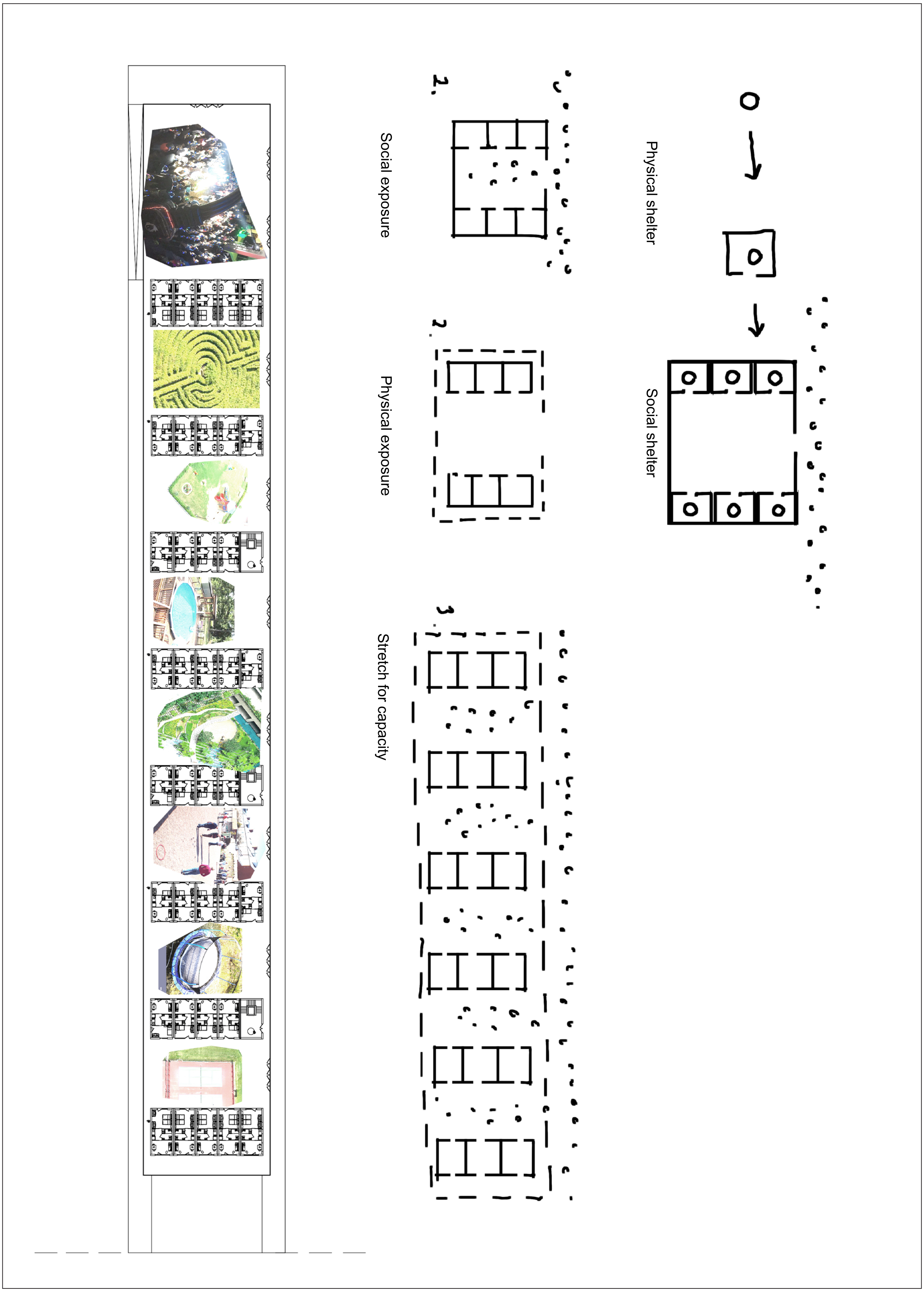
3.1 - 3.10 Own work.



3.6 Spatial effects of the displacement

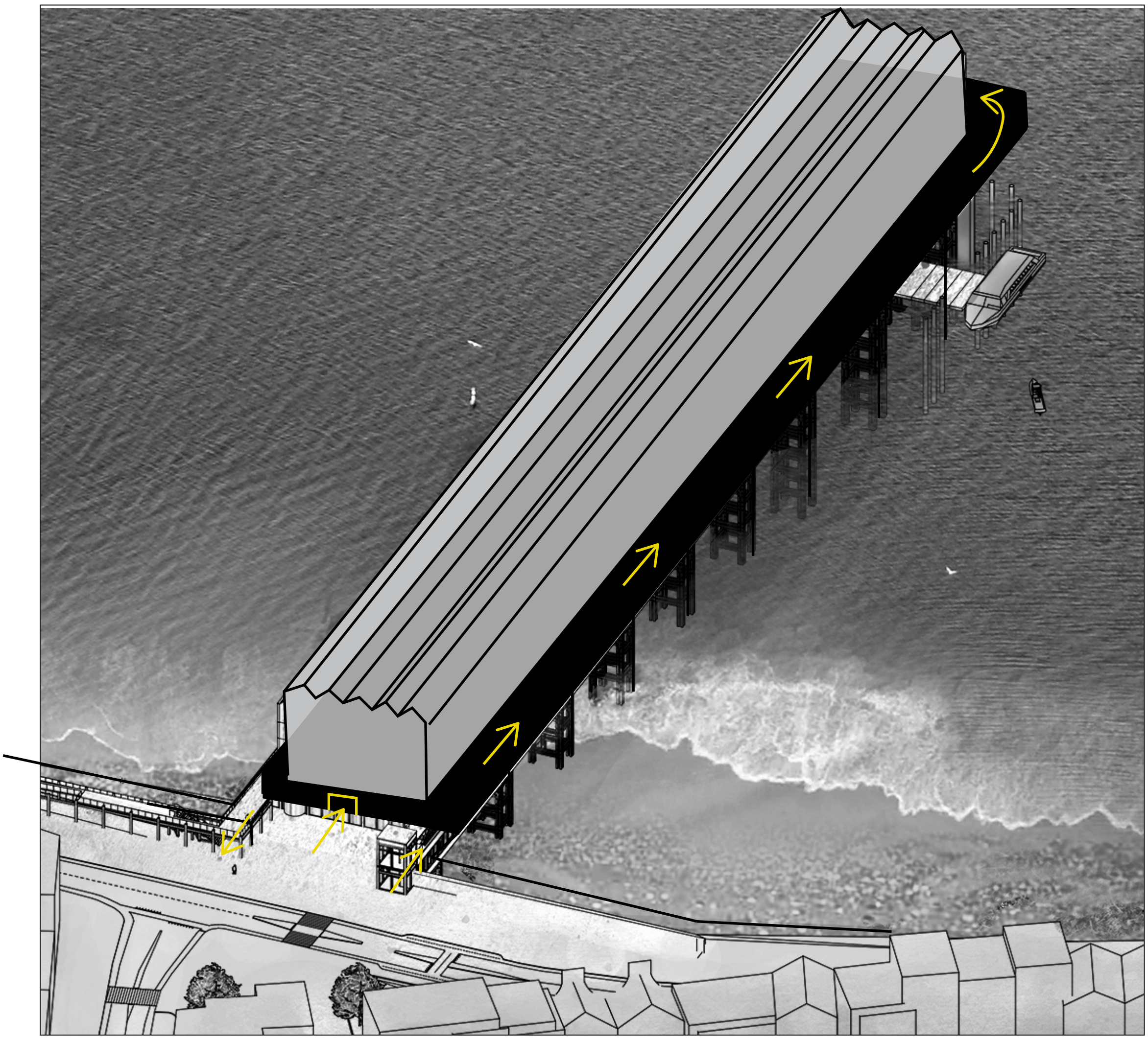


3.7 Results from displacement for the design



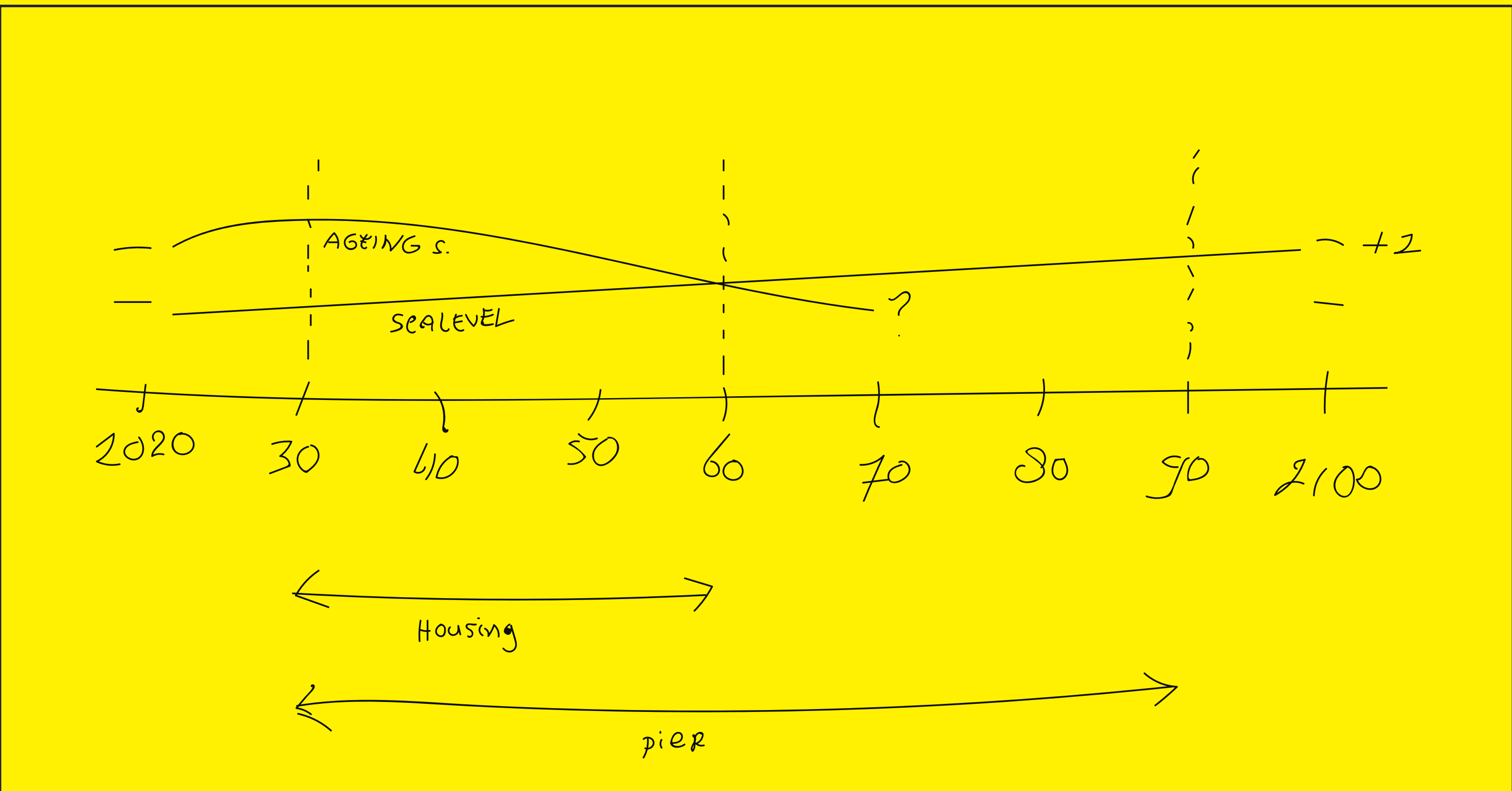
3.8 Configuring the concept

3.9 Impression of public functions



3.10 impression of exterior

4. Materials



4.1 Cycle of pier and housing

In chapter one, it is stated that sustainable construction is to build structures that future generations will want to and be able to maintain, as formulated by Jon Kristinsson. This approach is significant in the design project, on a location that has an extreme environment. This chapter explains the research that went into choices regarding the materialization fo the pier.

4.1 A cyclical structure

Previous chapter ended with a conceptual design of the pier, where elderly housing and pier structure as seen as separate elements that can work together. Another way to look at this division within the project, is according to the life cycles of the program. In image 4.1, the trend of ageing society and of risnig sea level are put into a graph. The ageing of society peaks around 2030-2040 and recedes in 2060. The sea level is predicted to rise between 2020-2100, with an amount of 2 meters. This span of 80 years can be assigned to the pier base structure, with the housing on top, based on a lifespan of 30 years.

Maintenance of the structure is important, in order to build osmething that futuregenerations will have few trouble with. So which material has sustainable properties, in a saline environment? Image 4.2 pictures a structure made of ‘roman concrete’. This material reacts with seawater in a way that increases the mass and strength of the material. The recipe of roman concrete is unknown, however research is being done to rediscover the ingredients and production procedure.

Untill then, we will work with materials that inadvertibly will desintegrate from seawater contact. Hastings pier’s steel structure was recently renovated (image 4.3) and the worst, corroded parts were replaced. Wood was used for the original pier of Vlissingen. Currently, regular boardwalks in the harbor of Vlissingen are also constructed of wood (image 4.4) A structure in sea made of wood will eventually rot and need replacement, just like steel needs eventual replacement. Concrete structures as well erode, rot, crumble and need immense repairs.

Impact of material cycle on the environment: for example with a beaver dam (image 4.5), a floating wood structure that keeps the animals safe, warm and dry - is continuously supplemented with twigs, as water movement affects the construction on a daily basis. Any waste material is carried away by streams, and if the shelter is abandoned, the whole structure can eventually fall apart and unfurl, with the twigs and small leftover elements finding another place in the ecosystem of the river. The ‘biodegradable’ quality of the buildnig materials, ensures that is has a place in the larger environmental system.

This is where wood as a structual material in a water setting is different from steel and concrete. Wood parts that eventually need replacement, have a place in the ecosystem. Wood and concrete, mostly, become pollutive waste.

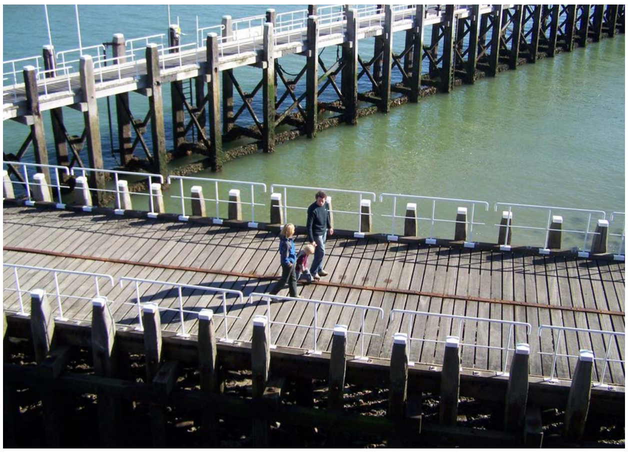
Furthermore, wood is a well-known material for Dutch ‘waterbouw’, there is much experience with for example construction of the ‘dukdalf’, image 4.6. This hardwood structure can stand in a harbor to guide ships, protect the shore and serve as an anchoring point. These cnstructions certainly need maintenance or are replaced after 30-50 years. Image 4.6 shows a recently developed technique for the repair of a dukdalf, using glassfibre anchoring and epoxy. This lightweight solution reduces costs of repair and maitnenance, but does pollute the ecological chain with plastic. However, the company justifies this by comparing the environmental impact of this solution with the production of a completely new dukdalf, where this method appears to be more sustainable. A crucial argument, is that the wood that is permanently under water or permanently out of the water, needs no repairing even after 50 years. It is the wood that is in the tidal zone, from wet to dry and repeated, that suffers the most degradation and needs repair.

In image 4.7 I compare the mentioned materials and their different qualities. with a variant of wood-wood connections, and wood with steel connections. Wood with wood connections is in this matrix the best outcome. For the design of the legs of the pier I based it on the dukdalf type of construction. Image 4.8-4.9 show the structure I came up with. Wood beams of similar size of the dukdalf are used, but in a scaled up system. Essentially, the dukdalf uses 4 poles, connected, to create one sturdy column in sea. The pier legs use this principle, but expanded four times. Four legs of each four poles, make up one big ‘leg’ of the pier that works as one column, thanks to connections that guide forces in x, y and z directions. Because the hardwood poles have a maximum length, and the pier legs can be 15 metres long, there are some vertical separations necessary. I solved this with a ‘knot’ where four more (short) poles are fit into the space between the other poles, fastened to create a connection.

