Graduation Project by Ailsa Craigen

Past to Present to Past

Settling in the Unsettle-able

July 2018

Past to Present to Past: Settling in the Unsettle-able

A Graduation Project by Ailsa Craigen

July 2018

Delft University of Technology
Delta Interventions Graduation Studio: Landscapes of Coexistence

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Preface

In the scope of the North Sea, the focus area of the project takes place in the Thames Estuary. Inspired by *Estuary* by Rachel Lichtenstein, the notion of the passage of time is explored. During her journey on a boat from London out to the Thames Estuary, Lichtenstein recalls "My childhood memories of time spent at these places were filled with colour, noise and laughter but, seen from the water, this is a melancholy landscape of grey and purple; it looks unpeopled, abandoned, silent." (Estuary, 2016) This quote was the jumping off point for the exploration of how landscapes and urbanscapes change over time, and how our recollections and memories shape our impressions of places.

The chapters that caught my attention the most were the ones where Lichtenstein visited the Maunsell Forts. The descriptions of her time at Sealand and Red Sands Forts were so vivid because of the stories that were told of people who lived or spent extended periods of time there.

And so, as a beginning, the Maunsell Forts stand scattered around the Thames Estuary, dilapidated and ghostly.

In their infancy they stood as icons of defense, strength in numbers, and the unmovable; and in the end that was exactly correct. Designed to be floated back to shore after the war, in the end they were left in their places, primed for new beginnings. A pirate radio station, a destination for trouble-making kids, an oasis, and an escape. The forts mean something to the people who have come into contact with them, and these people become their caretakers. Discussions arise as to the future of these metal follies; what is their purpose? Are they worth saving and renovating? At the moment they are useless structures, monuments of war subjected to "romanticization". So what can we learn from the them? As initially conceived temporary structures, what lead to their permanence and territorialisation of the waters? From this, the purpose of the project is to create a territorialisation of the Thames Estuary precipitated from the perpetual growth of the surrounding urban centres and rising sea levels, based on the learnings from the Maunsell Forts.

01. Research

The North Sea

The North Sea, connected to the Atlantic Ocean, is located between the UK, Scandinavia and continental Europe. The main areas of focus during the large scale research portion of the studio looked at the UK/Thames Estuary, the coast of Norway and the Belgian-Dutch-German coast. The North Sea has served several important purposes over the years; as a battle ground, a prominent shipping area as well as a source of many energy and food resources.

Due to its extensive reach, the North Sea has played a significant role in Europe's history. It served as a catalyst for the interchange of people, goods and ideas and was a key component in the cultural development northwestern Europe.

The North Sea has a unique geological and physiological composition that varies depending on the location. Ranging from 15-30 metres deep at Dogger Bank, to 300 metres deep around Bergen, Norway, and even 700 metres in the Skagerrak, the sea floor is constantly being morphed by tidal currents. The characteristics of these areas also differ greatly; around the Thames Estuary where it is quite shallow, the sea floor is composed mostly of clay and sand, whereas further north coastlines are primarily rocky. The saline-rich properties of the water combined with strong tidal movements have cause coastal erosion on many of the North Sea's coastlines.

The economic dependence of the North Sea by Europe is quite prevalent, providing a source for the fishery industry, oil and gas, trade and transportation.

As sea levels rise, land-reclamation and flood-control projects have been greatly explored, primarily in the Netherlands. Further, as metropolitan areas continue to grow, and the land essentially continued to shrink or be threatened, projects to create a resilient coexistence between humans and nature are more and more relevant and important. (Alexander, 2015.)

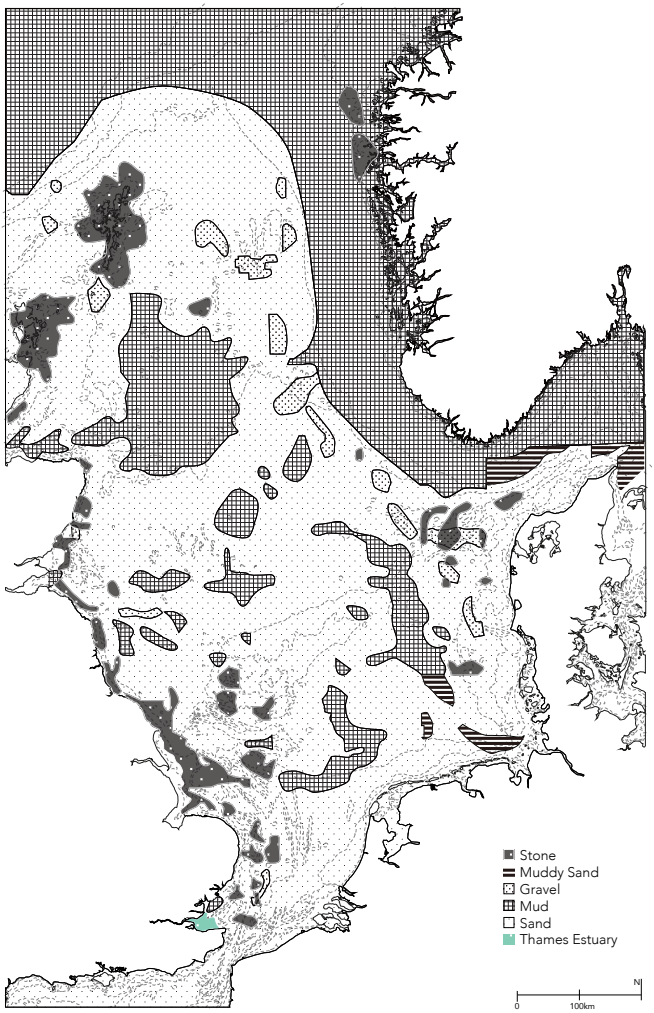


Figure 1 Bathymetry Map of North Sea

"Nautical charts become little more than a record of a moment in time" - Estuary

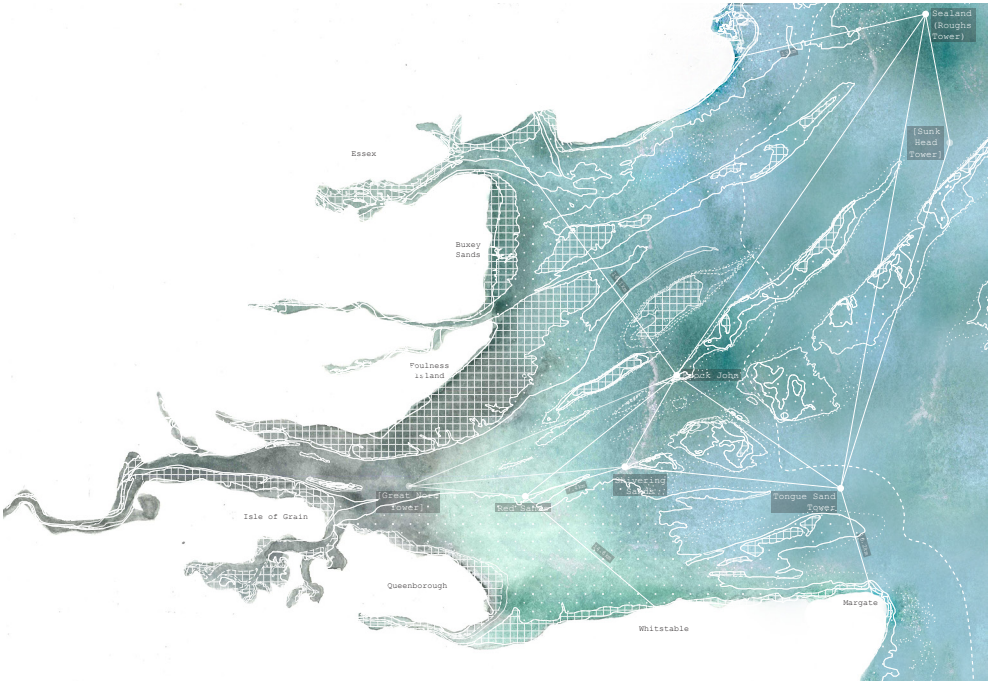


Figure 2 Thames Estuary Composite Image

The Thames Estuary

The Thames Estuary is the wider part of the waterscape where the River Thames meets the North Sea. The estuary is one of the largest inlets into the UK and is a major shipping route that leads from the rest of the world and London.

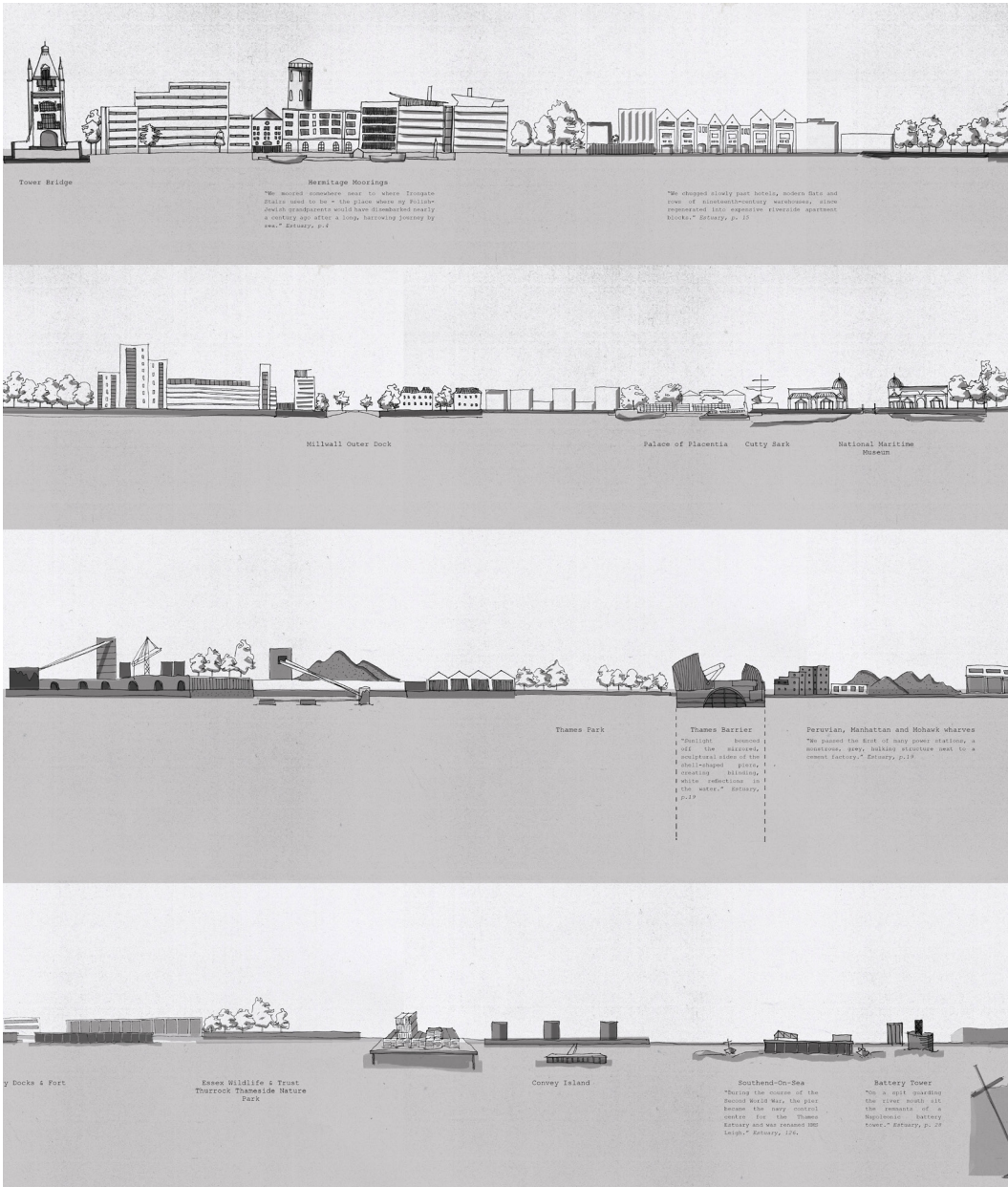
The area is characterized by the low-lying lands that boarder the estuary and continue into the middle of the waterscape. The area is comprised of mudflats, sandflats, salt marsh, reedbeds and grazing marsh. The loamy and clayey soils that make up most of the coastal flood plain create fertile land; however, the area is at risk due to increased sea level rise, which would not only affect the local ecological growth of the area but also the natural flood protection that these areas of growth provide. The coastal habitats are an important natural defense and reduce the impact of wave action along the estuary coast; however, they are being lost due to coastal squeeze, thereby affecting the balance of the estuary and its coastline as a whole. The characteristically flat, low-lying, open and expansive landscape of the estuary creates a sense of place within the water, but also along the coastline. The shallow creeks and tidal areas along the coast create a strong sense of movement, particularly of water, and enhances the dynamism of the area.

The Thames River is considered a freshwater river with a low average salinity. The estuary becomes brackish between Battersea and Gravesend. Upon reaching the North Sea, the salinity increase and freshwater fish are completed replaced by fully marine and fish fauna including euryhaline and stenohaline marine species. Internationally, the estuary is important for its coastal habitats and more than 15 000 ha. are protected by international designation.
Beyond the unique ecological characteristics of the estuary, there is a strong military history along the River Thames out to the North Sea. The coastline is lined with naval dockyards, and the middle of the estuary has remnants of WWII sea structures (Maunsell Forts), which played a pivotal role in protecting the city of London from enemy forces. Further to military history, there are important archaeological features including sea walls, iron-age/Roman salt mounds, bronze-age funerary monuments and the Saxon minister churches. (The-River-Thames.co.uk)

By mapping the Maunsell Sea Forts in relation to the seabed geology and bathymetry, architectural interventions can respond to the unique landscape of the estuary. Placing these forts reveals the issue of accessibility from the coast; they are not necessarily far, but hard to get to due to tides and shallow waters. Currently, the forts are most easily accessed by rigid inflatable boats (RIBs).

The UK territorial waters line indicates that only one (Sealand) fort lies beyond; however, this area has been disputed between the UK and Sealand. (Political layer)

Shipping routes through the estuary also influence where architectural interventions can and should be placed.


Tower Bridge
Hermitage Moorings
"We moored somewhere near to where Irongate Stairs used to be - the place where my Polish-Jewish grandparents would have disembarked nearly a century ago after a long, harrowing journey by sea." Estuary, p.4
"We chugged slowly past hotels, modern flats and rows of nineteenth-century warehouses, since regenerated into expensive riverside apartment blocks." Estuary, p. 15
Millwall Outer Dock
Palace of Placentia
Cutty Sark
National Maritime Museum
Thames Park
Thames Barrier
"Sunlight bounced off the mirrored, sculptural sides of the shell-shaped plinth, creating blinding, white reflections in the water." Estuary, p.19
Peruvian, Manhattan and Mohawk wharves
"We passed the Kvik of many power stations, a monstrous, grey, bulking structure next to a cement factory." Estuary, p.19
Essex Wildlife & Trust Thurrock Thameside Nature Park
Convey Island
Southend-On-Sea
"During the course of the Second World War, the pier became the navy control centre for the Thames Estuary and was renamed HMS Leigh." Estuary, 126.
Battery Tower
"On a spit guarding the river mouth sit the remnants of a Napoleonic battery tower." Estuary, p. 29

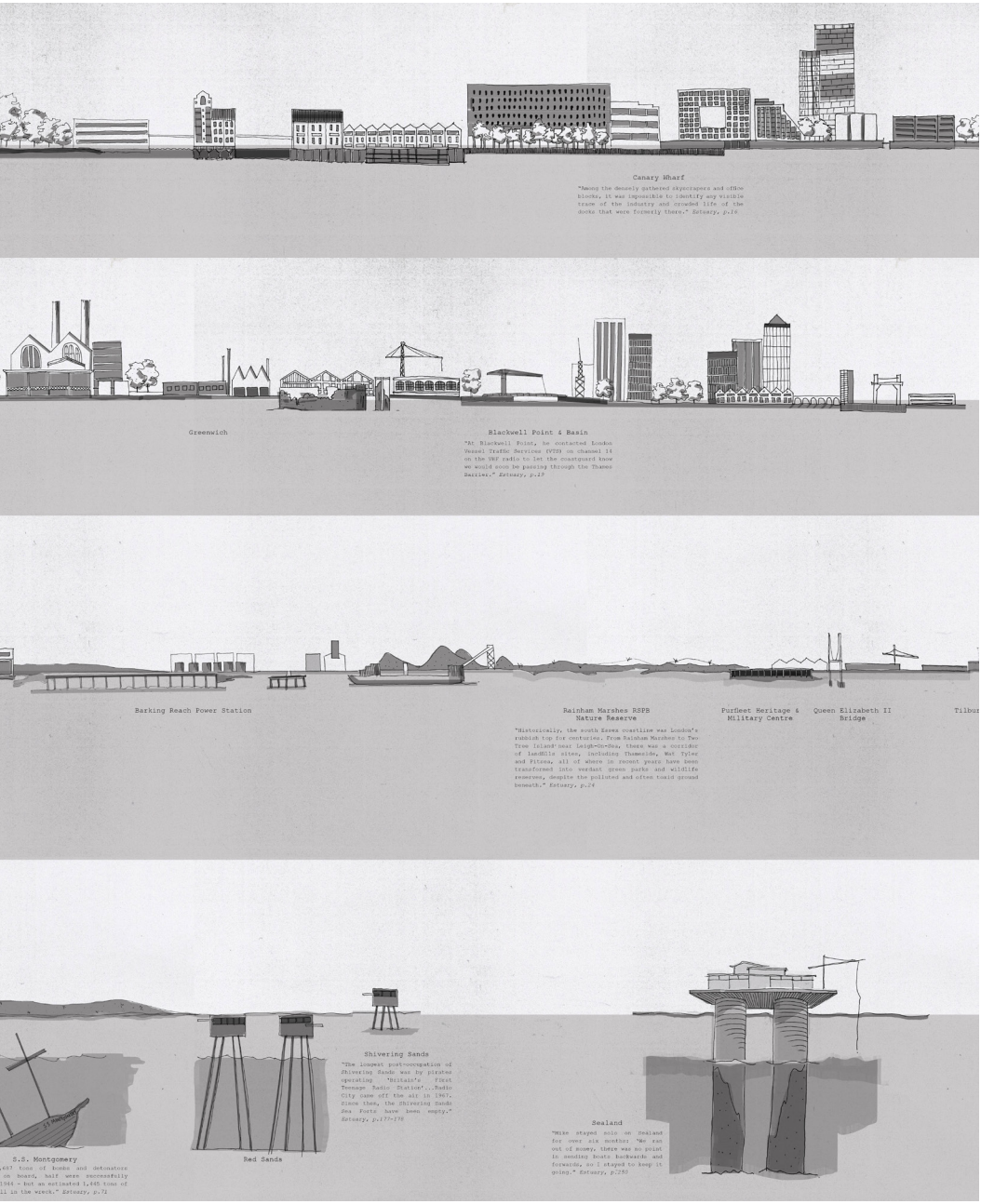


Figure 3 Experiential Elevation

Beginning from the Tower Bridge, London, the drawing highlights landmarks and forgotten places as one heads from the Thames River out to the Estuary.

Figure 4 Red Sands Forts during assembly

The Maunsell Sea Forts

The Maunsell Sea Forts, designed by Guy Maunsell during the Second World War, were considered "somewhat eccentric" and were designed as offshore forts to deal with the laying of mines by the Axis powers. After some modifications four offshore forts were manufactured of "reinforced concrete construction, built on land on a lozenge shaped reinforced base, and towed out to sea where they were sunk onto the seabed." Since their original use as forts for the Royal Artillery Reserve, the Maunsell Forts have taken on many other uses such as the location of a pirate radio station, or a destination for young teens to seek adventure. The stories and memories held by those who have spent time at the forts are an important aspect of their history.

"As we approached, we saw some pongoes hanging out of the window, they were keen for us to visit, anything to alleviate the boredom. So we climbed up some rickety ladders on to one of the forts." (Estuary, 2017.)

The design of the sea forts employed a "generic but pure technical" solution, a cluster of seven structures connected by steel gangways. Each of these clusters were scattered beyond the three-mile limit of British waters and were not as easy targets for planes flying above. The forts served a dual purpose as a checkpoint and barrier and extended the reach of the British territorial control into the Thames Estuary. The intention of the British Army was to construct 49 towers and connect them by phone cables underwater; however, only four forts (28 towers total) were realized. Each tower in the fort served a different purpose; a central radar/control tower, four heavy anti-aircraft gun towers, a light anti-aircraft gun tower, and a searchlight tower. Each tower had their own sleeping quarters and each fort could accommodate between 165-265 soldiers. As aforementioned, the Maunsell Forts have housed vastly different functions since their original use during WWII. In the mid 1960s a number of the forts were re-occupied for pirate radio stations until legislation was passed against the pirates in 1967. Roughs Tower, a naval fort has been occupied by the same family since 1964 and is known as the micro-principality; the Principality of Sealand, a self-proclaimed independent nation.

"When we reached the top of the ladders, we went directly into the tower, which is a building of floors. Inside, it was full

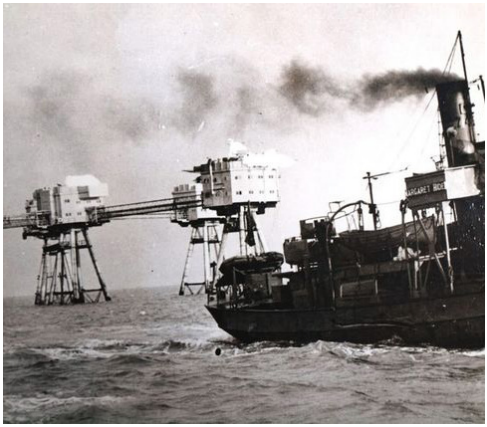


Figure 5 Red Sands Forts during WWII

Figure 6 Red Sands Forts while inhabited by navy soldiers during WWII

of rush and dust and all sorts of rubbish. Nothing really gets taken away from the forts because it is so hard to unload back on to the boats, so they are filled with strange bits and pieces: posters, tin mugs, papers, saucepans – a trail of stuff from those who have occupied the place at different points in time." (Estuary, 2017.)

While some of the Maunsell Forts were destroyed either during the war or after, some of few that remain are in serious decay. Red Sands Fort is currently the only of the remaining forts that can be accessed, though due to structural instability, the gangways that connected the seven towers have been removed. The fort is maintained by Project Red Sands who took on the task of trying to preserve the structures after threats of demolition in the early 2000s. Currently, the group is looking for uses for the fort and are in talks to develop the structures into a luxury hotel.

The Maunsell Forts are not located far from shore; Red Sands is 14.8km from Whitstable, Tongue Sand Tower is 10.2km from Margate, and Sealand is 13km from Essex. While they are not necessarily far, they are difficult to access due to drastic tide changes and shallow waters. Currently, the forts are most easily accessed by rigid inflatable boats (RIB's), that are substantial enough to navigate harsh waters, fast, and most importantly can deal with shallow water. Reminders of how quickly the tides can change are scattered all over the estuary with beached boats and shipwrecks who "broke their backs" thereby preventing them from ever being able to float again. If the Maunsell Forts are to have any significant future, the issue of accessibility from shore, as well as from the water up to the towers, will have to be addressed.

Currently, only one fort, Sealand (Rough Sands), lies beyond the UK territorial waters line. Sealand claims to be an independent nation as the Principality of Sealand; however, there is dispute on this claim by the UK. This raises the question as to if there is to be development in the Thames Estuary, and expands beyond the official UK territory line, how is this area governed, and who is responsible for it?

Forts as Memory

One of the most insightful research sources was the book *Estuary* by Rachel Lichtenstein. It in, she describes her time on a boat on several occasions in various parts of the Thames River and Estuary. Many of her interactions with locals are documented and provide rich insight into the history and memory of the Thames as well as the Maunsell Forts. The recollections of stories by these people provided the inspiration for the project's focus. By getting a sense of the people with deep connections to the site, the proposed project can be enriched to consider the future of these individuals and their surroundings.

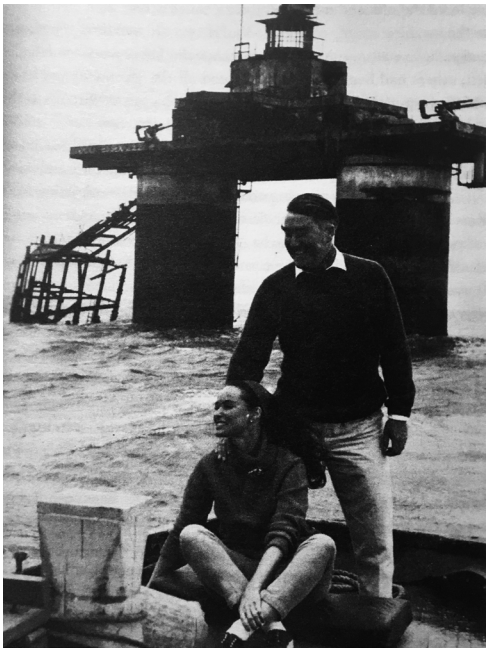


Figure 7, 8 Inhabitants of Sealand

"The legendary adventurer Paddy Roy Bates had formerly been a major in the Royal Fusiliers, and he wanted to go and have a look at Knock John Fort - previously, a Maunsell navel fort - in the mouth of the Estuary. 'We climbed up this rickety metal ladder off the boat and had a walk around,' said Michael [Bates]. 'It was derelict inside and very dark. There were loads of cormorants about the place. We explored the officers' mess and the captain's cabin, then went down to the machine room, where were found old wartime generators and some live ammunition on a workbench."

Estuary, 2016

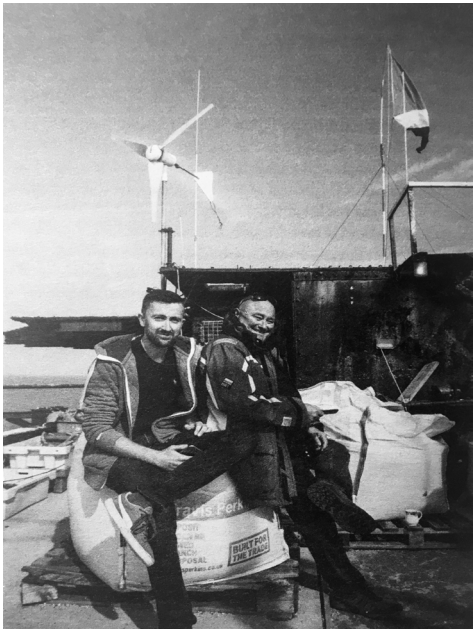


Figure 9 James and Michael Bates

"From an early age, it was just normal that my family had a sea fort in the middle of the Estuary, my brother and I used to get lifted up in a little crate. I remember peering over the edge at the sea - I must've been a toddler."

- James Bates, Prince Royal of Sealand

Estuary, 2016

"We ran out of money, there was no point in sending boats backwards and forwards, so I stayed to keep it going"

- Mike Barrington, Head of Homeland Security for Sealand

Estuary, 2016

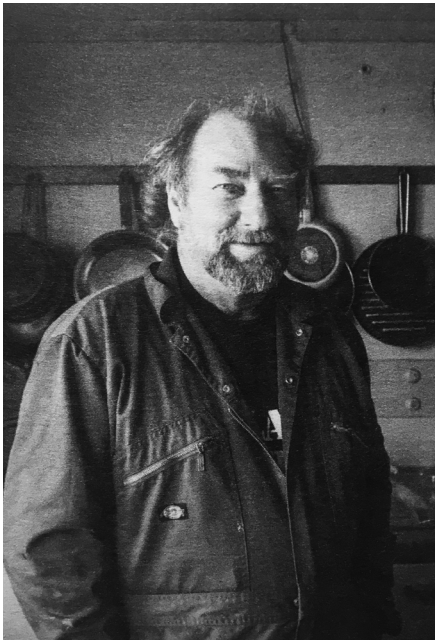


Figure 10 Mike Barrington

Forts as Past, Present & Future

This series of panels explores the various changes that the Maunsell Sea Forts underwent during their tenure in the Thames Estuary; from first being floated out during WWII, to considerations of their use in the future.

Viewed individually, each panel discusses a chapter in the life of the forts, but when read as a collection, the viewer gets an entire picture of the forts and the various roles they have played over the years. Similarly to how the forts are viewed in situ, one can see remnants of the different chapters by how the structures have weathered, or by the various relics that have been left behind by inhabitants. In this way, the forts can be read as objects from the past, the present and the future simultaneously.

The forts mean different things to different people based on their own personal experiences of them, or what they have heard of them from others. Figure 11 conveys the notion that different people can observe the forts at the same time, but have a different response to them based on their background.

The scenario in which my thesis projects exists is alluded to as the series moves towards the right; the urban area expands further and further towards the coastline and eventually reaches the threshold between the land and water. The consideration at this point is what happens? Does the city continue to grow or has it reached its end?

The future of the forts in the wake of expanding cities into the water was a major consideration for the project. The blank silhouette of the fort represents an uncertain role of the structures in the future in this condition. To take a position, in the end, the decision was made to leave the forts as they are to eventually fall away in the upcoming decades and to rely on intangible heritage to keep their memories alive.

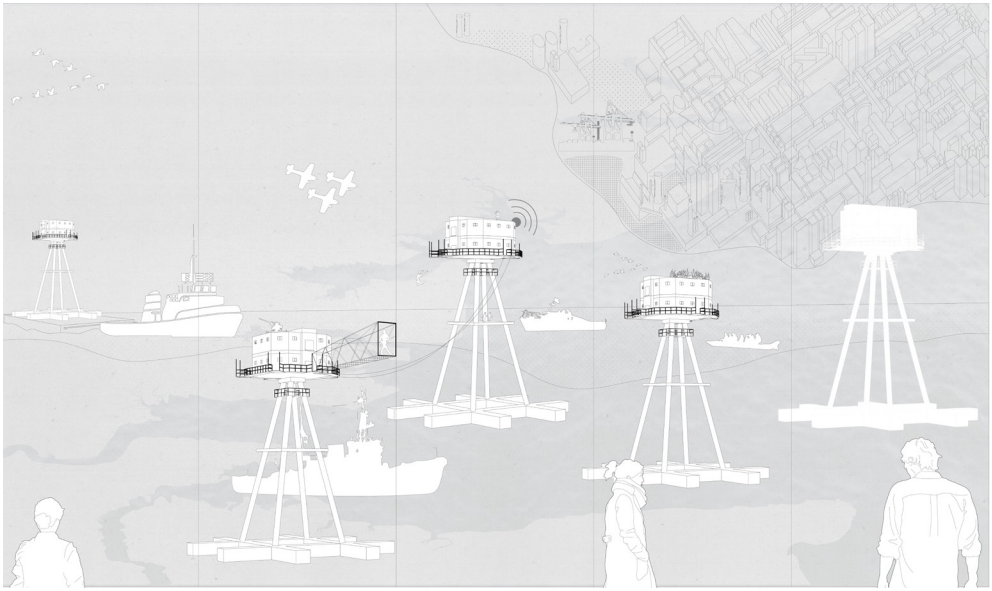


Figure 11 Red Sands Forts Through Time

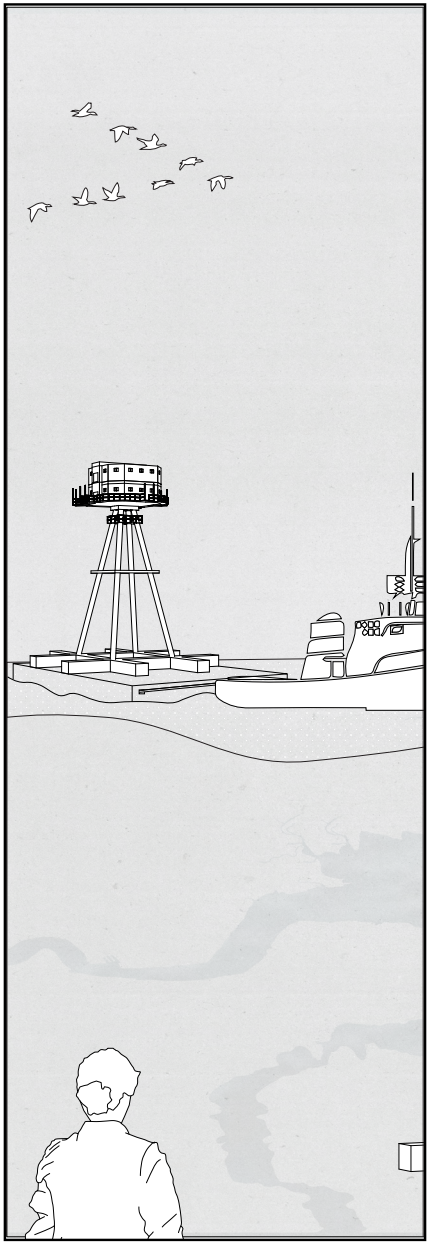


Figure 12 Red Sands Forts Floated Out

Chapter 1

"At the time Guy Maunsell's ideas were considered somewhat eccentric, but he was asked to submit plans for an offshore fort as an effective means of dealing with the laying of the mines. Plans were drawn up, and after some modification, approval was given for the manufacture and installation of four offshore forts. These were of mainly reinforced concrete construction, built on land on a lozenge shaped reinforced base, and towed out to sea where they were sunk onto the seabed."

Figure 13 Red Sands Forts WWII

Chapter 2

"As part of his research, Stephen managed to track down John Proctor, who had worked as the medical orderly on the Shivering Sands Sea Forts in 1944. He was in his eighties when Stephen interviewed him. On the forts, some of the men could no read or write, and one of Proctor's jobs was to write their letters and read the replies to them. He acted as a kind of counsellor, listening to the soldiers who came to see him. Some found their tour duty at the forts stressful: they weren't frontline troops, they were Royal Artillery Reserve; they did not like being out at sea, the felt incredibly cut off and isolated. Grown men came to him in tears."

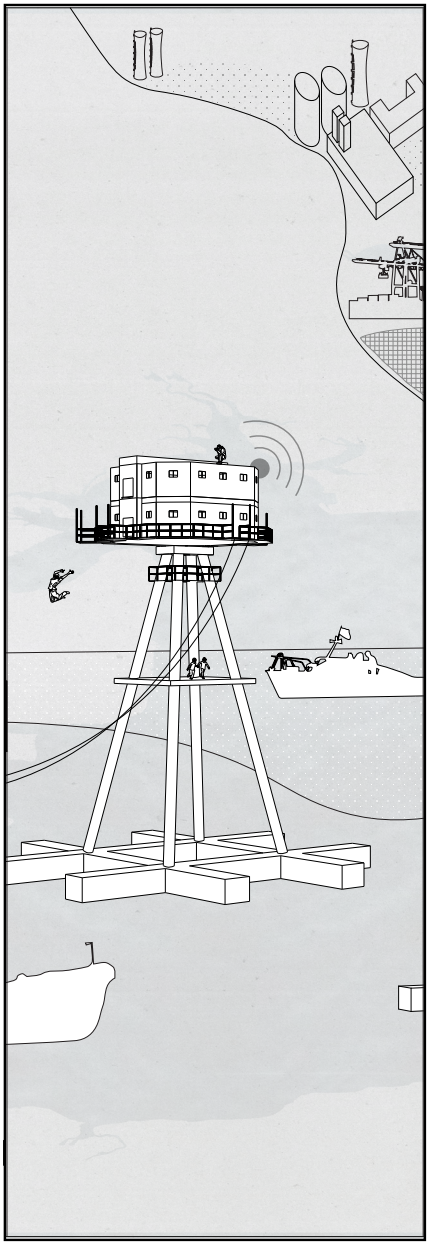


Figure 14 Red Sands Forts Pirate Radio

Chapter 3

"As we approached, we saw some pongoes hanging out of a window, they were keen for us to visit, anything to alleviate the boredom. So we climbed up some rickety ladders on to one of the forts. It was horrible inside, very partain. They were having a party for one of the soldiers' nineteenth birthday. The army cook made a wretched cake, which looked as though it was covered in ball bearings. We had a sing-song ate the cake, drank some tea, then the wind got up so we stayed the night in the soldiers' quarters on pope-cots, which were like shelves with mattresses on - they were pretty rudimentary. We had no way of contacting our parents. My father went out on the mud in the middle of the night, looking for the body of his son. We got hell off our parents when we got home the next day."

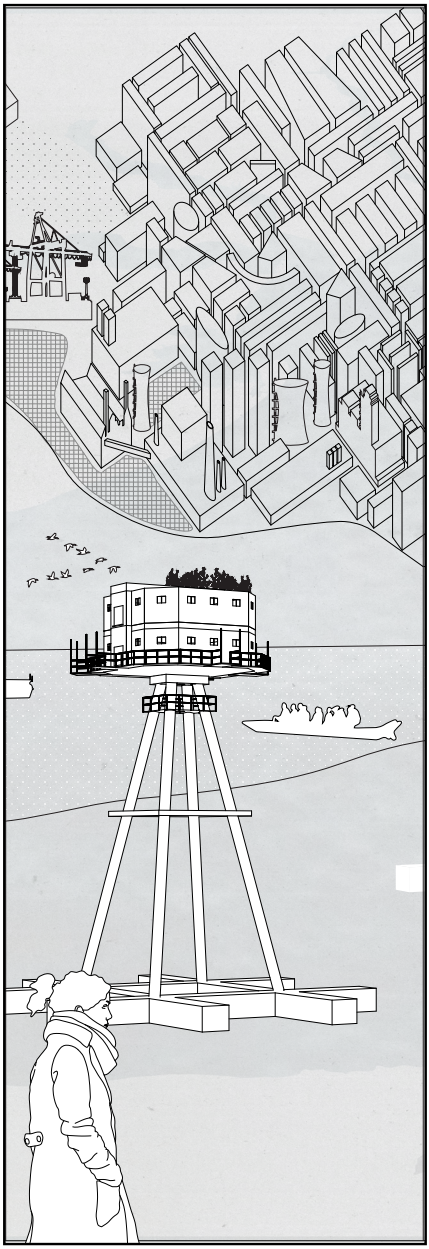


Figure 15 Red Sands Forts Abandoned

Chapter 4

"When we reached the top of the ladders, we went directly into the tower, which is a building of two floors. Inside, it was full of rust and dust and all sorts of rubbish. Nothing really gets taken away from the forts because it is so hard to unload back on to the boats, so they are filled with strange bits and pieces: posters, tin mugs, papers, saucepans - a trail of stuff from those who have occupied the place at different points in time."