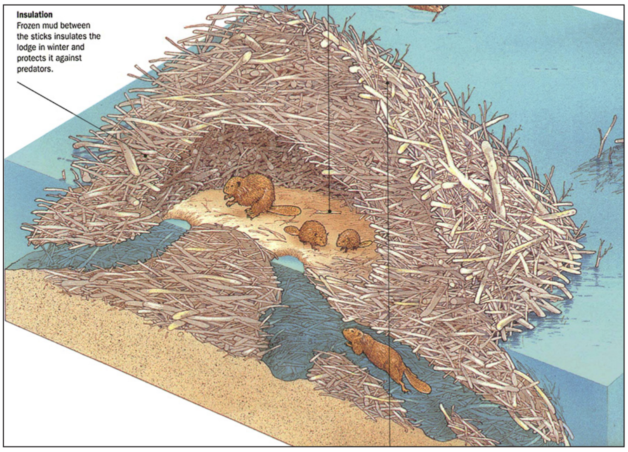
Image 4.10 shows how this principle is used in the entire design. here, the horizontal body of the pier that hosts public functions, can be made as a 3d vierendeel with use of lignoforce connectors, developed partly by TU Delft. This vierendeel part can be fully enveloped in a facade and protected from the weather, thus a softer wood can be used. The legs are done in the way as previously explained, in a hardwood. At the end of the pier, the legs are doubled to create a point tht can provide extra resistance to sea currents, letting the pier anchor there as well as at the shore. Furthermore, at the end of the pier, the hardwood legs extend up higher, making it possible for a vantage point accessible to the public to be realised there.

4.2 Remnant of roman concrete in sea

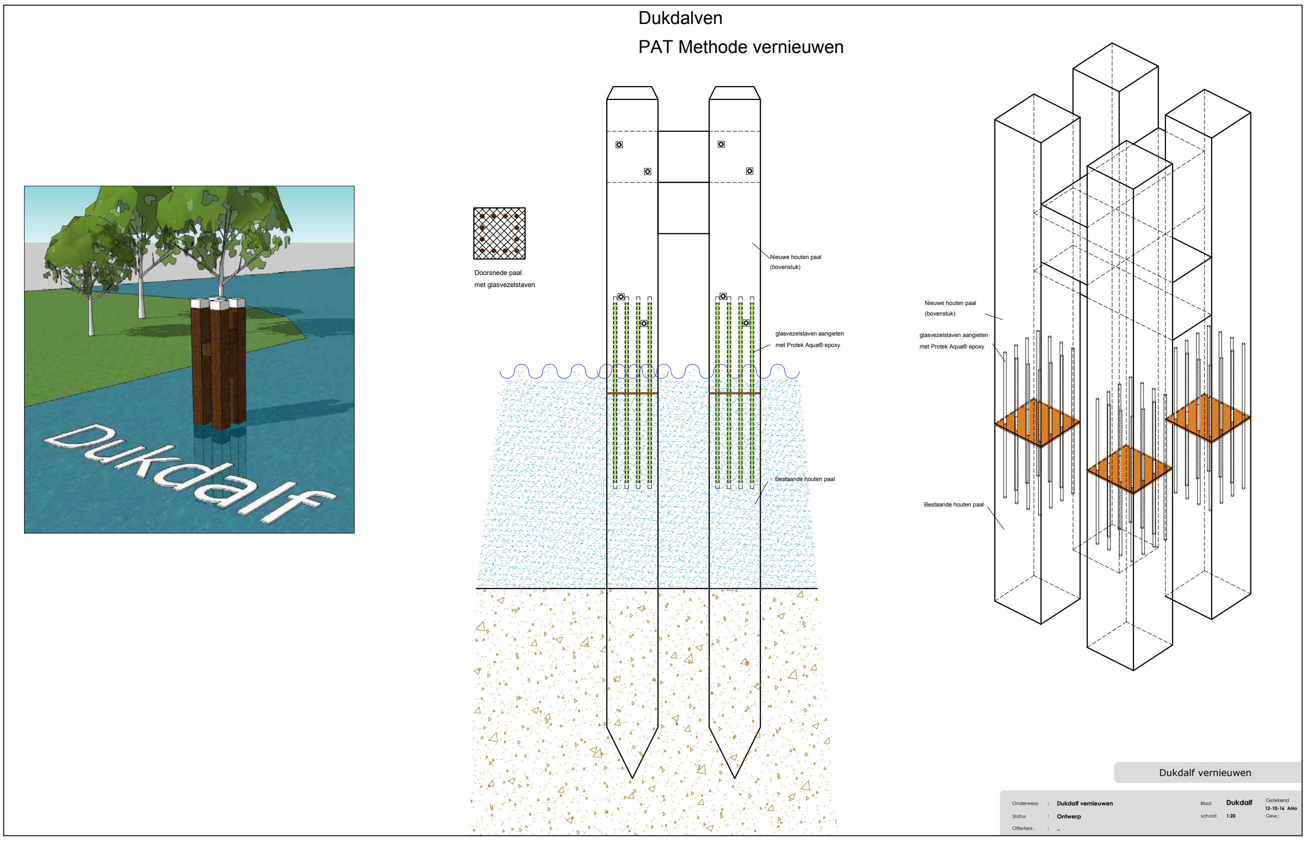
4.3 Renovation of Hastings pier



4.4 Boardwalk at Vlissingen



4.5 Beaver dam section

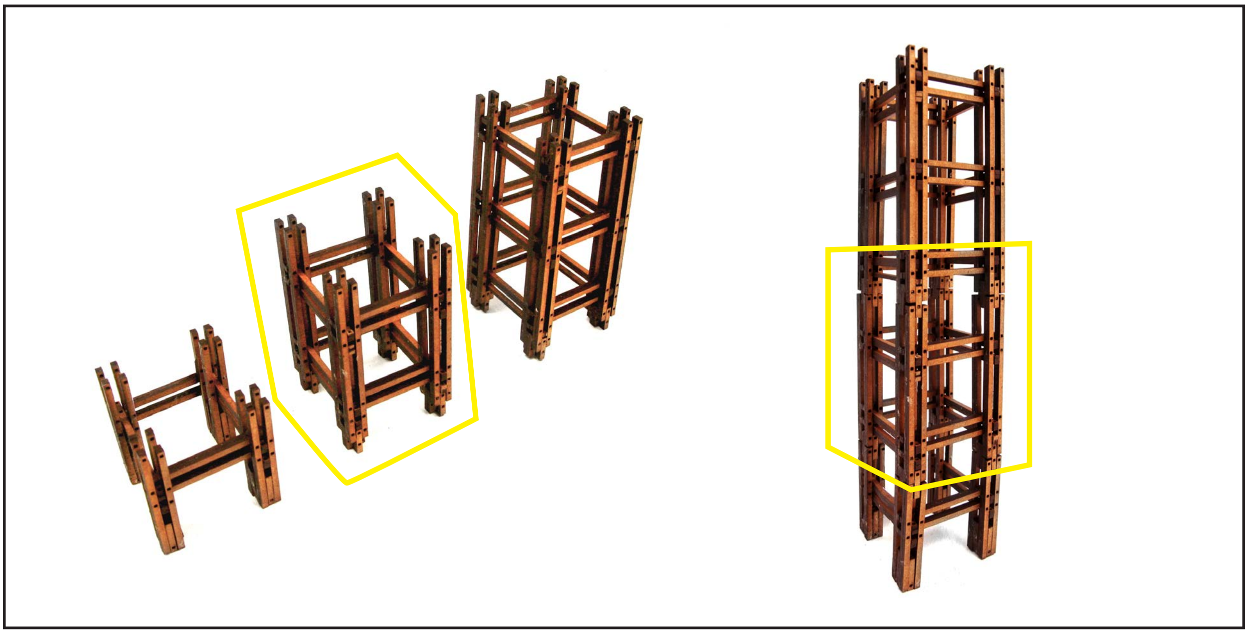


4.6 Dukdalf repair scheme

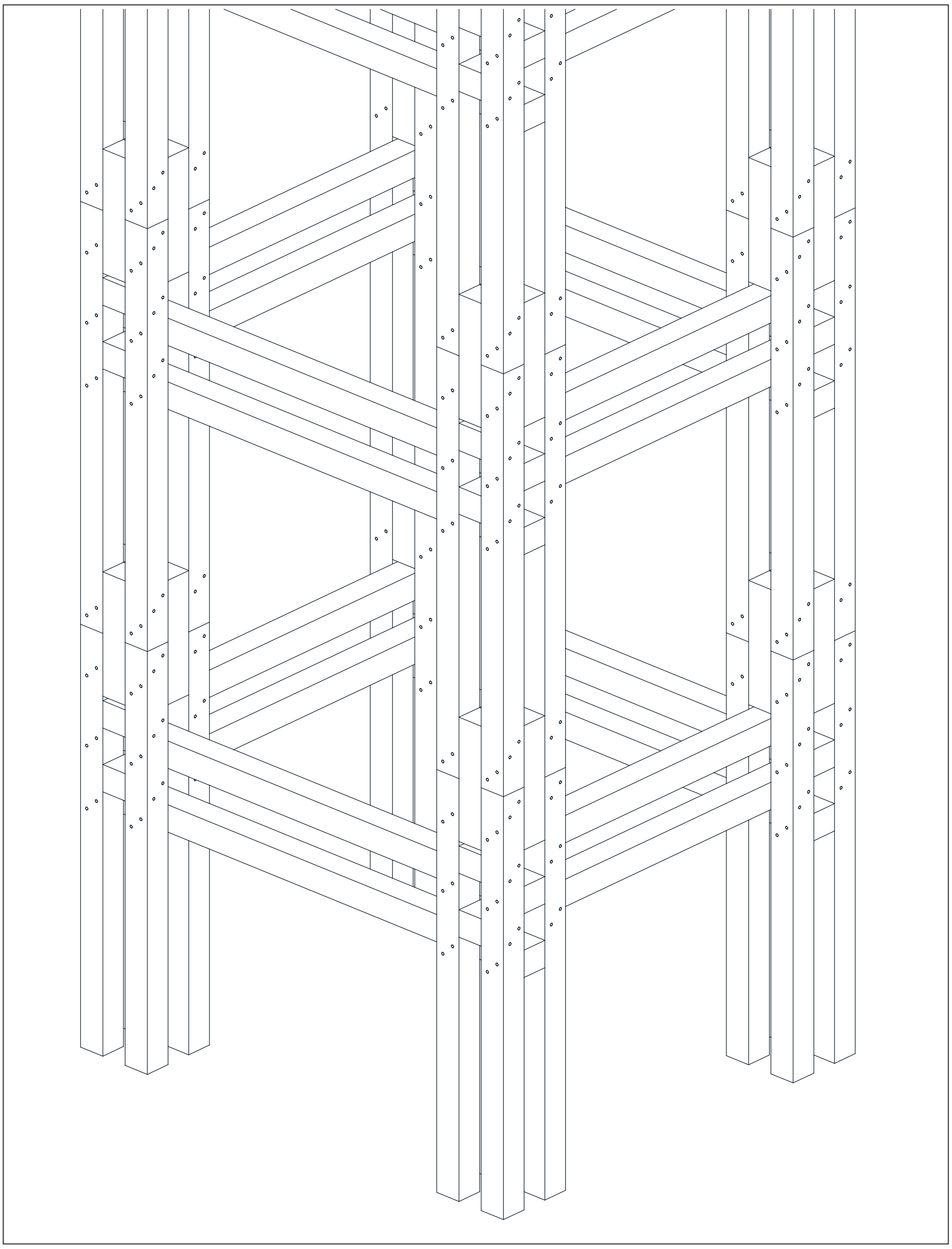
Main material and joint material	Resistance to (saline) environment	Lifespan* (years)	Maintenance during lifespan	Circularity	Material source proximity	Amount of manual work on site	Amount of manual work in factory	Pollution of site ecosystem	Structural strength**	local familiarity with technique	
Wood, wood (tropical)	O	O (100)	O	O	.	.	o	O	o	o***	13
Wood (tropical), steel	o	o (30>100)	o	o	o	o	o	o	o	.	9
Steel, steel	.	. (30)	.	.	o	O	o	o	O	o	8
Reinforced concrete, steel	.	. (>30)	.	.	o	O	o	o	o	o	7

* before needing major structural repairs
** materials have different ‘weak spots’, however steel is easiest to guarantee a specific strength, discounting the saline environment.
*** wooden piers are common in smaller scale, related to harbors, also present in Vlissingen

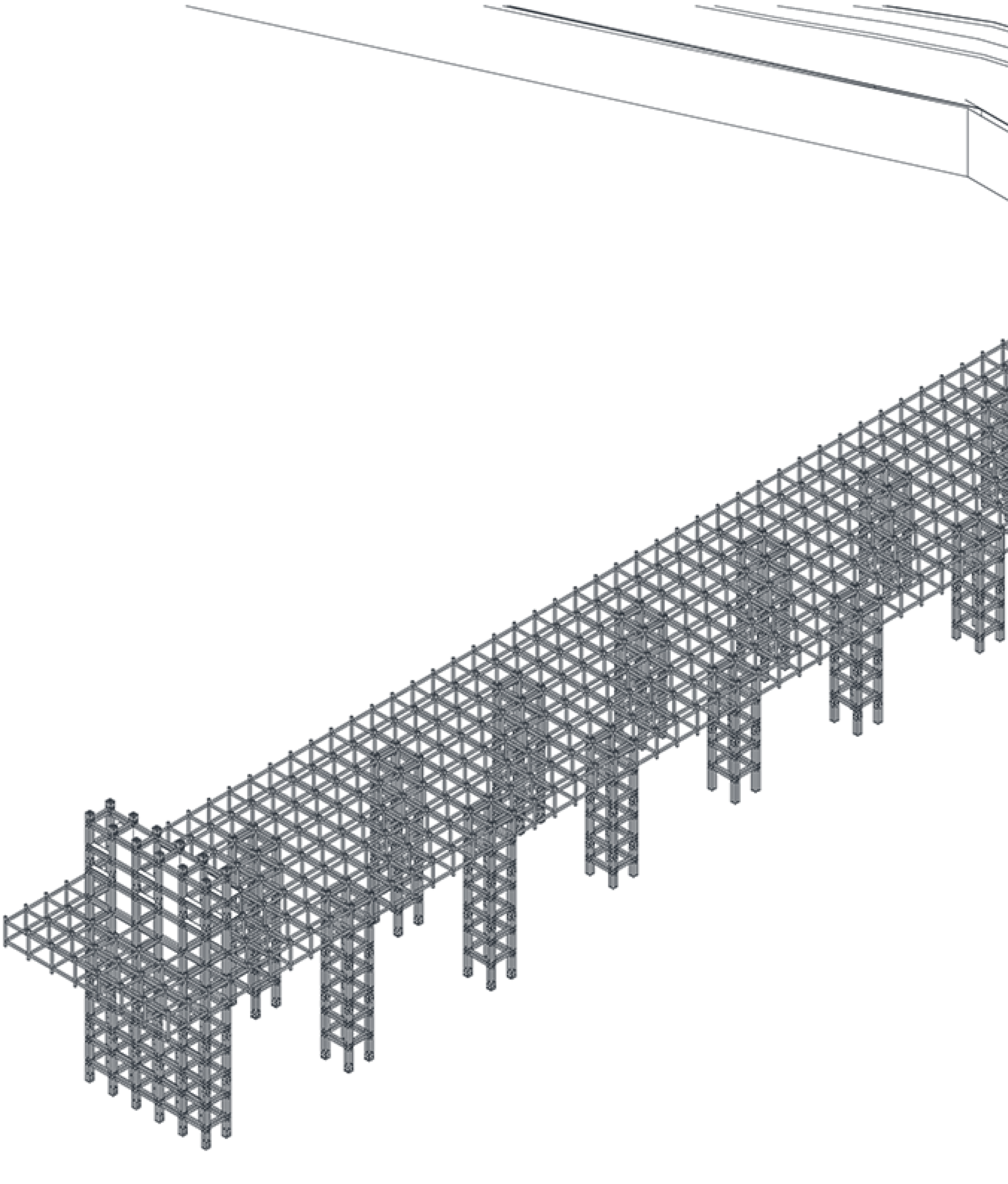
4.7 Pier structure material matrix



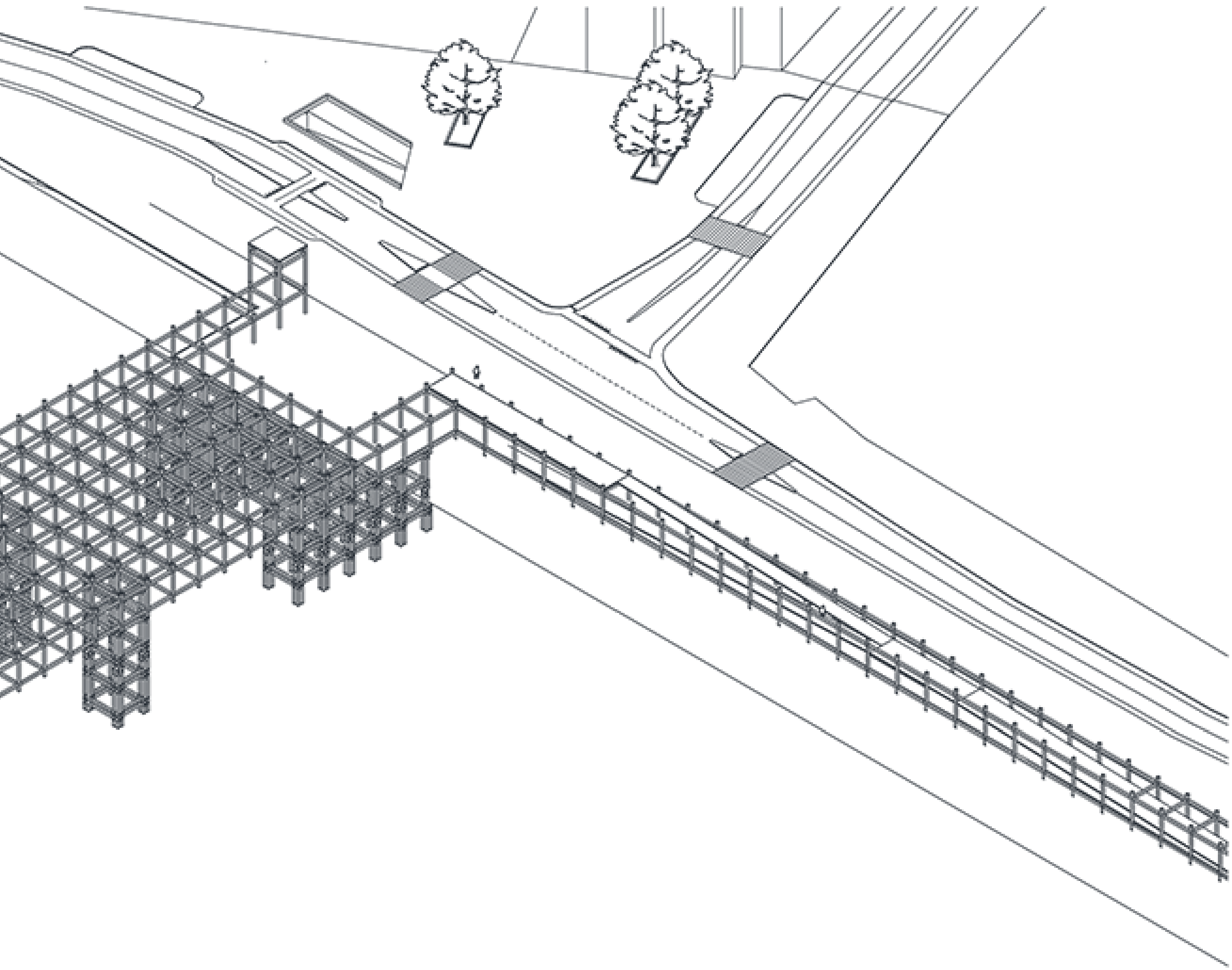
4.8 Pier legs physical model



4.9 Pier leg connection drawing



4.10 Pier structure scheme



4.2 Intersection of cycles

A final detail of the pier leg I designed, is how t odeal with the part that is in the 'tidal zone' that, as mentioned before, needs repairing much soone than the permanently wet and permanently dry parts? Image 4.8 shows that the pier legs are made up of 3 part. The middle part will be possible to remove and replace, with the upper and lower part staying in place. Because the construction is based on the dukdalf principle, it is possible to remove a single pole at a time. Thus, it would be possible to put a temporary support frame between the upper and lower part, and then proceed to take apart and rebuild the middle part of the structure. This is a theoretical idea which I could not test or prove during this design process.

According to the collected information about the materials, the moment to replace the middle part of the leg would be after about 30 years. This moment, in the theoretical planning of this design, would be at 2060, coinciding with the moment that the ageing effect of soceity has faded out. This means that within the timeline of the project, the ier could undergo a repair of the legs, as well as a removal of the elderly housing on top. With a renovated structure, the program of the pier could be revised and adapted to the needs of that moment. It seems possible that the houses would be simply removed, leaving an empty public space that can be filled in with publi initiaitves, as with a public square, becoming more at service of the city. In any case, the empty space would be full of potential to Vlissingen, and the base pier structure would be ready for another cycle.

4.3 Temporary roof material

The concept of image 3.8 and 3.10 demands a large, connecting roof structure. In the matrix of 4.11 I find that polycarbonate, as a material, could fulfill many of the needs of the structure. Lightweight, allowing daylight, are very important factors to create a livable space. Considering the shorter lifespan of the housing structure, materials that degrade fast can be considerd an acceptable option. However, a material that can fulfill the requirements without becoming pollutive waste would be better, but this material has not been developed yet.

I tried to minimize the damage of using this material by looking at the detailing. Image 4.12 shows a principle for the envelope, where 3 sheets are used in a frame. With this, the idea is that at some point, after the outer polycarbonate layer has degraded, these panels can be removed an replaced for another lifespan, while the interior 2/3 plates are still in good condition. With this material, I estimate the lifespan at 15 years for the outer layer, however information on this was not easy to acquire so may need more research. The columns of 'resistance to saline environment' of image 4.11 proved nearly impossible to complete.

The lightweight plus translucence requirements were the deciding factors, because that would make it safer and more livable. The detail of image 4.12 uses three layers, to address sustainability and quality of view, but as well helps to reduce the sound amplification that might happen when it rains on the roof. Three layers allow for two insulating airlayers, and the sheets are of different widths, as to prevent the sheets from vibrating with thesame frequency, which would carry any sound stronger.

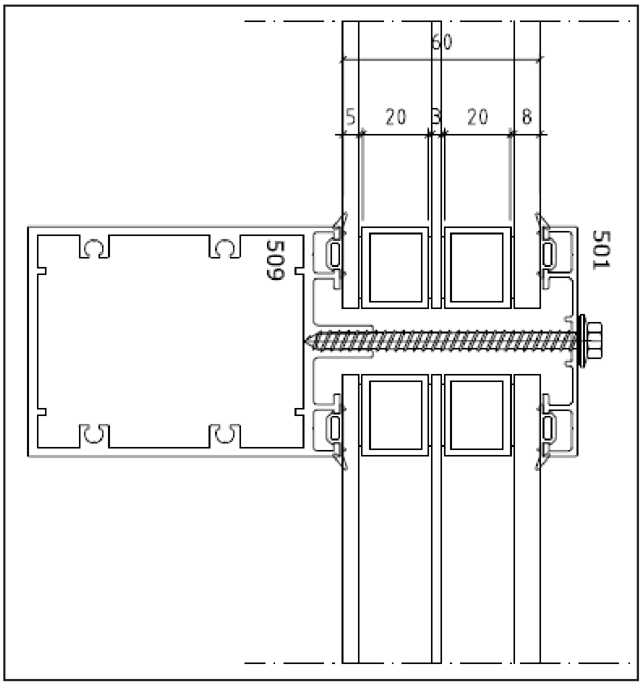
4.4 Climate of the environment

Referencing back to the sketch by Jon Kristinsson in the first chapter: the building responds to its environment and the other way around as well. For a clmiatic and energy concept, therefore, I must look to the direct vicinity of the building. We have the base of the pier with public functions, and housing on top, which have energy needs. With the idea of exchange with the direct environment in mind, I decided to implement a seawater plant that generates heating and cooling. A succesful case of such an energy source is already implemented in den Haag by Vestia (image 4.13). I researched the dimensions of this system, to estimate how much space it will need within the pier structure. A sizable room of about two shipping containers would suffice. Of course, this room is then filled with machienry and a pipe system extends to the sea below and to the inside of the pier, to distribute the water.

The principle of the seawater plant is that the temperature of the water is useful in every season: in winter it is a bit warmer than the outside temperature, in summer it is quite a lot cooler than the general temperature. Therefore, water with which it is possible to cool or heat, can be produced efficiently with heat pumps, with the seawater as a base source.

Material	Opacity	Weight	Circularity	Acoustic insulation	Greenhouse effect	Price	Resistance to wind	Resistance to (saline) environment	
Multiwall polycarbonate	o	O	.	.	o	o	o		6
Single sheet polycarbnate	O	O	.	.	.	O	.		6
Triple sheet polycarbonate in frame	O	o	o	o	o	O	o		9
Single glazing	O	.	.	.	.	O	.		4
Triple glazing	O	.	o	o	o	o	o		7
ETFE (possible with rain suppressor)	o	O	o	.	o	o	o		7
Arboskin (bioplastic)	.	O	o	.	o	.	.		4
Wood cladding	.	o	O	O	O	o	o		9