"Historically, the south Essex coastline was London's rubbish top for centuries. From Rainham Marshes to Two Tree Island near Leigh-On-Sea, there was a corridor of landfills sites, including Thameside, Wat Tyler and Pitsea, all of where in recent years have been transformed into verdant green parks and wildlife reserves, despite the polluted and often toxic ground beneath."

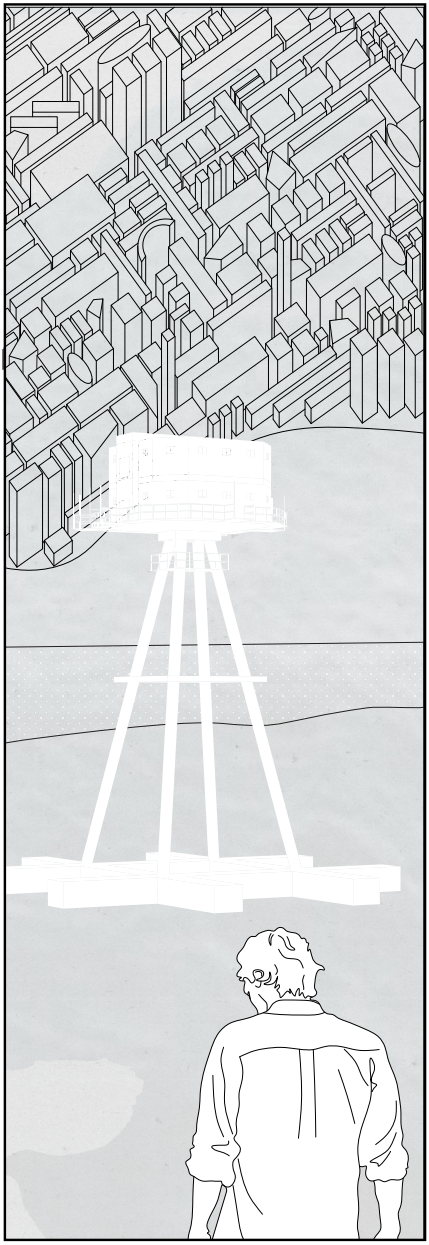


Figure 16 Red Sands Forts Future

Chapter 5

The City of London has reached its maximum growth on land along the River Thames and has reached the Thames Estuary. The city intends to grow further to accommodate more people coming to the city looking for the same services available to those living on the mainland. The Maunsell Forts, a symbol of protection of the city from the threats of the North Sea inspires growth in the seascape to protect the city from natural disaster.

"The follie distorts time, place and space and in so doing mixes magic with mystery, fun with fantasy, now with then."

Cedric Price, The Folly

Forts as Follie: Research

The theme of the Maunsell Forts as follies was central in the research process for this project. In architecture, a follie is defined as a "building constructed primarily for decoration, but suggesting through its appearance some other purpose". Typically without function, a follie is typically constructed to enhance its natural landscape surroundings. Of course, the Maunsell Forts were constructed for a very specific purpose; however, the consideration of the forts after their useful life reflects on what their current purpose is. In a sense, the forts are currently a kind of ornamentation in the Thames Estuary. They are sculptures that refer to the history of the seascape and are often romanticized by visitors, photographers and artists.

The research into the forts decomposes them into their parts beyond recognition and reassembles them in various ways to see how their meanings change when their forms or configuration is altered. By using the same parts and assembling them into a nonsensical fashion, the forts truly take on the definition of a follie, a structure with no function. In parallel, the deeper consideration of what a follie is was explored through the work of John Hedjuk's Mask of Medusa, a collection of hundreds of drawings exploring different themes but in non-functional forms. Almost monster-like, these sketches echoed the forms of the Manusell Forts and methodology presented by Hedjuk lead the framework for the exploration and deconstruction of the forts during the research component of the project.

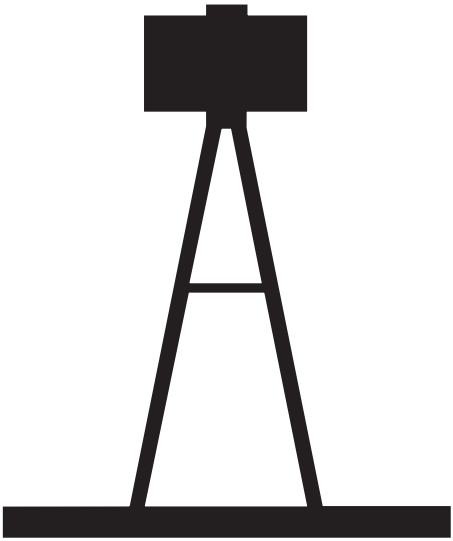


Figure 17 Fort as Follie

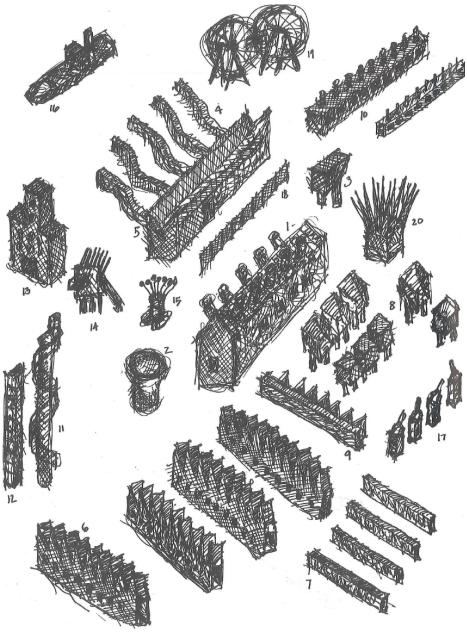


Figure 18 Mask of Medusa, Berlin 1983. John Hedjuk.

"Instead of having a set message of its own, it interacts with other elements to create something else, [a] model of the city of the future."

Arata Isozaki, Osaka's Green Crossroads

"In a way they are like dancers, who can create momentary spaces with the movements of their bodies."

Koji Taki, Imagination & Excess

Osaka Follies

"Despite everything, the follies managed to project a consciously international image that contrasted sharply with the standard pavilions. It could be said that they set a historic precedent, allowing architects of different nationalities to undertake highly individual projects." - Koji Taki.

The Osaka Follies was a design exhibition in 1990 held in the Parc de la Villette where architects explored architectural ideas through fantasies through the design of follies. As follies do no have a function, these were pure ideas manifested in pure forms.

In the research of follies these experimentations showed how ideas can be demonstrated when function is of no consequence. Additionally, the writings of what a folly is by architects such as Macdonald & Salter and Architecturburo Bolles-Wilson provided insight into how the folly medium can change state over time, acquiring different meanings and qualities. This notion is important in the future consideration of how the design intervention on the water will take on different meanings and qualities over time.

"An architecture which is briefly observed and impermanent while simultaneously striving for a sublime relationship with nature."

Macdonald & Salter, Osaka Follies

"A follie is one of those magical things that must first exist as a pure object - an object of delight. Only later does it acquire, almost accidentally, qualities of use and even meaning."

Architecturburo Bolles-Wilson, Osaka Follies

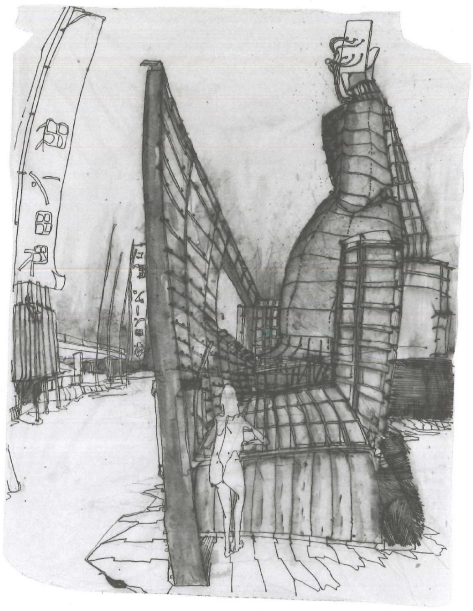


Figure 19 Osaka Follies Sketch by Macdonald & Salter, 1991.

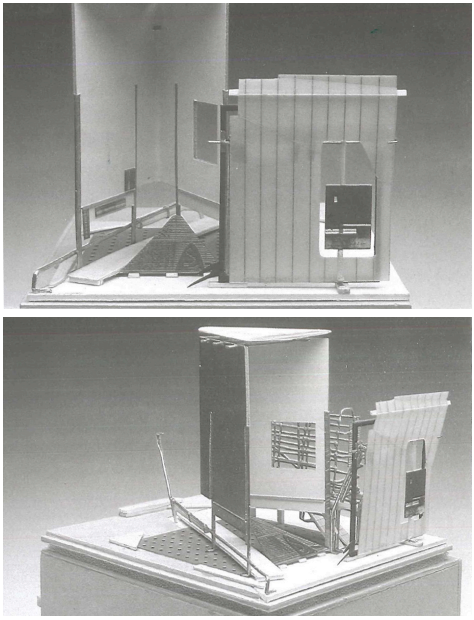


Figure 20 Osaka Follies Model by Architecturburo Bolles-Wilson, 1991.

Forts as Follie:
Bending Time

Figure 21 Red Sands Forts: Composite Image. Ailsa Craigen, 2017.

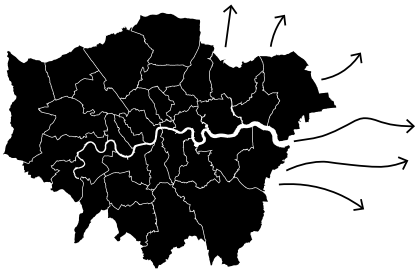
Figure 22 Sealand: Composite Image. Ailsa Craigen, 2017.

The composite images express various times in the histories of both Red Sands Forts and Sealand to be read simultaneously as a structure that bends time by encapsulating various time periods at once. The forts bend and distort time by keeping a record of their history through the preservation of objects such as radio station equipment and crafts made by soldiers during the war. The slowly dilapidating structures show a passage of time; however, if you enter the forts themselves you can be transported back to time periods where they were inhabited.

The Project

Urban Question

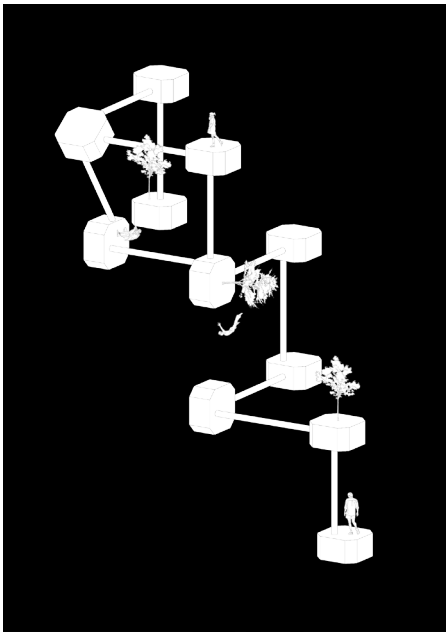
How can an urban environment on the water successfully respond to the needs of people in the current situation and iteratively grow and adapt to these changing needs in a dynamic seascape?



Architectural Question

How can a strategy for architectural interventions be replicated in various locations while still responding to site-specific elements?

Sub-question: What can we learn from the Maunsell Forts to achieve this?



Proposition

The growing need to address sea level rise prompted by climate change, calls for an architectural intervention, a follie, to passively facilitate urban growth in the water. To take advantage of the rich intangible heritage of the Thames Estuary to promote a close relationship between a new type of urban area and the dynamic waterscape.

Project Principles

1. Follies to guide movement through the estuary in relation to the Maunsell Forts.

2. Out of conflict a more adaptable and resilient architecture and urban fabric is developed.

3. Urbanising the waterscape

4. Follies as a response to an event or need.

5. Follie network grows iteratively, each new one learning from the previous. (living lab for adaptable and resilient strategies for living in the water)

6. Bringing follies from the land, back to the water.

7. Once skeleton follie network is complete, urban growth can begin.

8. Follies brought to locations and house functions based on the needs of the location.

The Project

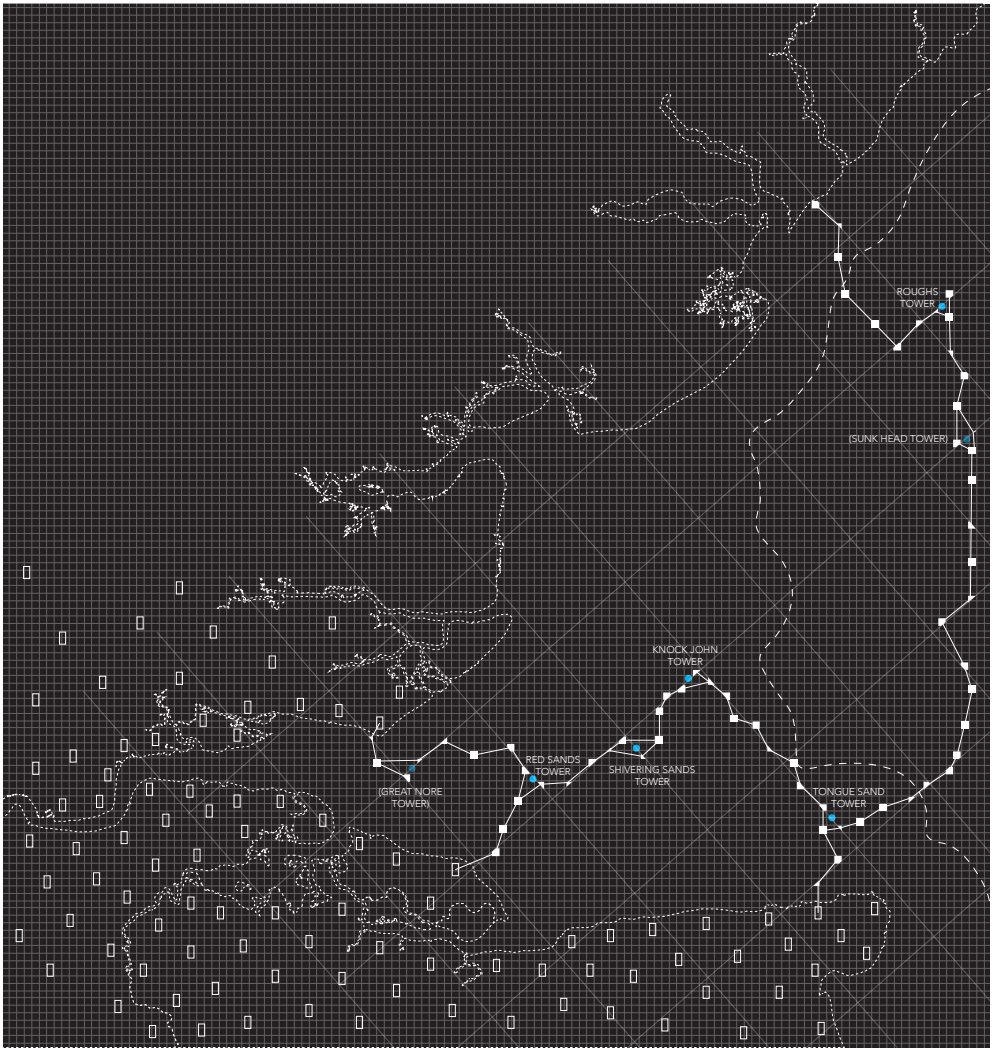


Figure 23 Project scheme based on the locations of the Manusell Forts

The project assumes a scenario in which London has expanded as far as it can eastward towards the North Sea and has reached the coastline. If it is to grow any further it needs to consider the waterscape as a new landscape for urban development.

On Forms of Life: Resistance and Acceptance

An essay on the resistance and acceptance of water in designing within the Thames Estuary and urbanizing a dynamic waterscape.

As coastal cities face increased threats from extreme weather events, the relationship between the urban environment and water has traditionally had a strong binary existence. Flood as a natural process is only a devastating event when it interacts with the "unnatural" built environment because the design operations try to actively resist it. Resilient design applies lessons from natural systems, including buffering, zone separation, redundancy, rapid feedback, and decentralization, to design for extreme conditions.

Particularly in Europe, as pressure from increased rainfall and storm surge threatens coastal cities, new design strategies incorporating the acceptance of water need to be developed in order to achieve truly resilient spaces. With the acceptance of water in design, there are opportunities to harness the benefits of floods if spaces are properly designed to accommodate it. For example, areas susceptible to salinity can be cleansed by increased water presence, or serve as a replenishing and stabilizing agent for vegetative soil layers. (Watson & Adams, 2010.)

Three levels of interventions are explored in the project "Past to Present to Past", the first being a temporary structure that completely embraces water and will eventually fall away into the estuary, the second being a permanent intervention that learns from the temporary structures and embraces the dynamics of the waterscape, and the third a semi-permanent structure that is flexible and adaptable to the needs of the community living on the water, and the ever-changing dynamics of the Thames Estuary.

The Thames Estuary is a prime location to practice resilient design through the acceptance of water as there are many existing natural systems in place to integrate into the architectural and urban fabric. The introduction of a series of interventions stretching from the coast of Leysdown-on-Sea out to the estuary will allow for a testing ground to design architecture that embraces water rather than resists it.

"The emerging concept of resilience considers flooding as a natural process. Addressing flooding as a given natural process of weather and water leads to imaginative and comprehensive approaches to resilient design, applicable at regional, community, and building scale."

Waston & Adams, 2010.

Acceptance: An Approach to Design

Resilience theory is based on thresholds or tipping points, complex adaptive systems, adaptive cycles and transformability. (Pickett, 2013). In architecture and urban planning, resilient design anticipates and prepares for natural disaster, and with respect to water, mitigates the threats brought on by extreme weather and climate change while harnessing the resource to enhance the built environment. (Watson & Adams, 2010). On the architectural scale, the existing strategies for designing for resiliency with water include "sacrificial areas", stilts, floating, and waterproofing. Currently, the most prominent strategies for creating resilient architecture are elevating the habitable structure above the waterline (by stilts, floating, etc.), but there are less strategies that embrace and accept water into the structure. The idea of having a "sacrificial" floor employs the strategy of flooding one area of a structure in order to save the rest of the space; however, this solution still limits the use of the space. Ideally, the flooded area/ zone should be more integrated into the essence of the project and continue to serve purpose even while flooded, whether it be to establish an atmosphere, or to temporarily hold water for other future uses.

On the urban scale, a number of strategies can be employed to integrate and manage water in a larger scale. Watershed planning focuses on water flows within the natural systems of the region that can increase urban resiliency beginning from upper catchments to flood defenses. ARUP highlights key areas of focus and principles in order to re-integrate catchment-scale water management to enhance resiliency; upper catchment management, water footprinting, agriculture and food, sustainable urban extension, extended asset life for existing infrastructure, inner city retrofit, protection of critical infrastructure, spatial planning and land use, campus/business park, green infrastructure, city centre, revitalized river space, water-resilient infrastructure, municipal treatment works, smart infrastructure, restored and revitalized canals and waterways, flood-resilient development, dynamic natural coast, and coastal defenses. (ARUP) By identifying multiple points that affect the overall success of the system, a variety of design strategies can be integrated over a large area. The urban aspect of the design for Leysdown-on-Sea and the Thames Estuary will focus on the dynamic natural coast and coastal defenses. These zones are also the most likely locations for interventions to have the closest interactions with water and can best showcase a strategy of water acceptance.

Water as a Catalyst for Resilient Design

In designing for the acceptance rather than resistance of weather events such as flooding, water can be seen as a catalyst for resilient urban and architectural design. As previously mentioned, there are a number of benefits that water can bring to a landscape when said area is properly prepared for it. When areas are prepared, flood are not always disastrous. Further, areas that are hazard resilient tend to be agile, which placed in the scope of water requires a shift from rigidity and flood control to a flood adaptation paradigm. Communities that can easily transform themselves to operate in wet conditions and preserve overall functionality by making changes to subsystems like transportation and physical arrangement of houses, are inherently more agile and more likely to be less negatively impacted by extreme weather events. (Liao et al., 2016). Hazard mitigation on the built environment calls for novel design approaches in urban planning such as responsive architecture. This type of design does not necessarily have to be comprised of high-tech mechanized components, but can also be a flexibility in the circulation of a building, or a morphing of the building's volume when a tide comes in, all while accommodating the needs of the building's users. "The integration of responsive components in architecture offers the potential to enhance the experience of the building by giving expression to fleeting, changeable aspects of the environment." (Meagher, 2015). By integrating the responsiveness of the building into its essence, the visitor will become immersed in the experience. (Figure 1). Finally, building for the acceptance of water sparks more creative solutions that not only enhance the resilience of a community or architecture, but also improves the experience of the building by drawing attention to the changing environment in which this seemingly static structure or development stands.

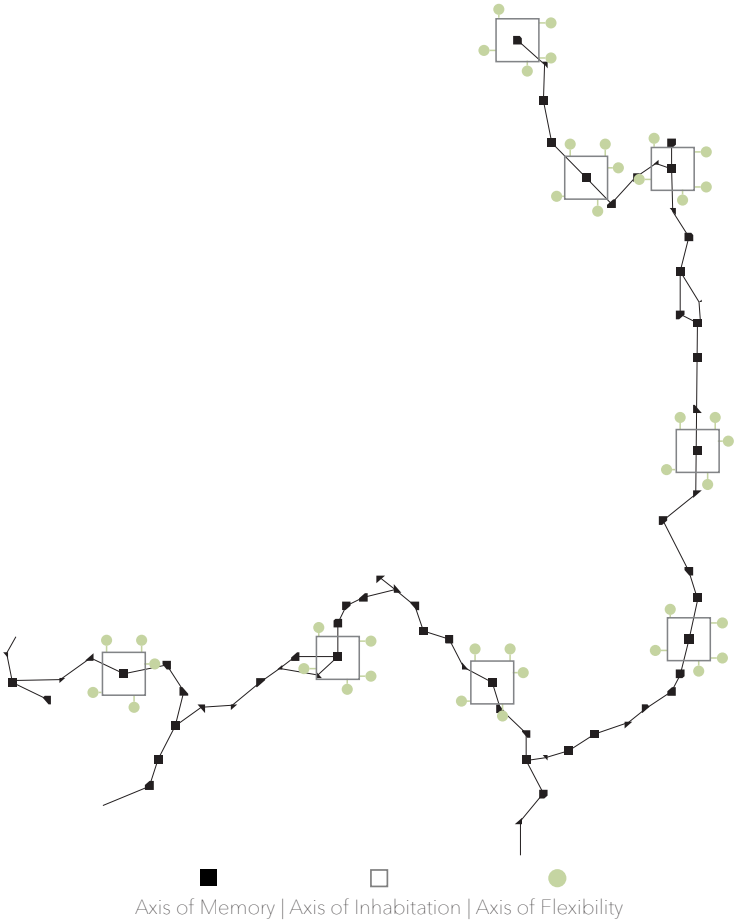


Figure 24 Three Axes of Urbanisation

The three axes of the project denote three phases. The first Axis of Memory as a series of follies scattered around the estuary nearby to Maunsell Fort sites, which are designed to eventually fall away. The Axis of Inhabitation to be permanent structures that urbanise the waterscape, and the Axis of Flexibility as satellite structures to adapt to various needs of the urban area.

Refection: Building on the Thames Estuary

In the design for urbanizing the Thames Estuary, the principle of water acceptance is a key driver in creating a resilient and adaptable urban fabric that exists on the water. By reading the seascape and landscape as a homogeneous building site, the harsh duality that currently exists between the two is blurred, and water becomes an element that is inevitably integrated into the design. The current task is to identify what types of structures can exist on the waterscape and investigate the conditions it creates. By conducting a heuristic typological investigation of structures interacting with water at various levels of dynamics, one can evaluate which typology, or coupling of typologies is best for the site; in this case, the area between Leysdown-on-Sea and the Red Sands Towers. As described by Hill in Frontiers in Ecology and the Environment, there are four quadrants of architectural typologies that deal with water: static structures and statics walls [1,2], and dynamic structures and dynamic walls [3,4]. (Figure 2) Similarly, on the urban front, there are static and dynamic landforms. These two sets of typologies manifest themselves in a variety of urban districts; a) those that are vulnerable to any flooding, b) resilient to temporary flooding, and c) adaptive for permanent flooding. In the case of the project zone (Leysdown-on-Sea to Red Sands Tower), the variety of conditions in the area calls for interventions to create urban districts that are both resilient to temporary flooding as well adaptive for permanent flooding. Based on this, we can now establish what infrastructural and architectural typologies will be necessary to achieve urbanization on the water and in intertidal zones.

In order to be reflective and critical, the heuristic typological investigation can also raise the question as to if any existing typologies provide the best solution to urbanizing the seascape. If they do not, how do we go about designing a completely new typology? Breaking down typologies into a kit of parts, as elements, can become a tool in investigating new assemblies. (Lochhead, 2017). Further, the materiality and construction of these elements can provide insight into developing typologies. Can the chosen materiality enhance the ecological status of the area, can the ease of assembly and disassembly of the construction in the water affect what the structure looks like? All while considering how these aspects of the design respond to the acceptance of water, or conversely, how does the principle of accepting water shape what the design looks like?

Further to establishing what kind of architectural and urban typologies are best suited for the Thames Estuary region, a prediction and reflection on the effect of the interventions on the environment needs to be conducted in order to achieve a responsible design proposal. Will there be a positive or negative impact on the local and greater ecology, or the local and greater community? Currently artificial coastal structures have a variety of effects, both negative and positive, on the geomorphology and ecology of coastal systems; usually interfering with the spatial dynamics of sediment transport, salinity, flooding and animal movements. (Hill, 2015). Alternatively, some interventions have the intention of preserving these natural dynamics and preventing negative effects these movements can have on other ecological aspects; for example, coastal erosion minimizing animal habitats. By being aware of these issues, the design can respond to and mitigate the interference of the intervention and enhance the current, or create a new, urban environment on the coastline and waterscape.

The project for urbanizing the Thames Estuary is a response to the urban sprawl of London; however, the project is yet to establish if it will facilitate urban sprawl to continue on forever, or offer a solution to create some sort of end point. This consideration will also play a role in the typology of the interventions; how can the intervention be self-containing on an infrastructural level while also creating a flexible urban settlement? Principles from natural systems such as sediment transport, which in a way occupies a defined space but is shifting constantly, can be used to gain inspiration for a new typology on the water.

Epilogue

The acceptance of water versus resistance requires a shift in the designer's state of mind and values in their approach to creating space. In order to achieve truly resilient design, the space not only must be agile and transformable, but so too should the society that operates within it. By referencing natural spatial and fluid dynamics, a new typology, or coupling or existing typologies, can create resilient spaces that thrive on the interplay between the urban environment and waterscape.

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The Scenario

The Alternative History of the Growth of London

The scenario in which the project exists is under the revised history that London was established from a follie brought by the Romans. New follie structures physically embodied the historical events that took place that shaped and grew the city of London. The city grew further and further towards the North Sea, creating a network of follies that would eventually sprawl so far that it reaches the threshold where the coast meets the Thames Estuary and the North Sea, and the city no longer has usable land to grow.

London: The Follie

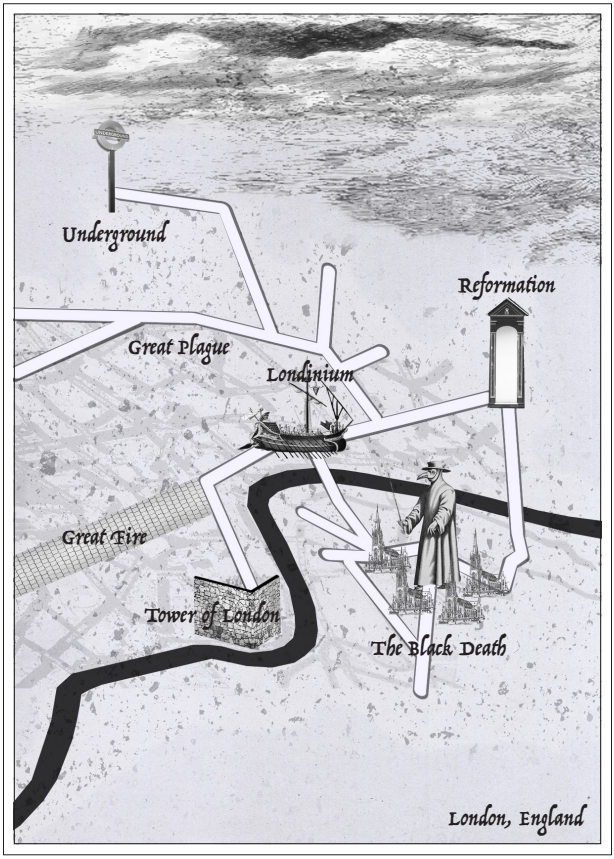
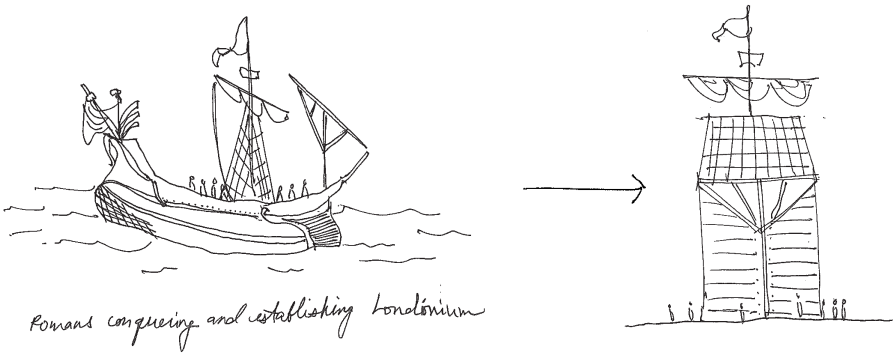
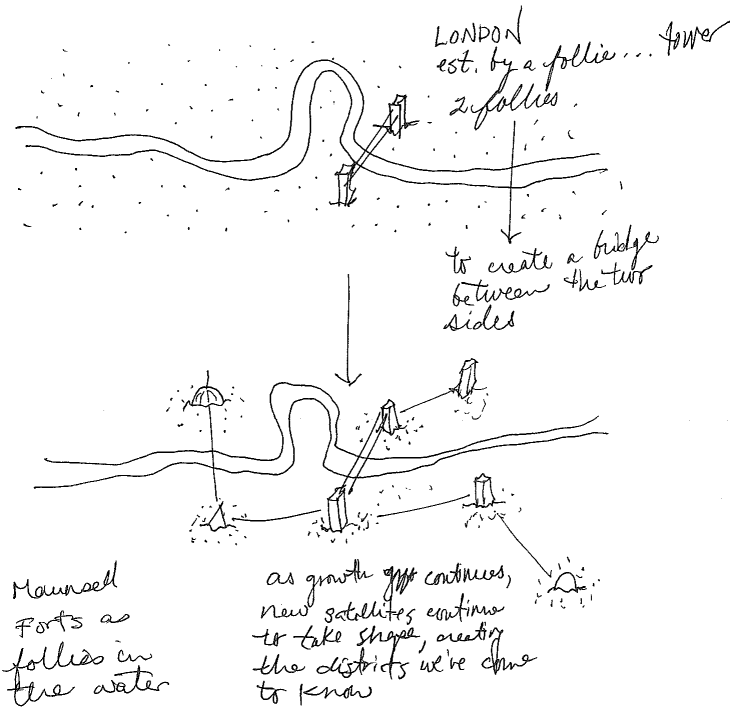


Figure 25 Alternate History of London

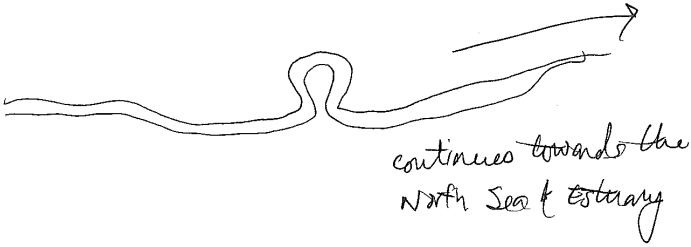
The follie as the starting point of the city.



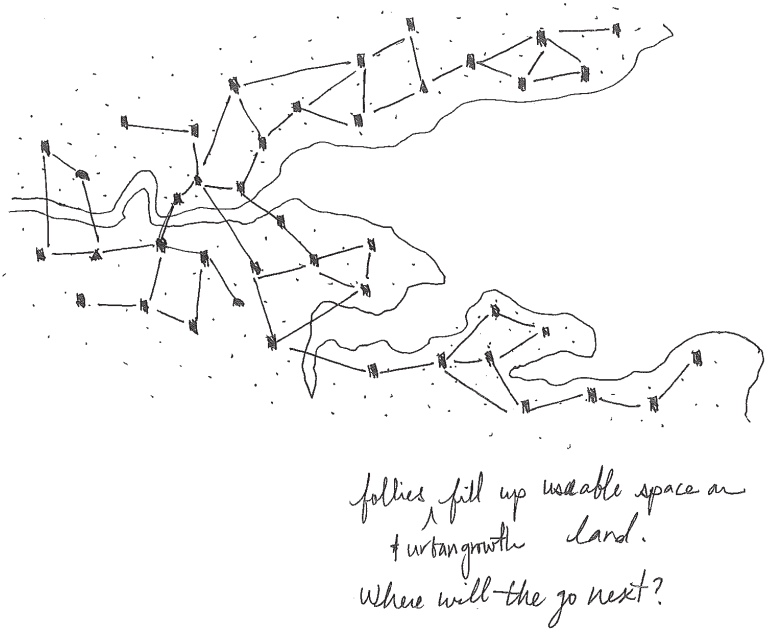
The follies appear as a response to events that occur, or to facilitate the needs of the city.

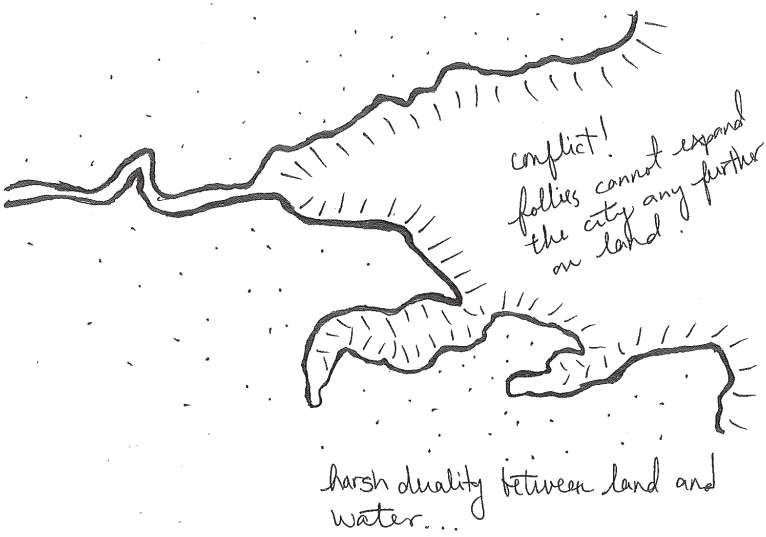


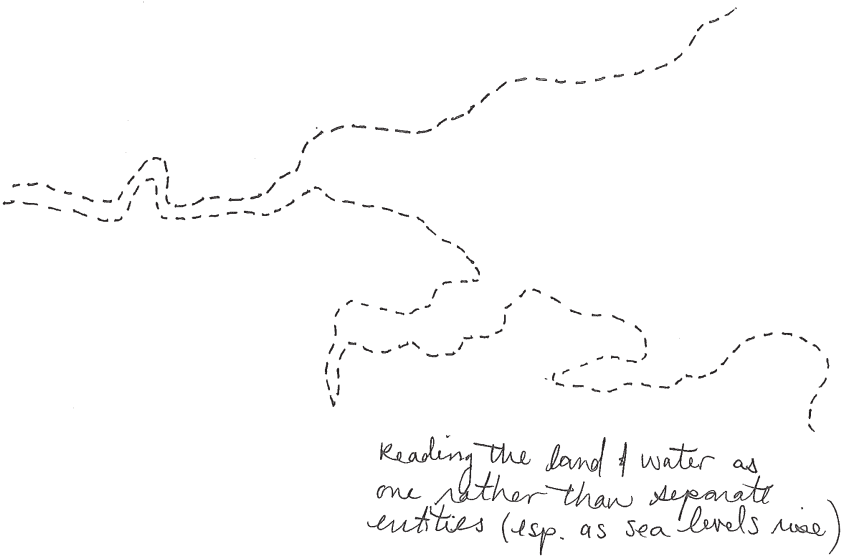
The city grows towards the North Sea

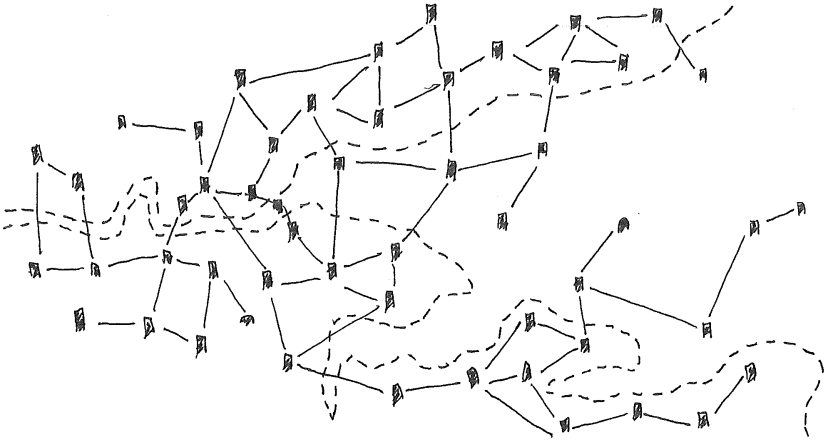


Urban growth reaching coastal boundary




conflict!
follies cannot expand
the city any further
on land!
harsh duality between land and
water...