4.11 Housing roof material matrix



4.12 Polycarbonate triple layer detail

Image credits

4.1 By JP Oleson, retrieved at www.bbc.com

4.2 By James Robertshaw, retrieved at www.bdonline.co.uk

4.3 By Bill Donohoe, retrieved at http://billdonohoe.com/categories/diagrams-and-cutaways/beaver-dam-cutaway

4.4 By Protekta, retrieved at https://www.protekta.nl

4.5 Own work

4.6 Own work

4.7 Own work

4.8 Own work

4.9 Own work

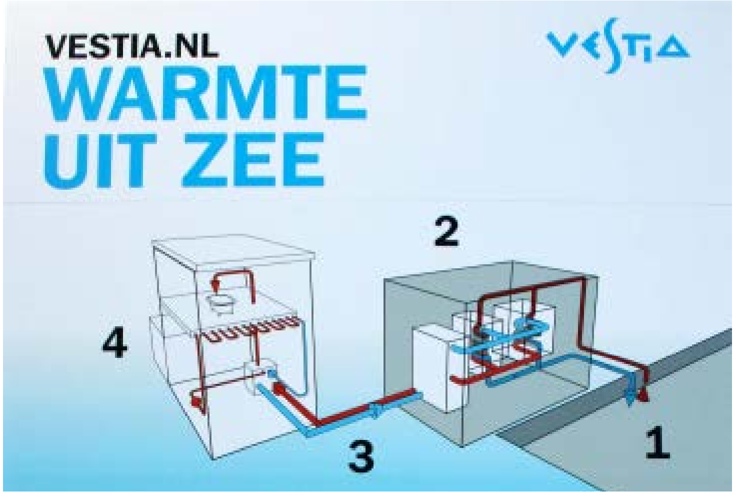
4.10 Own work

4.11 Own work

4.12 By Apollo France Diffusion published in Dakenraad december 2015

4.13 By Vestia

4.14 Retrieved at maps.google.com



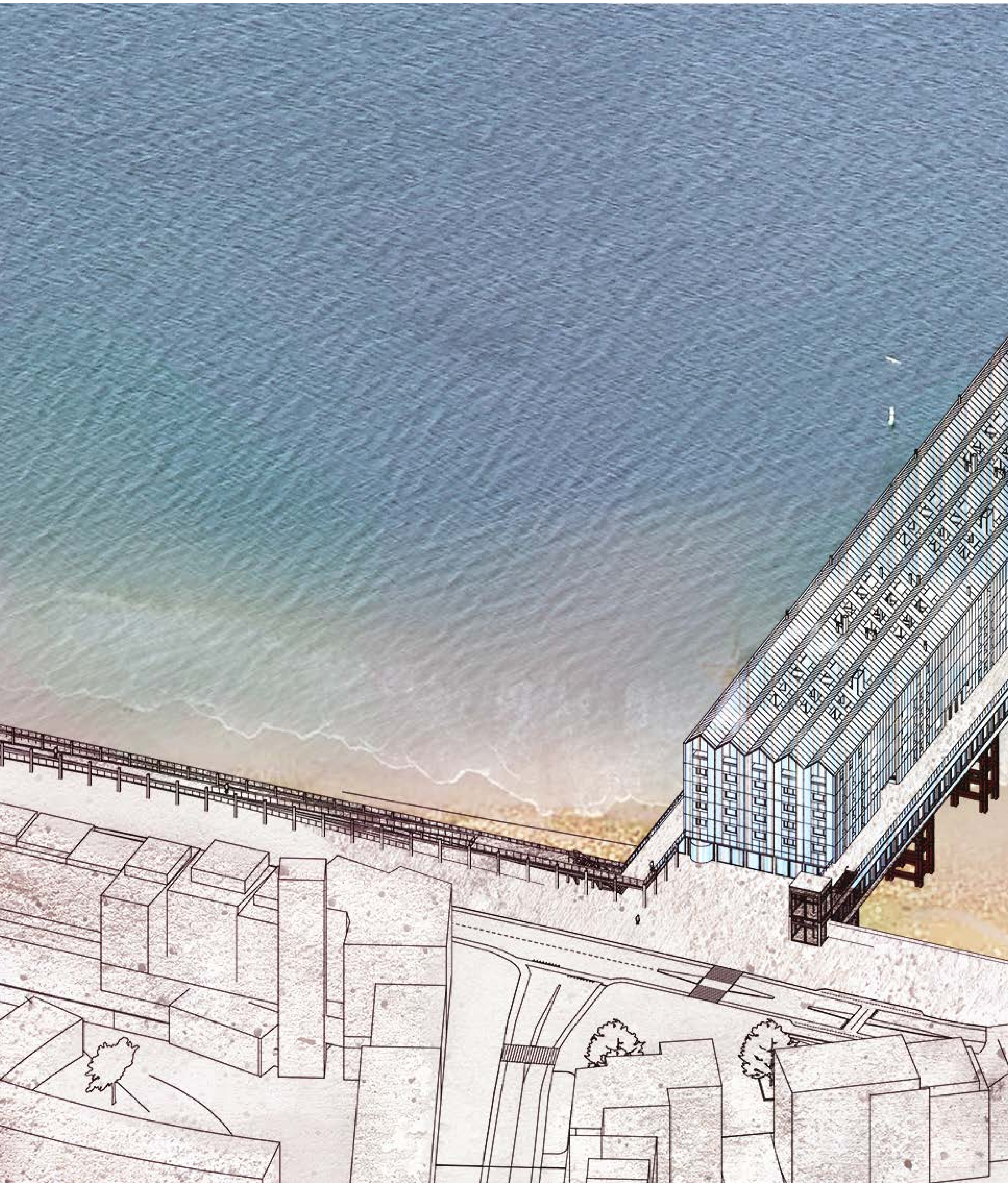
4.13 Scheme of seawater plant technique

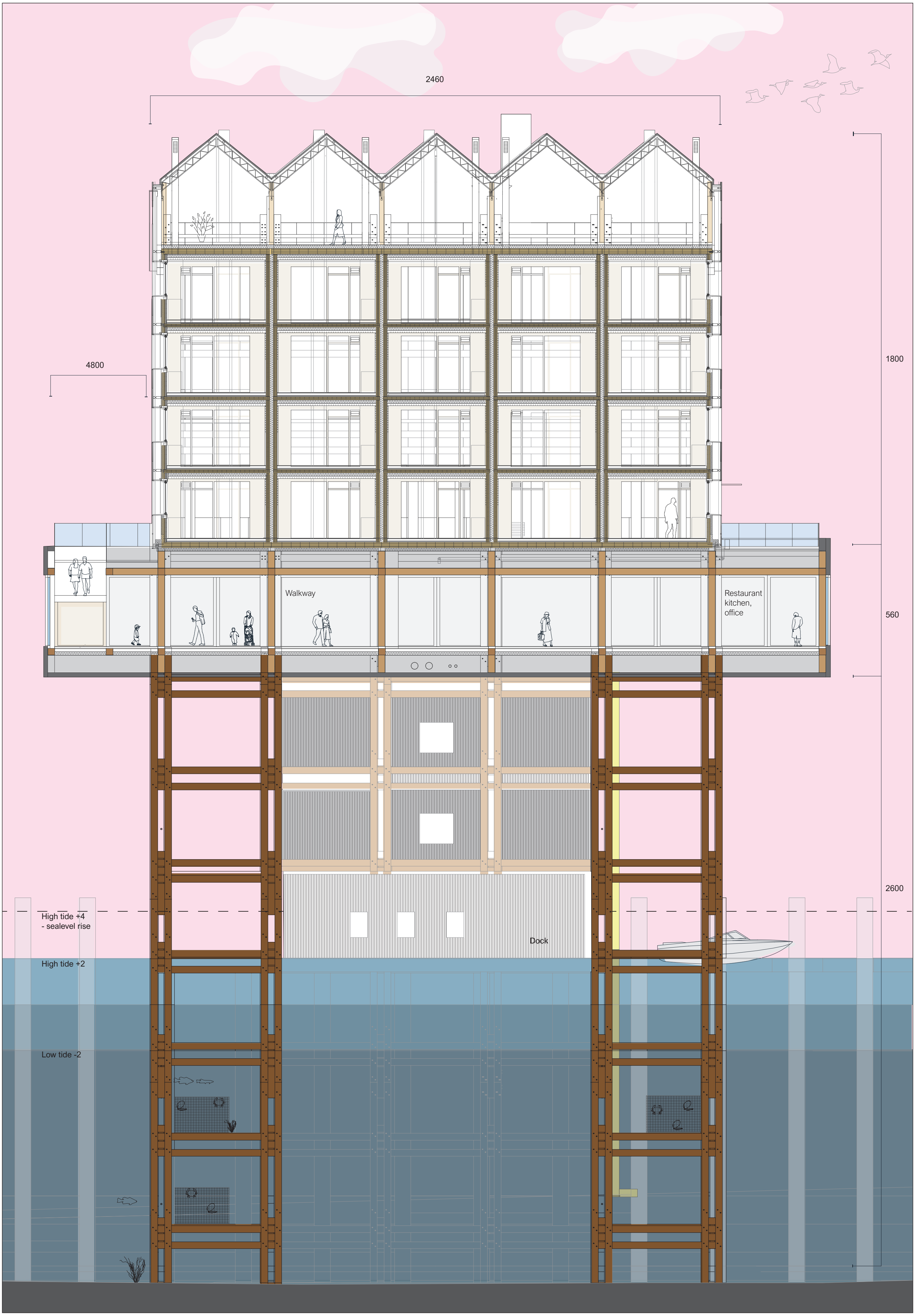

4.14 Views of seawater plant with scale

5. Life on the pier

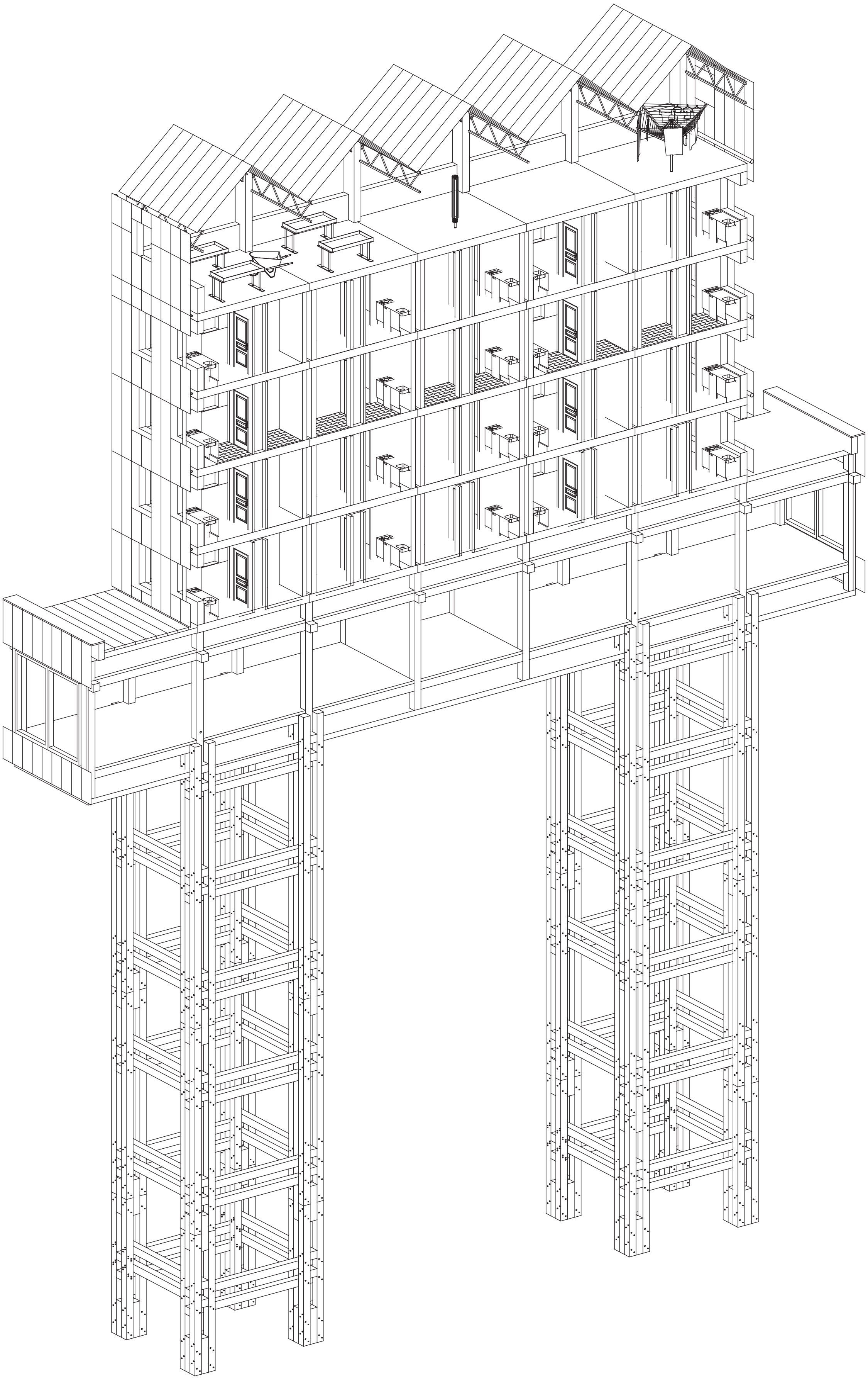
1.1 Driftwood Pier logo

This chapter is a collection of the images that present the final design of Driftwood Pier. Here it is possible to see how the research part and the various design choices, have materialized.