Reading the land + water as
one rather than separate
entities (esp. as sea levels rise)



@Bringing the follies back to the water (Romans brought first follie [ships] to land from water)

Follies extend into the water (the new landscape) – but how can their locations be rationally located? Is there a reasoning?

cyclical.

The Sites

Two sites, Leysdown-on-Sea, and Red Sands Forts were selected as areas of focus as the represent two ends of the project: the threshold between land and water, and the water itself. Leysdown-on-Sea, located on the south side of the Thames Estuary, is one of the few sites where the Maunsell Forts are visible from the land; therefore, making it an ideal location to represent the jumping off point where the growth of London makes the transition from land to water. The Red Sands Forts site uses the forts as a central point of focus to show a direct relationship between the new construction and its inspiration.

During a visit along the south coast of the Thames Estuary, I noted that as one makes their way further east the landscape changes dramatically. Close to London, the landscape echoes the industrial period that took over the area during the 1700s. Generally dark with desaturated hues, the area is relatively depressing but with pockets of glimmers of hope where development brings buildings out of the dark into the modern age. Gentrified areas spearing up towards the sky appear every once in a while indicating the growth of the metropolitan area towards the North Sea.

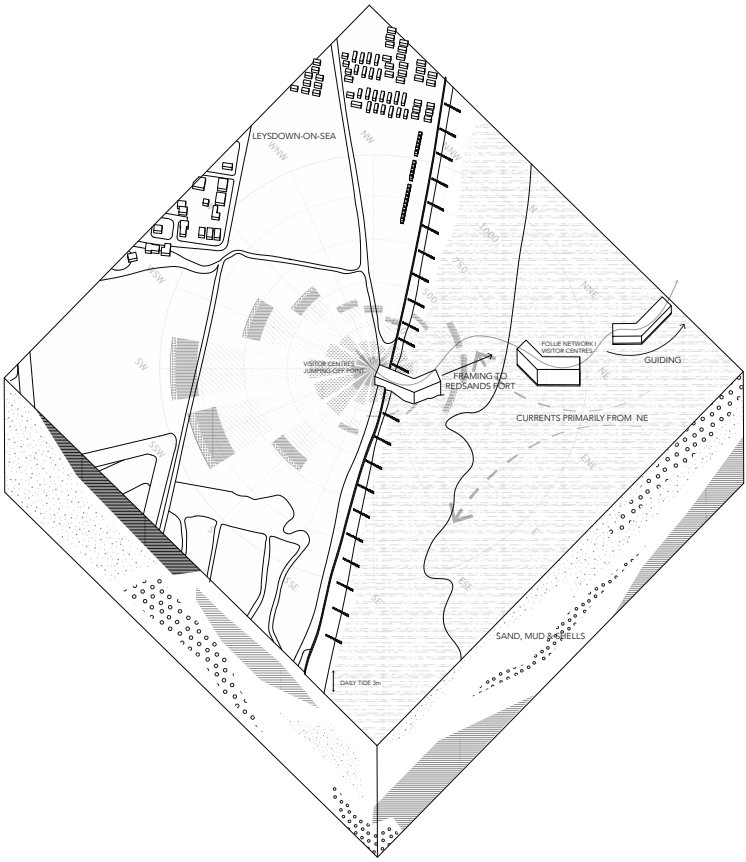


Figure 26 Leysdown-on-Sea, Thames Estuary, UK. Site Axonometric.

The Thames Estuary 2050 Growth Commission was established to "Develop an ambitious vision and delivery plan for North Kent, South Essex and East London up to 2050. […] It will also look at how to make the most of opportunities from planned infrastructure such as the Lower Thames Crossing." As outlined by the Item B1 Report (The Thames Estuary, Opportunities and Challenges, 2016.), the wider Thames Estuary is the largest opportunity for new housing and commercial growth for the city of London. This being said, an urban strategy that integrates the challenges, opportunities and solutions identified by the Commission should be considered as well as what it not only beneficial for the City of London, but for the surrounding areas where the city would be expanding to.

"Historically, the south Essex coastline was London's rubbish top for centuries. From Rainham Marshes to Two Tree Island near Leigh-On-Sea, there was a corridor of landfill sites, including Thameside, Wat Tyler and Pitsea, all of which in recent years have been transformed into verdant green parks and wildlife reserves, despite the polluted and often toxic ground beneath." (Estuary, 2016.)

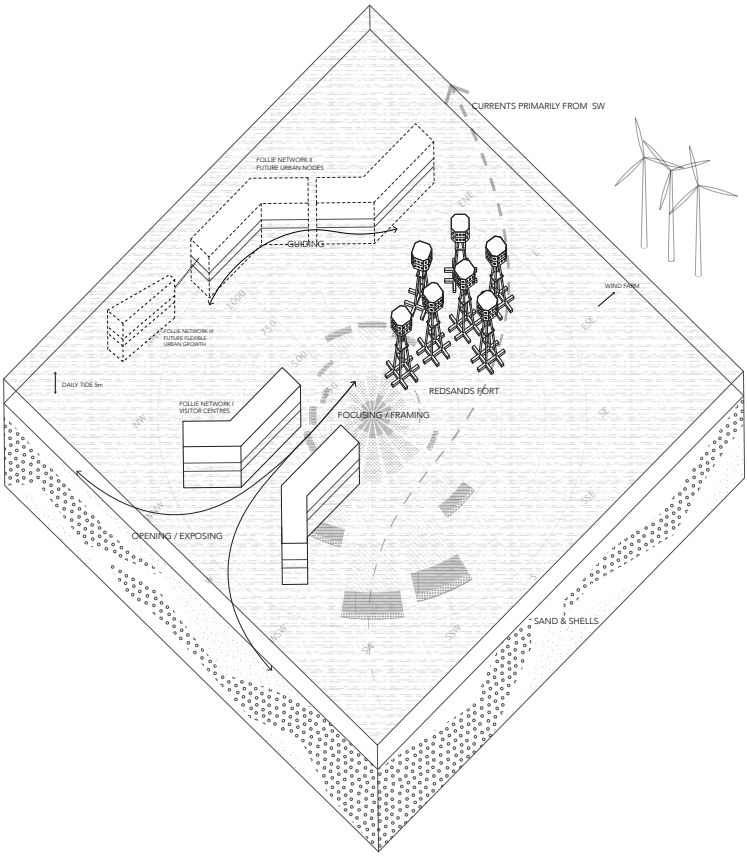


Figure 27 Red Sands Forts, Thames Estuary, UK. Site Axonometric.

The Sites:
Settling in the Unsettle-able

As one makes their way along the River Thames,
out to the North Sea,
they are faced with a dynamic riverside scape,
lit up like a marquee.

Illuminated, white monuments and landmarks,
transition to something best concealed,
ghosts of structures from London's smog-filled era,
now line the coast as brownfields.

Suddenly the river widens,
the city falls away,
the riverside landscape becomes flat and green,
the water, a bluish grey.

An interstitial zone,
between urban city and open sea,
with dynamic tides that hide and reveal
the seabed of the estuary.

It is a place where many have lived and worked,
navigating the sinuous seascape.
And even the most skillful captains do say,
the sea never maintains her shape.

For "nautical charts become little more,
than a record of a moment in time".
Which could not prevent the S.S. Montgomery,
from becoming a harsh warning sign.

Monster-like structures emerge from the shallows,
rusted and in disrepair.
That were once home to those who defended their country,
from threats of the sea and the air.

The Maunsell Forts were considered eccentric,
their shape was curious and wrong.
But later were praised for their picturesque beauty
and would air the first pirate song.

Can we extend and restore the vibrant colour
and life of the city towards the sea,
without ploughing things that inhabit this place,
making their existence an antiquity?

As the city grows and migration rises,
How will the landscape respond?
Will the answer be in building up,
taking over the very last laund?

Or will we look towards the water,
and not be put off by its dynamics.
To create a livable seascape where humans
and nature coexist without panic.

Ailsa Craigen, 2017 Symposium.

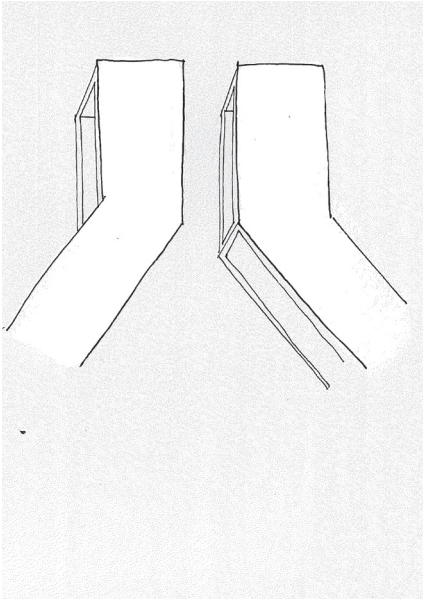
Figure 28 Leysdown-on-Sea Shoreline. Ailsa Craigen, 2018.

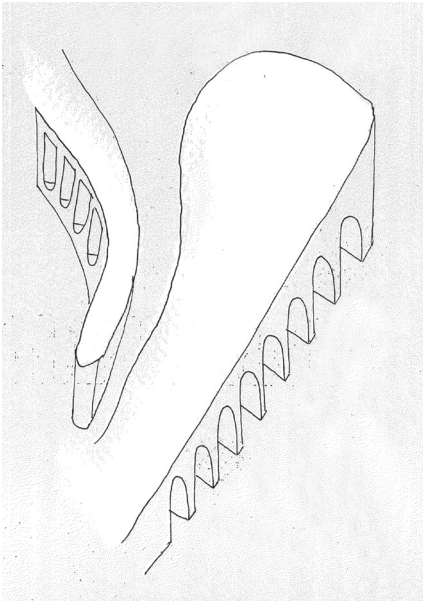
Figure 29 View of forts from Leysdown-on-Sea. Ailsa Craigen, 2018.

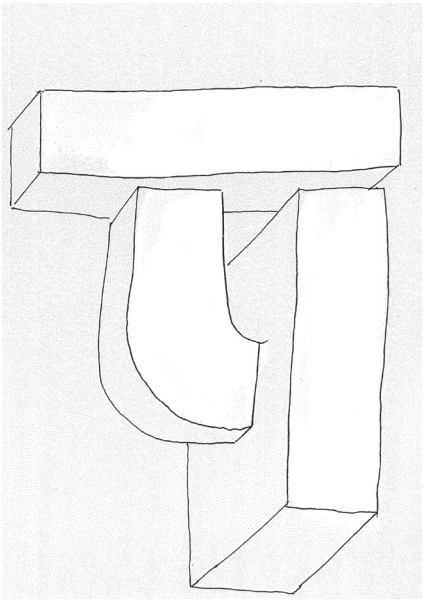
Figure 30 Red Sands Forts. Lowdown Magazine.

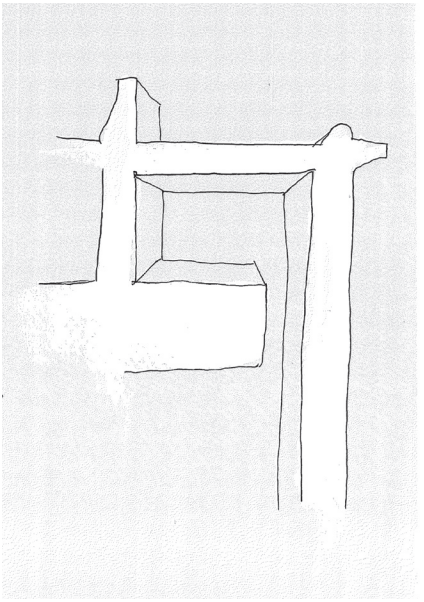
Formal Exploration: Paint Brush Strokes

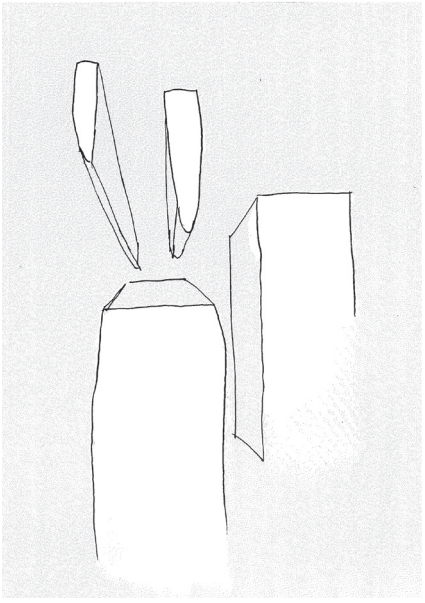
The formal exploration for the interventions began with the intention to seek a directional form, a form that would guide movement through the estuary. The study used single brush strokes to create the main form, and secondary ink lines were added to give the two-dimensional strokes three-dimensional architectonic qualities while still remaining scale-less.











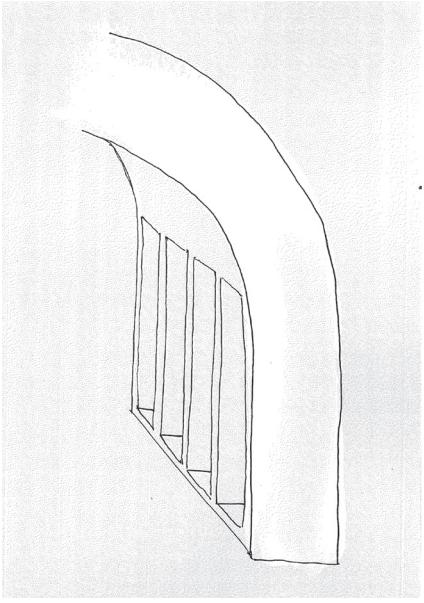
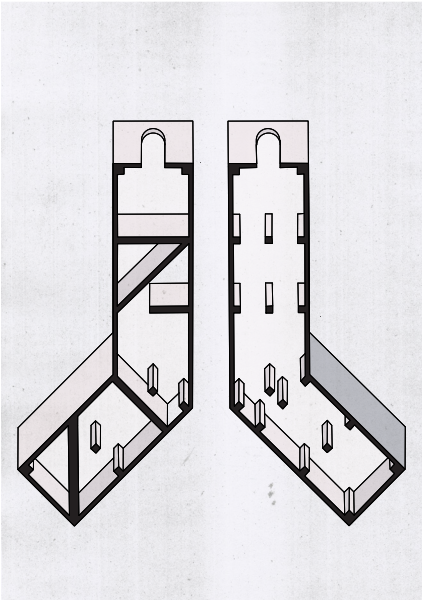
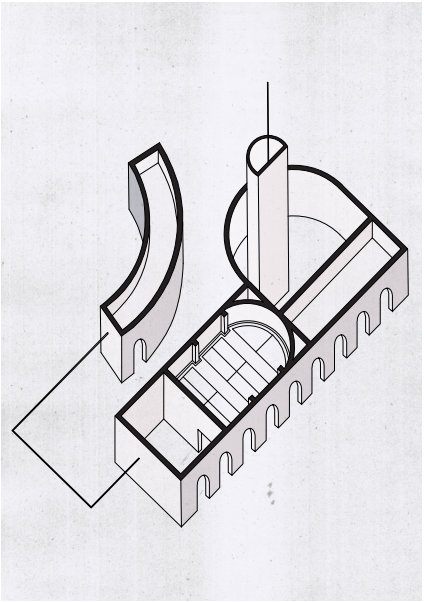


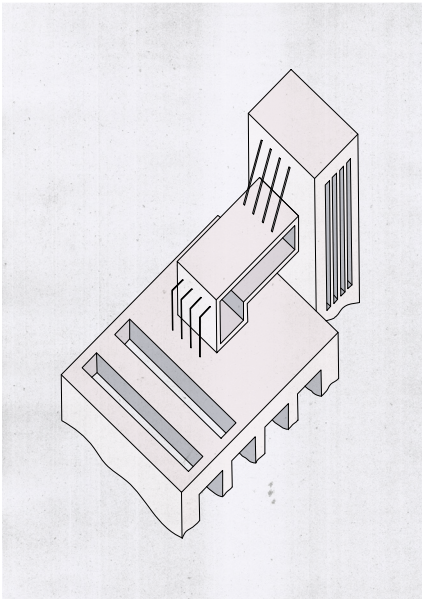
Figure 31 Hand Drawn Formal Exploration

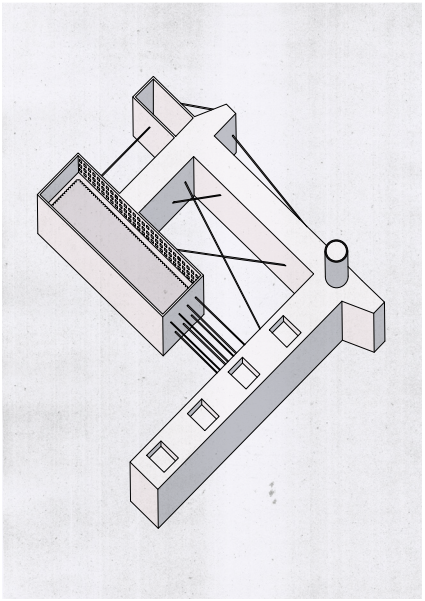
Formal Exploration: Architectural Elements

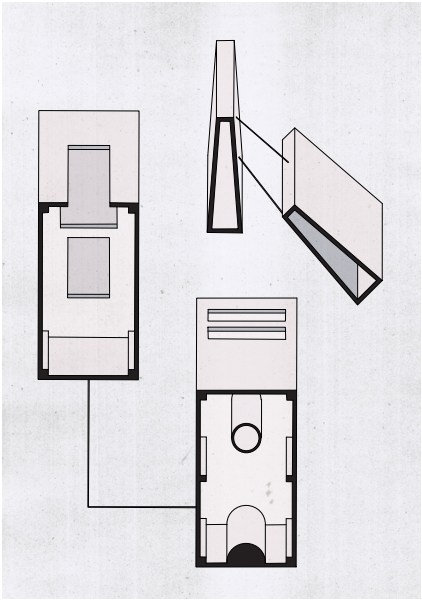
Following the brush stroke study, a selection of pieces were chosen to generate regulated and structured drawings that still have directional, architectonic and scale-less qualities. From these, the final form was decided on.











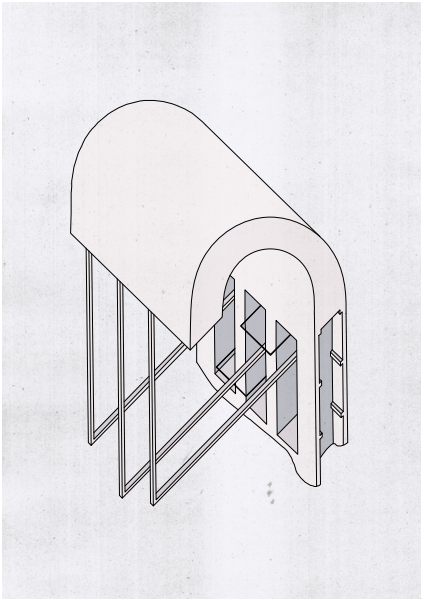


Figure 32 Computerized Formal Exploration

Intervention

The formal decision for the design intervention

This form was selected from the previous anthology as it allowed for the most variations in its configuration to create different spatial qualities between the elements and had one of the stronger directional qualities among the collection. This form serves as the basis for the intervention design in the project.

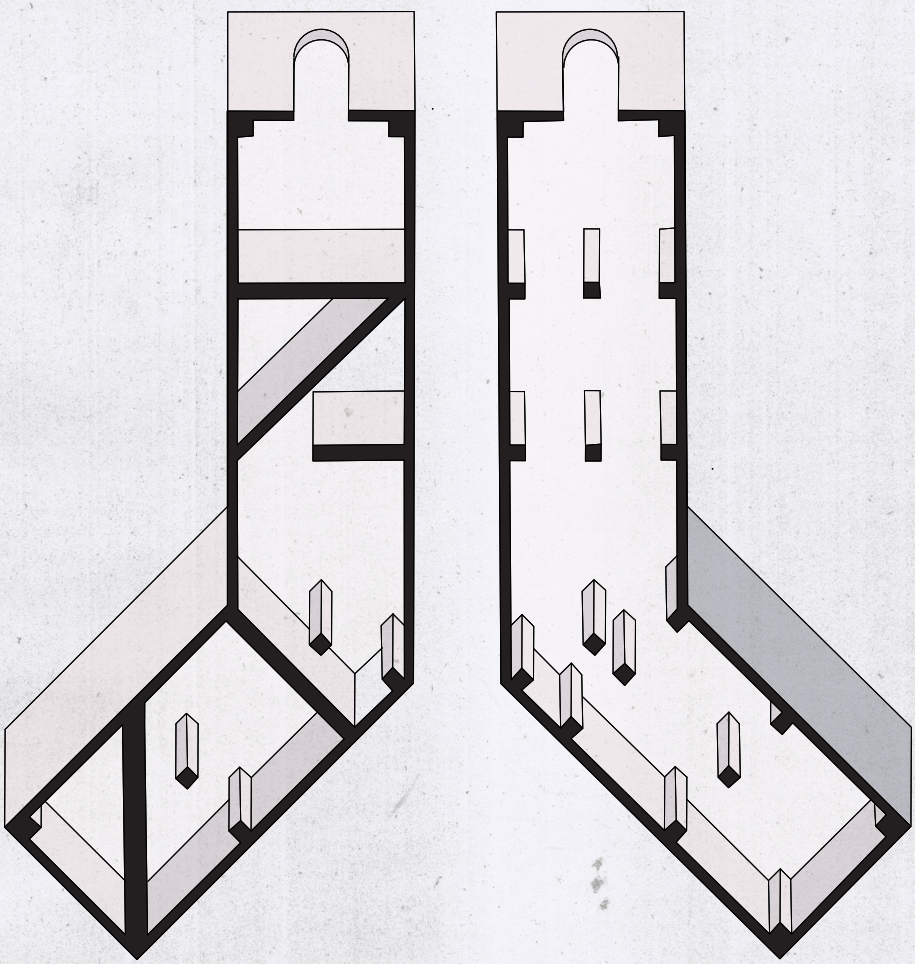


Figure 33 Intervention Form Choice

02. Design Implementation

Design Implementation: Configuration Study

The chosen form was implemented onto the sites and configured to respond to various site specific elements while also experimenting with size variation.

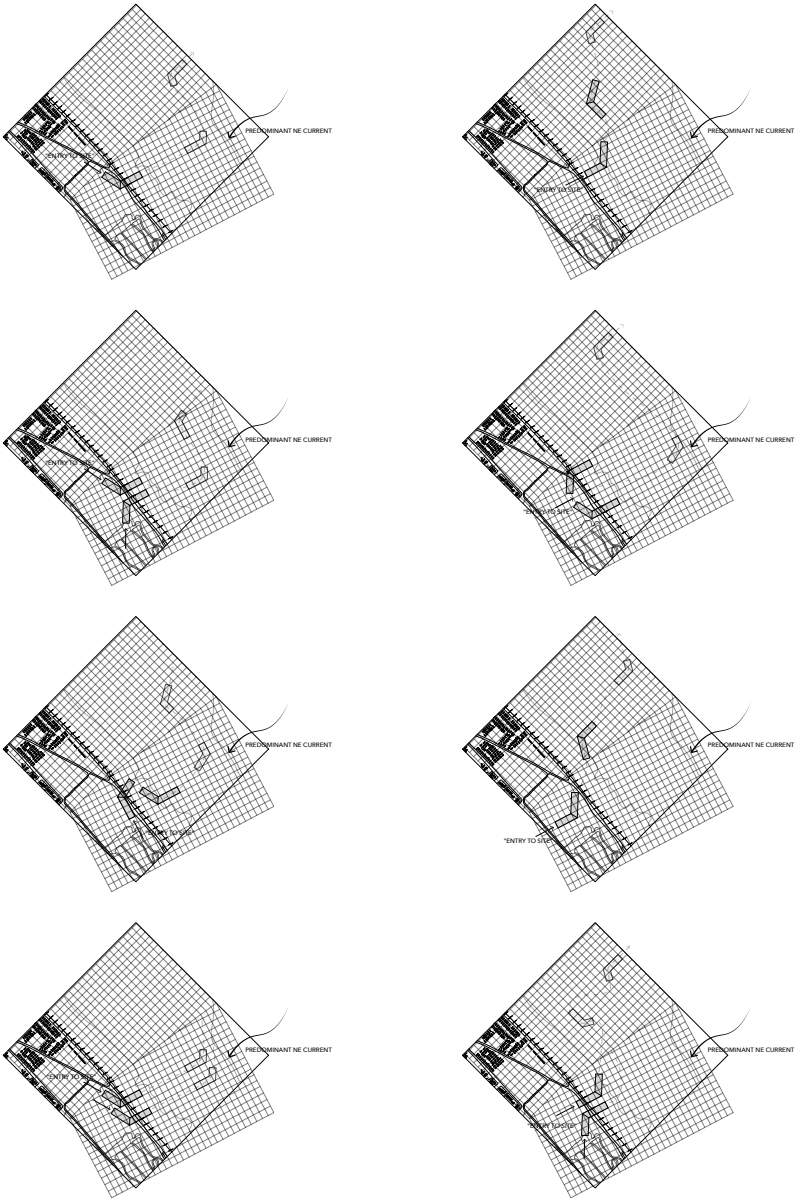
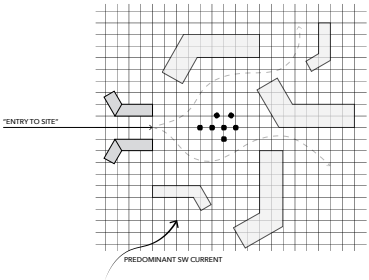
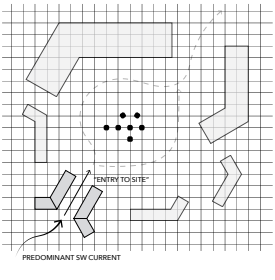
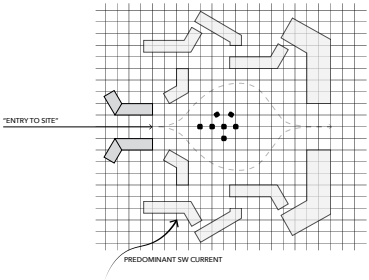
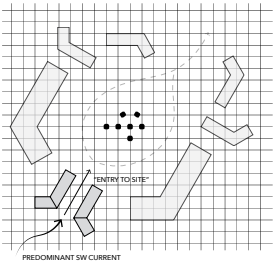


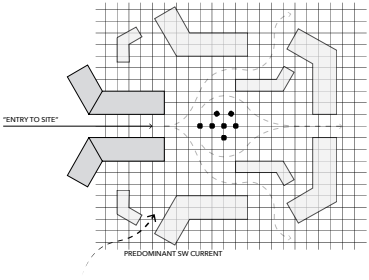
Figure 34 Configuration Study: Leysdown-on-Sea

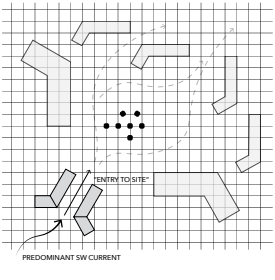


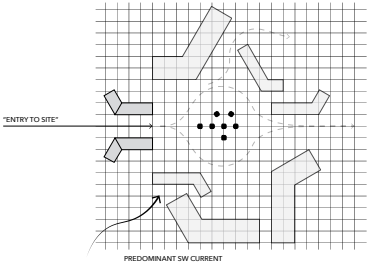












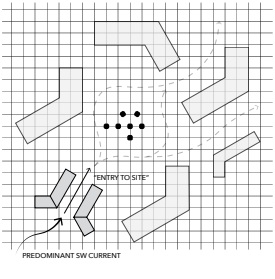
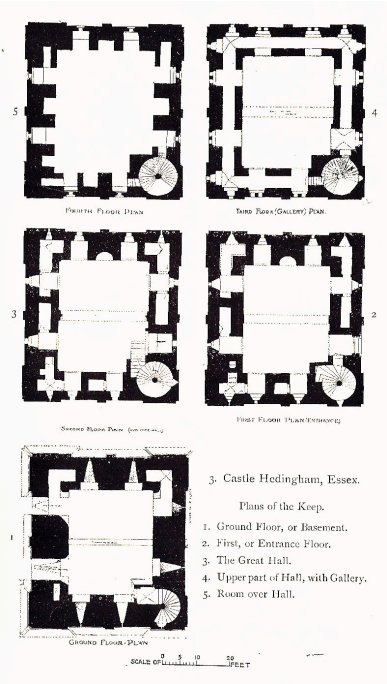


Figure 35 Configuration Study: Red Sands Forts

The Inhabitable Wall

Concept for Rationalisation

The concept of the inhabitable wall considers the wall as rooms to inhabit while also dividing an interior and exterior environment either physically or symbolically. This concept is implemented on a large scale for the project site configurations which establish a border wall which is then carved based on site-specific elements and then inhabited by the design to create interstitial areas between in the interior and exterior conditions.



3. Castle Hedingham, Essex.

Plans of the Keep.

1. Ground Floor, or Basement.
2. First, or Entrance Floor.
3. The Great Hall.
4. Upper part of Hall, with Gallery.
5. Room over Hall.

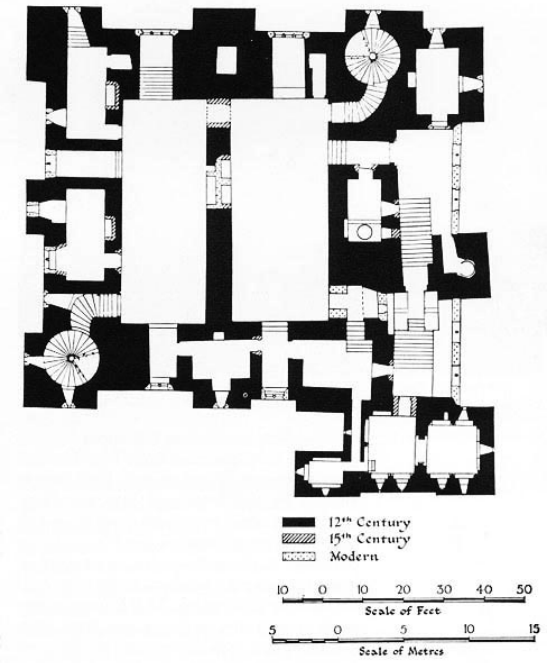
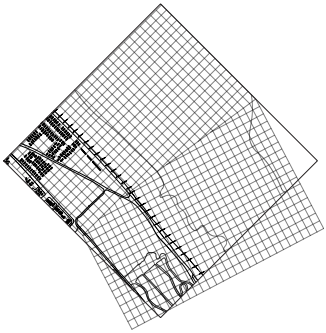


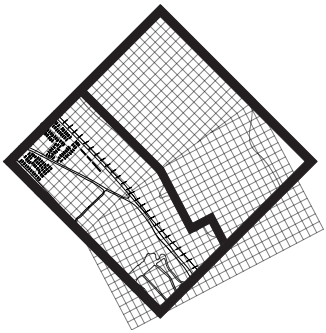
Figure 36 Inhabitable Wall: Medieval English Castles - Floor Plans from GOTCH: Growth of the English House, 1909.

Design Implementation: Rationalisation Study

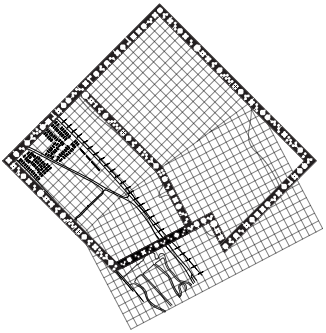
The process of site rationalization utilised the concept of the inhabitable wall to establish a border for the territory, which then was carved to create openings based on site elements such as current, prevailing winds and boat movement.



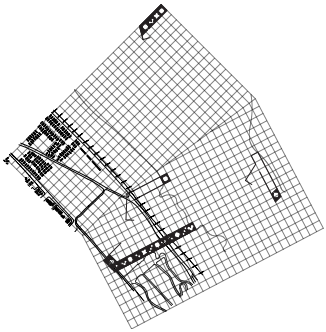
The Site



The Inhabitable Wall

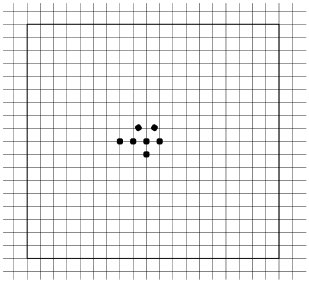


Wall as Rooms

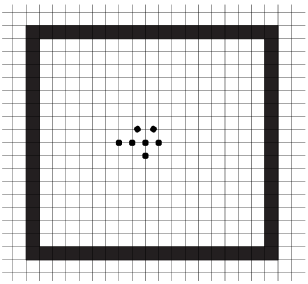


Wall as Rooms - Carved

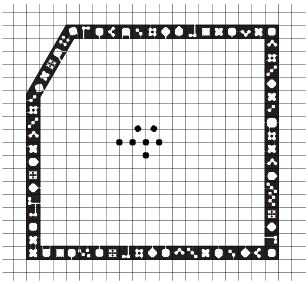
Figure 37 Rationalisation Study: Leysdown-on-Sea



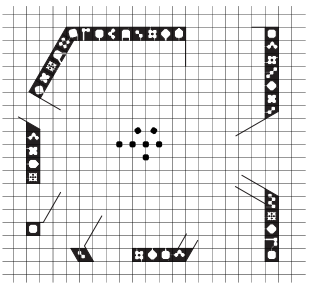
The Site



The Inhabitable Wall



Wall as Rooms



Wall as Rooms - Carved

Figure 38 Rationalisation Study: Red Sands Forts

Plug-In City

Concept for System Scheme

The Plug-In City, conceived by Archigram between 1960 and 1974 is a project that proposes a fantasy city in which modular residential units are plugged into a central infrastructural mega machine. It imagines not a city, but a continuously changing and evolving structure that incorporates residences, transportation and other services.

This concept is one of the central cornerstones of the design of the project interventions.

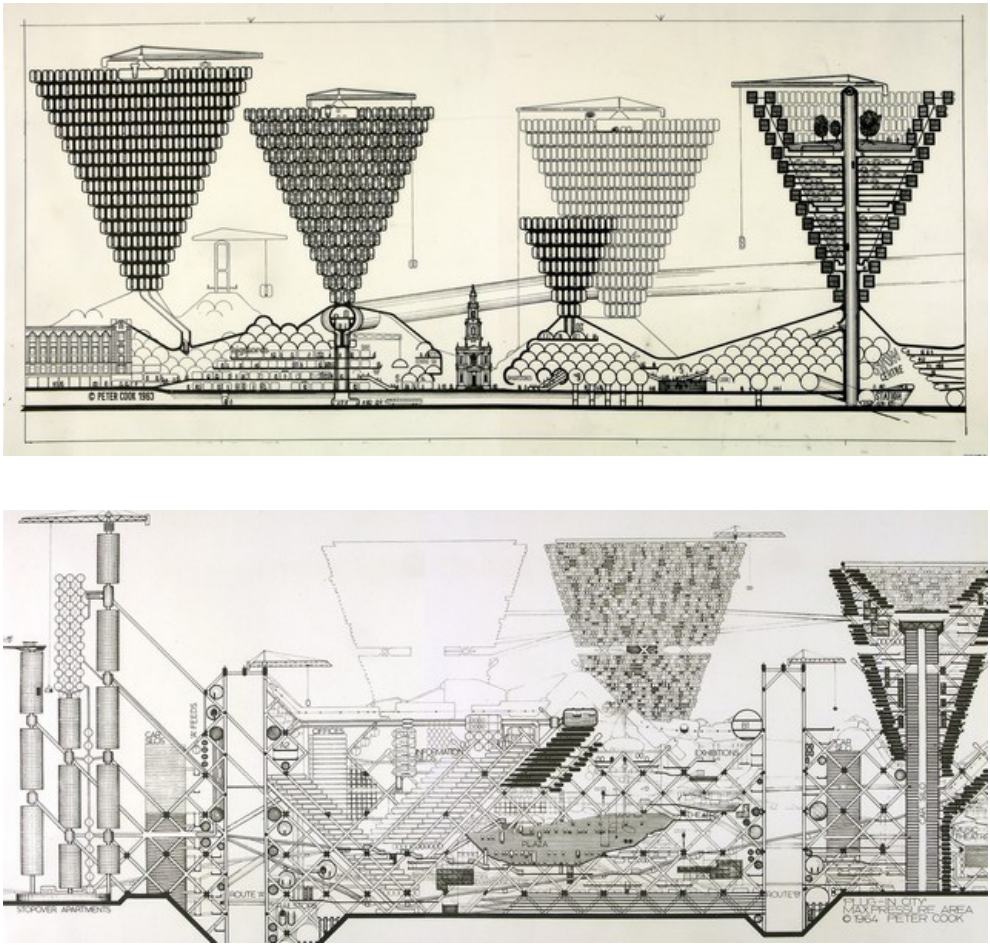


Figure 39 Plug-In City, by Archigram & Peter Cook, 1963.

Follies:
Three States

There are three states in which the follies exist. The first as individual separate units scattered without any particular organisation. Each of these objects have their own character and they do not have a function. This state is described as Follies as UNITS.

The second state as an ANTHOLOGY of follies that are captured within a regulating structure, but still have enough freedom to occasionally break free.

The third state as an STOREHOUSE of follies that are regulated to the structure and exist as unique entities within a set of rules.

The intervention at Leysdown-on-Sea puts forth an Anthology of Objects (Second State). Follies that are captured within a structure that occasionally break free, particularly as the make their way across the threshold between land and water.

The intervention at Red Sands Forts puts forward a Storehouse of Objects (Third State). The follies are heavily regulated within the structure which acts as a storehouse that records the passage of time through the preservation of objects that are periodically added to the overall system.

Each of these states have a correlation to the three axes of urbanisation. The first axis, which is defined as the Axis of Memory, is a series of scattered follies that beyond denoting an area, do not serve much of a function, but evoke memories through their placements and formal qualities. The first axis directly relates to then first state of follies as units. The second axis, the Axis of Inhabitation, follows the third state of follies as storehouse. Interventions

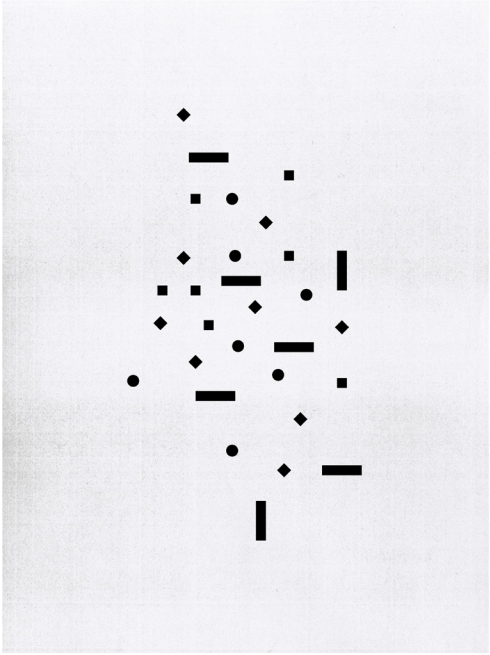


Figure 40a Follies as Units

that has a strict regulatory scheme and set of rules. The third axis, the Axis of Flexibility, directly correlates to the second state of follies as an anthology of objects. This looser regulation of objects allows for flexibility to adapt to various requirements of programme, location and environmental qualities.

The overarching scheme of the axes and how they manifest through the follies helps to create an adaptable system for urbanising a large area that has many different kinds of environments and site-specific elements.

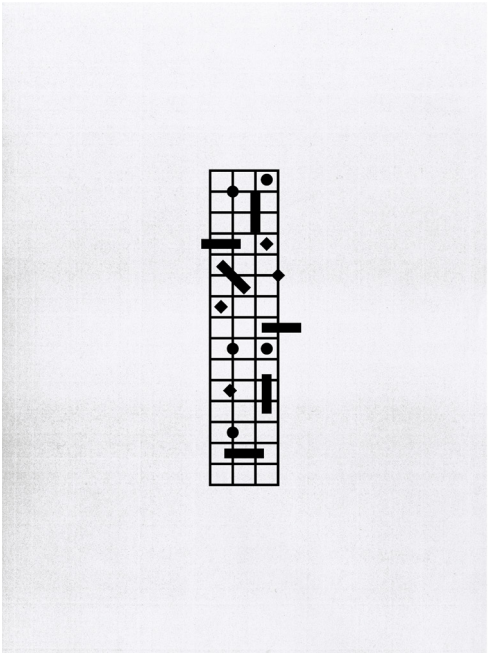


Figure 40b Follies as Anthology

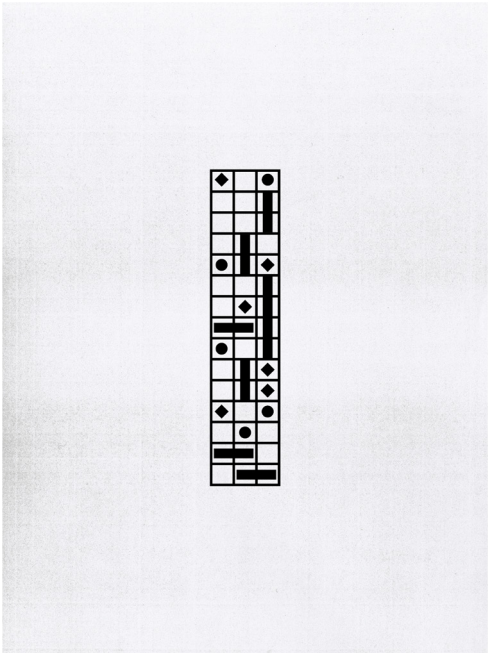
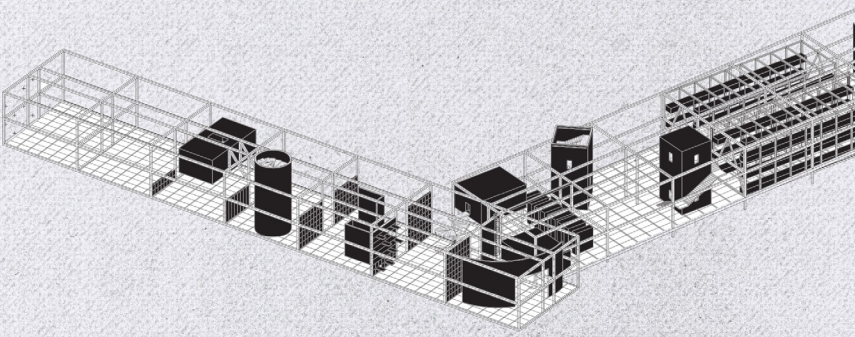
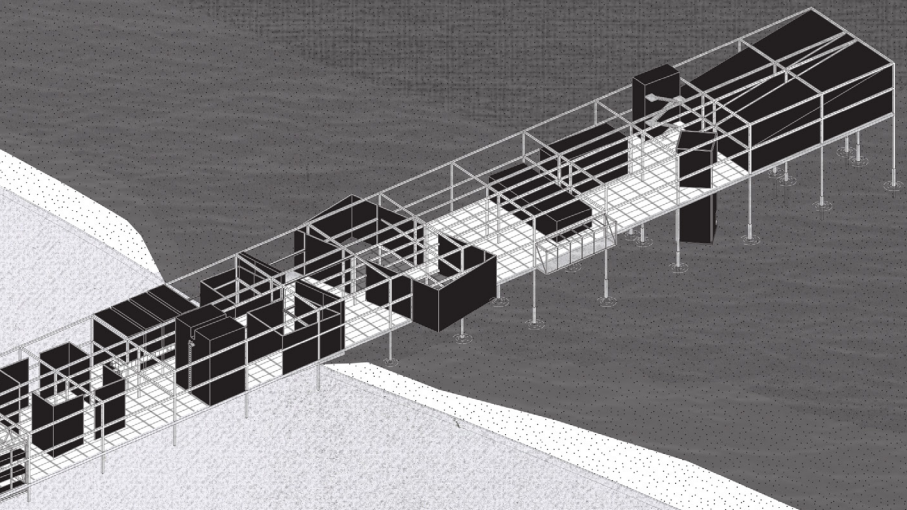


Figure 40c Follies as Storehouse



LEYSDOWN-ON-SEA

Anthology of Objects



10m

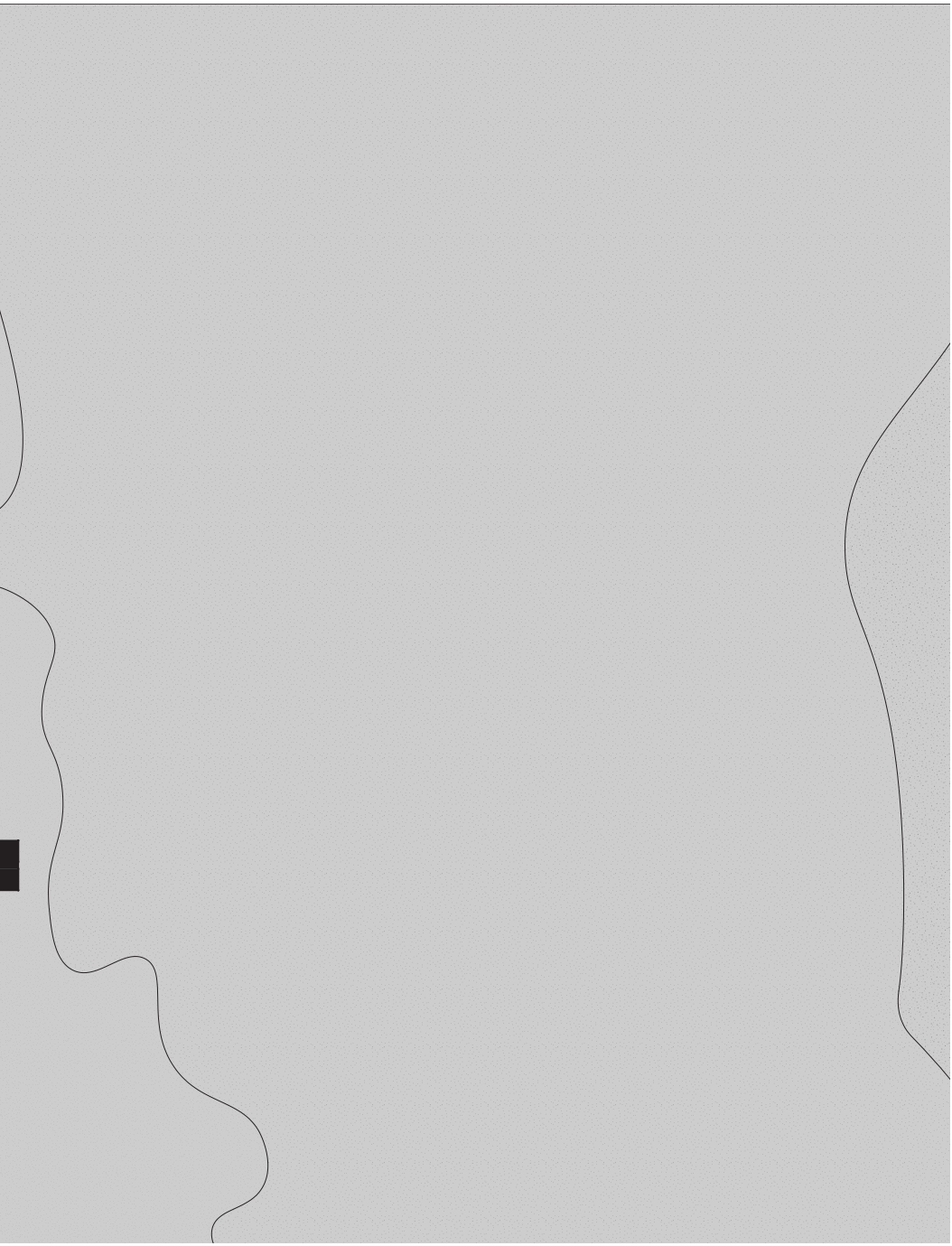
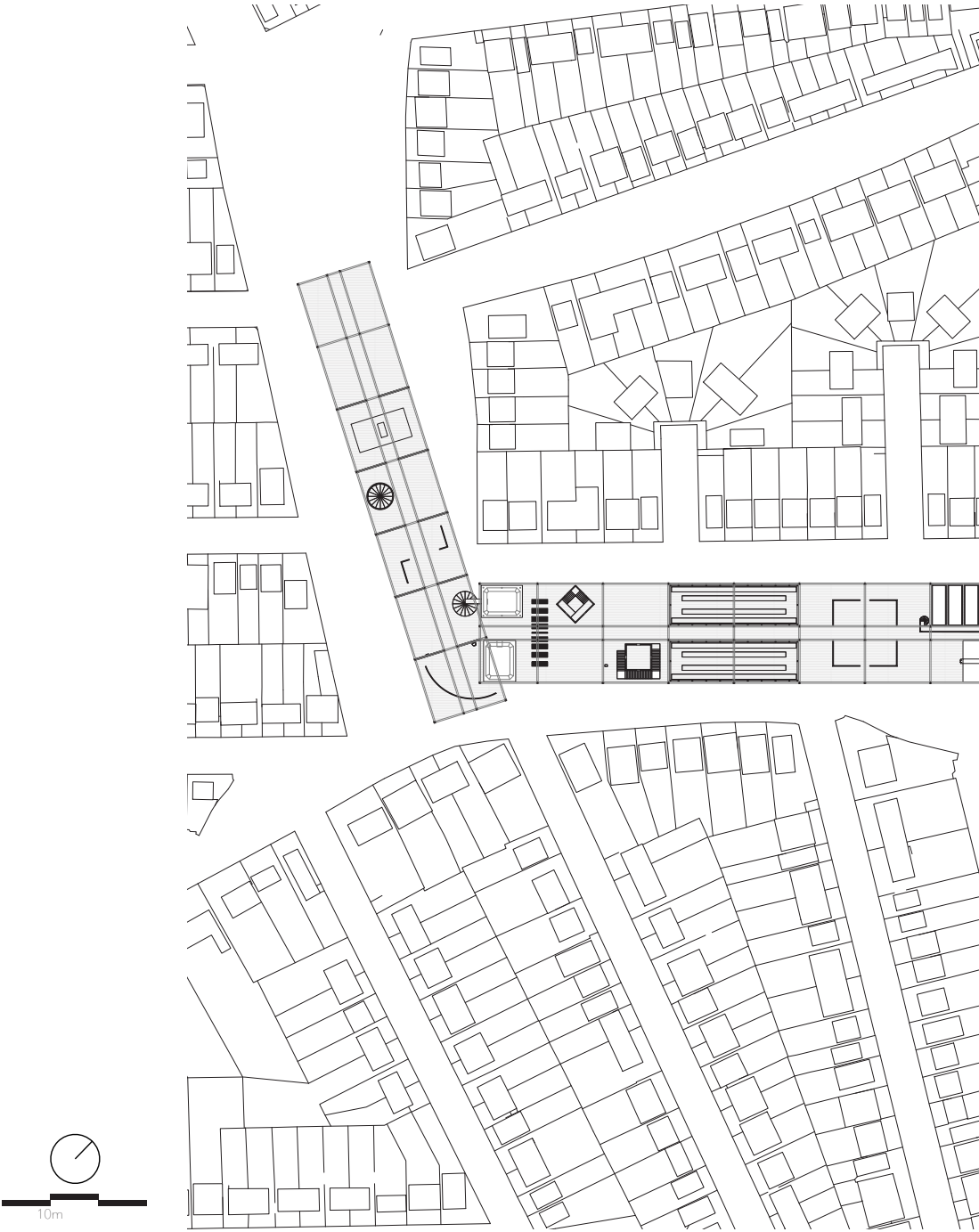


Figure 42 Site Plan: Leysdown-on-Sea

Previous (p.64) Figure 41 Axonometric: Leysdown-on-Sea


10m

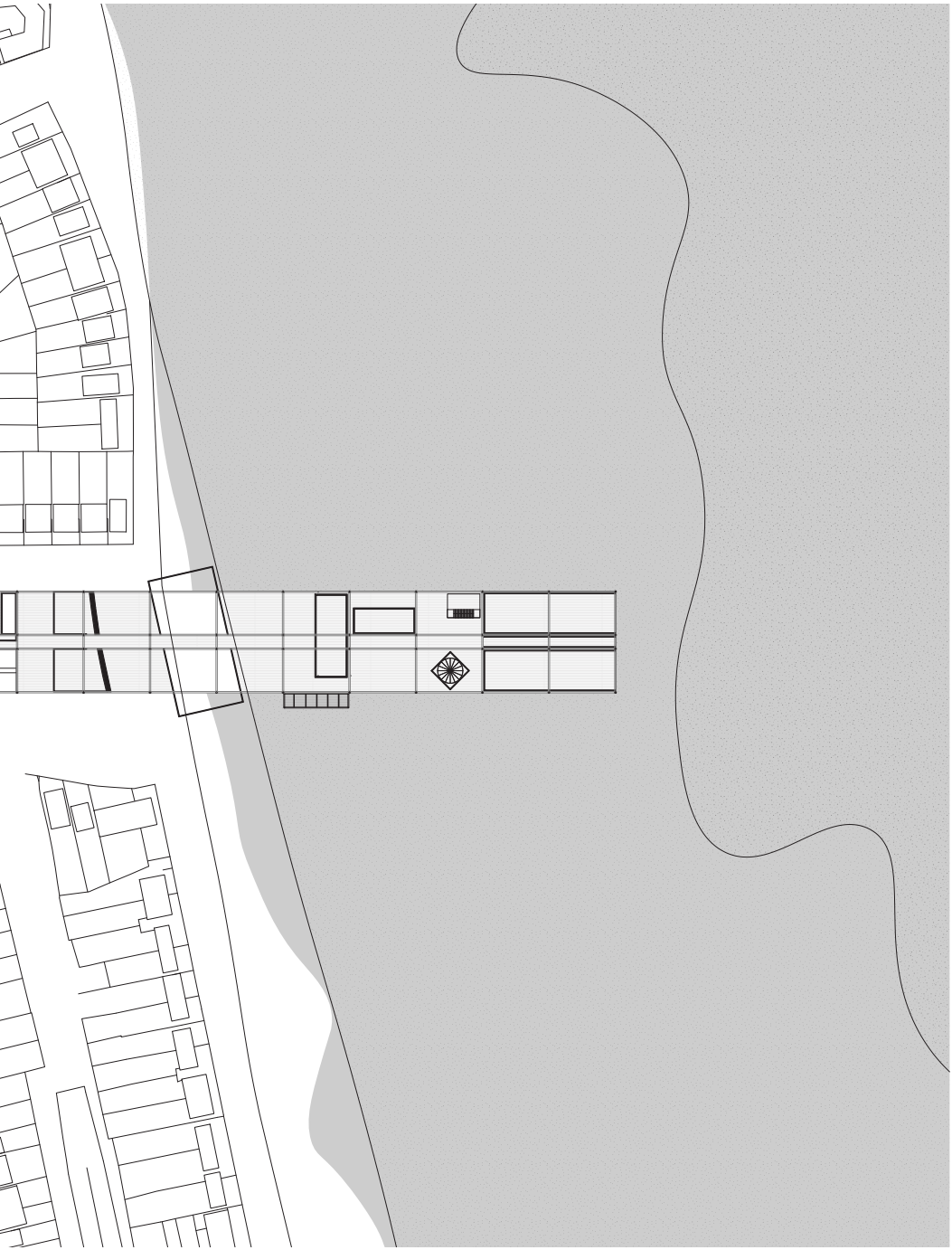


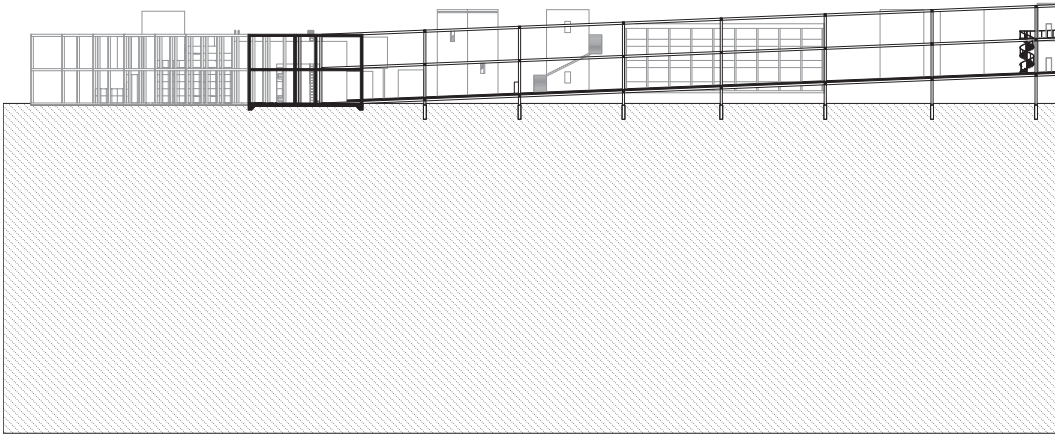
Figure 43 Plan: Leysdown-on-Sea

Anthology of Objects

Intervention at Leysdown-on-Sea

The Intervention at Leysdown-on-Sea puts forth an Anthology of Objects. Follies that are captured within a structure that occasionally break free, particularly as the make their way across the threshold between land and water.

The orientation of the intervention is directly linked to the placement of the forts on the horizon. The site serves as a jumping off point between the ever-growing urban landscape and the possibilities afforded by building on the water.



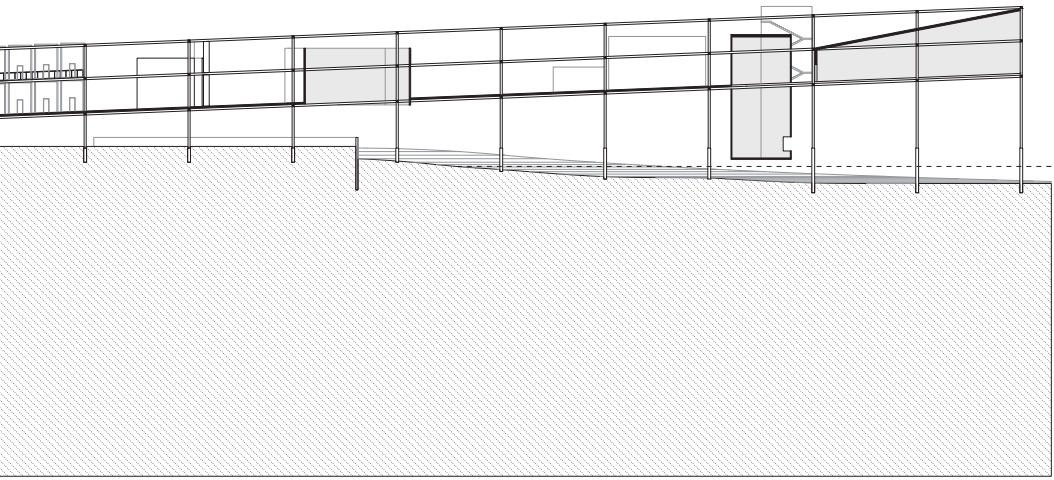
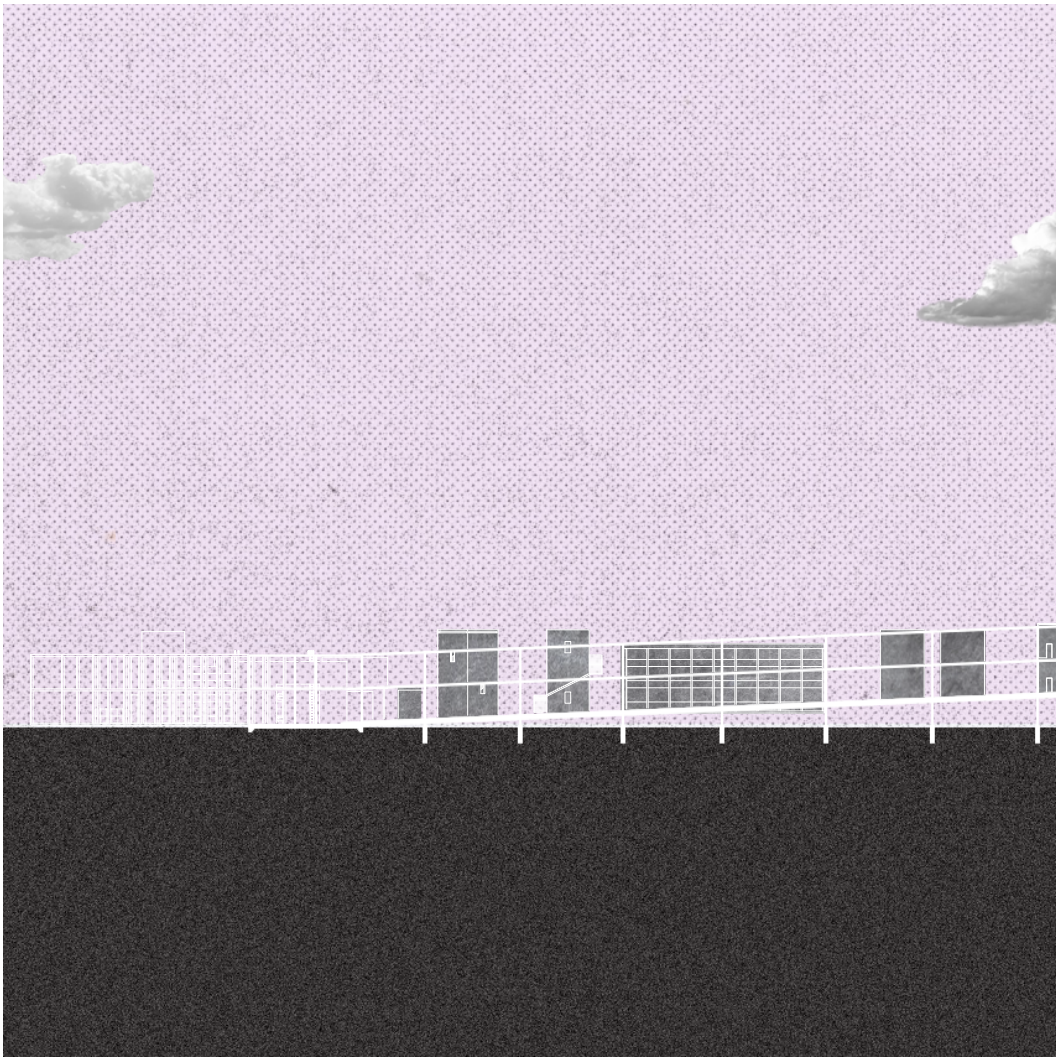


Figure 44 Elevation: Leysdown-on-Sea



Each unique object reveals something different to the visitor, whether it be a new experience, new information, or new techniques. As a visitor's centre of sorts, the Anthology of Objects intend to leave its users enriched in some facet.

The structure gradually elevates as it reaches the water, resembling a sloped pier bringing its passengers to the point where they depart from the land into a new territory.

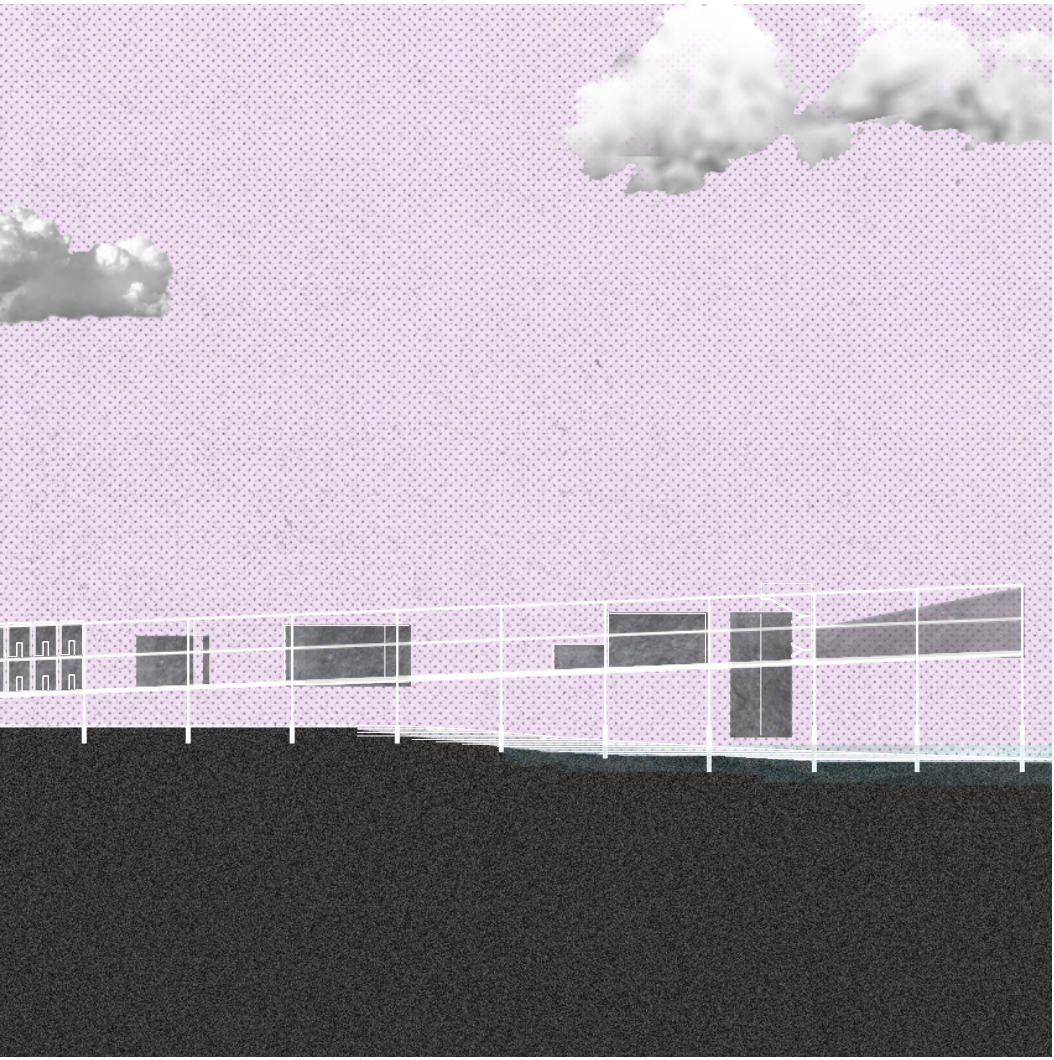


Figure 45 Rendered Elevation: Leysdown-on-Sea

Re: Scheme | Anthology of Objects

The Anthology of Objects is an intervention that represents the core elements of the design for urbanising the waterscape. Each of the objects are represented as whole pieces, but they each are sub-components to the entire urbanisation scheme. Because of the fact that each object is left relatively simple in their forms, it leaves room for the unexpected; unexpected programmes, unexpected additions, unexpected experiences.

Represented metaphorically, these objects serve as the in-between from the objects as scattered follies (their initial state), and objects as regulated elements (in the final intervention scheme).

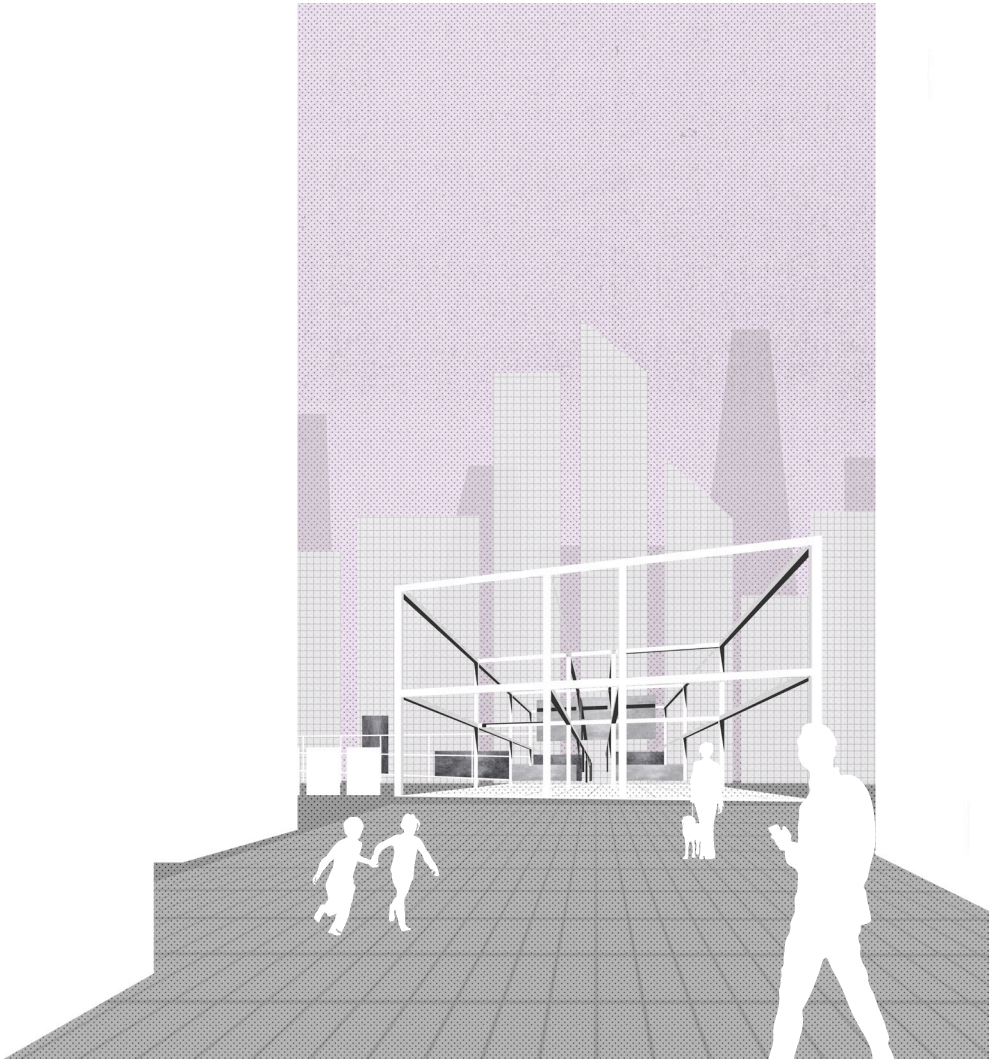


Figure 46 Plaza Entrance to Leysdown-on-Sea Intervention

Ritual

The ritual procession begins first by departing the metropolitan urbanscape onto a plaza caged in a bone-like lattice structure. The plaza hardscape bleeds out into the urbanised area to lead the procession to the structure.