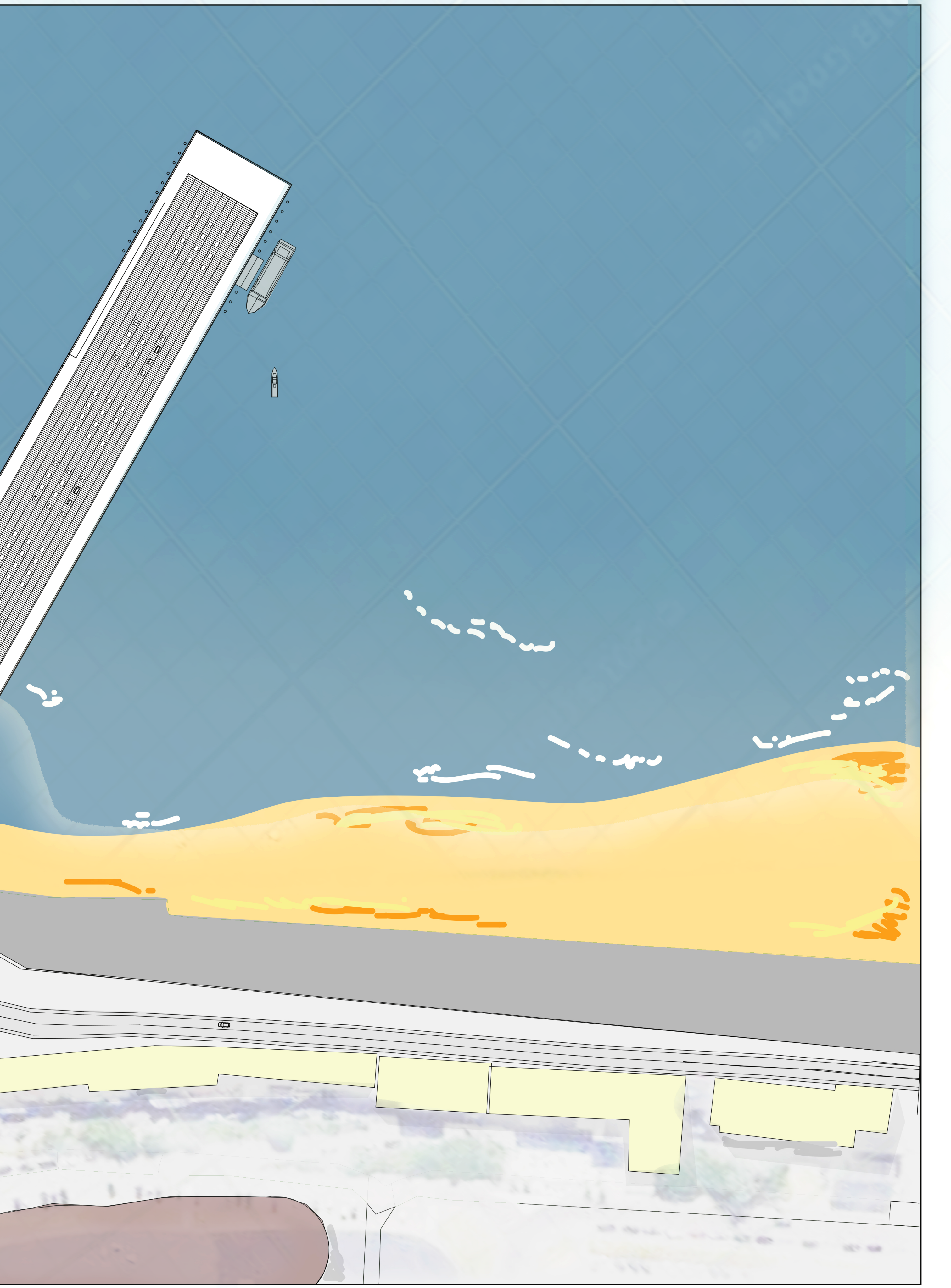


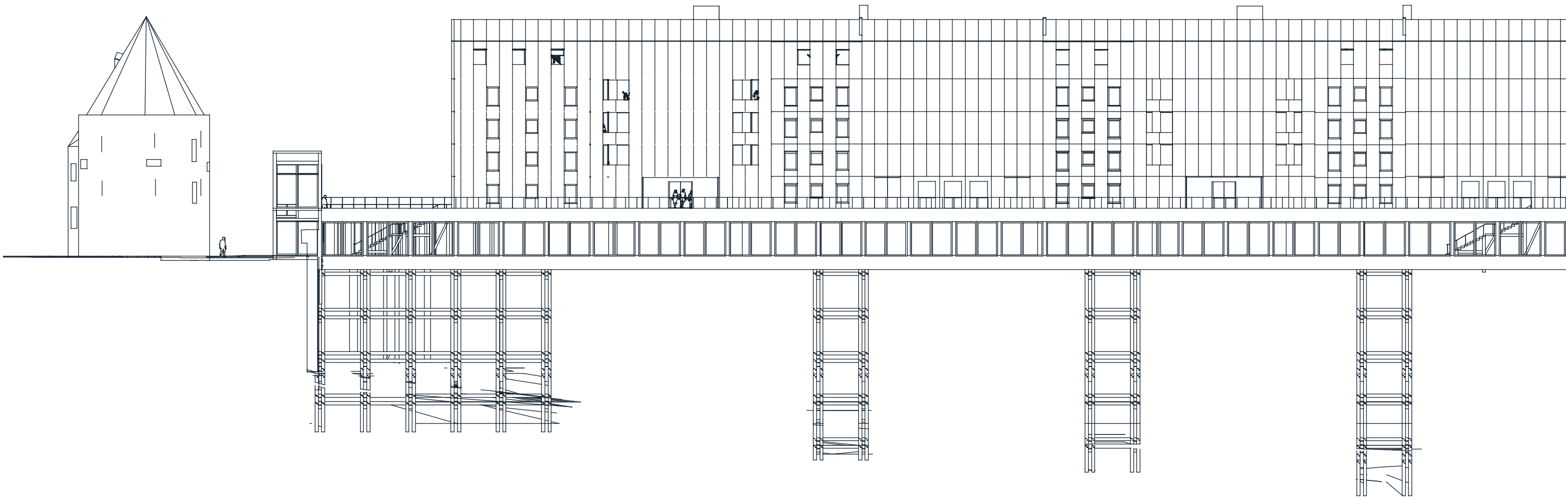


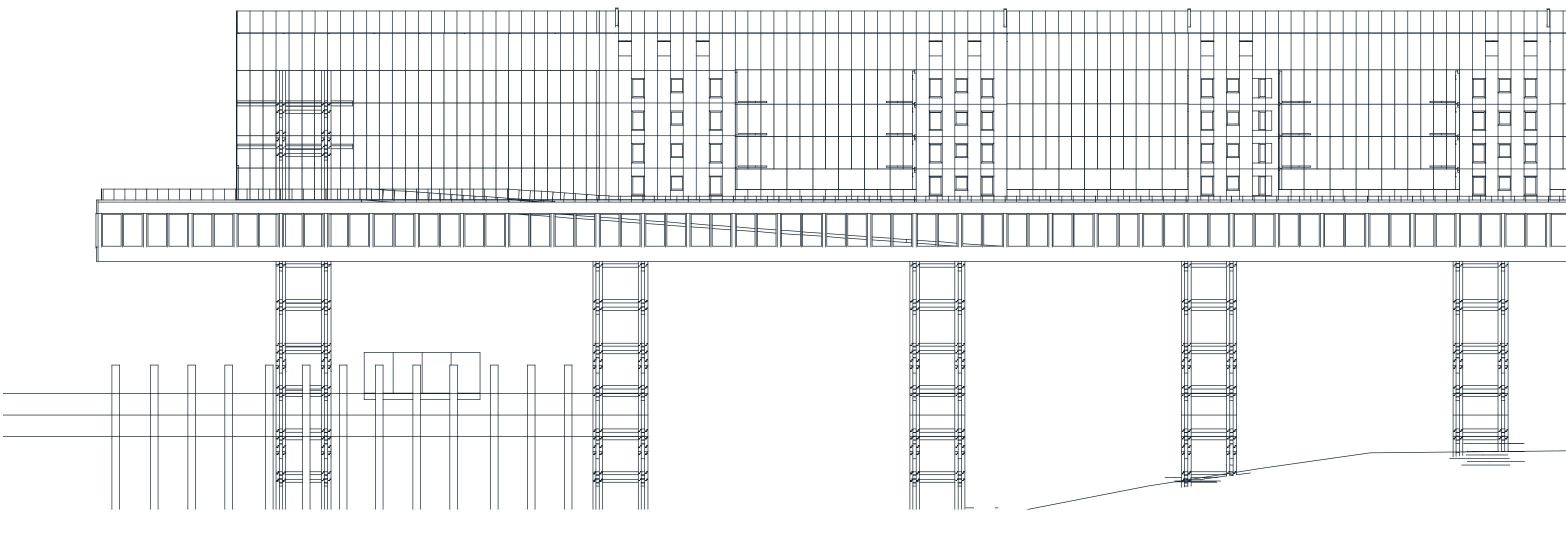
1:100 Section towards sea

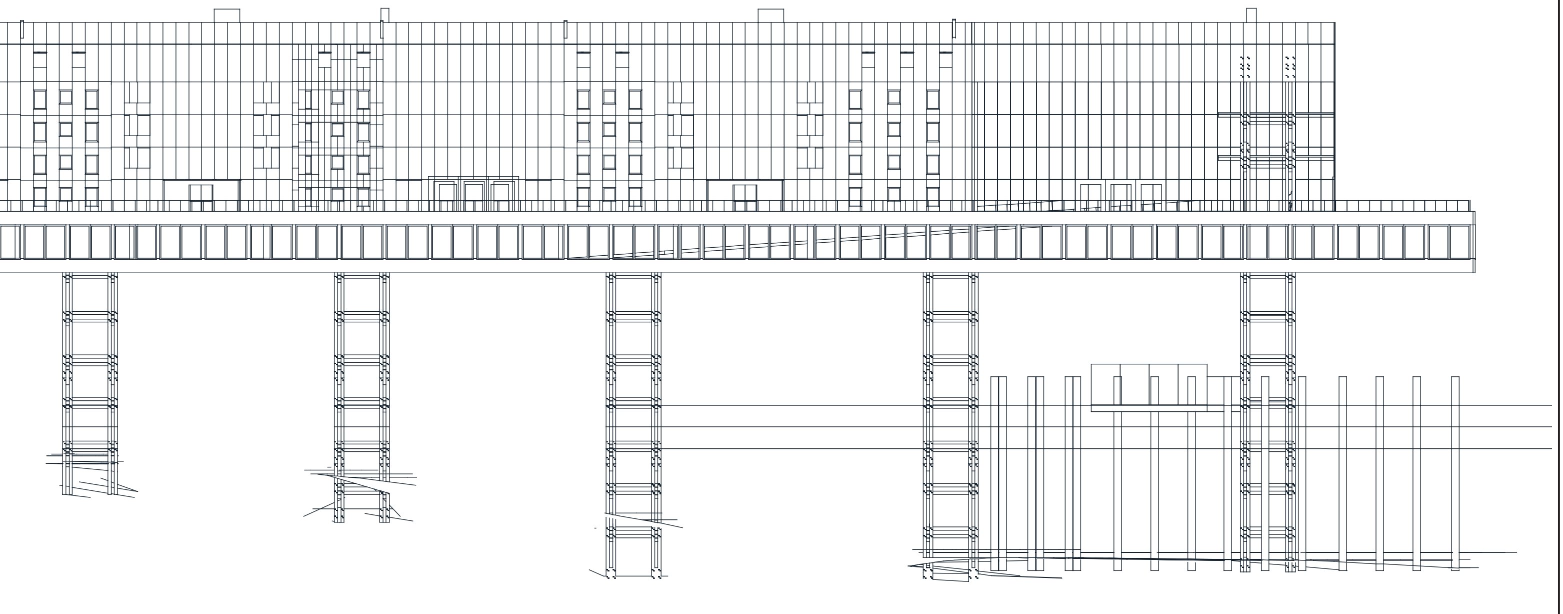


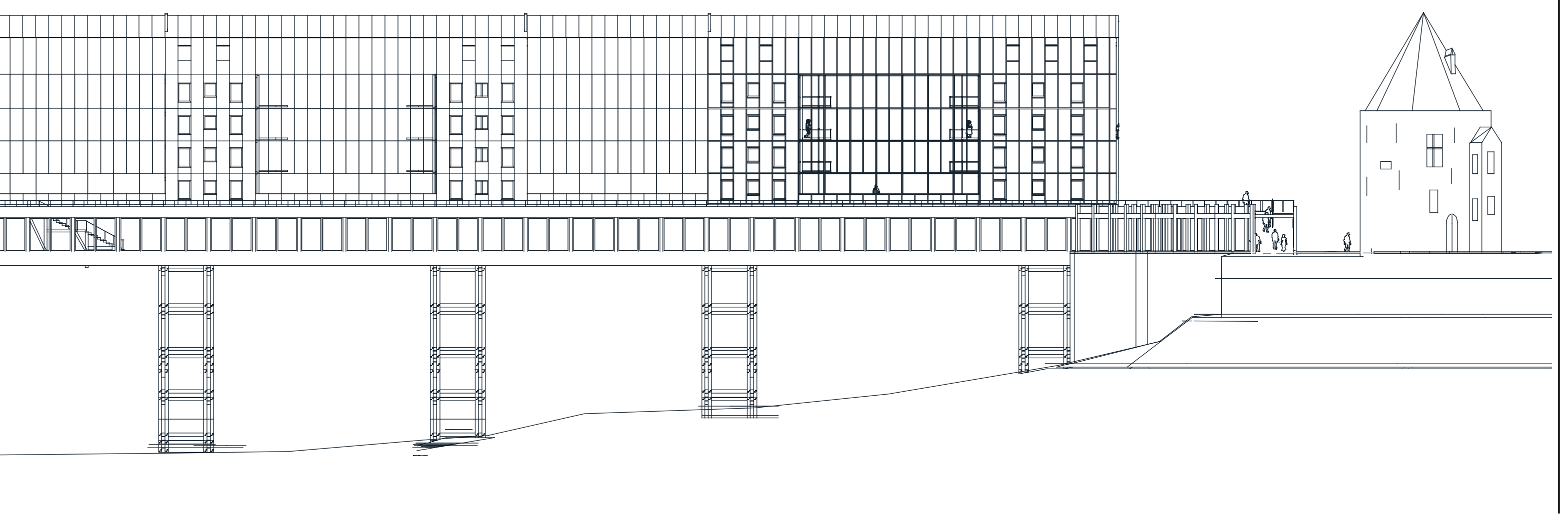

1:1000 area plan

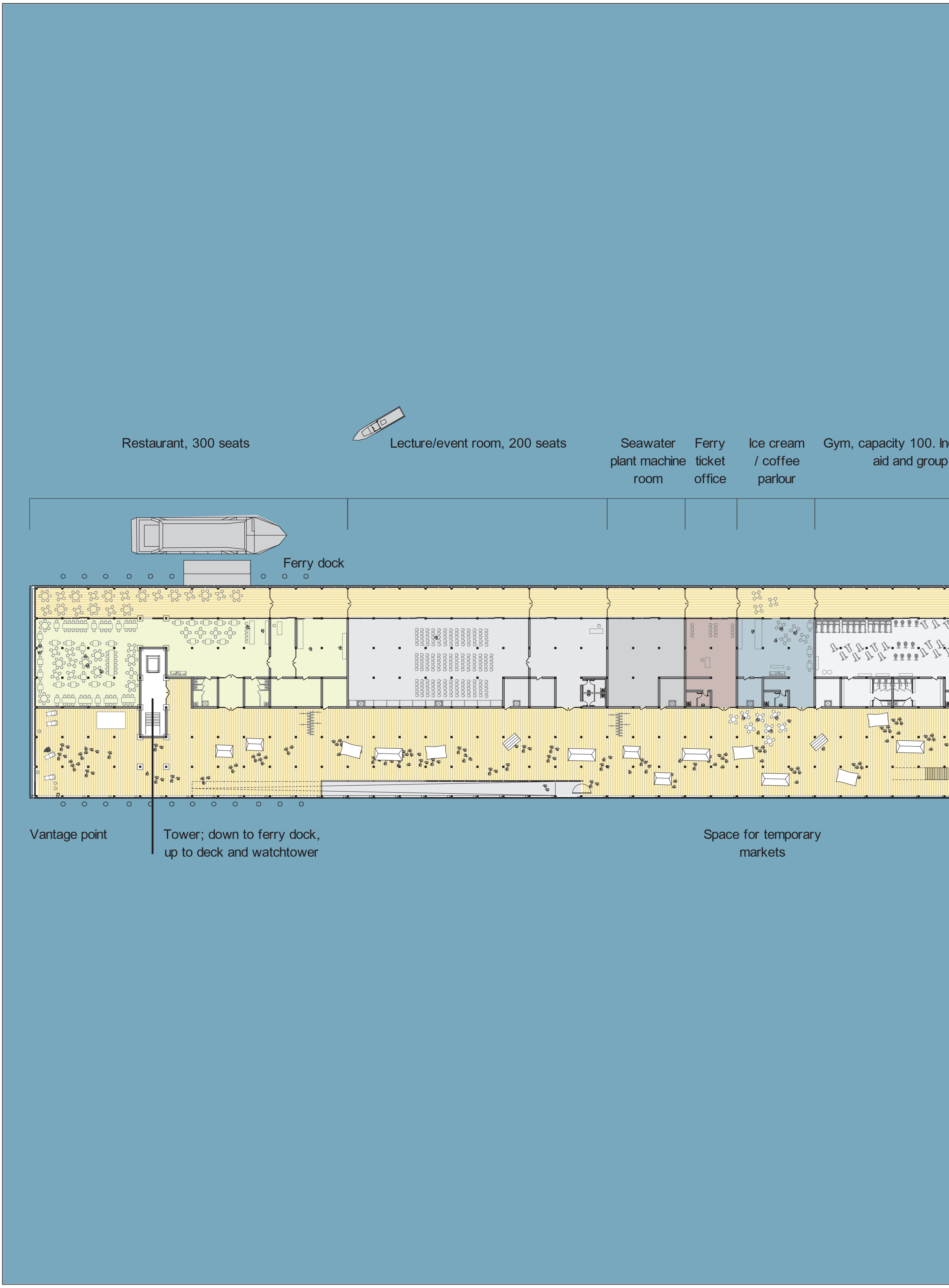




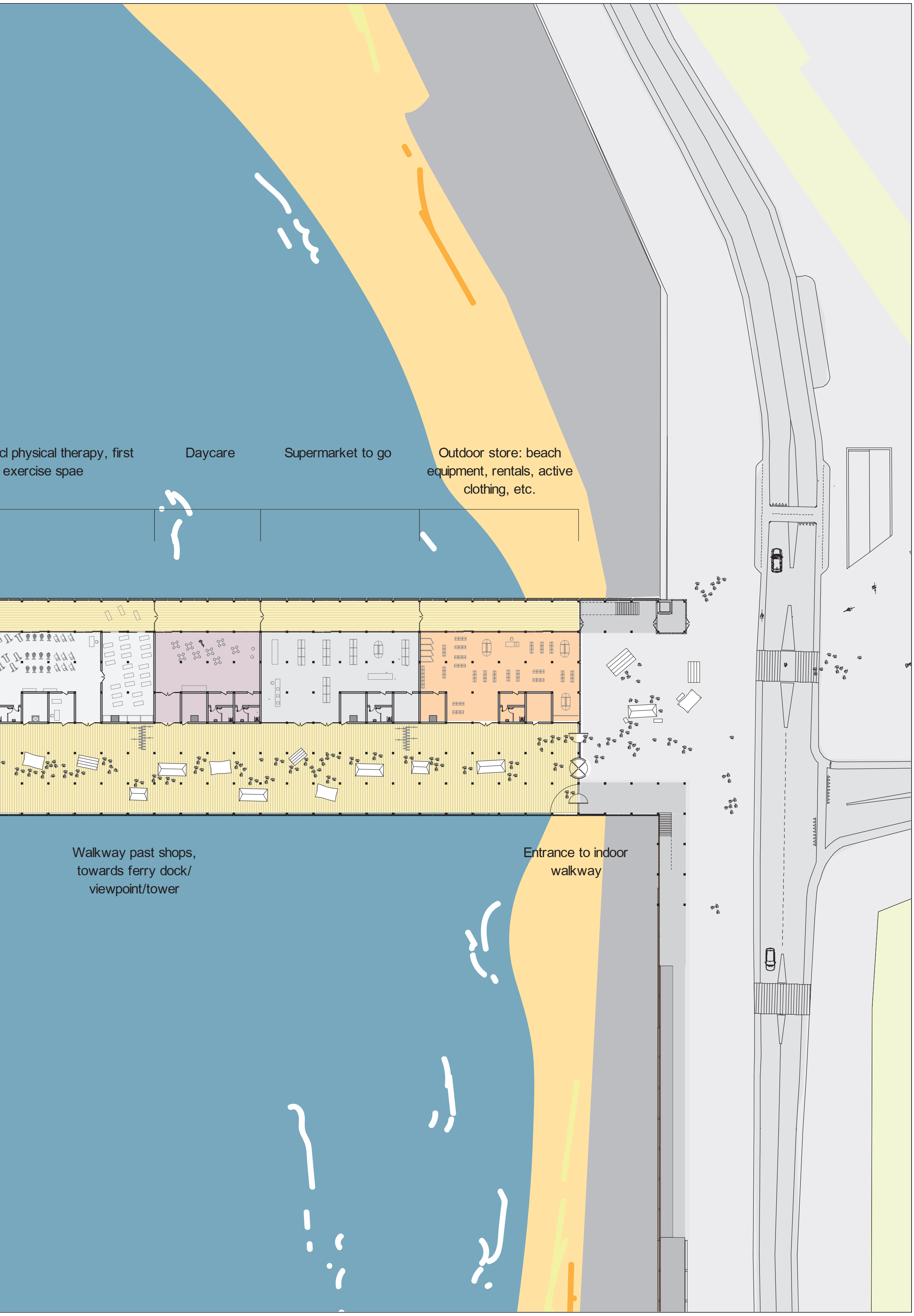




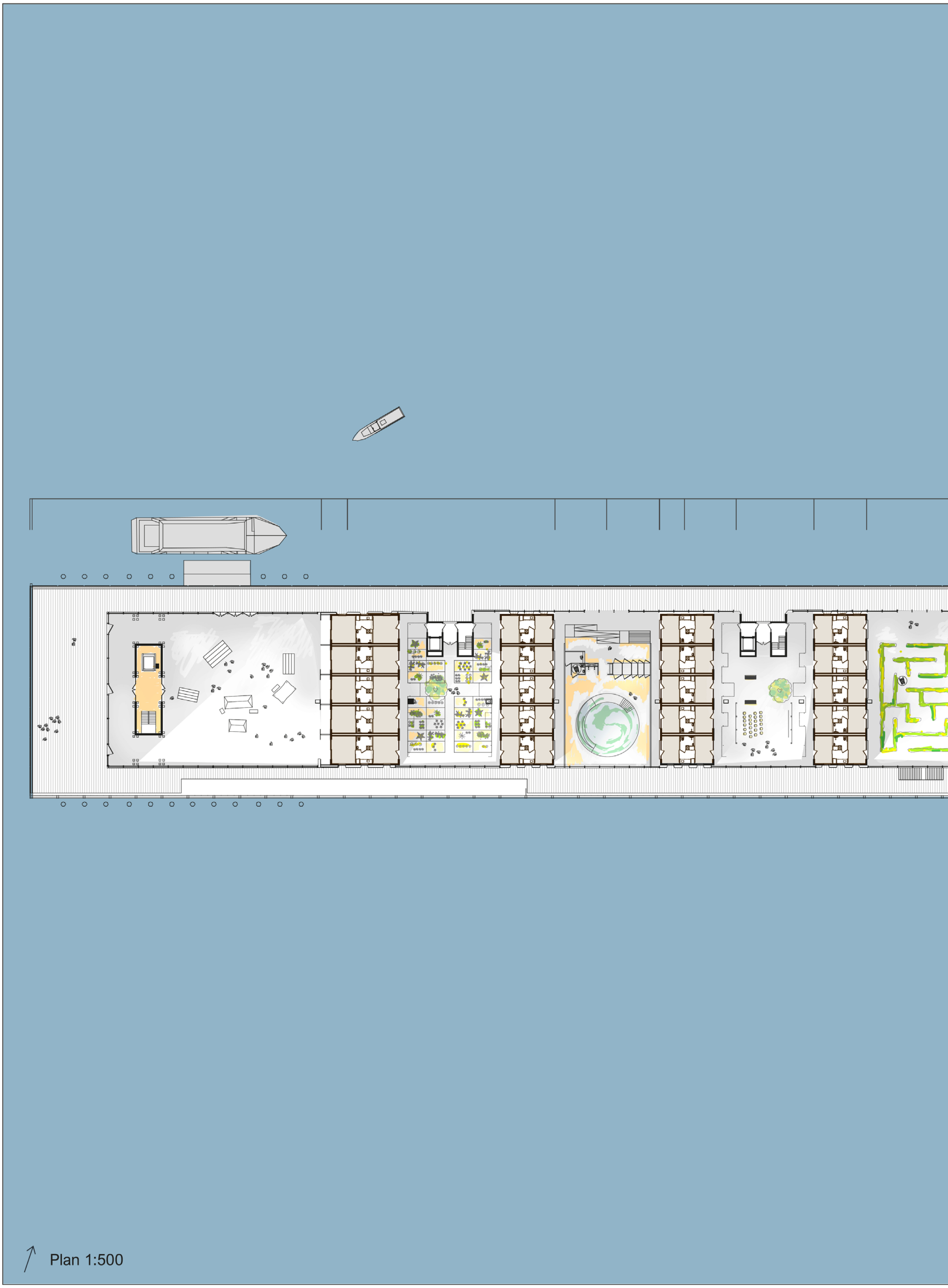




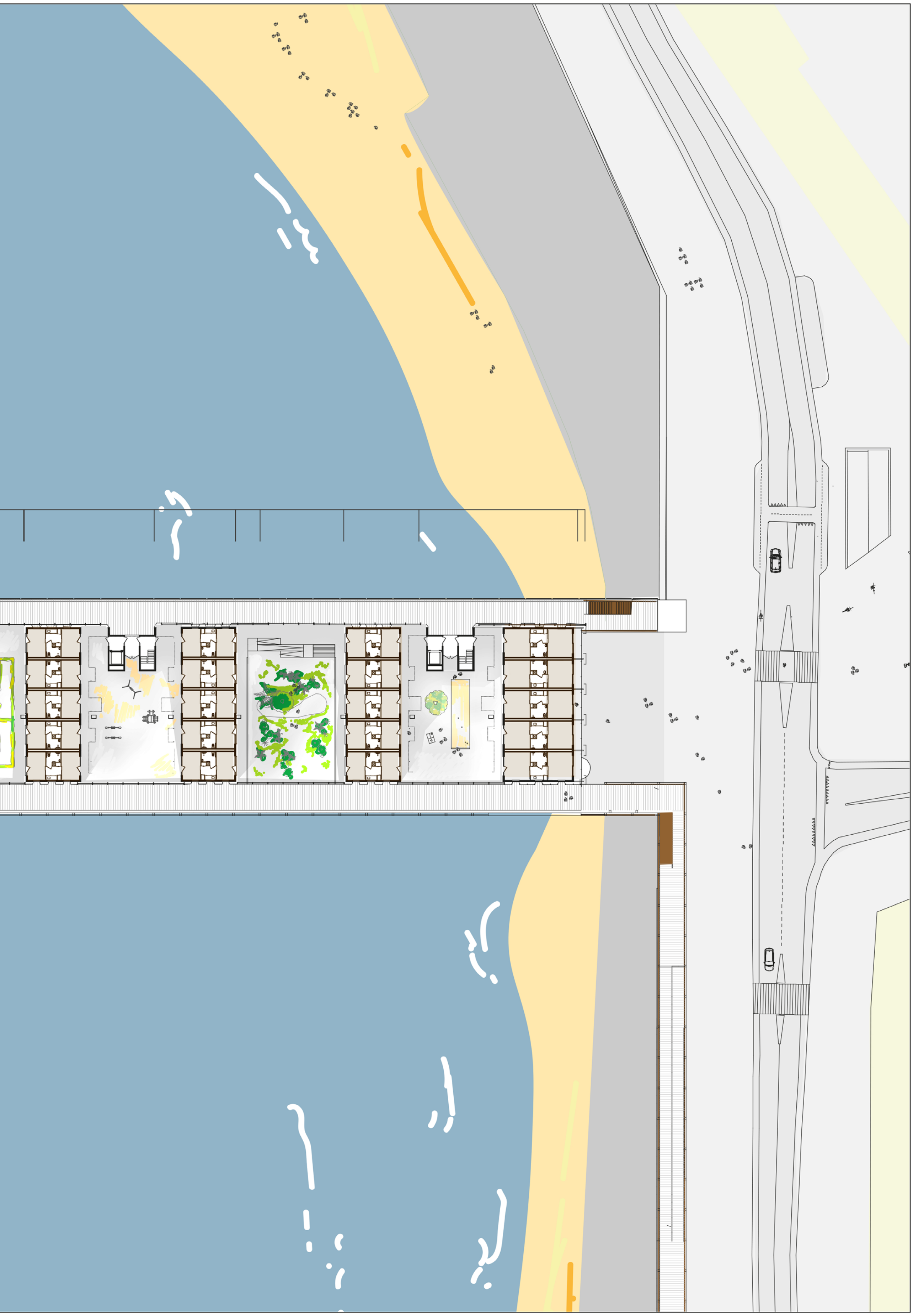
Restaurant, 300 seats
Lecture/event room, 200 seats
Seawater plant machine room