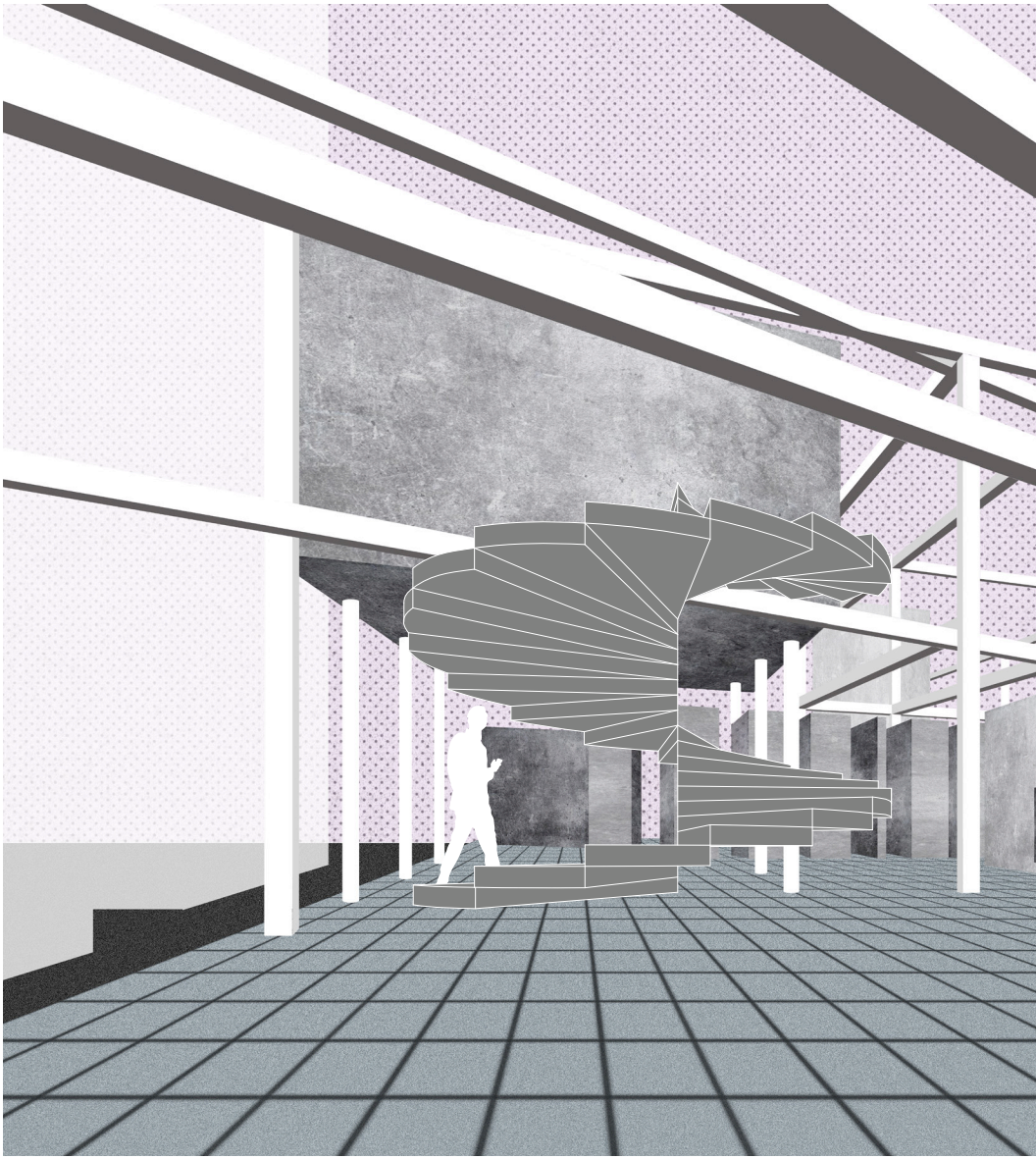
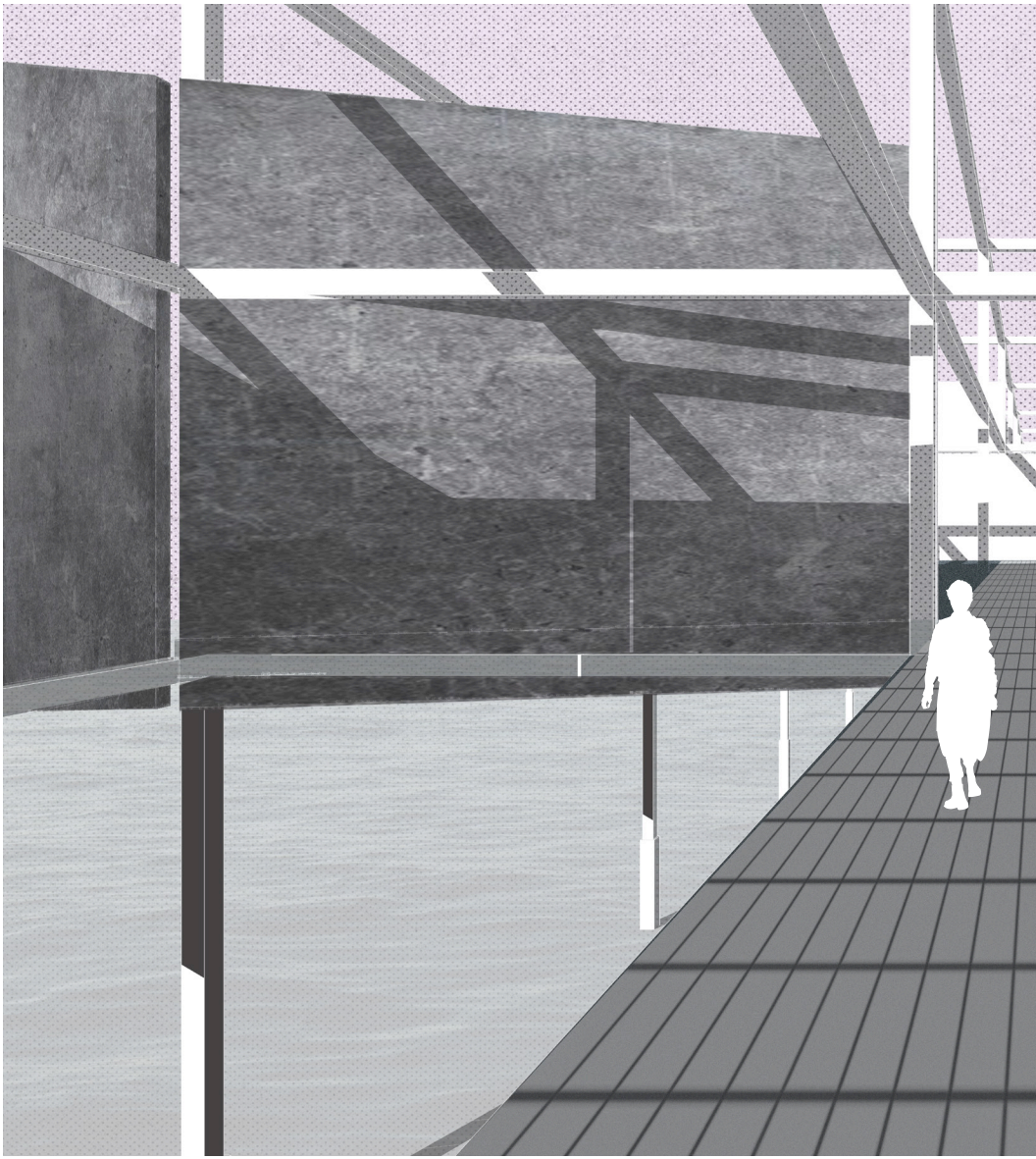


Figure 47 Playground of Objects at Leysdown-on-Sea

Playground

Follie structures create a playground for visitors to explore as they make their way closer and closer to the water; which can only be noticed if they ascend to the occasional tall structure that protrudes above the regulating structure.



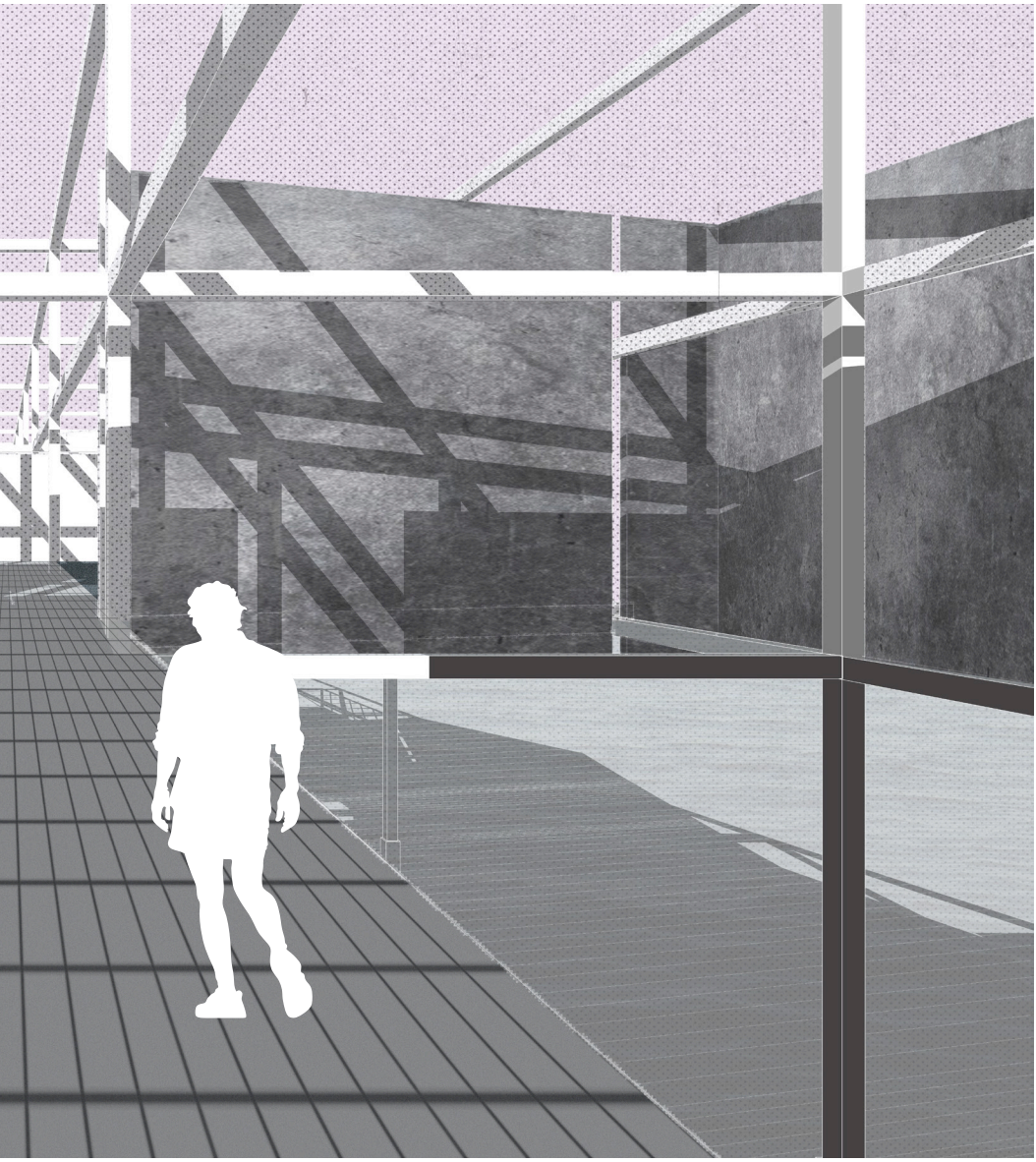


Figure 48 Transition Between Land and Water at Leysdown-on-Sea

Bridging Transitions

Ascending further and further, the user eventually meets the bridging transition that hovers above the tidal zone. If one is to spend some time here, they can notice the environment below changing from dark, rocky sand, to grey-blue shallow water, and vice versa.

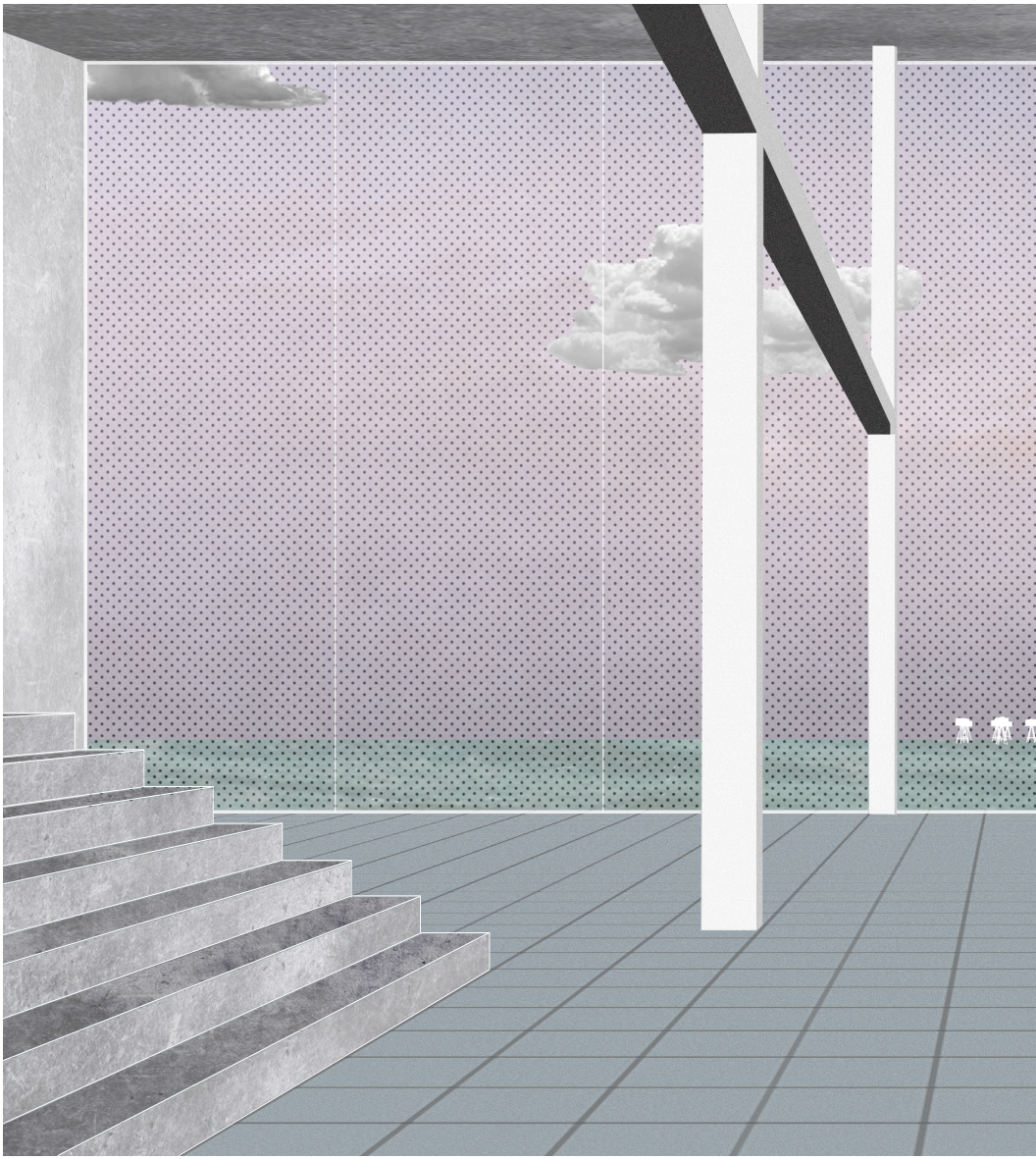


Figure 49 The Final Lookout Point at Leysdown-on-Sea

Jumping Off

Finally, the visitor comes to a mid point in the journey and reaches the jumping-off point, an observation plaza that allows the visitor to depart visually from the land and drift off into the waterscape.

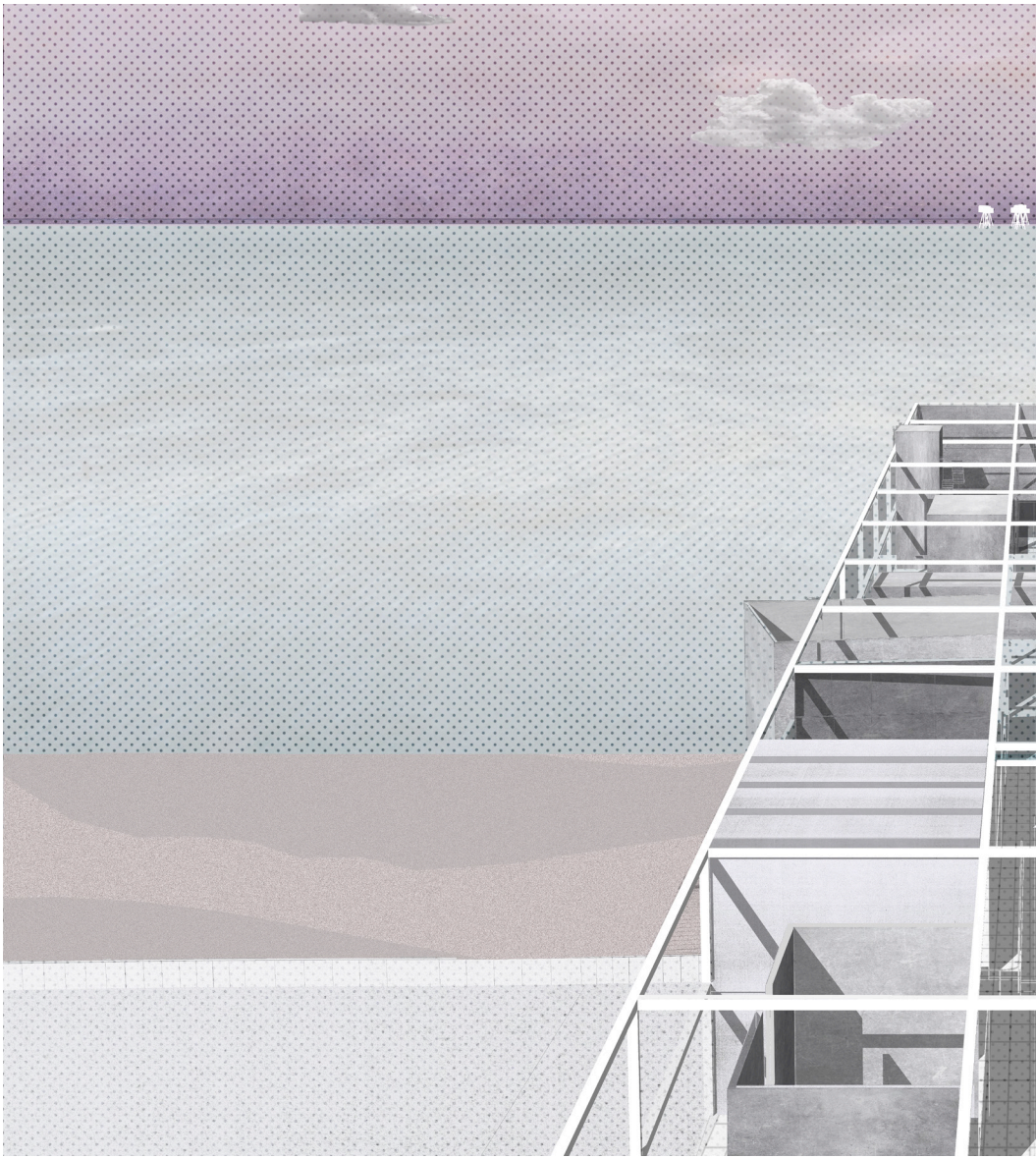
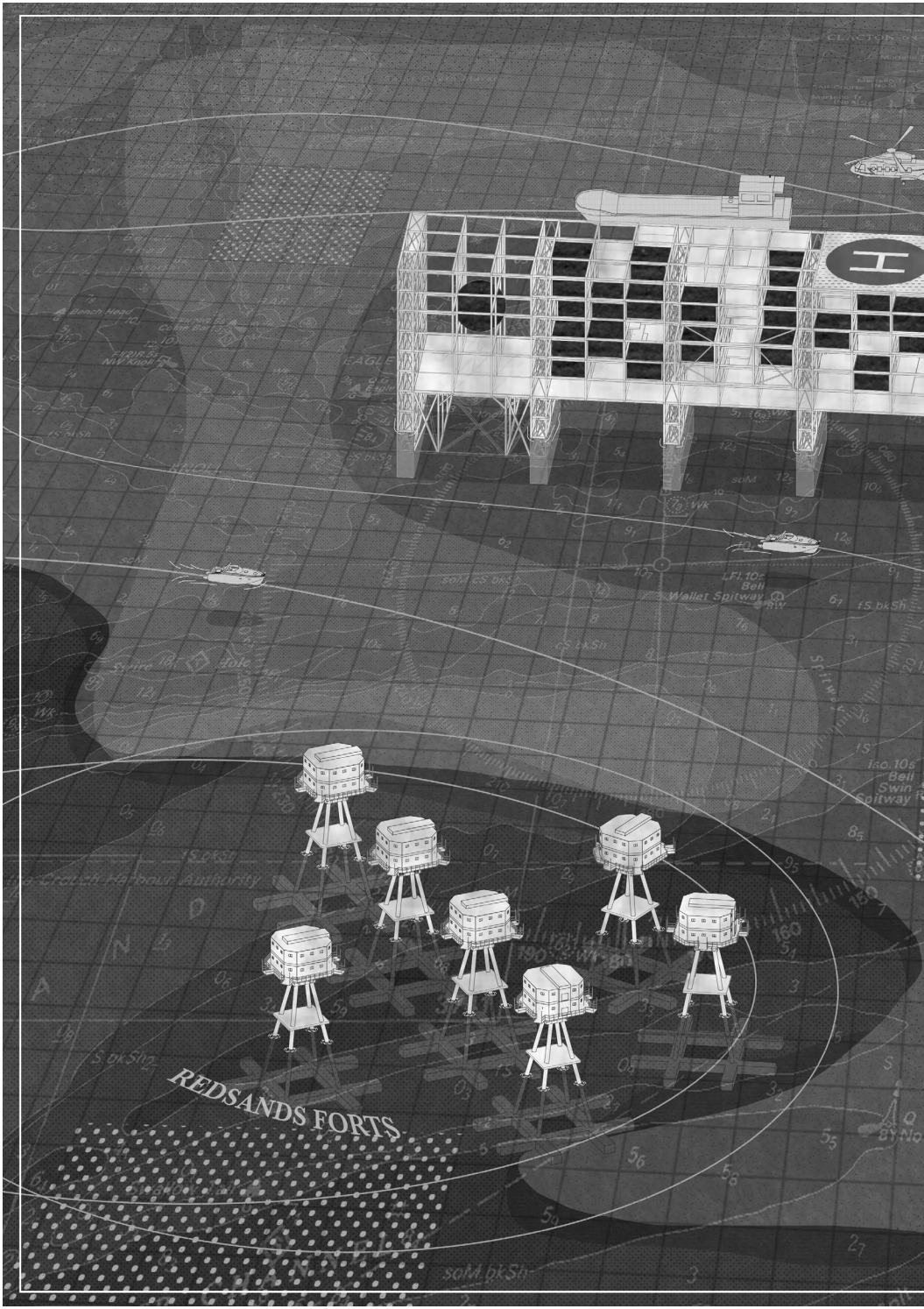


Figure 50 A birdseye view at Leysdown-on-Sea looking out towards Red Sands Forts

Voyage

Like a barge heading out to sea, the intervention at Leysdown-on-Sea bridges the transition between the land and water. Visitors prepare to head off onto the water towards Red Sands Forts, the location of new urbanisation.


REDSANDS FORTS

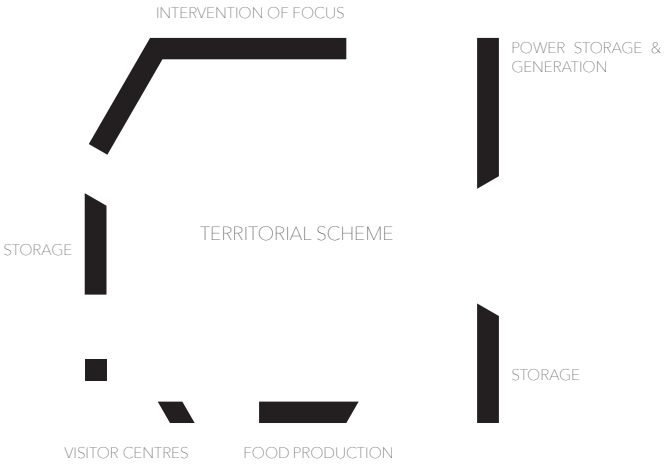
RED SANDS FORTS

Repository for Humanity

The Site Plan

The Red Sands Forts settlement is an ever-changing structure the serves as a Repository for Humanity. Taking cues from Archigram's Plug-in City, the lattice structural frame rests on load-bearing legs that go down to the estuary floor, with modular elements inhabiting the space. Cranes and helicopters move supplies and people respectively in and out of this machine. The structure orients itself around the Red Sands Forts, and irregularities in the structural frame protrude from the façade to serve as points of pause to observe and reflect on the metal follies.

On a territorial scale, the goal of the site is to be as self-sustaining as possible. Using power from nearby wind farms, the area would be responsible for its own productions for survival. Apart from the construction materials, the building would be autonomous from the land.



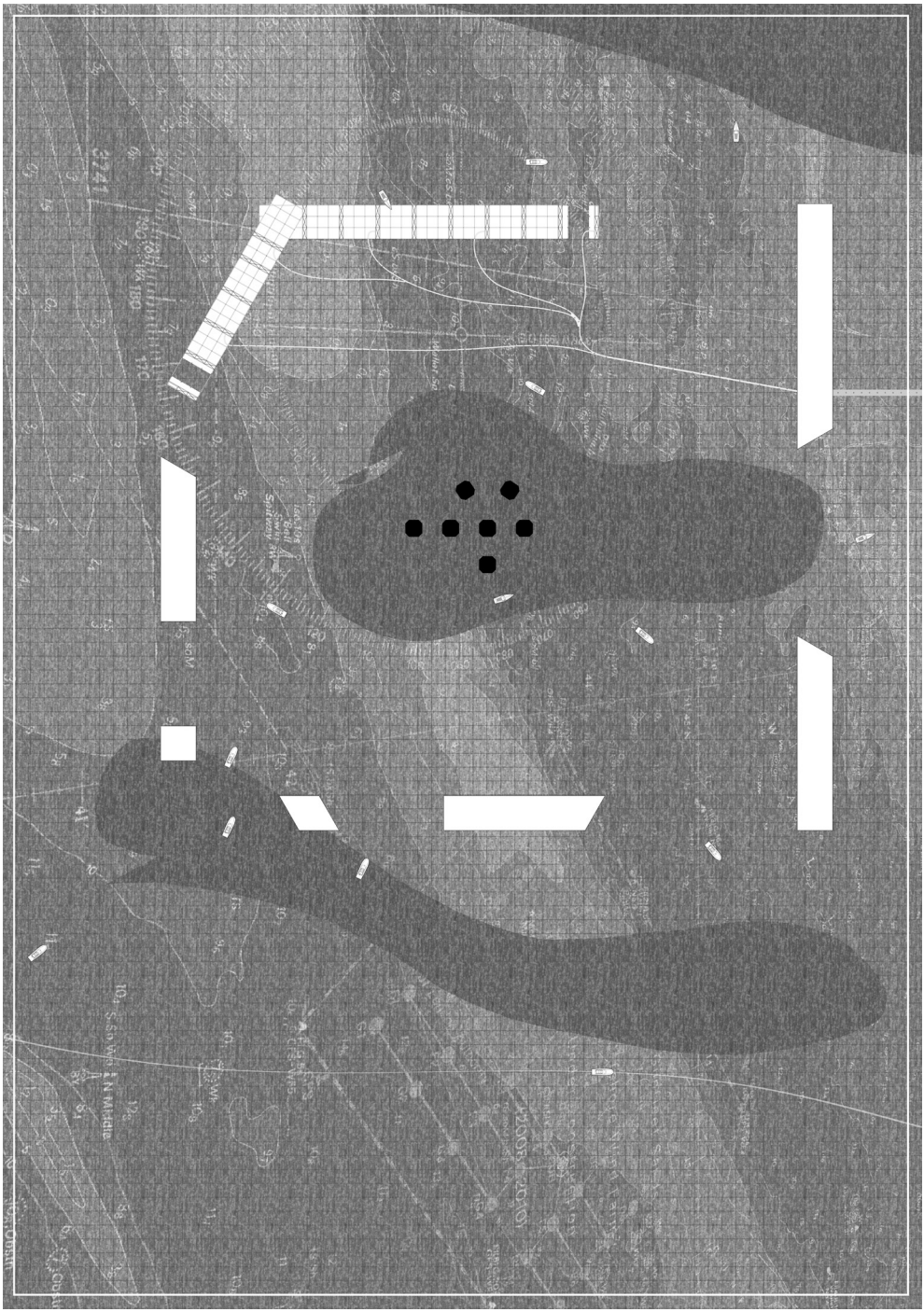


Figure 52 Site Plan: Red Sands Forts

Previous (p.84) Figure 51 Axonometric: Red Sands Forts

The ground level of the building has a boulevard that connects one end of the building to the other and acts as a space for interactions between each of the neighbourhoods.
Neighbourhoods defined by each zone between two of the main structural legs. Within each neighbourhood there is a central vertical circulation core, assembled with the structure; and modular elements for inhabitable space, as well as open courtyards.

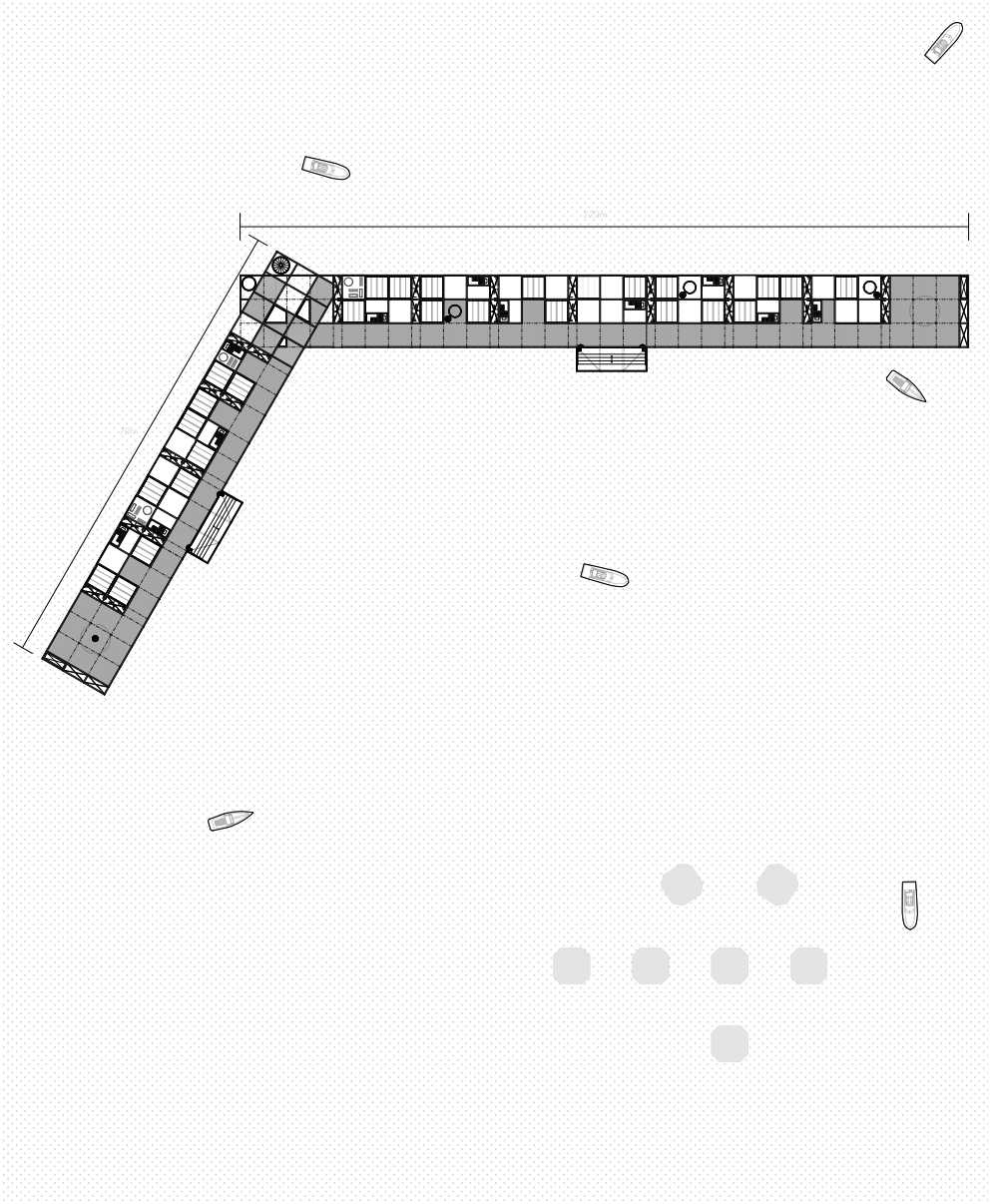


Figure 53 Plan Level 1: Red Sands Forts

The second level of the structure reveals the organised chaos afforded by inputting objects into an open structure freely. On upper floors, each of the modules are connected to the vertical access cores by pathways, ladders and steps depending on their proximity and elevation within the structure. Services that run through the building such as piping, are exposed through the lattice zone and work their way down the structural legs towards the service quarters below water level.

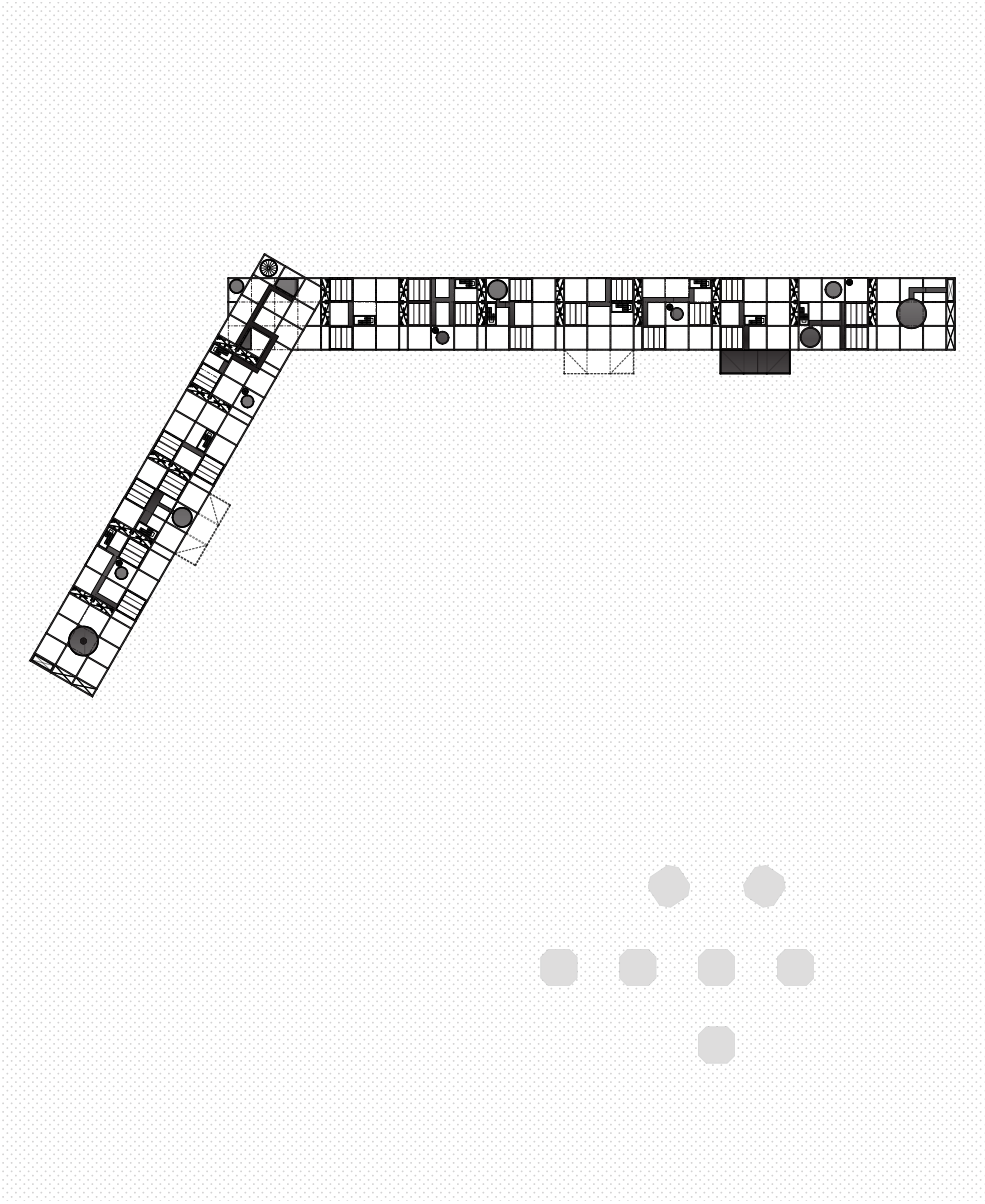


Figure 54 Plan Level 2: Red Sands Forts

The bases of each structural leg houses services such as water treatment, waste storage and treatment and electrical storage. Each of the rooms are accessible through a water/airlock system.

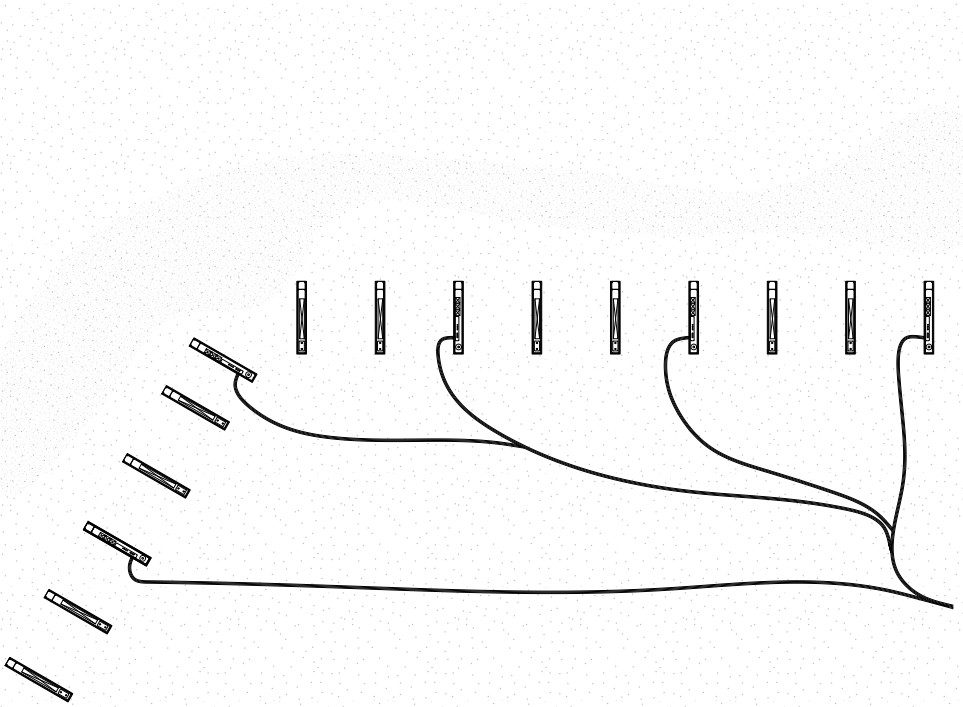


Figure 55 Plan Level -2: Red Sands Forts

In order to board the structure, two lock systems are implemented at each end which close and allow the water to calm before passengers disembark the boats and make their ways up into the structure.