Ferry ticket office
Ice cream / coffee parlour
Gym, capacity 100. In
aid and group
Ferry dock
Vantage point
Tower; down to ferry dock, up to deck and watchtower
Space for temporary markets

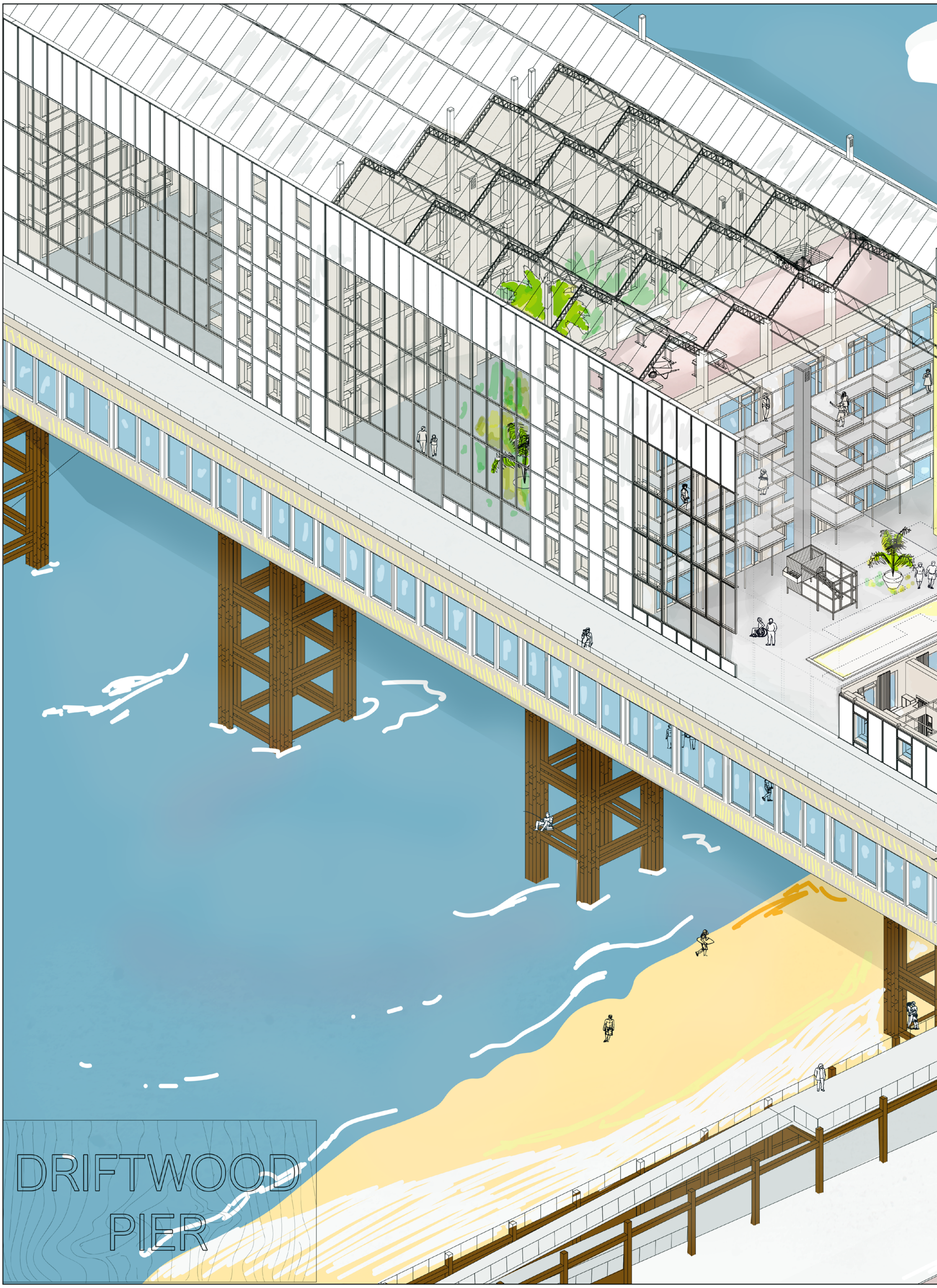


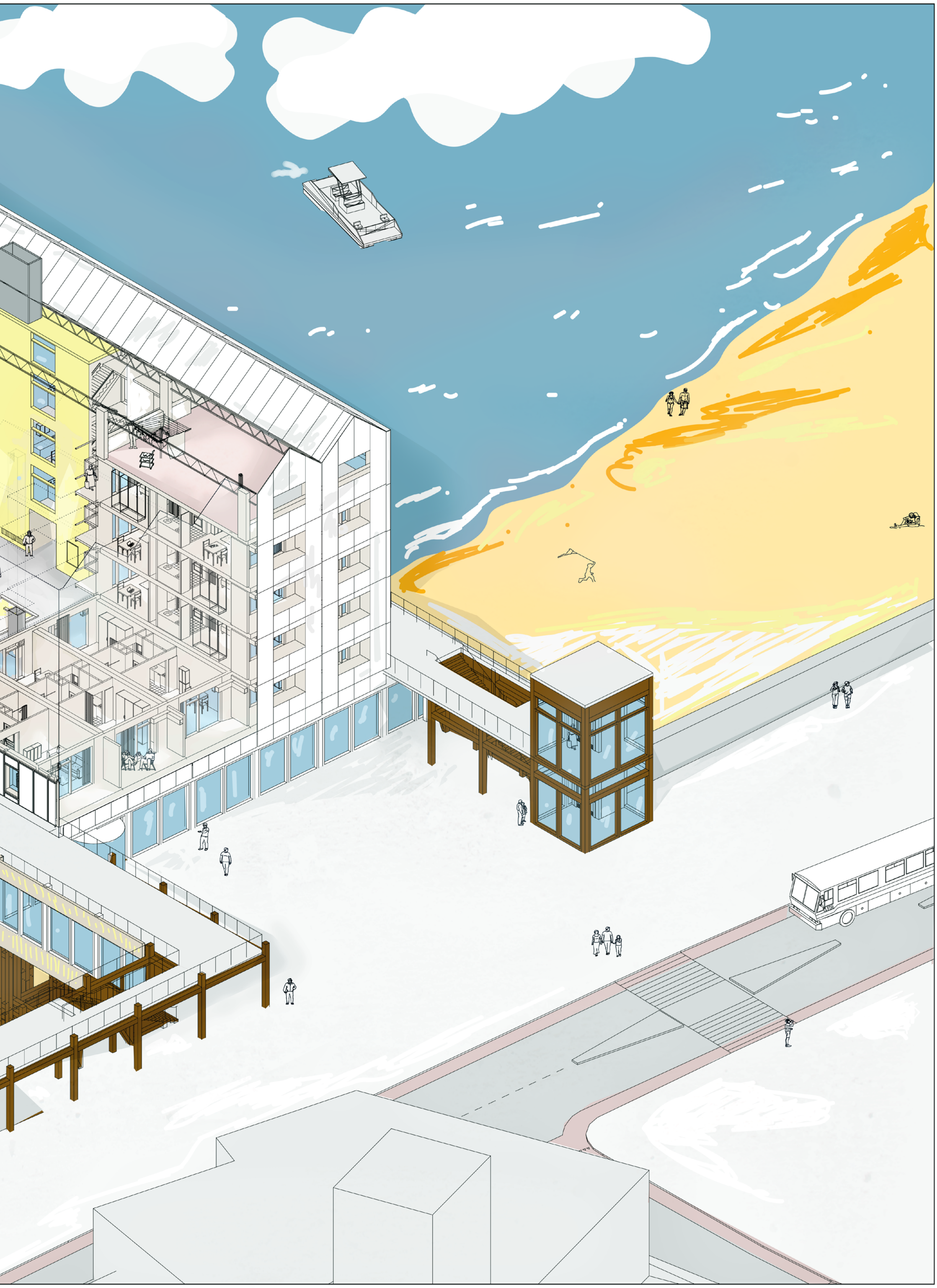
d physical therapy, first
exercise spae
Daycare
Supermarket to go
Outdoor store: beach
equipment, rentals, active
clothing, etc.
Walkway past shops,
towards ferry dock/
viewpoint/tower
Entrance to indoor
walkway