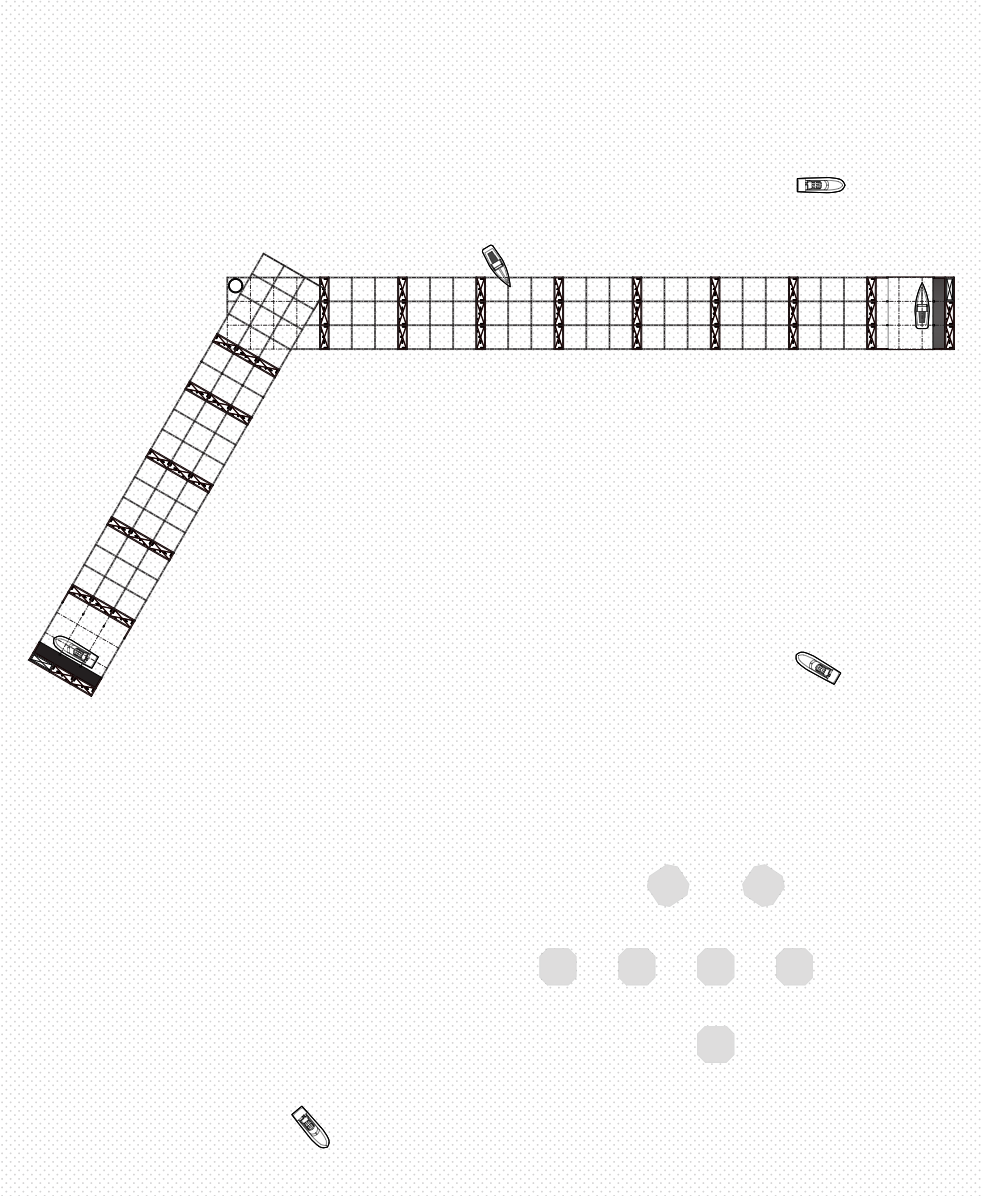
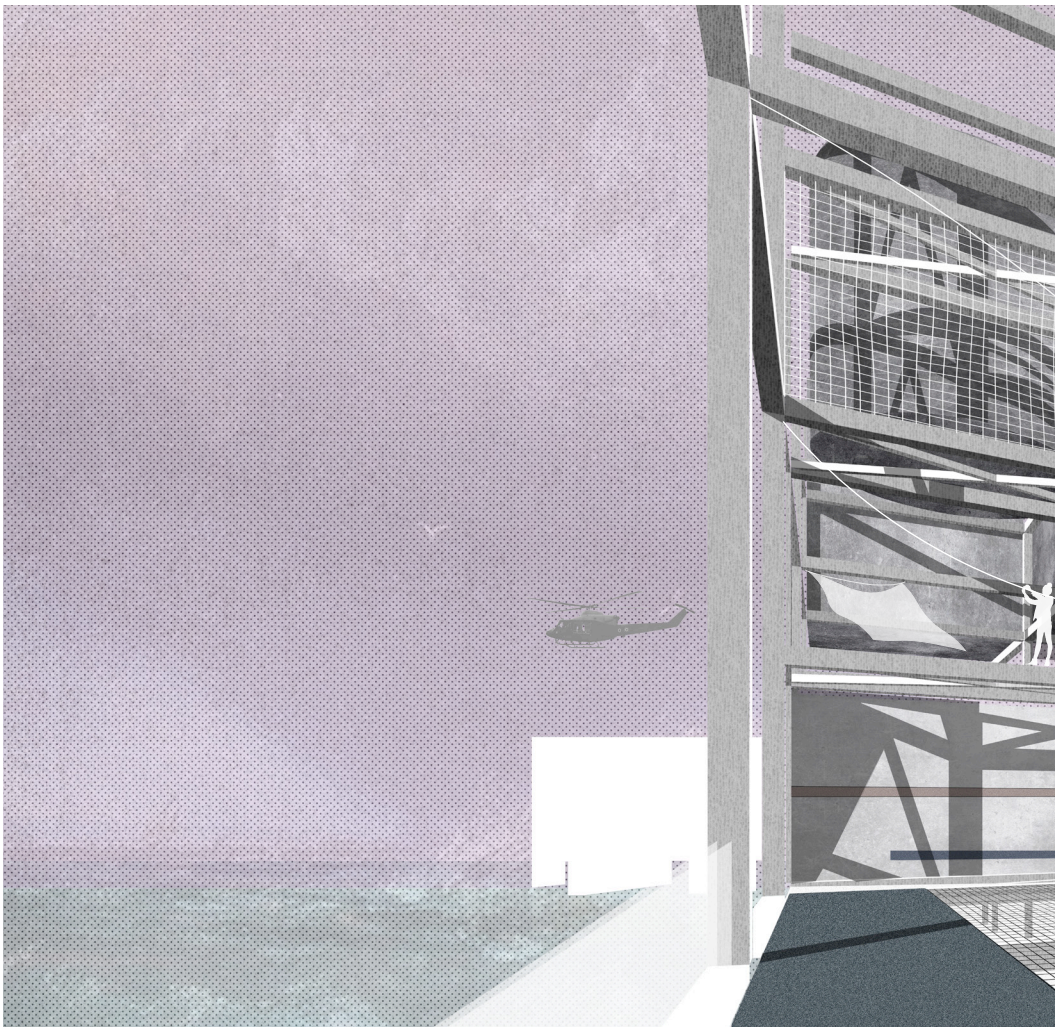


Figure 56 Plan Level -1: Red Sands Forts



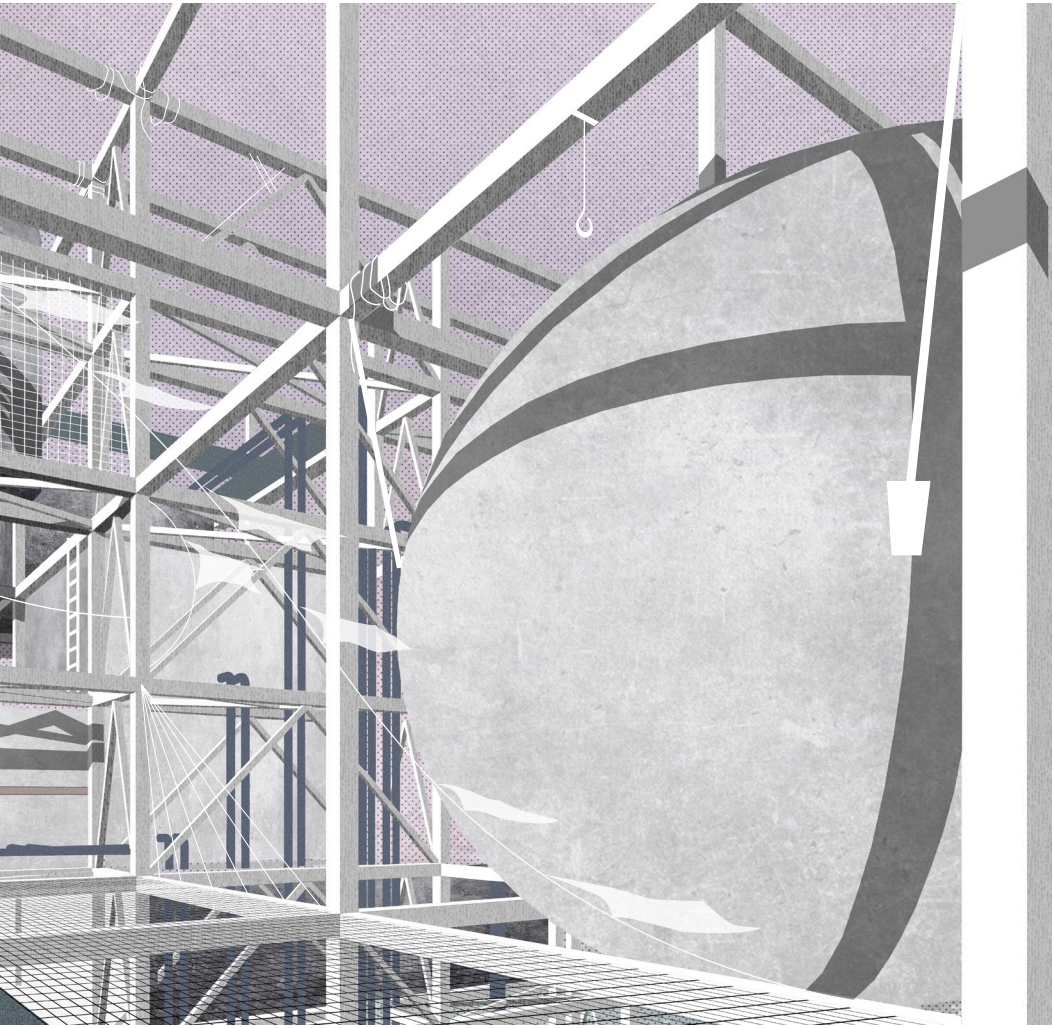


Figure 57 **The Micro-Metropolis** Public Space View: Red Sands Forts

The public space reveals the openness of the structure and exposes each modular element as a unique object within this three dimensional frame. These open, in-between zones allow for the development of a micro-metropolis on the water, filled with spaces where people can interact with one-another, with the structure, and with the site in a unique way.

Artist Neighbourhood: Developing Spaces

One of the intervention neighbourhoods have been developed in detail. Based on the previous research into the history about the Maunsell Forts I decided to establish an Artist Block. The Maunsell forts served as escapes for artists to create their work in isolation. The designed programme and spaces look to facilitate the creativity of the artists. The neighbourhood is an assemblage of spaces serving both the needs of its inhabitants while maintaining the overarching principles of the overall intervention. On the ground floor the gradient of privacy moves from the public boulevard to the semi public spaces that are appropriated by the neighbourhood.

Moving further back and up in the neighbourhood the spaces are interconnected by pathways. This plan shows an example of a residential unit, a greenhouse relating back to the circular living model for the building, as well as unexpected spaces.

Similarly, the structure acts as a repository that houses modules that can be added at different times and blends together different time periods. As a visitor walks through the structure they can see a record of time through the different module structures.

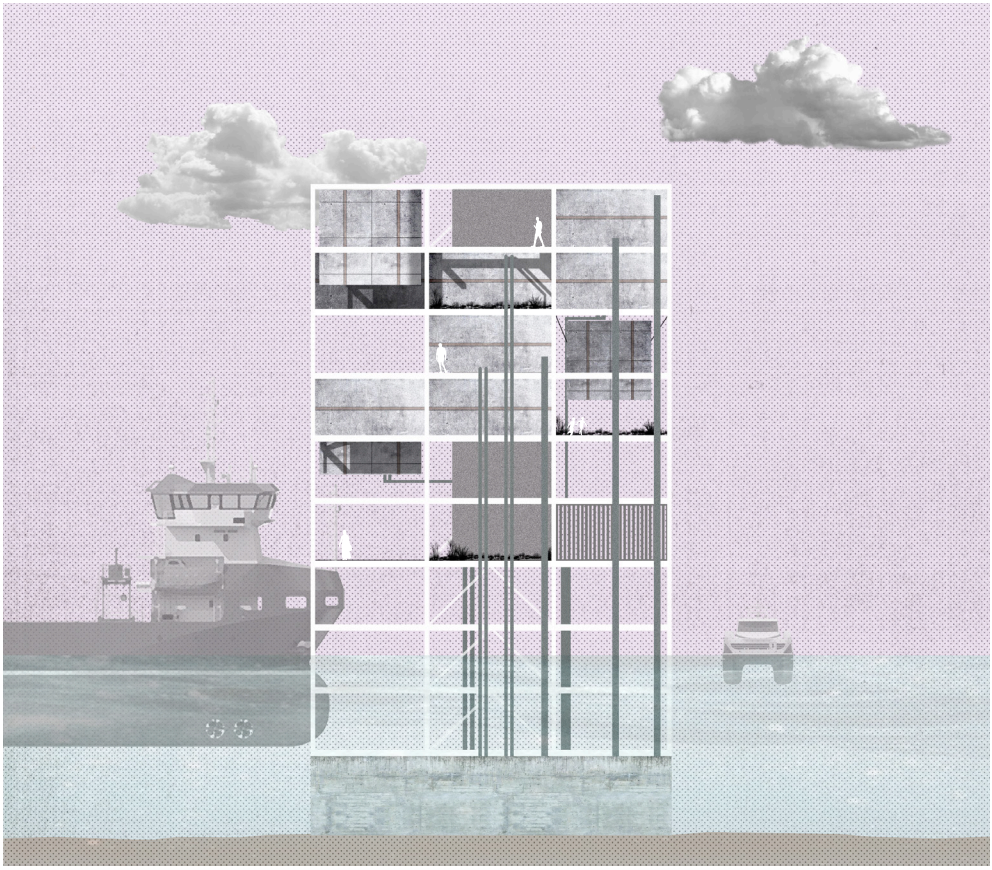


Figure 58 East Elevation Neighbourhood Fragment: Red Sands Forts

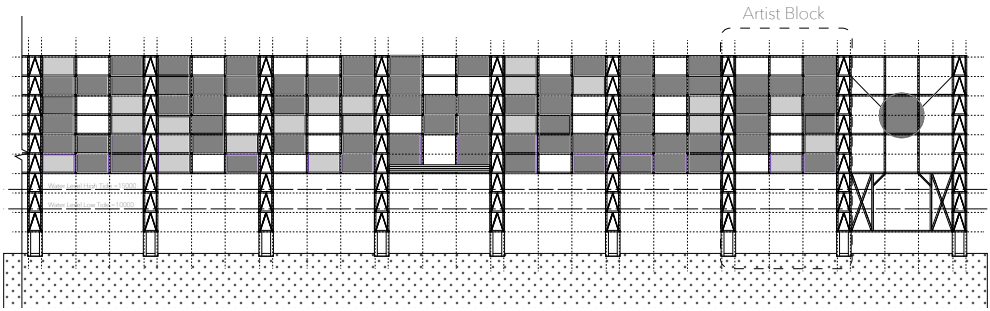


Figure 60 Key Building Section of East Wing: Red Sands Forts

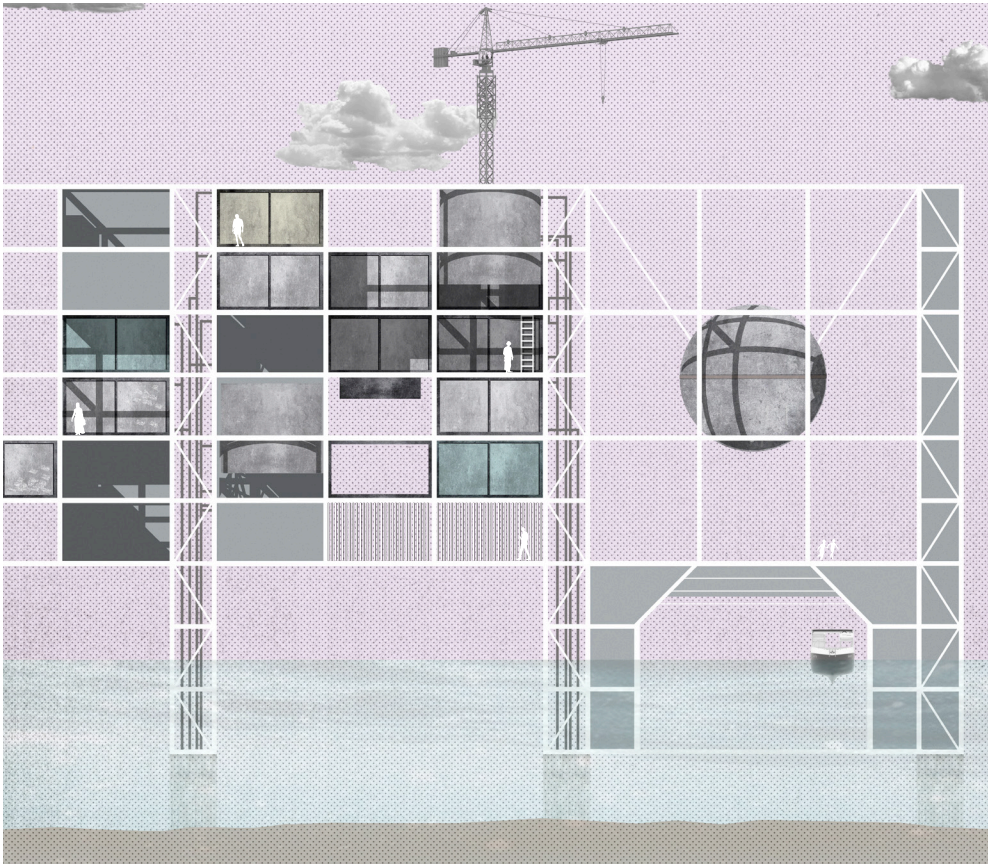


Figure 59 South Elevation Neighbourhood Fragment: Red Sands Forts

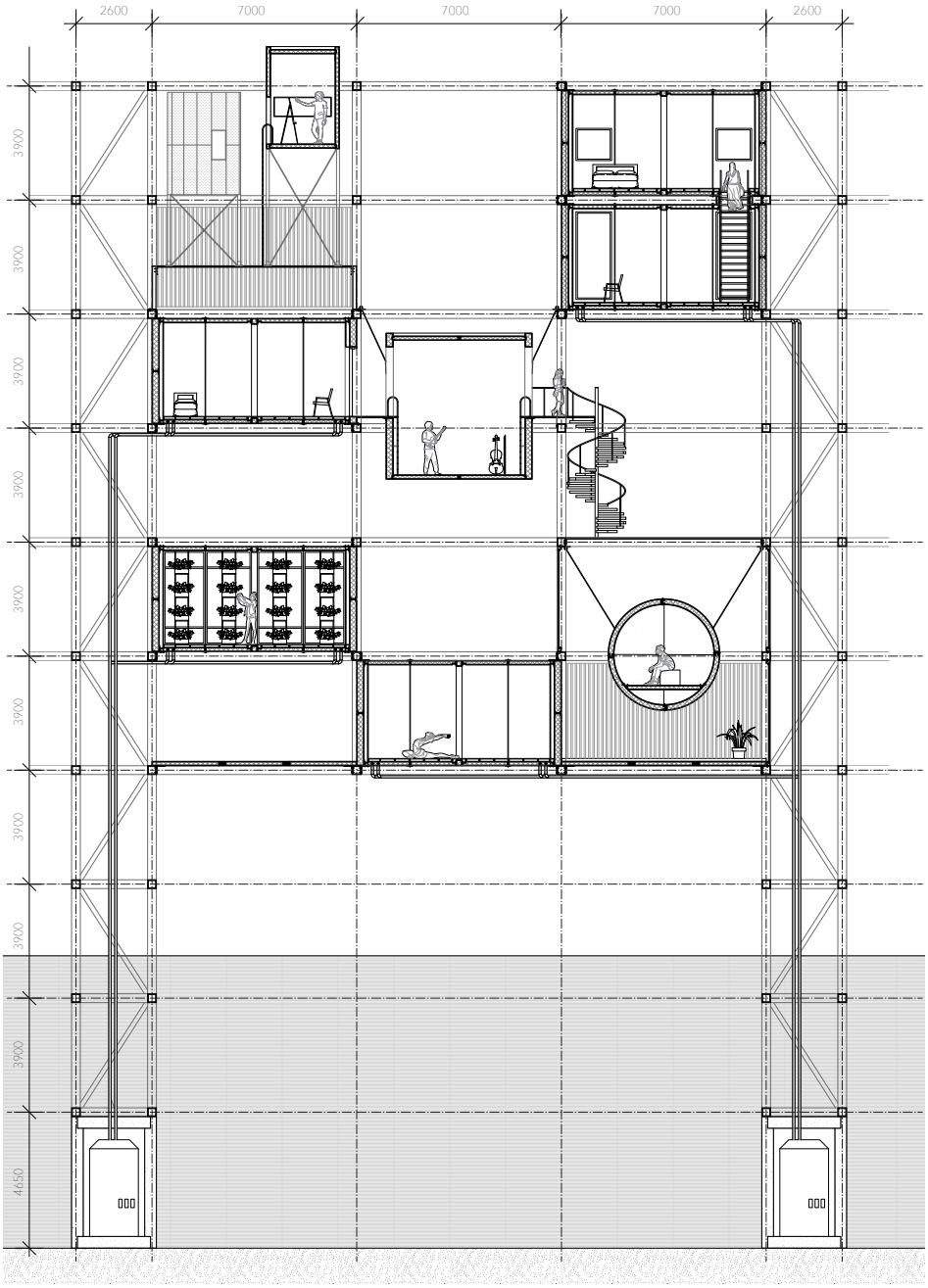


Figure 61 Artist Neighbourhood Section: Red Sands Forts

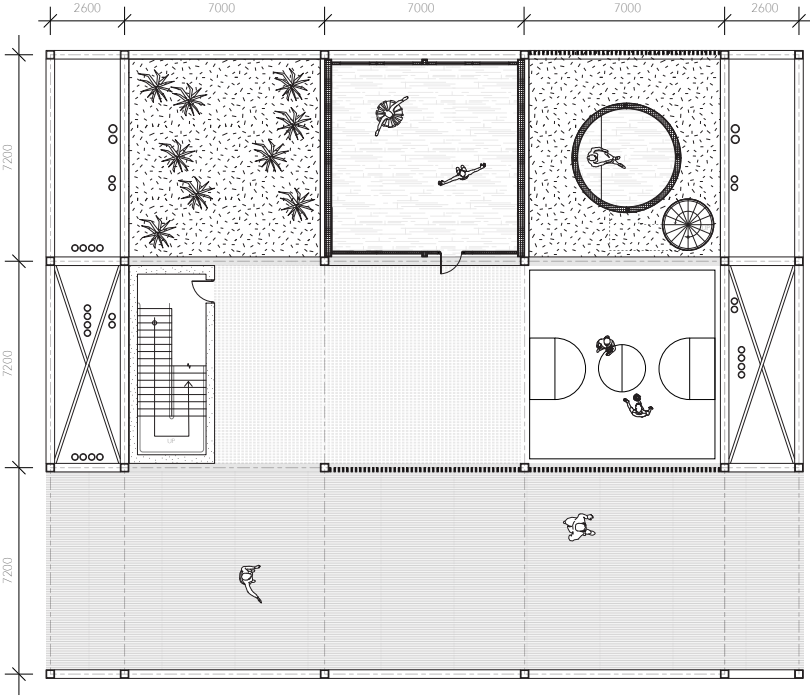


Figure 62
Artist Neighbourhood
Plan Level 0: Red Sands
Forts

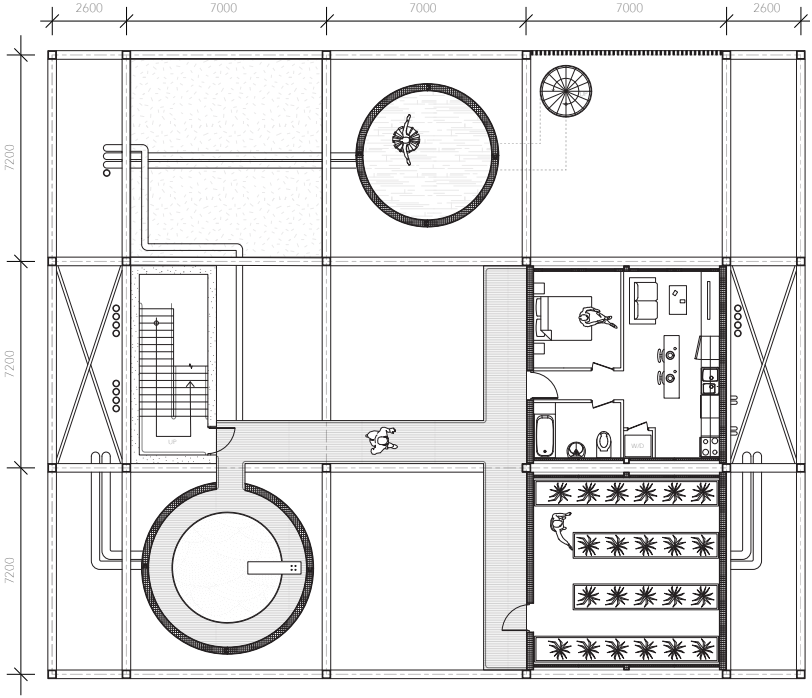
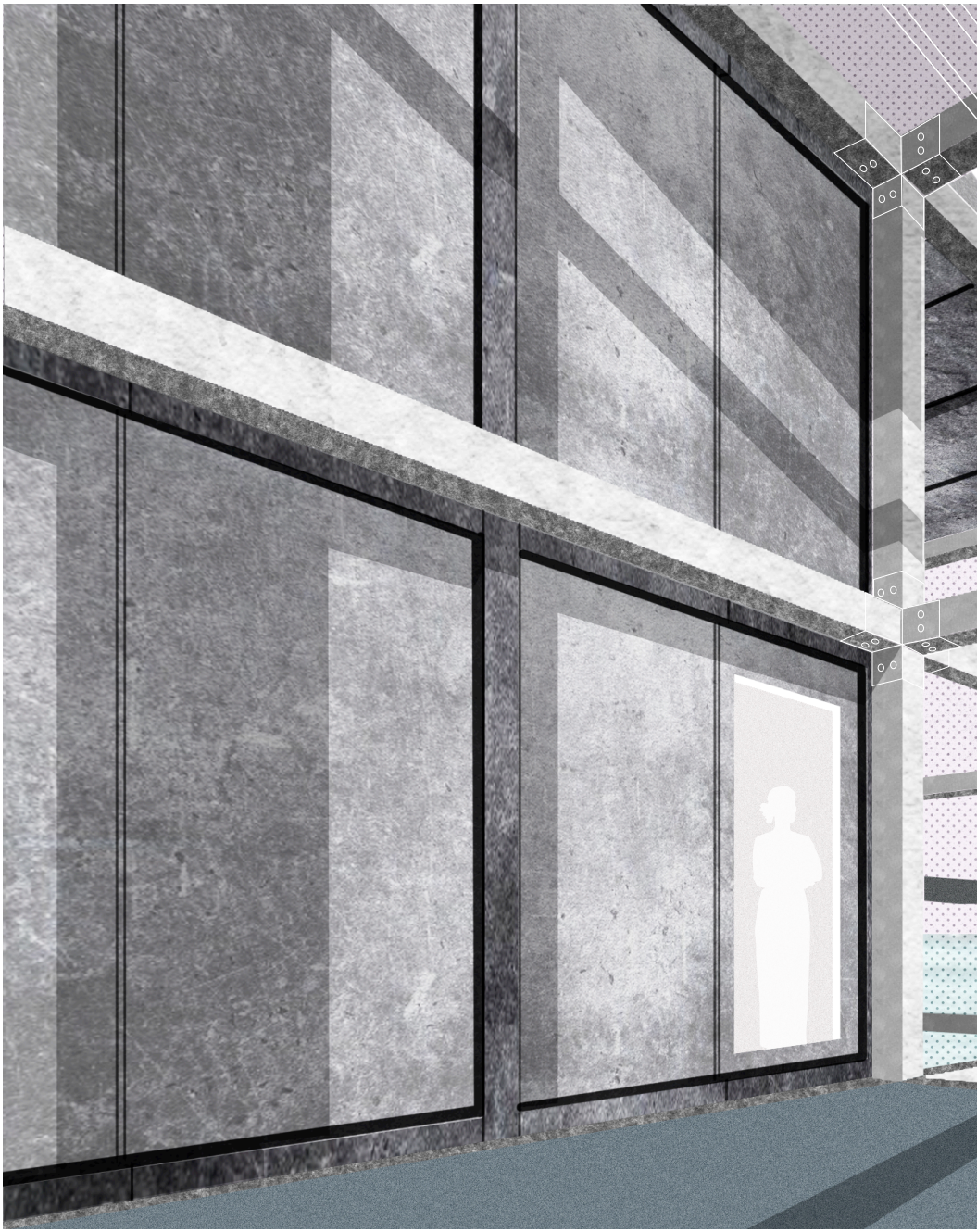


Figure 63
Artist Neighbourhood
Plan Level 2: Red Sands
Forts



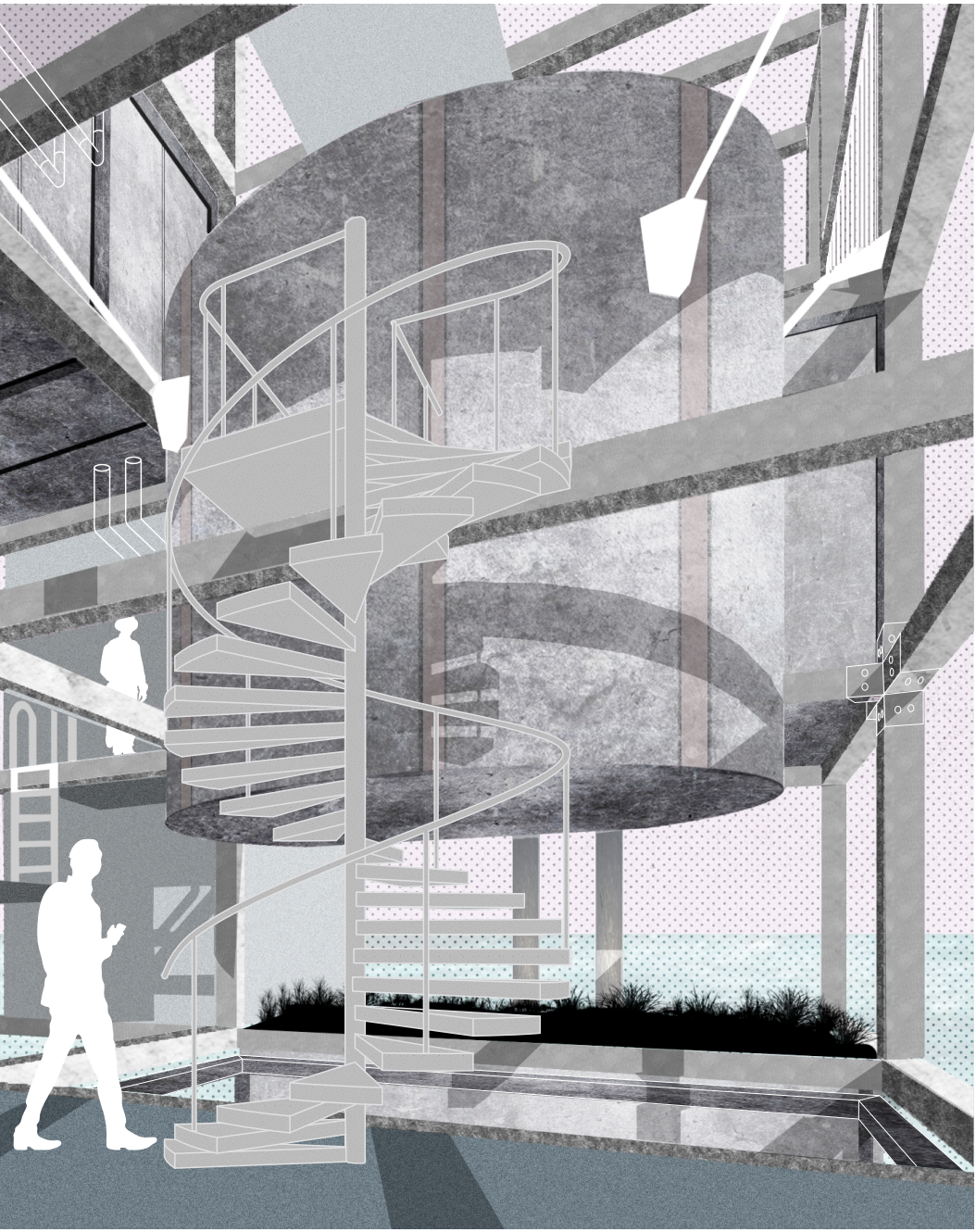


Figure 64 Artist Neighbourhood Appropriated Space View: Red Sands Forts

The adjacent spaces to the modules act as occupy-able space for the neighbourhood inhabitants and allow for moments to observe the vastness of the structure, and the relationship between module to module and their uniqueness.

Artist Neighbourhood

Unexpected Spaces

The structure acts as a storehouse for unexpected spaces. Suspending within the lattice, a space can be used as a music studio, or a swimming pool. Within a structure that is so heavily regulated, unexpected spaces and programmes are vital in establishing the character of living on the water.