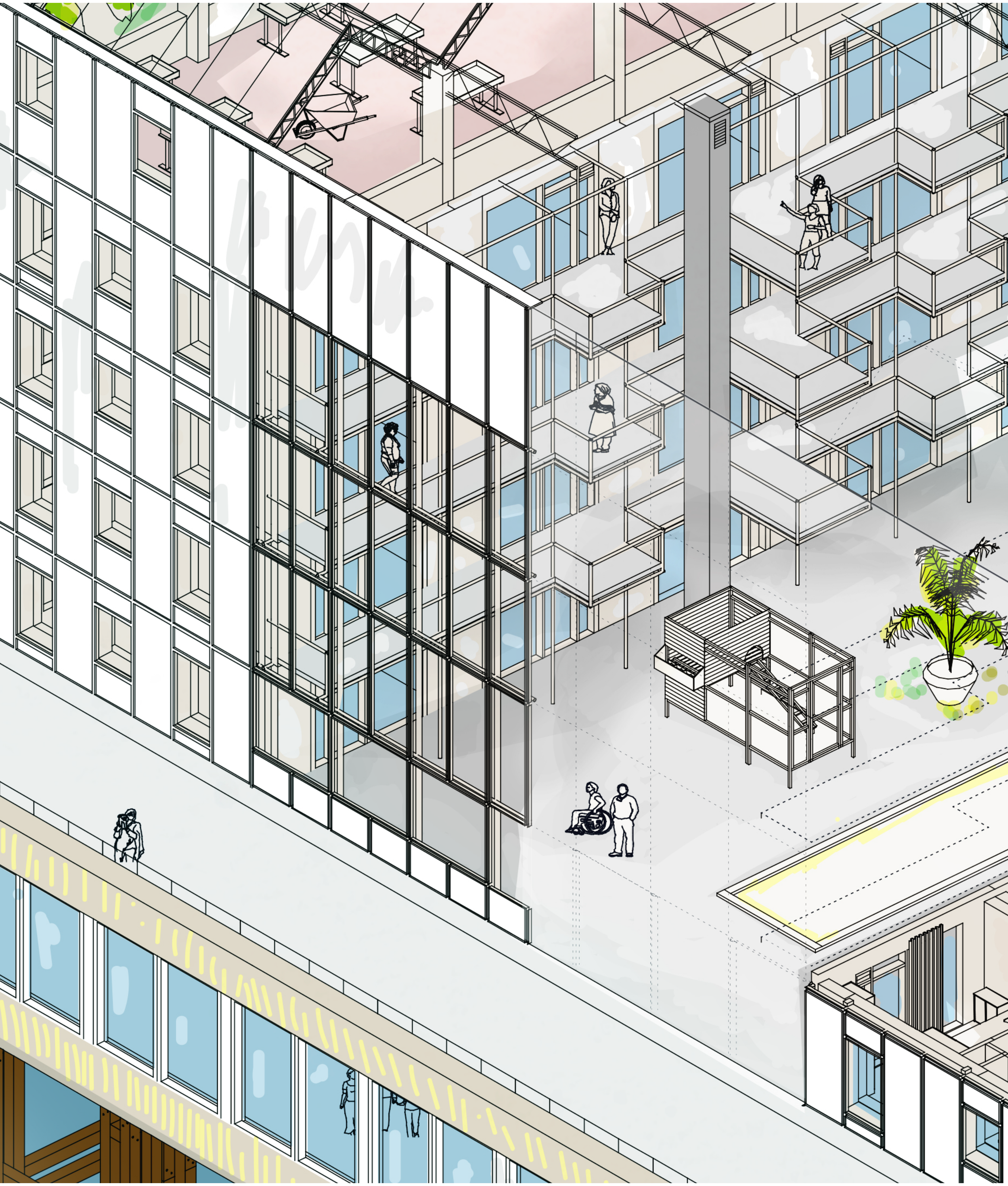


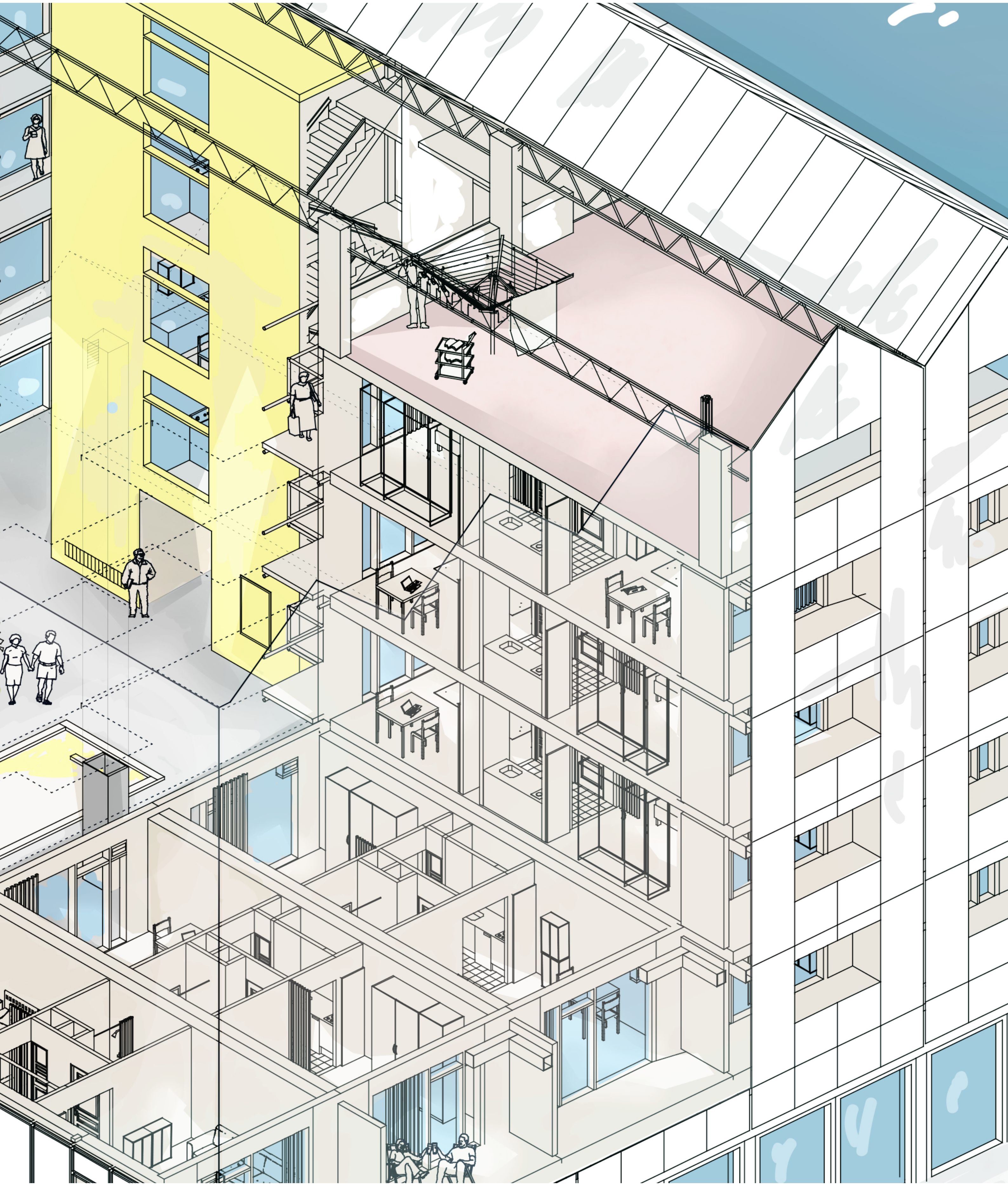
Plan 1:500



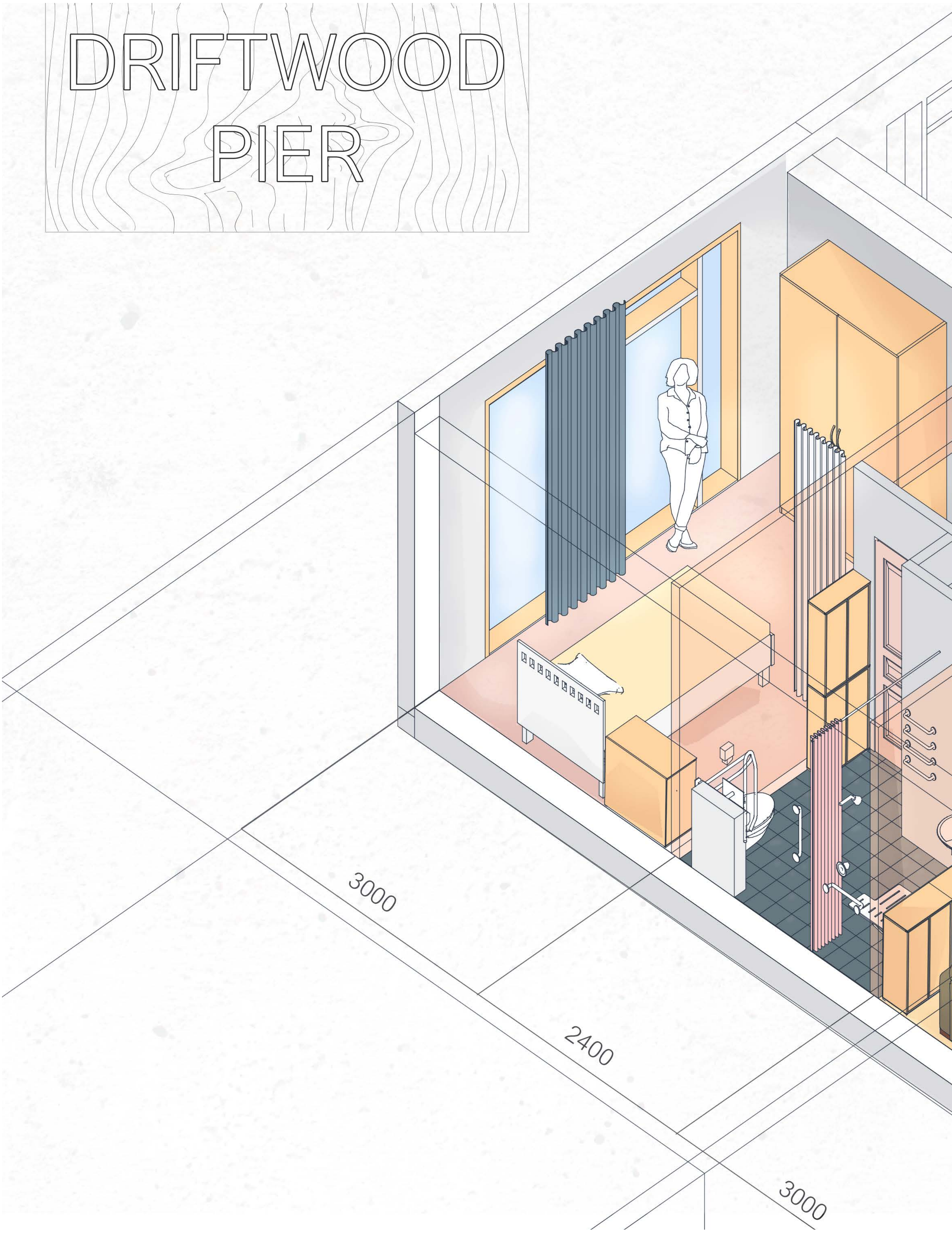

DRIFTWOOD
PIER

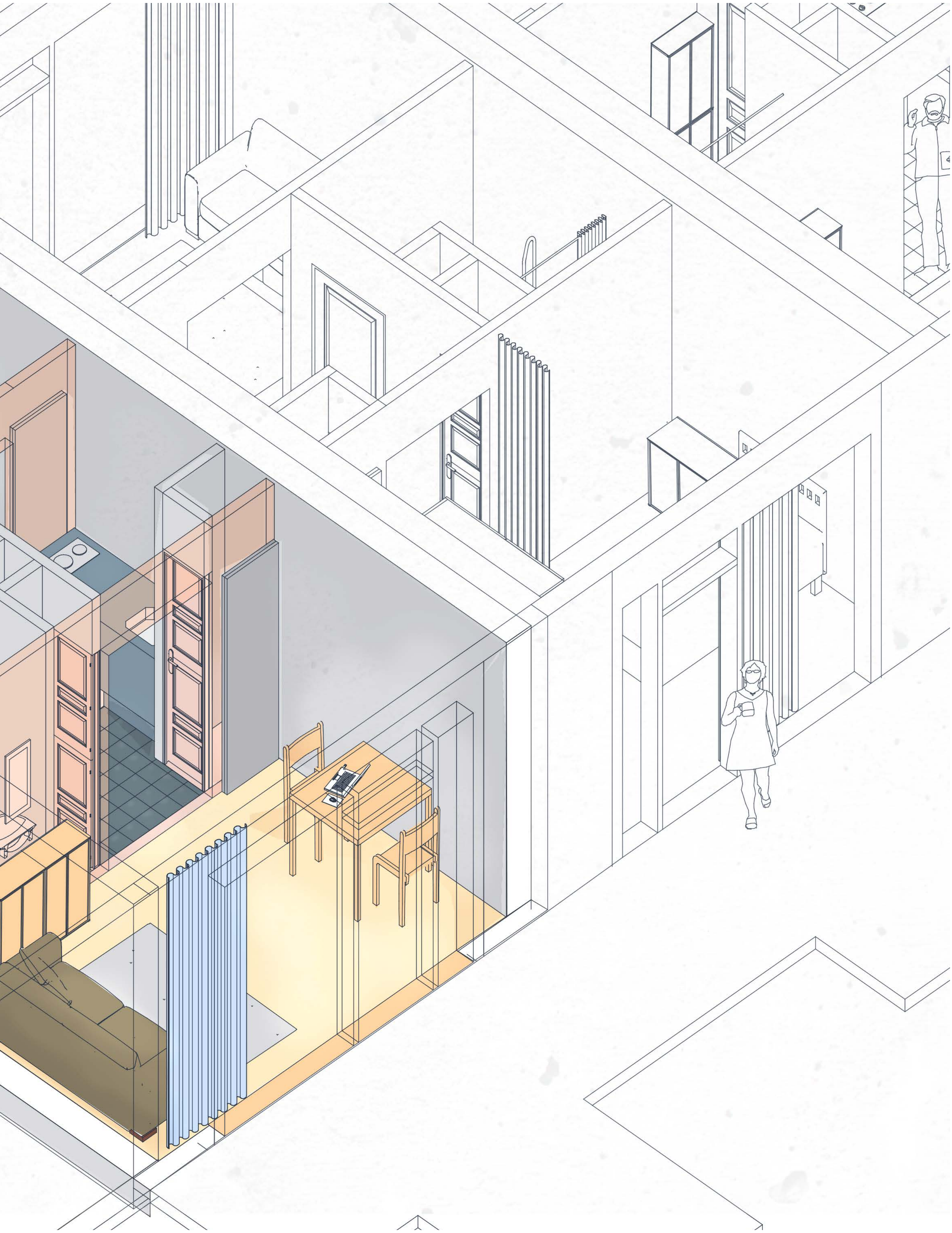


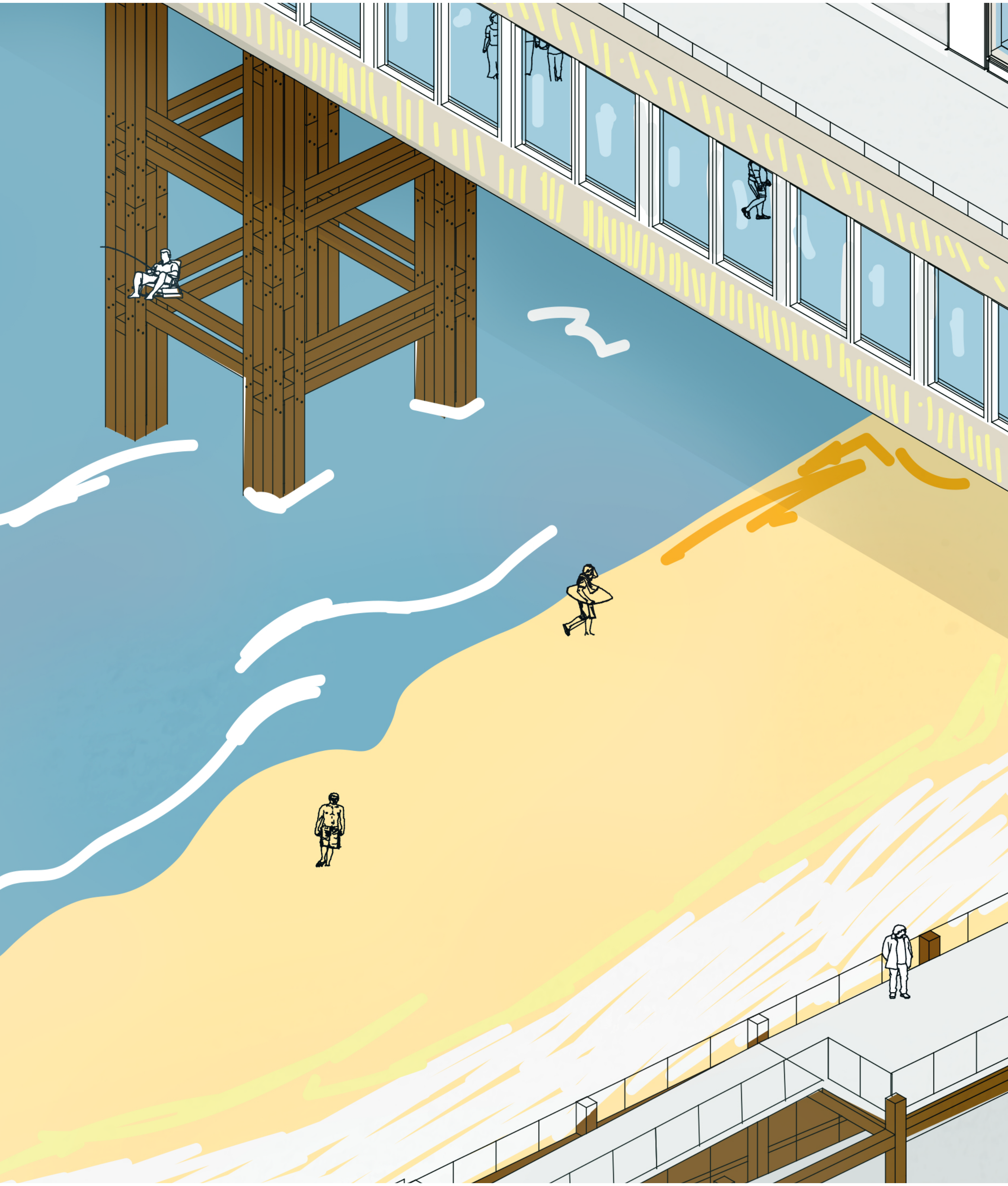


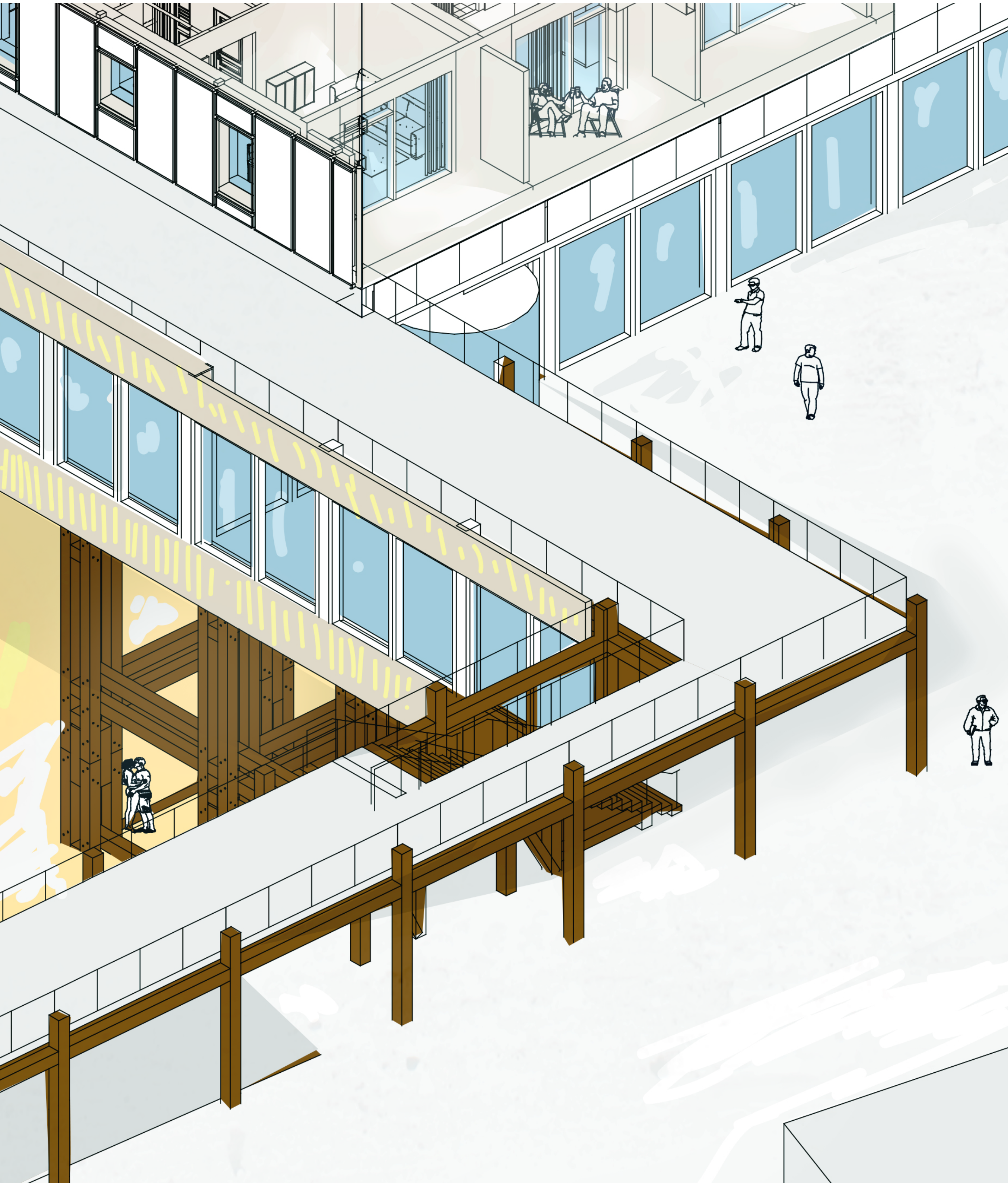


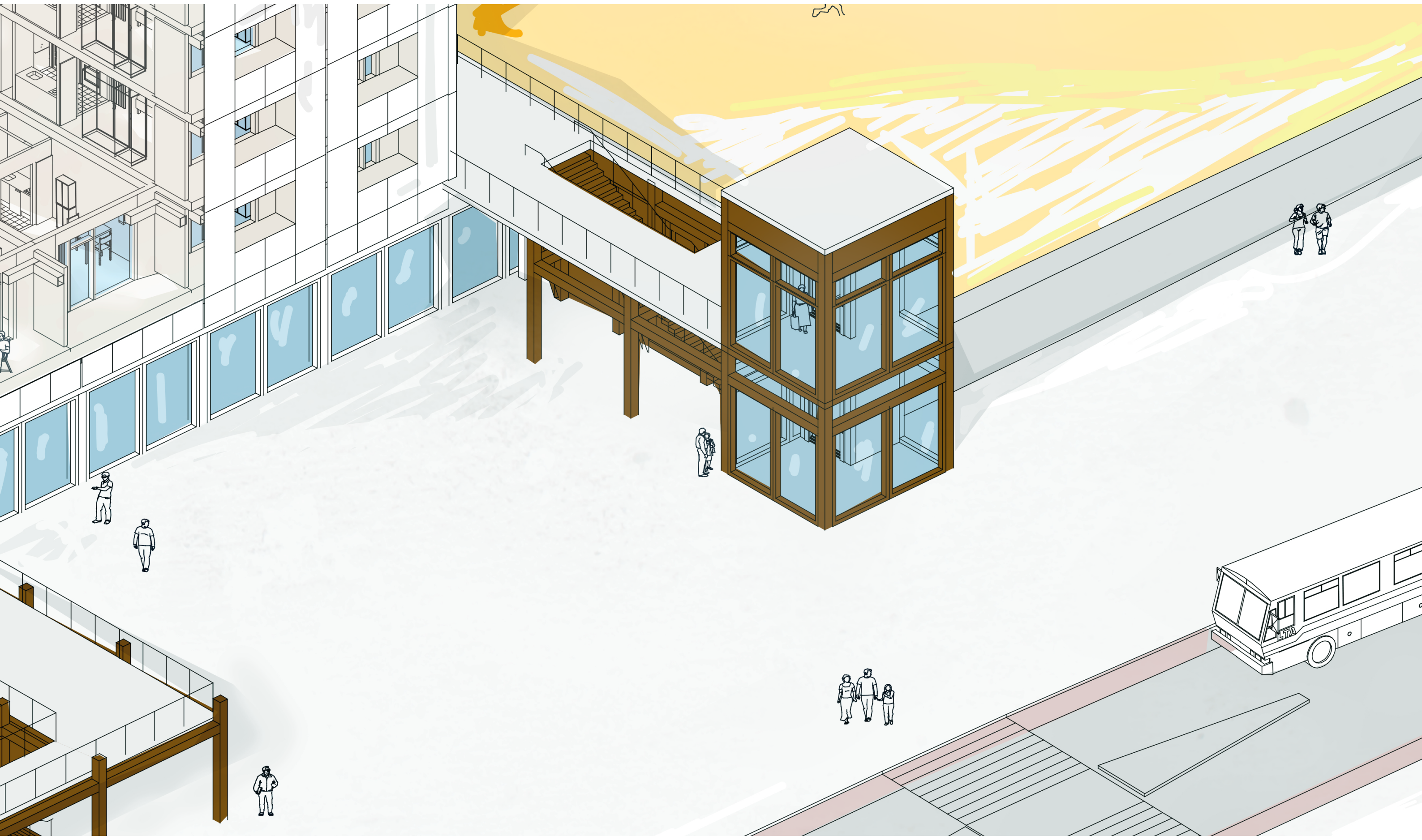
DRIFTWOOD PIER

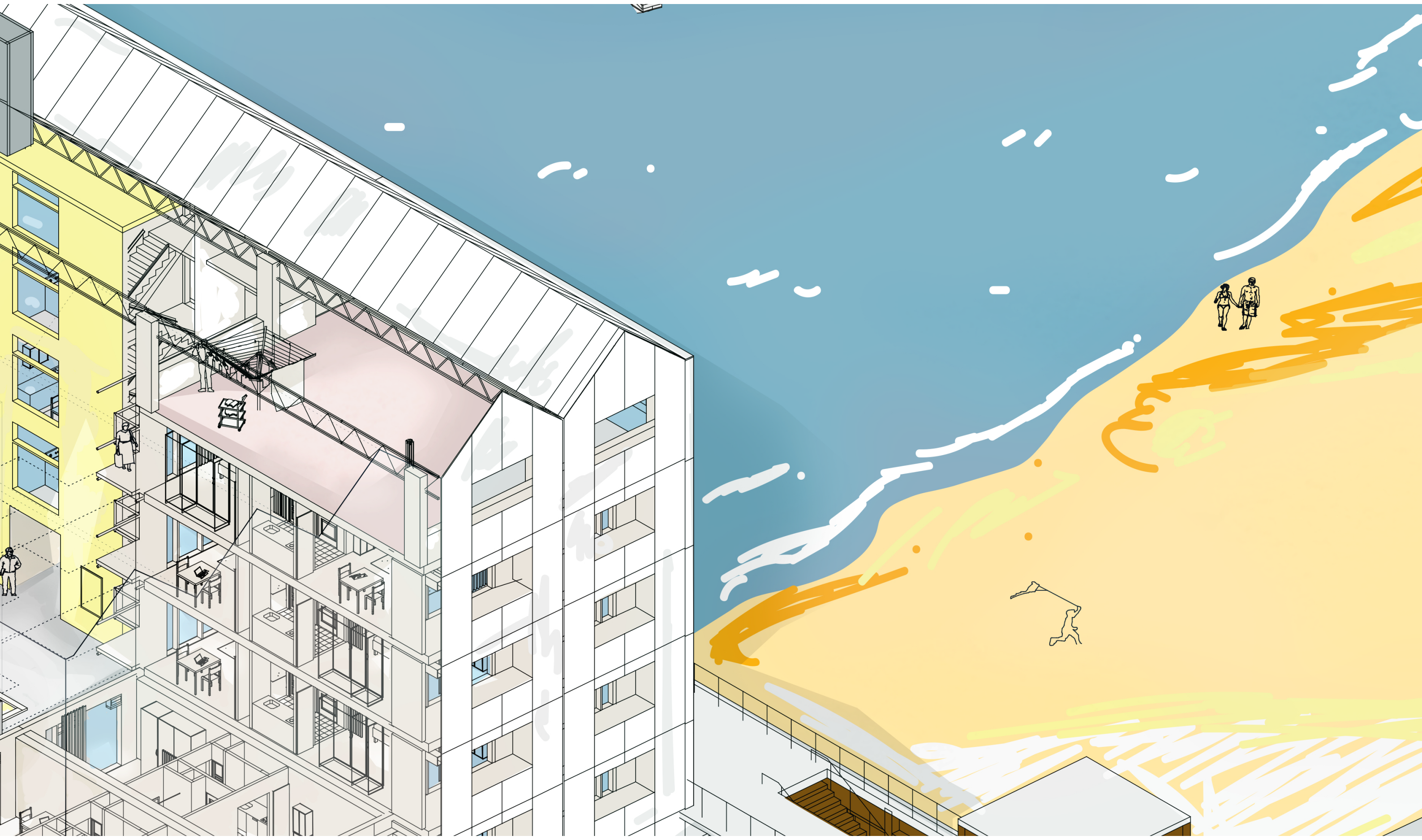


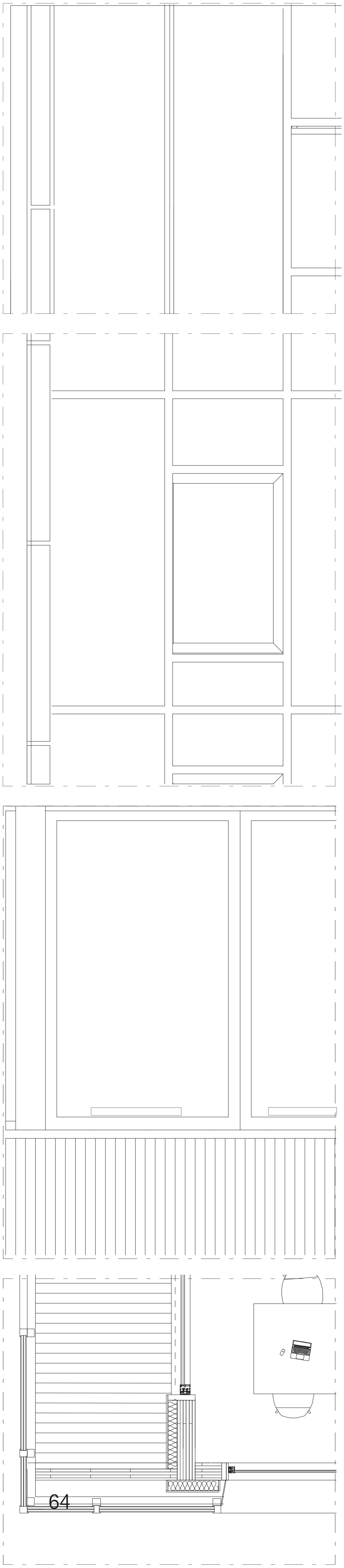












polycarbonate panels, triple layer:
5mm - 20mm - 3mm - 20mm - 8mm.

Air layers and variation of thickness of sheets increases acoustic performance of the facade.

The outer sheet will deteriorate fast and is replaced after 5-10 years.

For this the whole panels is screwed off, adjusted and replaced.

'regular' house window, behind opening in polycarbinate/ aluminium facade.

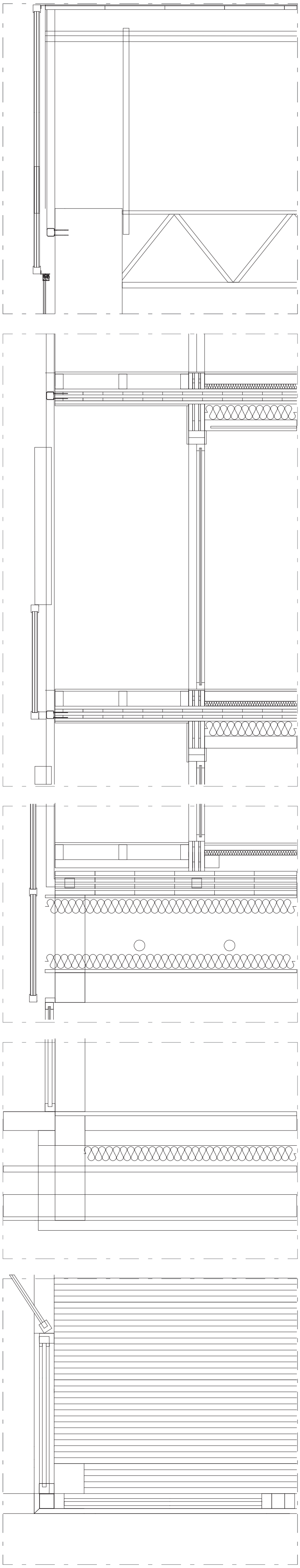
window set back with slanted connections

window of store in pier

wood cladding (cue from shipbuilding)