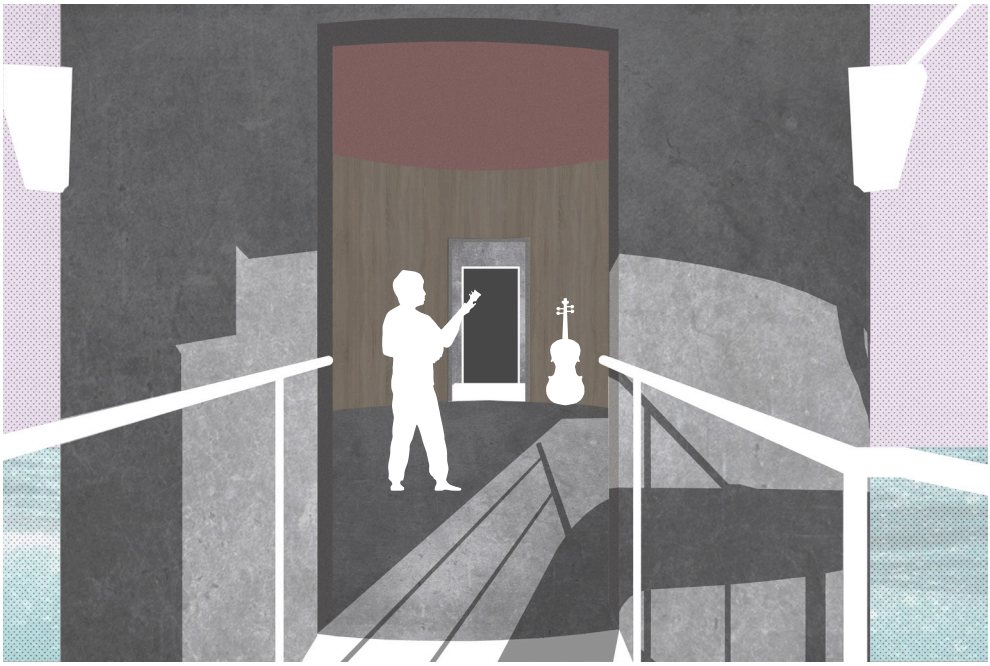


Figure 65 Artist Neighbourhood Unexpected Spaces: Music Studio
Red Sands Forts

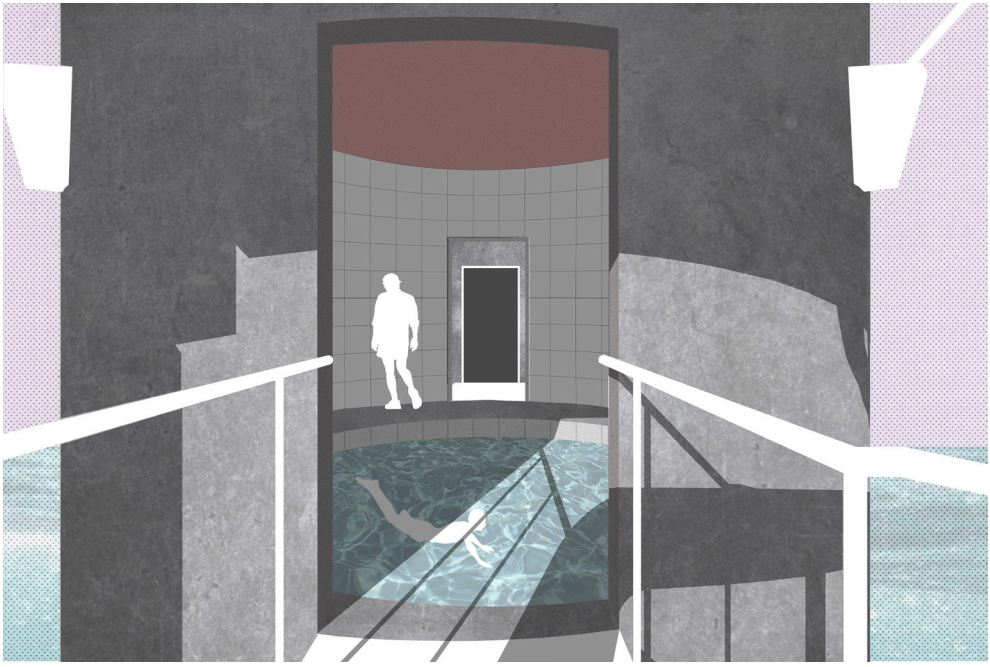
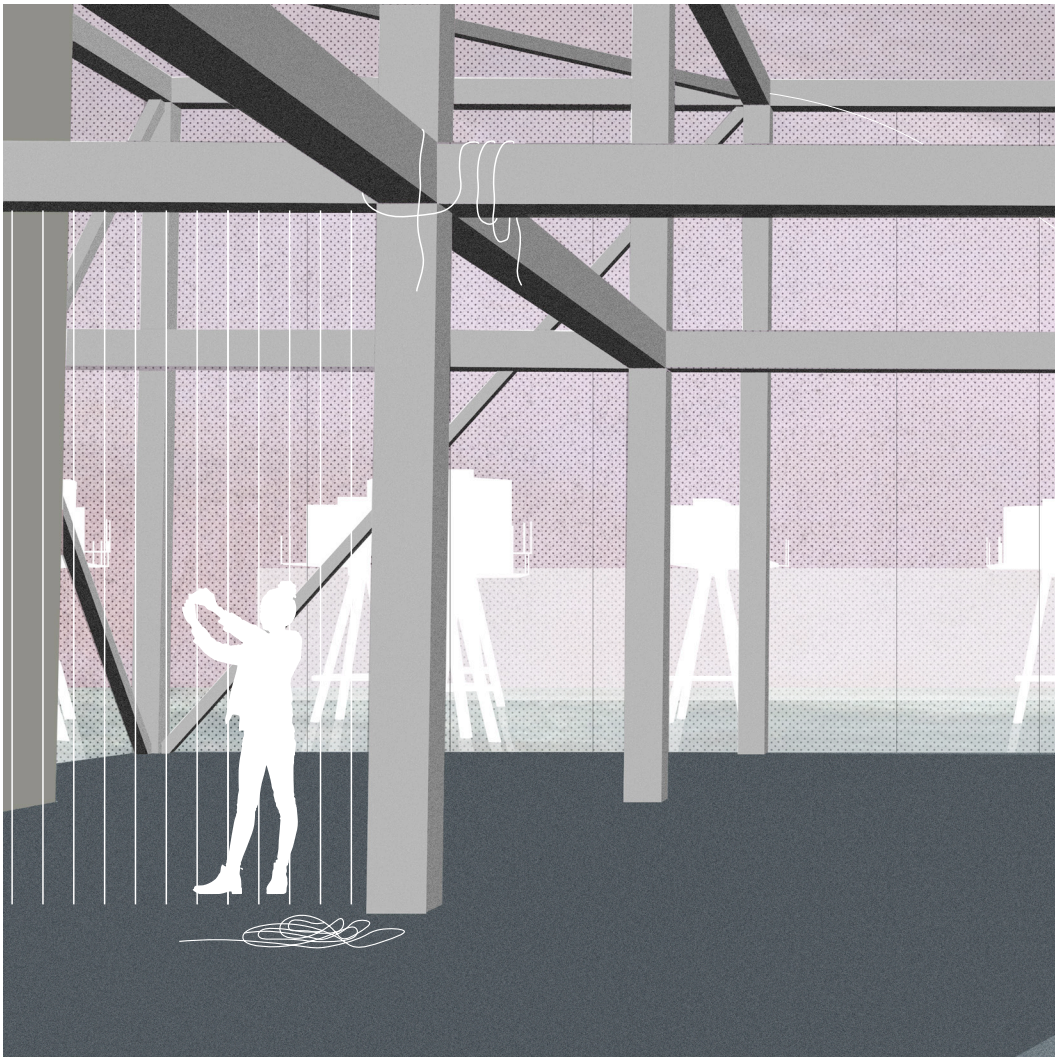


Figure 66 Artist Neighbourhood Unexpected Spaces: Swimming Pool
Red Sands Forts



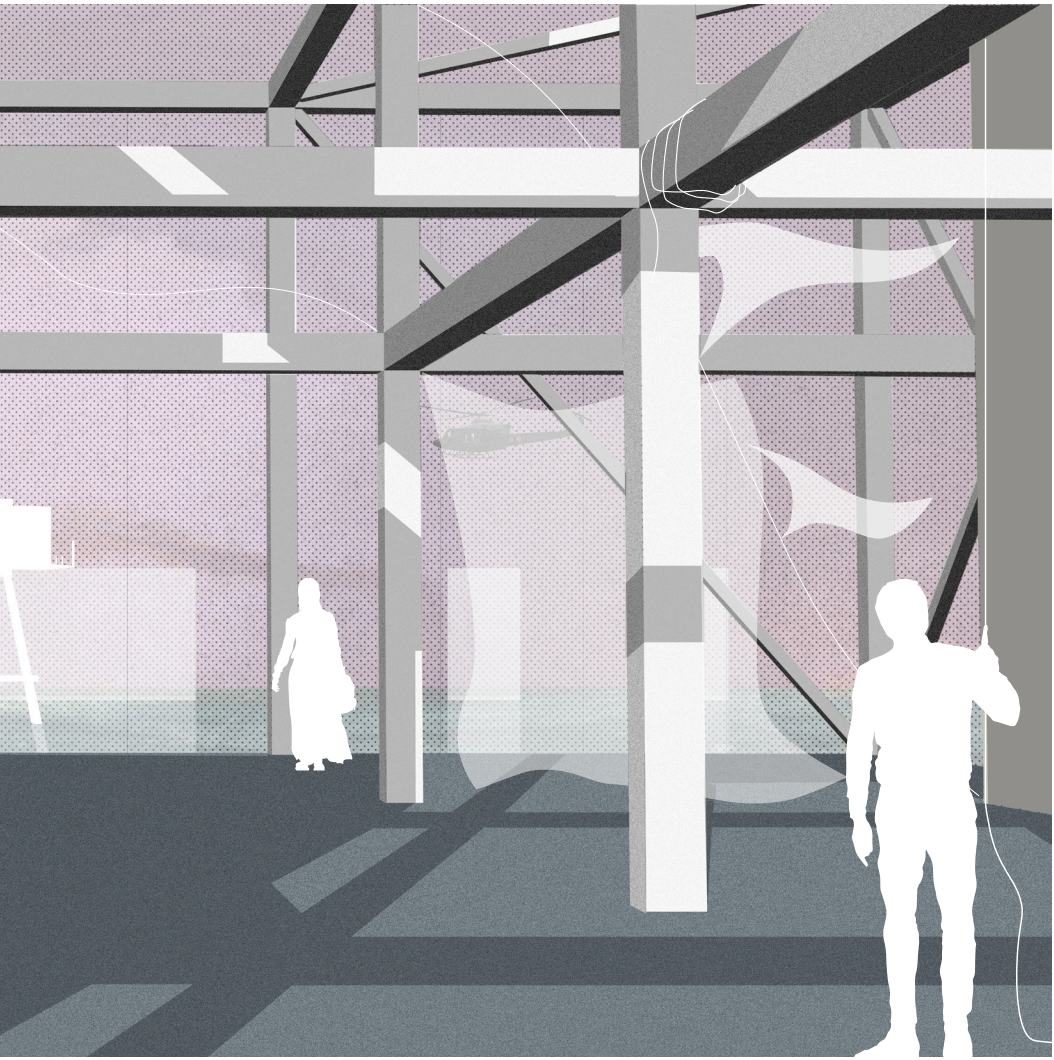


Figure 67 Moment of Pause: Red Sands Forts

Volumetric protrusions from the main structure create spaces for moments of pause for the inhabitants/visitors to reflect on where the design originated: the Maunsell Forts. These moments bridge the past and present and facilitate thoughts about the future of the site as the urbanisation of the waterscape continues.

Neighbourhood as Machine

Sum of Components

One of the key takeaway from the analysis of the forts is the concept of a kit of parts. By disassembling the fort into parts and studying their relationships to one another, the concept of unit to whole became as key concept in the workings on the modules within the structure. The intervention works as a machine that is a collection of its components, comprising of people, spaces and mechanical elements that are imperative to the function of the whole system.

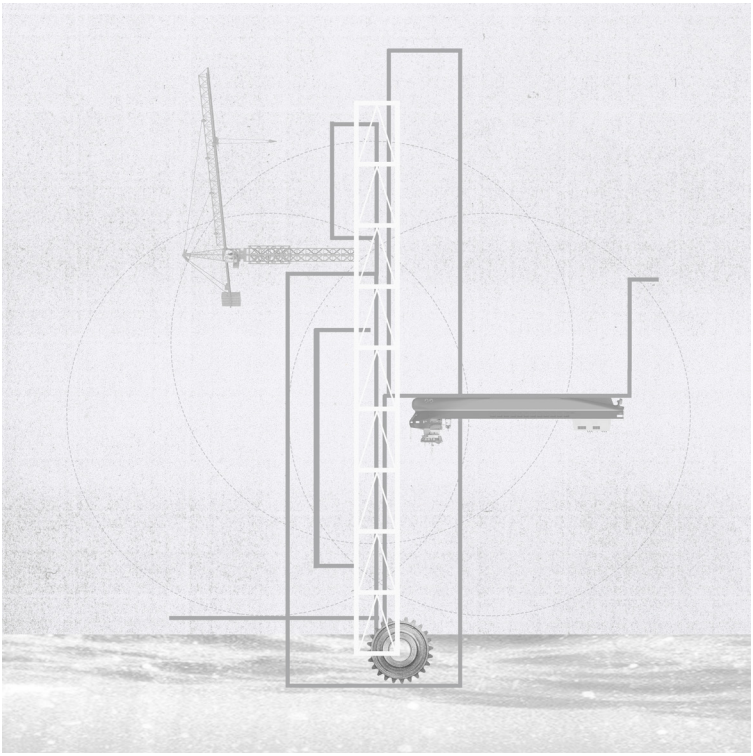


Figure 68 Neighbourhood as Machine

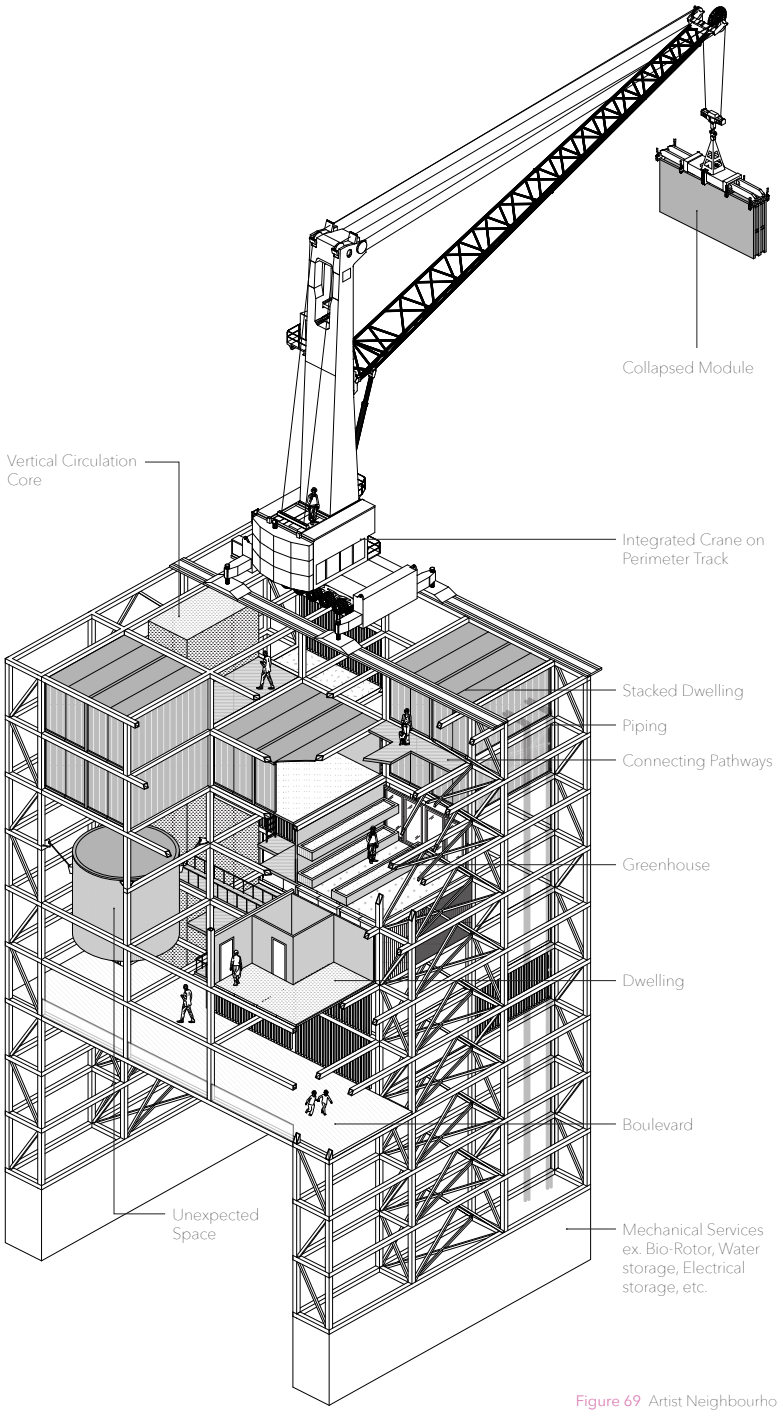
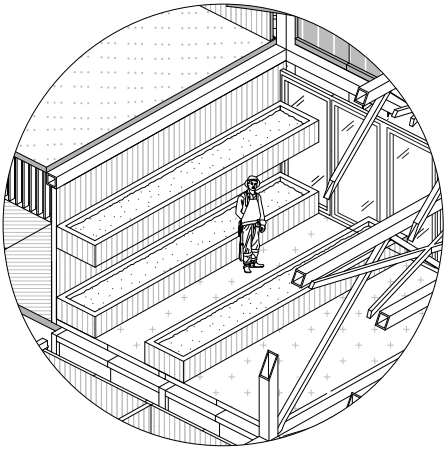
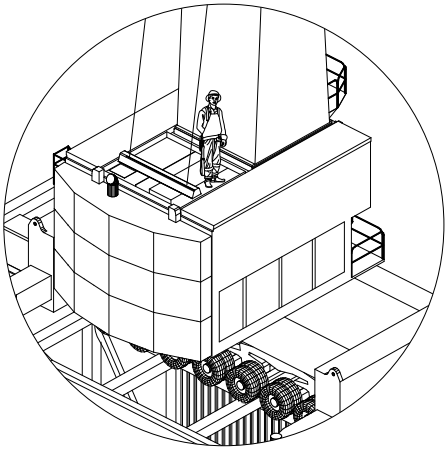


Figure 69 Artist Neighbourhood Axonometric



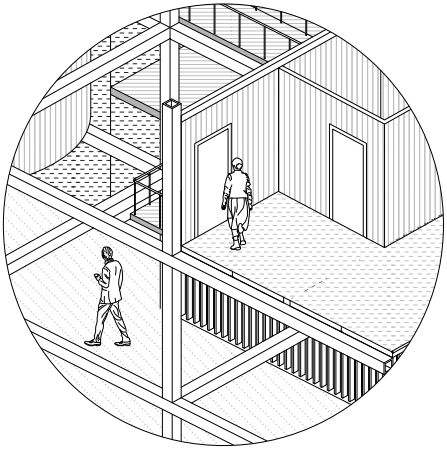
Self-Sustaining

Circular living is an important principle in the neighbourhood as machine. By facilitating spaces where individuals can produce their own food, then the community can be self-sustaining away from the land.



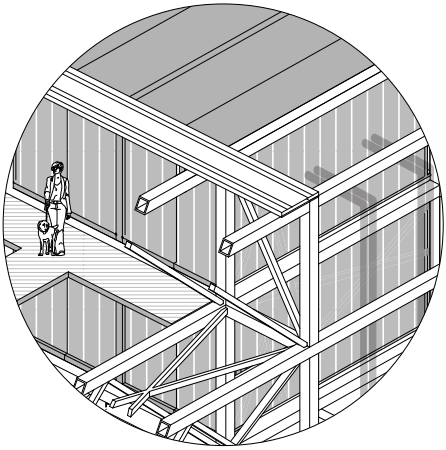
Self-Supporting

By integrating mechanical components such as a crane into the structure, adding more modules to the structure, maintenance and improvements can be made more easily and accurately compared to vessel-mounted cranes.



Modular Living

By creating a modular system that maximizes the inhabitable space within the structure, and one that is collapsible and able to be stored in its collapsed form around the structure, customizable configurations are possible to enhance the livability of living on the water.



Outdoor Spaces

The open air structure maximizes the amount of fresh air that the inhabitants can benefit from as well as allow flexibility for system services such as plumbing to efficiently run through the structure.

Building Technology: Structural Scheme

The Manusell Forts were assembled off-site and floated out to their locations in the Thames Estuary. The construction style for the interventions follows a similar approach and takes cues from the structural organisation of the fort clusters themselves. The basic structural organisation of Red Sands Forts is a lightweight structure resting on heavy bases that sink to the bottom of the estuary as they are filled with water. Similarly for the project intervention, a lightweight structure will rest of heavy foundations that are constructed on-site and house various maintenance and support spaces.

The structural scheme for the intervention is relatively simple to achieve as easy construction as possible given the difficulty of building in the water, and specifically the Thames Estuary. Following the grid of the Red Sands Forts, the load-bearing legs are constructed at 23.6m O.C. from Hollow Square Section Pultruded Composite with diagonal cross-bracing to counteract horizontal forces (SW prevailing winds and currents). The vertical loads are distributed down to concrete foundations that rest on estuary floor.

The Secondary Lattice Structure (SLS) is a Hollow Square Section Pultruded Composite lattice that supports inhabitable modules and pathways. The loads put on SLS are distributed to cross beams towards the load-bearing leg structures.

The repetitive structural scheme allows for the potential to expand the intervention both horizontal and vertically and the modular aspect allows for ease of maintenance and replacing elements should it be necessary.

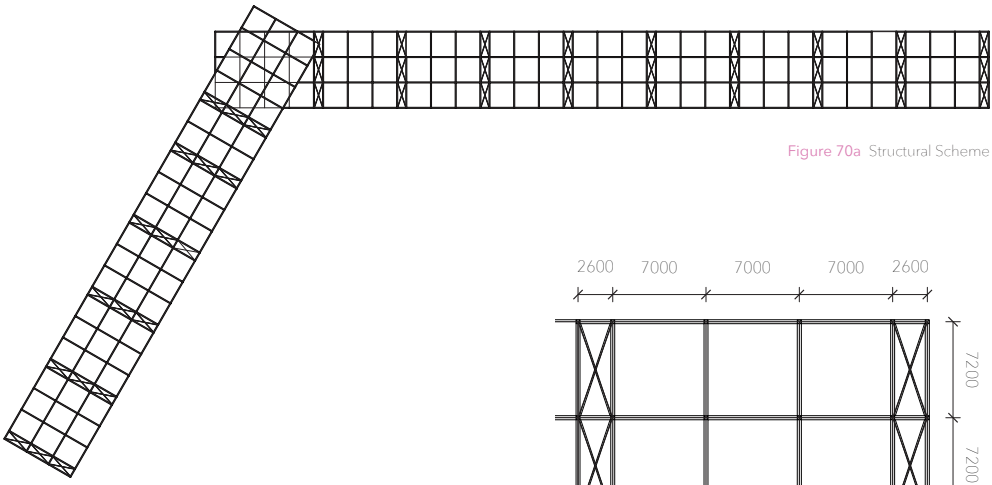


Figure 70a Structural Scheme

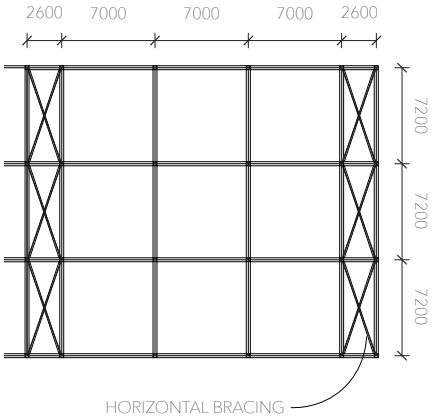


Figure 70b Structural Scheme Dimensions

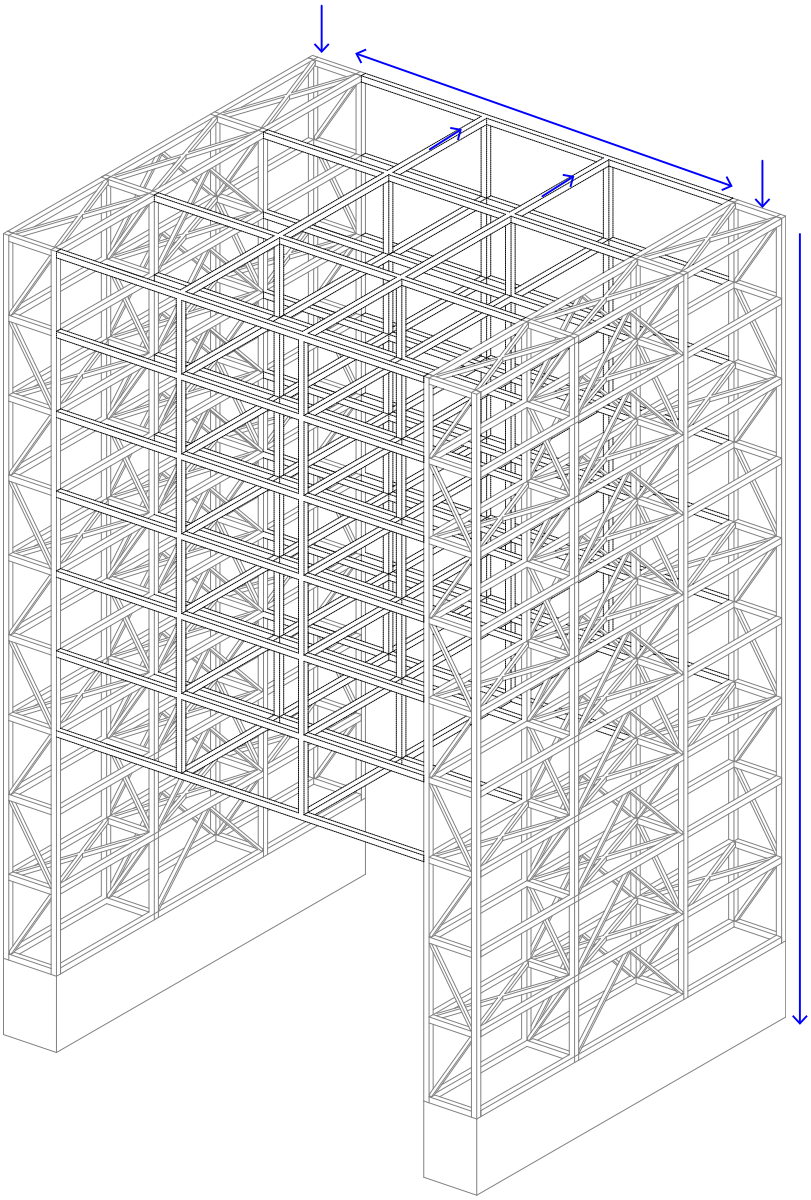


Figure 71 Structural Load Distribution Diagram

Building Technology: Structural Material

PULTRUDED COMPOSITE is a glass fibre resin composite that uses pultrusion to create structural members with constant cross-sections. The material is beneficial for construction in the Thames Estuary due to its corrosion-resistance and lightweight attributes. Hollow square profiles are used as they have a better strength to weight ratio compared to other profiles such as I or C. Since the material is a glass fibre resin composite, it is not possible to weld connections, so the intersections will be bolted together using non-rust steel sleeves.

The modules themselves are collapsible units, modeled after emergency housing, that are constructed of pultruded composite sandwich panels. This structural material is beneficial for this application because it is strong, lightweight, corrosion resistant, has acoustic dampening properties, insulative, fire resistant and low-cost. Based on material specifications from TRANSONITE FRP (Fibre-Reinforced Plastic) pultruded sandwich panels, the modules were designed according to dimensions within the product range.

"TRANSONITE pultruded sandwich panels feature z-axis reinforcement, yielding a composite with structural fibers that span three orthogonal directions. The through-thickness fibers (precut rovings) are deposited through the top and bottom skins of the panel, tying the skins together through the core. The finished panel offers high strength at very low weight, adds thermal and acoustical insulation, and increases durability."

Source: Ebert Composites Corp.

Figure 72 Pultruded Composite Fibres from Fibreline Composites

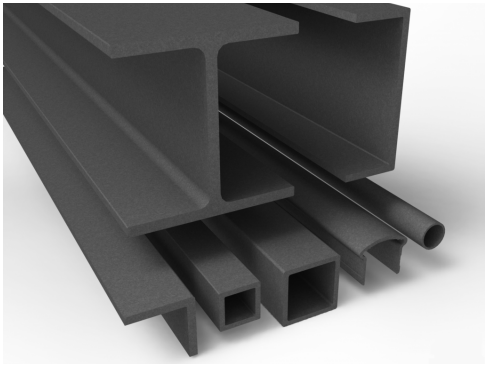


Figure 73 Pultruded Composite Profiles from Dura Composites

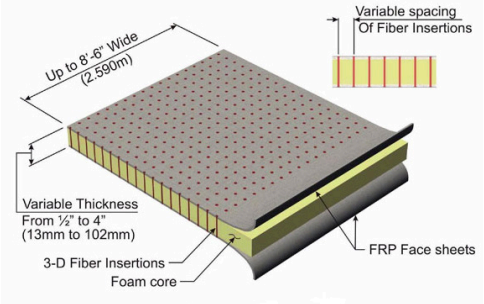


Figure 74 Transonite Pultruded Fibreglass Reinforced Panel (RFP) with 3D Fibre Insertions

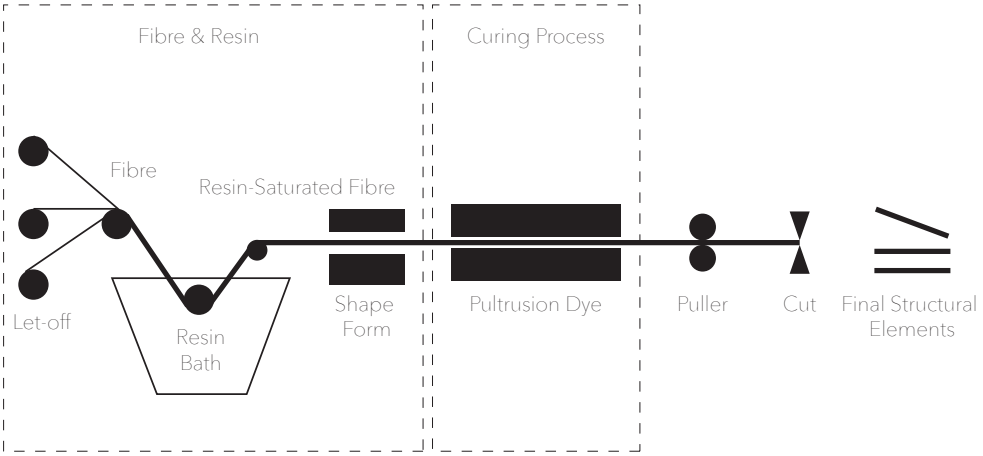


Figure 75 Pultrusion Process Diagram

The pultrusion process allows for the production of composite profiles that have a constant cross section. As described by Fibreline Composites A/S (a manufacturer of pultruded composites), the pultrusion process starts with a continuously reinforced materials being pulled through a guide that carefully places the fibres in relation to the profile cross sections. The fibres go through the resin bath that further reinforce the profile and then are pulled through the shape form where the final profile is defined and cured. If necessary, the pultrusion can be dyed to specification. Finally when the profile is cured it is cut into the defined lengths.

Source: Fibreline Composites A/S

Building Technology: Inhabitable Module

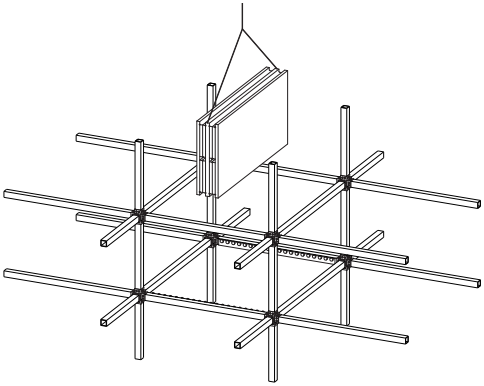


Figure 76a Module Installation: Lowering
Pre-assembled and collapsible module composted of pultruded composite sandwich panels is lowered into the lattice structure via crane attached to the perimeter of the structure.

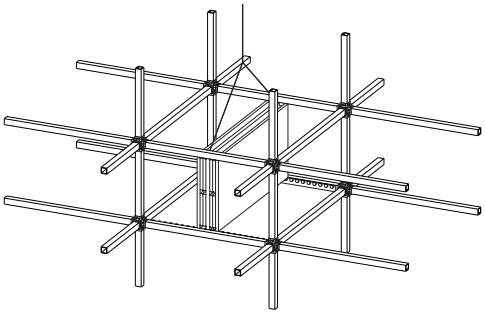


Figure 76b Module Installation: Placement
A roller track acts as a guide for the positioning of the module within the lattice structure.

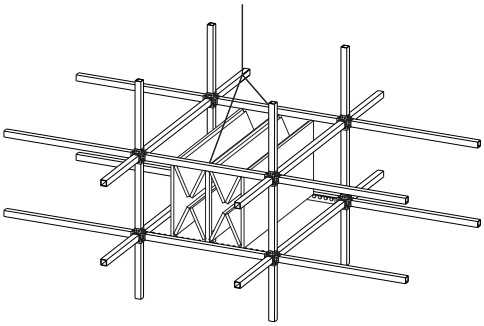


Figure 76c Module Installation: Opening
The module utilises the roller track as a guide to expand into its opened form within the lattice structure.

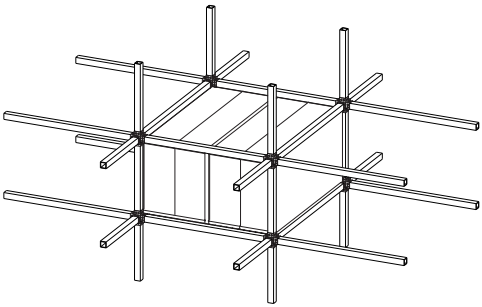


Figure 76d Module Installation: Side Walls
The assembled module is fully opened and rests on the bottom left and right structural members of the lattice structure. The front and back walls rotate into place from within the top panels and are fastened.

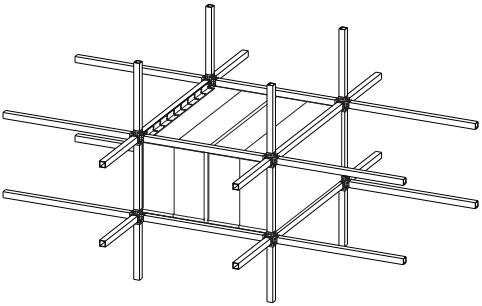


Figure 76e Module Installation: Fastening
The assembled module is fastened into the lattice structure by rust-proof steel angles and bolts on the top and bottom of the module.

Building Technology:
Inhabitable Module

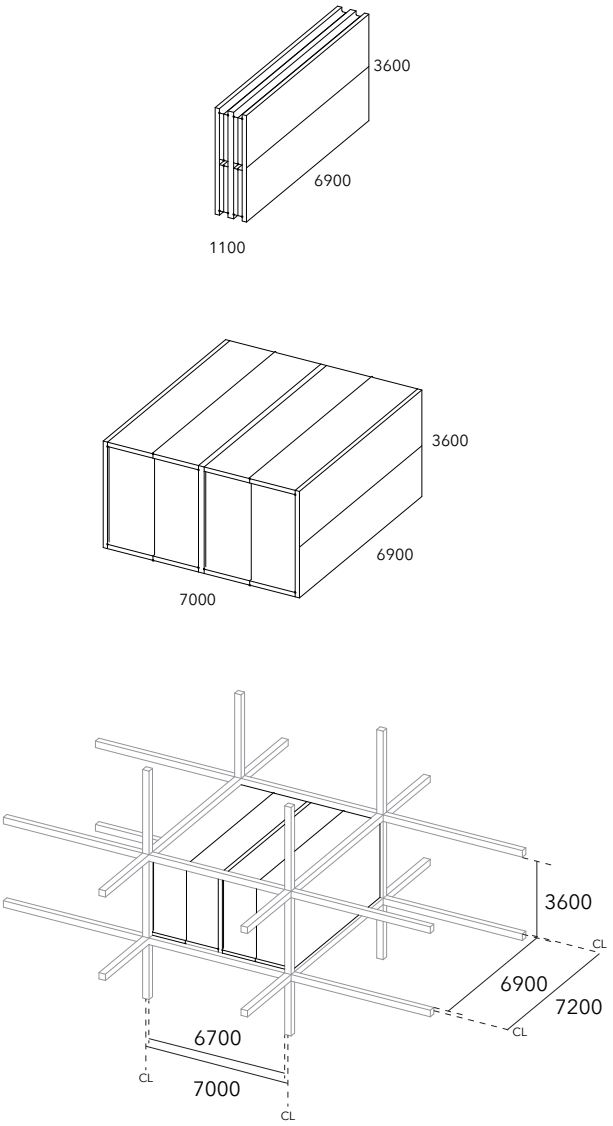


Figure 77 Module Dimensions
Collapsed
Opened
Within Lattice Structure

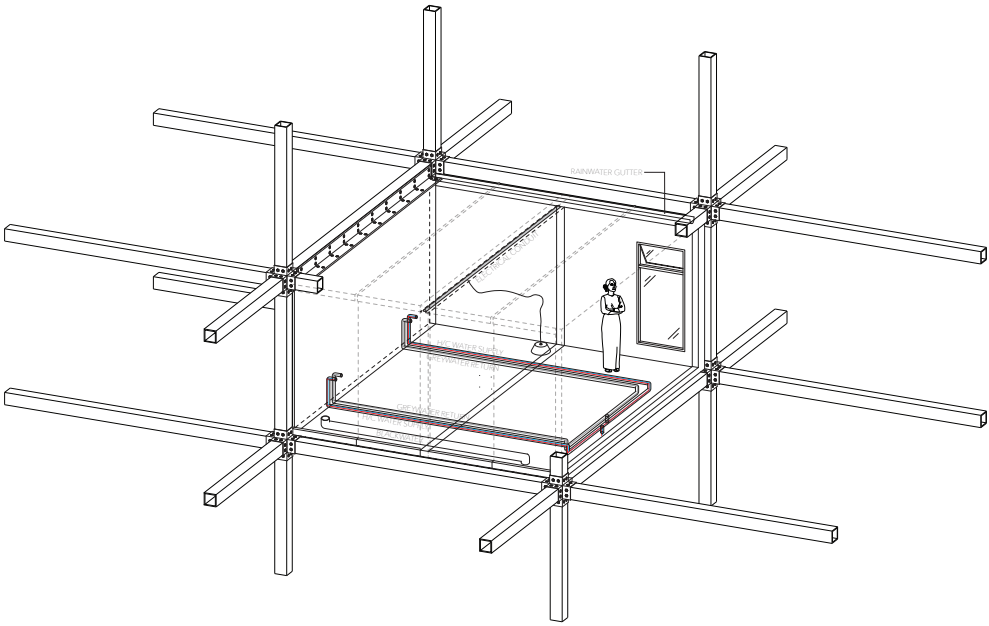


Figure 78 Module Plug & Play

Building Technology: Circularity

Circularity in the built environment focuses on "sourcing sustainable, maintaining material productivity over the lifecycle of developments, and reducing losses of non-renewable materials". (Carra (ARUP), 2016) In the scenario of extensively urbanising the waterscape, a circular economy is a sustainable approach to maximizing the efficiency and success of building on the water, as it emphasizes the importance of an autonomous system that promotes growth separate from resource extraction, and relies on "closed loops for technical components" and the "increase of sustainable renewable materials". (Carra (ARUP), 2016)

In order to effectively utilise a circular approach, there are many enabling factors that have to be taken into consideration in three categories: design, information and collaboration. The design component focuses on deconstruction, reassembly and future flexibility. These considerations are the main focus in the design of the interventions for the project Past to Present to Past.

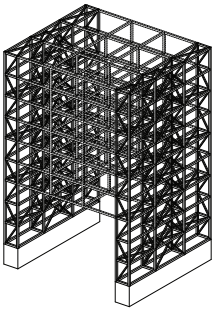
Firstly, in the design consideration for a circular economy, the material choice plays a significant role as pultruded composite has a lifespan of 100 years. This long lifecycle allows for the useful period of the material to surpass that of other more traditional materials such as wood and steel. Particularly in a corrosive climate like the Thames Estuary and the North Sea, a building material that can sustain its usefulness is uncommon. More and more material innovation would be welcome in this environment to develop other solutions for building in and on the water. The deconstruction and reassembly of the intervention's main structure is also a main focus in the design for circularity. This design consideration manifests itself most through the universal node connection component at the intersection of the pultruded composite lattice network. Since pultruded composite cannot be welded, removable connections are required while also helping to maintain the integrity of the material for future use. The universal connection allows for many of the same components to be used in multiple building instances and also makes for easy assembly and disassembly. Additionally, standard sized fittings such as windows and doors, are used so they can be easily reused elsewhere or returned to the manufacturer, after they are no longer needed, for resale or recycling.