living area with sliding doors to balcony

pier base structure wrapped in glass facade



1. steel roof spans.

2. cladded with translucent/ opaque polycarbonate panels of triple layer. Top layer treated with UV protection and nanocoating against filth.

3. clear polycarbonate windows in north facing sides

4.solar panels on south facing sides

5.greenhouse-type cloth/screen sunscreen on wires suspended between steel rafters

1. CLT walls and floors; thermal and acoustic insulation,

2. ceiling cooling in summer and floor heating in winter

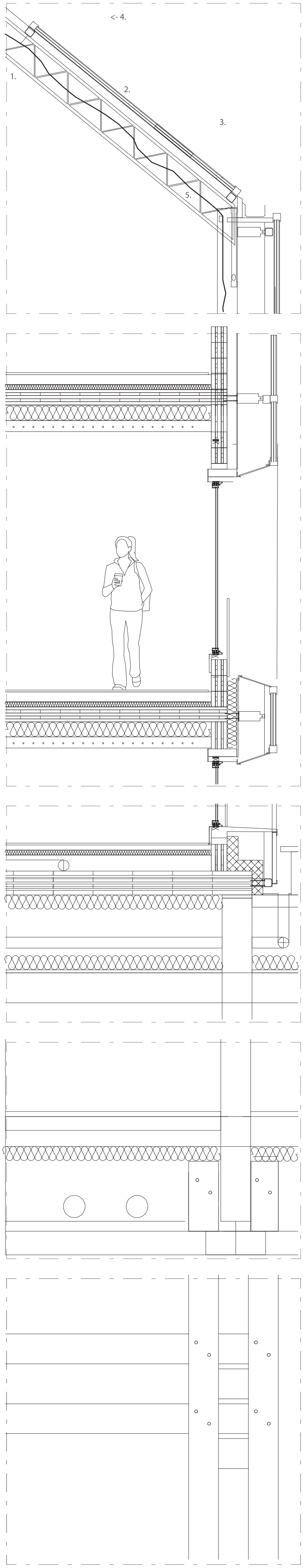
CLT stacked onto lignoforce-joined pier structure.

Space for piping of housing 600mm

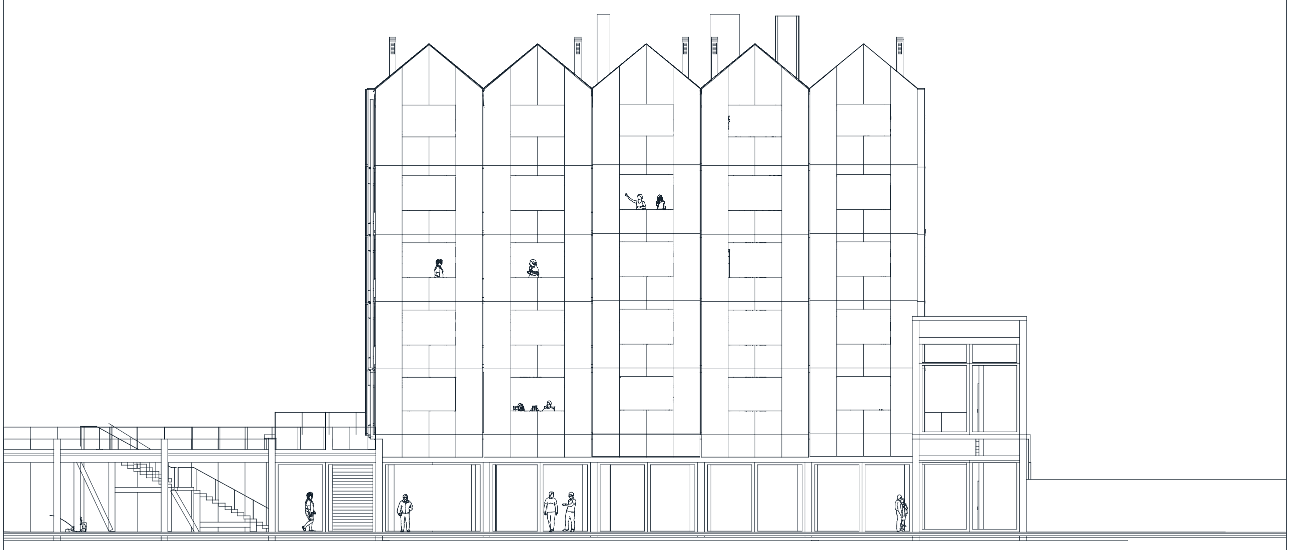
Space (600mm) for pipery connecting to city supplies. (waste recycling, sewage, drinking water)

CLT vierendeel connection with azobe pier legs

Azobe pier legs construction based on dukdalf/dolphin water timber structures



1:20 fragments



1:100 east elevation