Considering the circular use of the design and materials is also an important factor in the whole lifecycle. By creating collapsible modular elements such as the inhabitable unit, the design allows for the transposition to other sites, which is a main goal in the urbanisation scheme. This flexibility extends the useful life of the design components and effectively prolongs the lifecycle of the element. Further, the concept of structures as material banks (MB), enables materials to be placed in the water near the settlements to provide storage of materials in close proximity. These structures can serve a dual purpose for energy production or storage, within the territorial scale of the urbanisation scheme, as these programmes are not advisable to be combined with dwellings. These structures would not only provide surplus materials in an environment that is relatively hard to get to from the land, but would also enhance the autonomy of the site.

Finally, circular recovery is last component in the loop to maintain the effectiveness of circularity in this scenario. Take-back systems and collection services recover useful resources (building components, fittings, etc.) and refurbish or maintain them for future use. Since pultruded composite is a corrosive-resistant material it is maintenance-free, which makes its recovery quite simple. Such take-back systems and services can be located within the territorial scheme of the urbanised area on the water, further emphasizing the closed-loop autonomous system the design endeavours to be.

The remote-ness of the building sites requires a smart a solution for bringing goods out into the estuary in a responsible and economical way. Partially driven by necessity, a circular economy is an effective approach to sustaining the autonomous system of urbanising the water.

CIRCULAR **DESIGN**



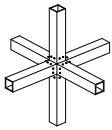
LONG LIFECYCLE

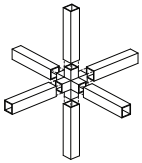
Structural Material =
Pultruded Composite - 100 year lifespan

Possibility for disassembly and reuse elsewhere

Pultruded composite cannot be welded so removable connections are used and helps maintain the integrity of the material for future use

REVERSIBLE BUILDING DESIGN

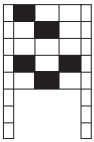


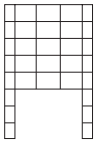


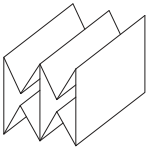
Universal node connection component

CIRCULAR **USE**

STRUCTURE







Inhabited

Uninhabited

Skeleton: Material Bank (MB) (located in water near settlement to provide storage of materials in close proximity to site)

Dual-Function: Material Bank and...
- Energy Structure (Solar, wind...)
- Storage
- Housing...

MODULE

Re-collapsible

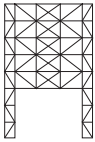
to move to other locations or put in storage until use

remove finishes and water-tight solutions ex. pads/strips - recyclable & replaceable

Fittings such as windows use standard sizes so they can be reused elsewhere or returned to the manufacturer after they are no longer needed for resale or recycling

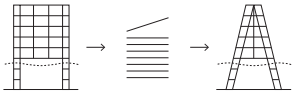
CIRCULAR **RECOVERY**

take-back systems and collection services to recover useful resources from disposed products or by-products



Over-structure MB's to create surplus of materials available for recovery and use elsewhere

Refurbish & Maintain
- non-corrosion-resistant materials
- Pultruded Composite = maintenance free



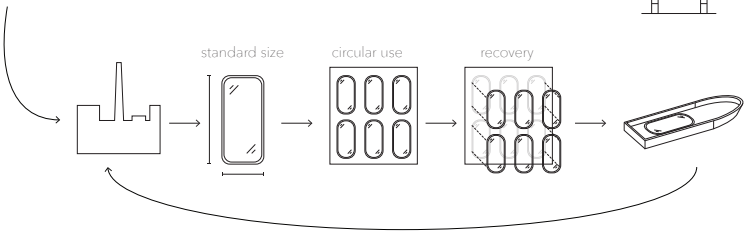


Figure 79 Circularity Considerations

Building Technology: Inhabitable Modules

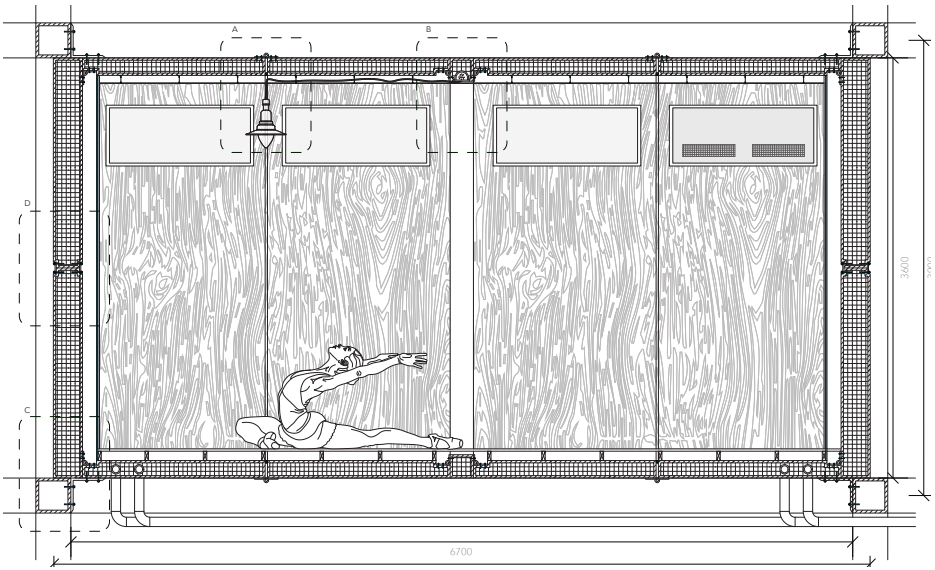


Figure 80 Single Module Detail Latitudinal Section

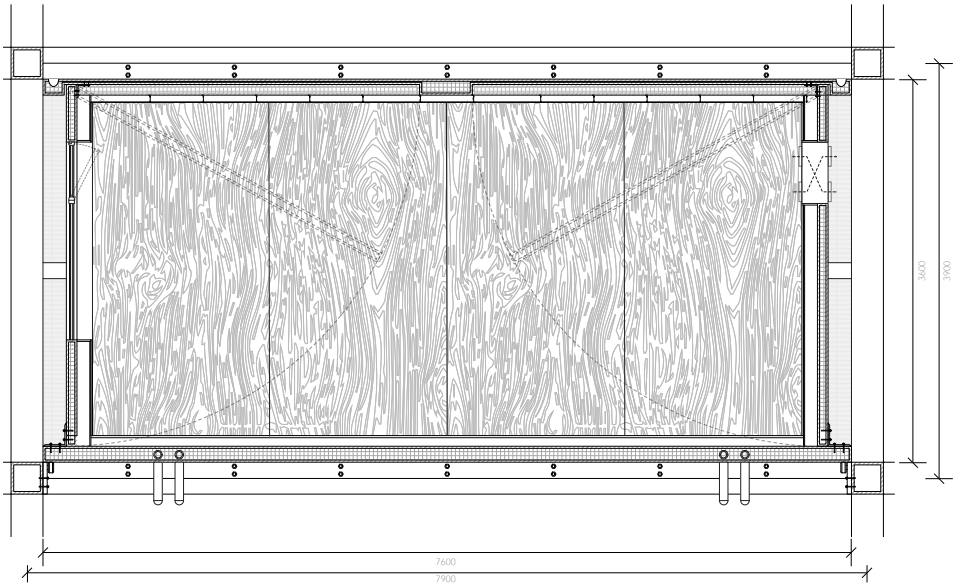


Figure 81 Single Module Detail Longitudinal Section

Figure 80 cuts through one of the inhabitable modules shows the main structure with the option to finish the inside based on the function of the unit. This one shows a dance studio with raised floors to provide some give for the dancers, and wooden wall finishes. The drop-ceiling hides the electrical wiring running from the conduit to the light fixture. Figure 81 cuts the other direction shows the rotation of the front and back walls from the roof. The void left behind is filled with secondary panels to reinforce the insulation in those areas. A void a left in the roof for a compact air handling unit to heat the module. The option to stack modules also demonstrates the permanence of their placements within the structure. A void between the two connects the units with a set of stairs, and the gap is in-filled with insulation panels to enforce the thermal properties of the structure.

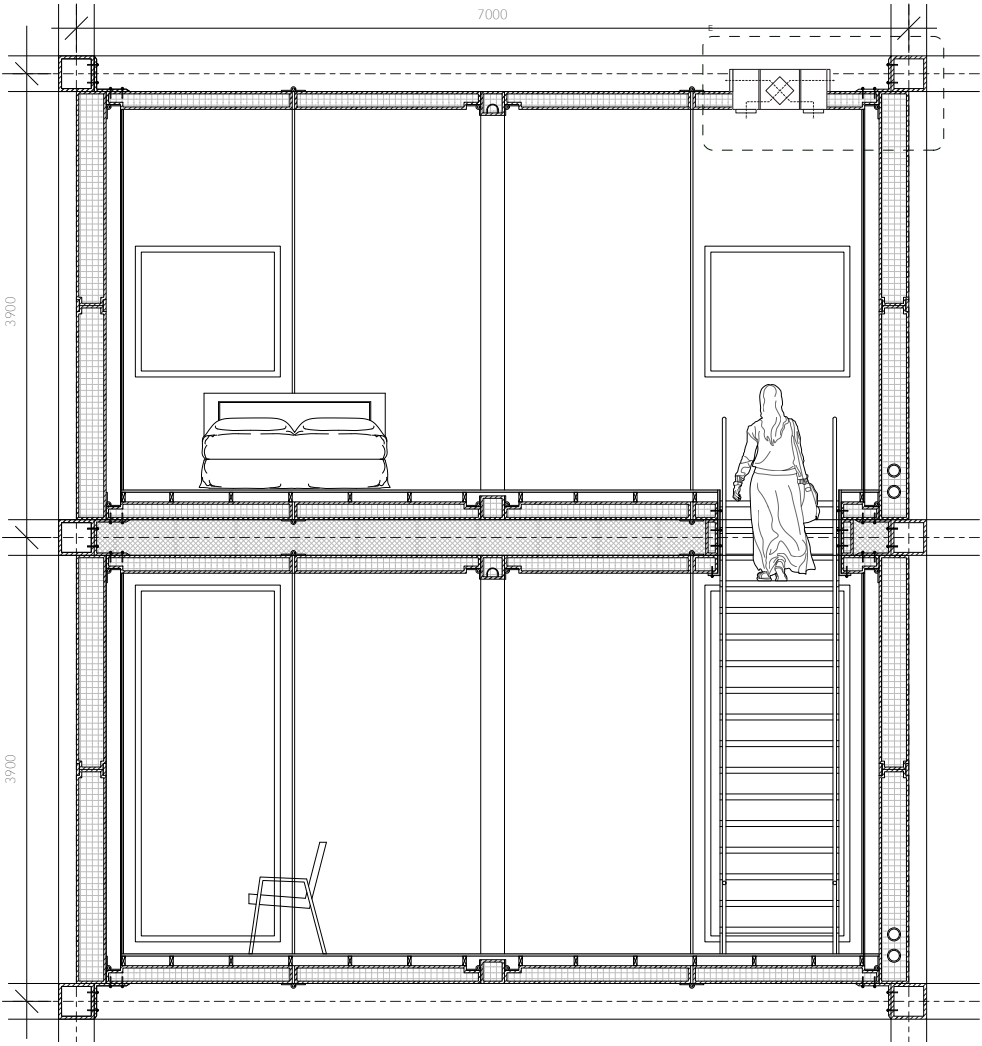


Figure 82 Stacked Module Detail Section

Building Technology: Climate Scheme

The goal of the climate scheme is to service the building with as little reliance on exterior mechanical sources as possible. Each of the modules is ventilated passively due to the prevailing southwest winds that run through the site and open structure. To harness this each module is equipped with operable windows on both the north and south walls. For heating, a compact packaged system is the most optimal solution as it maximizes control to the inhabitant as well as the specifics of the space. Electric AHU's have 100% efficiency and are able to be plugged into the main electrical grid of the building rather than running a separate HVAC service, cluttering the lightweight structure. Since modules can take in different functions, decentralised air handling units with heat recovery can best service these wide ranges of spaces.

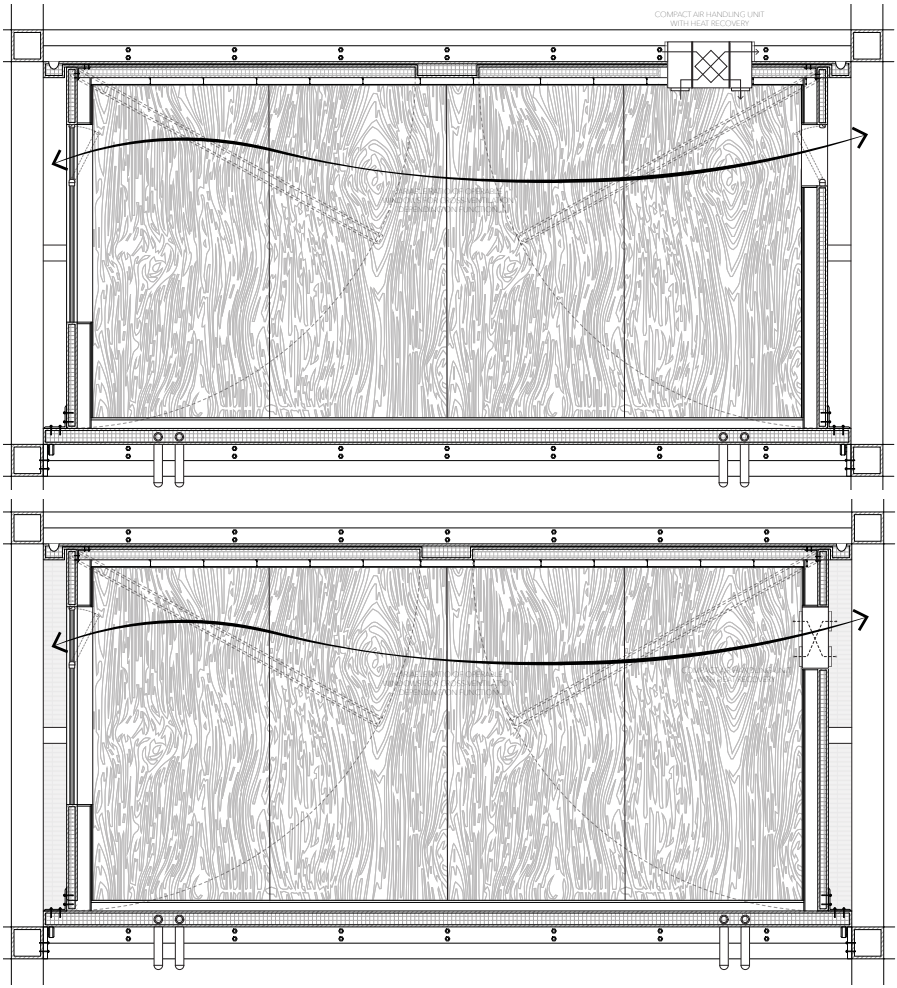


Figure 83a Climate Diagram with Ceiling-Mounted AHU
Figure 83b Climate Diagram with Window-Mounted AHU

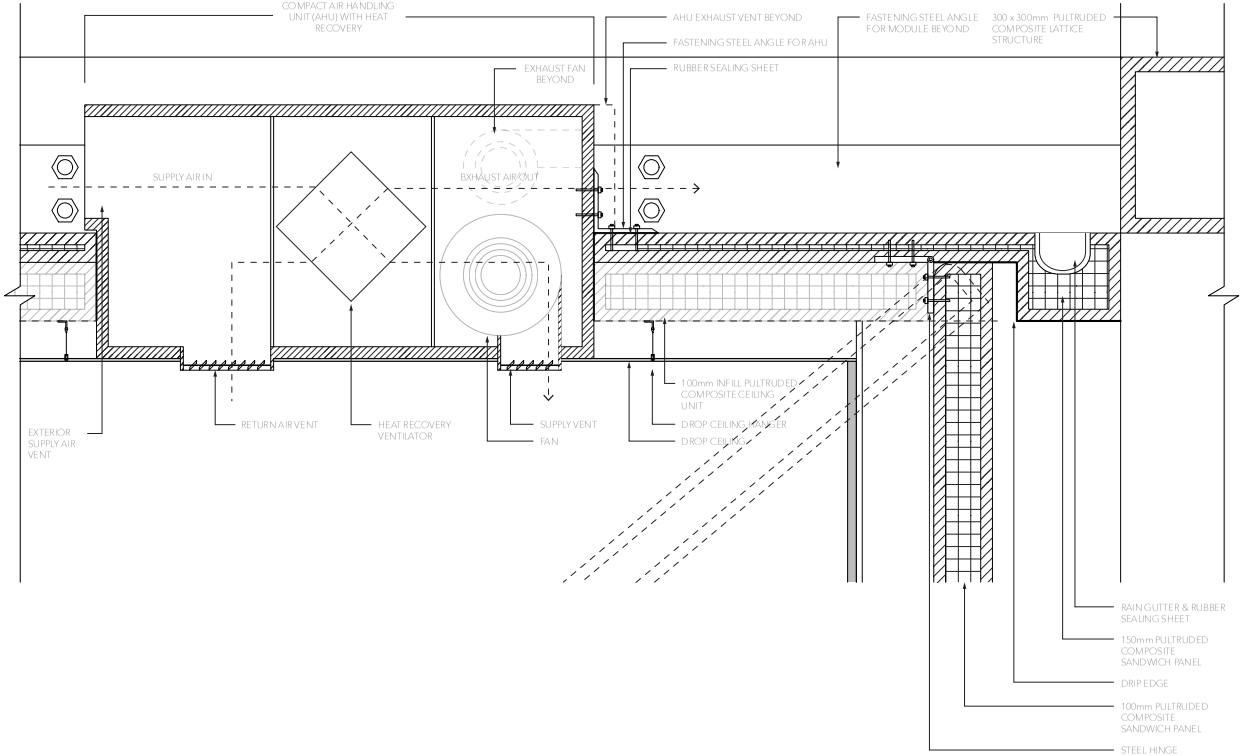


Figure 85 Ceiling Fixed Air Handling Unit with Heat Recovery Detail (NTS)

Building Technology:
Inhabitable Module Details

Detail A

This detail illustrates the inhabitable module in it's opened form with the interior drop ceiling and electrical fixtures installed. The rubber sealant strips are also placed once the module is opened in order to enhance to air-tight qualities of the construction.

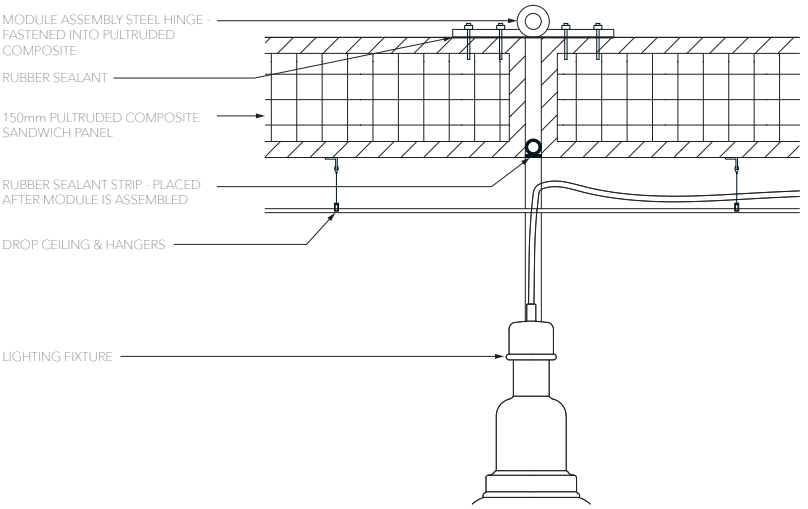


Figure 86 Detail A: Hinge Roof with Lighting Fixture

Detail B

This detail focuses on the connection between the inhabitable module and the large-scale lattice structure. This connection shows how the warm and cold structures are fixed together as well as gives an indication as to the tolerance required to install the module within the lattice structure. The pultruded composite angle fixes the module to the lattice structure and the rubber pad place between the lattice and the module provides some give when installing the module.

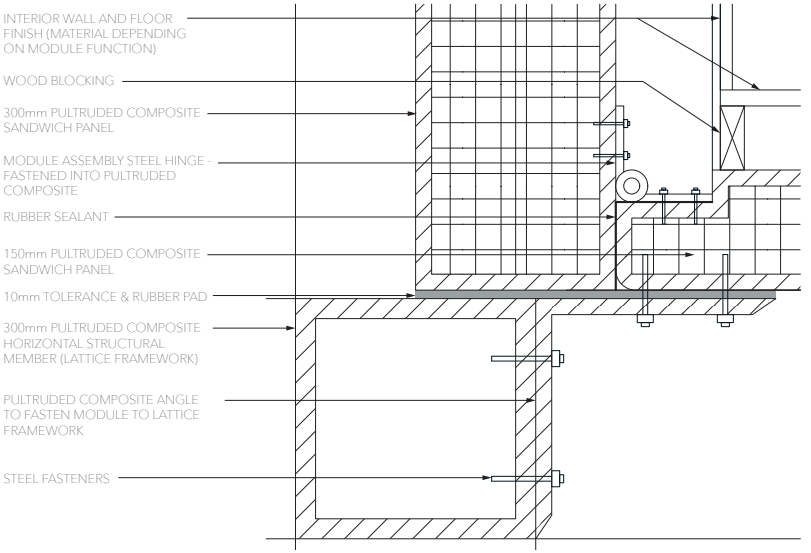


Figure 87 Detail C: Module to Pultruded Composite Lattice Structure

Detail C

This detail shows the centre structural component of the inhabitable module and the ceiling components in their opened form. The centre structural component also houses the main electrical conduit from which electrical fixtures are connected. The main conduit is connected to the overall neighbourhood's electrical grid, thus the module is able to become a plug and play element within a larger system.

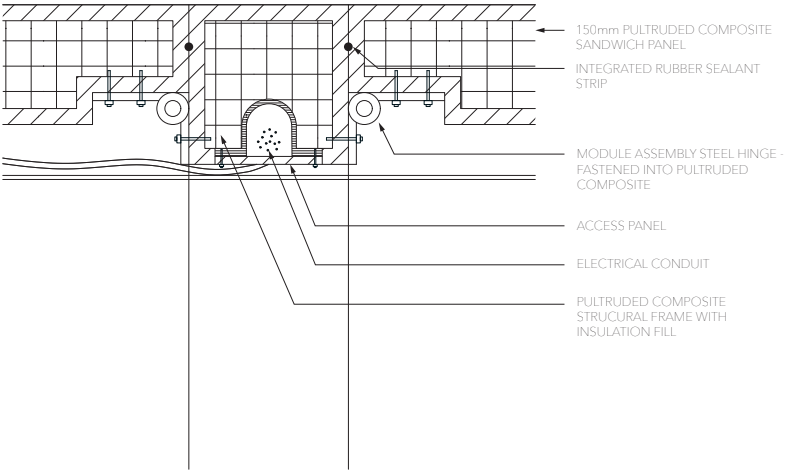


Figure 88 Detail B: Electrical Conduit and Centre Structural Element

Detail D

Based on manufacturer specifications, this detail illustrates the seam connection between two pultruded composite sandwich panels at the side walls of the inhabitable module. The two panels are fixed together with a plate and bolt connection. The plate is also constructed of pultruded composite as it has a constant profile. Since pultruded composite has inherent thermal properties, the cold bridge at this seam is minimal.

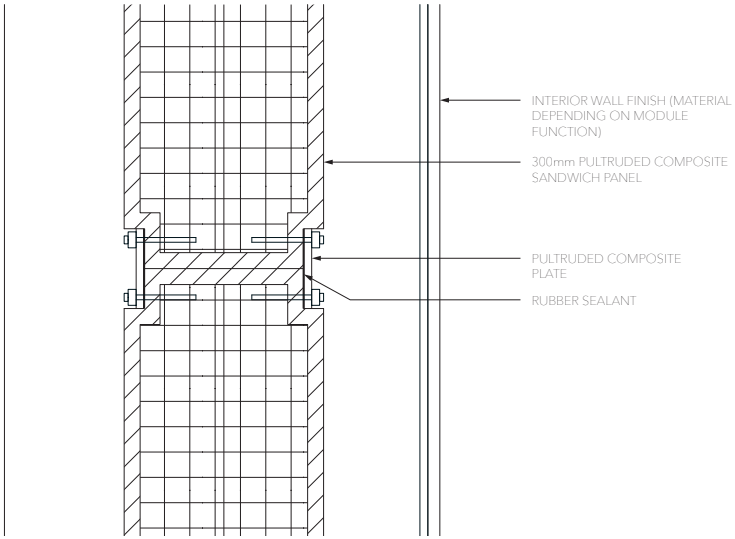


Figure 89 Detail D: Module Wall Seam Connection

Catalogue of Spaces

Inhabitable Module

The intention for the collapsible module, and by extension the entire intervention, is to create a lightweight structure that can be finished on the interior to be suited to its function. Some of these decisions have to be made during the fabrication process inland, such as provisions for openings and glazing, but finishes are left to on-site construction. The following is a catalogue of possible spaces using the same module.

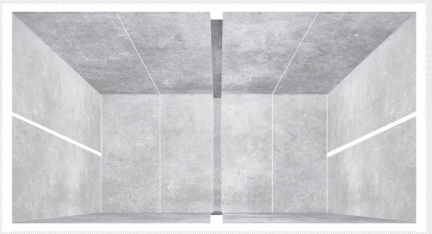


Figure 90 Inhabitable Module: Base

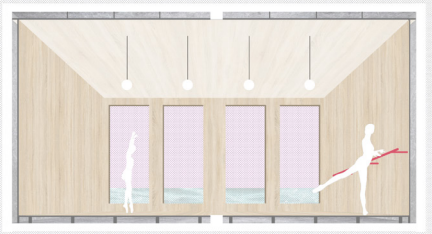


Figure 91 Inhabitable Module: Dance Studio

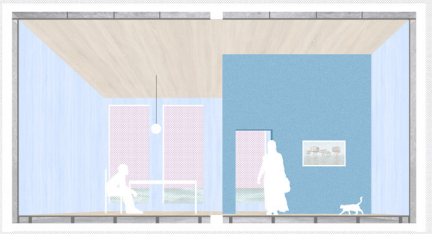


Figure 92 Inhabitable Module: Residence

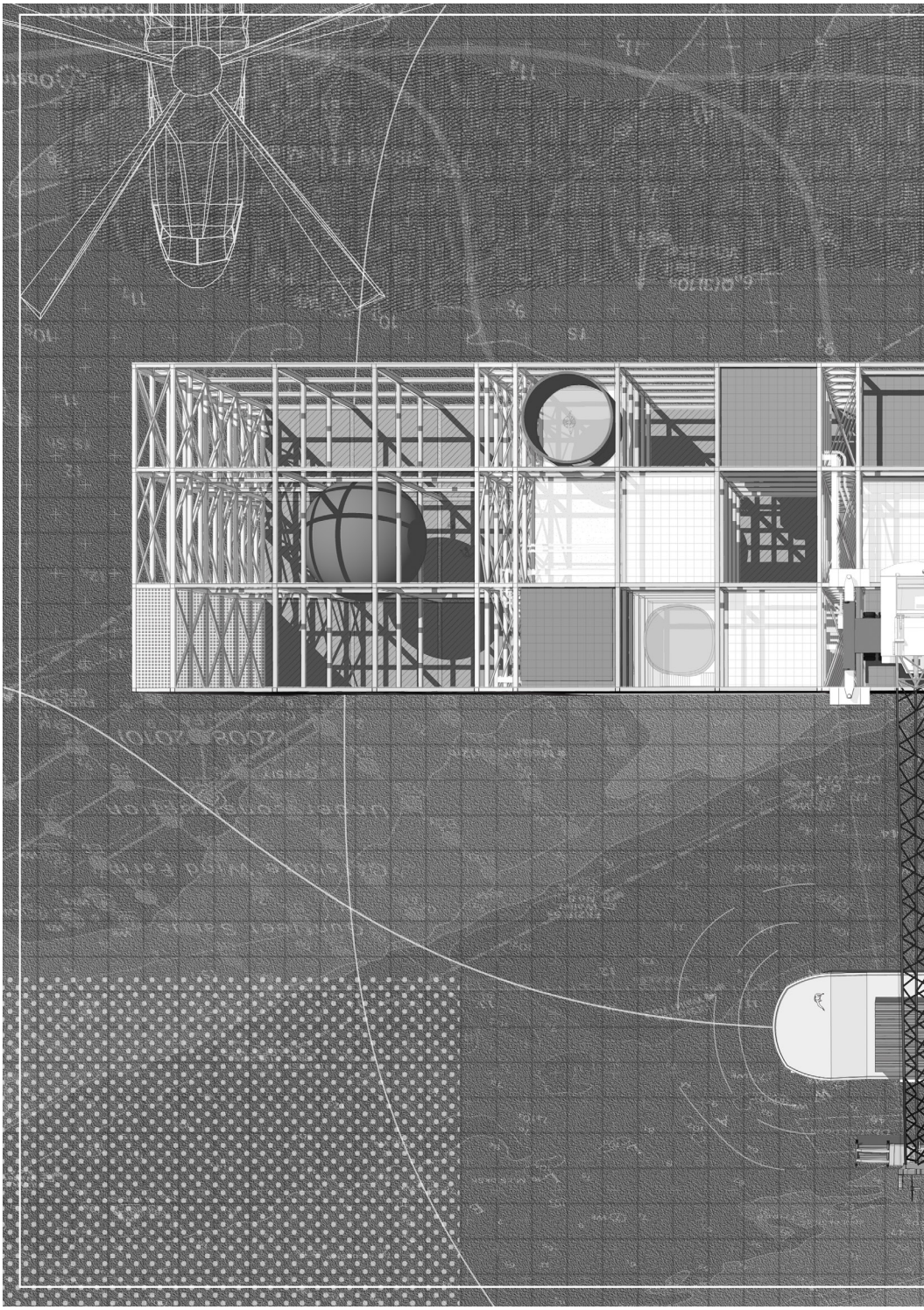
Figure 93 Inhabitable Module: Greenhouse

Epilogue

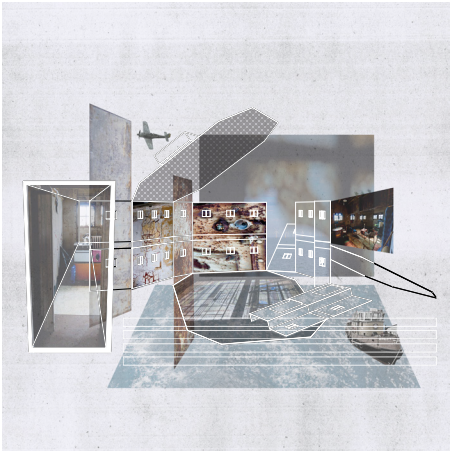
Instability driven by climate change is a major global topic of discussion. As sea levels rise, coastal cities in particular will have an increasing obligation to develop strategies to deal with coexistence with water. From active strategies of protection or more passive strategies that allow for controlled flooding, there are many opportunities for coastal cities to enhance their waterfronts. The urgency for developing these strategies is not isolated to just cities bordering water; in countries such as the Netherlands that are below sea level, cities far inland can also be susceptible to the same risks of water. In order to best address the issues posed by climate change, architecture, urbanism, policy, water management, etc. all come together to create a holistic approach to creating solutions. In this thesis, multiple aspects of designing with water to enhance urban living are employed to create a unique environment where the urban fabric stretches into the waterscape.

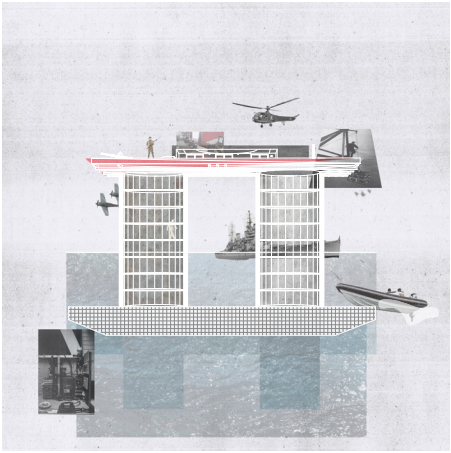
By investigating possible strategies of urbanizing the seascape, this project will provide alternative schemes and architectural approaches for urban growth and strengthening human coexistence with water, particularly in the Thames Estuary territory. The dynamism of the North Sea landscape challenges conventional design and how we define cities thereby reaching into the future. Additionally, building on the seascape provides a number of technical and logistical issues; developing approaches to these will enhance the feasibility of using water as a location for potential urban development globally.

Based on my research and my design implementation, I think that many aspects of the Maunsell Forts can be appropriated to territorialize the seascape, and these principles can facilitate iterative growth throughout the estuary while being flexible enough to respond to site-specific elements.



03. APPENDIX





Maunsell Forts Composite Images. Ailsa Craigen.

Past to Present to Past: Reflection

A reflective essay about the research process for Past to Present to Past: Settling in the Unsettle-able. Submitted for the Delta Interventions Graduation Studio P4 on May 31, 2018.

The characteristics of the North Sea and challenges that face it driven by climate change make it a living lab for designing for coexistence between the built and natural environment. The urban question proposed for my graduation project is "How can an urban environment on the water successfully respond to the needs of people in current and future situations and iteratively grow to adapt to the dynamic seascape?" And further, architecturally, "How can a temporary architectural intervention generate urban growth that is resilient and adaptable to climate change?"

In order to address my graduation project that investigates the possibilities of urbanising the waterscape in the context of the London and the Thames Estuary, a number of research processes were employed in order to gain as much insight as possible to develop a well thought out design proposal. The investigative process utilised in my graduation project consisted of conceptual research and analysis through precedent studies of projects such as Archigram's Plug-In City, Peter Wilson's The Villa Auto, and John Hedjuk's Mask of Medusa. Simultaneously, other non-technical and non-architectural literary resources were referenced in order to bring a more experiential and narrative dimension to the research. The information gathered from this exploration was synthesized and used to inform the strategy of typological and site analyses conducted thereafter. The majority of the typological research surrounded the study of the Maunsell sea forts. During the research process the forts were dissected, deconstructed and reconstructed in a number of was to gain insight into their structures, components, functions and stories. From here, an investigation into the forts in relation to the concept of the follie, referencing the Osaka Follies, further informed what the architectural interventions of the graduation project would be. The conclusion of the forts as follie resulted in a structure that distorts time and evokes memory, creates a momentary space that is temporary and ephemeral, and creates a living lab for the city of the future.

By investigating the narrative from which the Maunsell Forts emerged, I worked towards developing a narrative where my graduation project would come into existence. By imagining an alternative past for the growth of the city of London I developed a narrative where the city continues to grow towards the North Sea (substantiated by current city growth trend reports), and eventually into the water thereby urbanising the waterscape. Later

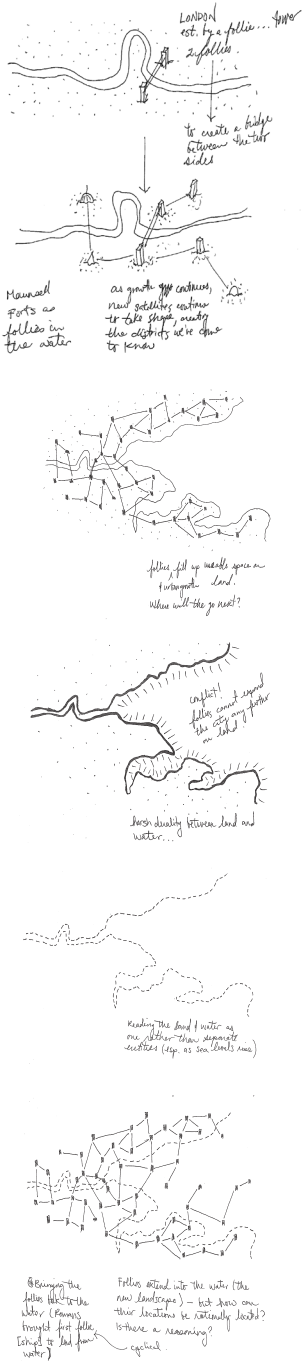
in the design of the architectural intervention, this experiential narrative will be continued in order to achieve a consistency that links the project proposal for the future to its past.

Following this first stage of research, an urbanisation strategy for the waterscape was proposed as a set of three axes – "Three Axes of Urbanisation"; the initial follie network (Axis of Memory) of visitor centre structures leading from Leysdown-on-Sea around the Thames Estuary, which have a temporary character that are "doomed to die" by letting them disappear into the environment; the secondary follie network (Axis of Inhabitation) of larger architectural interventions with programmes to facilitate urban development; and the tertiary follie network (Axis of Flexibility) of flexible and transformable architectural and infrastructural networks that respond to the changing situations over time.

The second stage of the research process comprised of a number of studies for each of the two sites (Leysdown-on-Sea and Red Sands Forts) in order to investigate if the proposed urbanisation framework (Three Axes of Urbanisation) can be successfully implemented into two different locations with differing requirements and difficulties for the design to respond to. Firstly, a comprehensive study of the sites was conducted to look at the physical features such as prevailing wind and currents, sun, bathymetry and soil types and what role they play in developing the character of the architectural interventions. The result of this investigation coincided research earlier in the process, which put emphasis on the narrative dimension of the project. The goal of the interventions in all three axes is to guide movement through the estuary from the land; therefore, directionality plays an important role through the project. This conclusion led to the next study series, which investigated how movement and directionality could manifest itself architecturally.

In order to investigate movement and directionality in architecture, a study series of forms were generated by creating single paintbrush strokes and attributing scale-less architectural elements to them. From there, the forms were regulated into architectural isometric drawings where they were each assessed in their formal suitability for guiding movement through the Thames Estuary.

Once the form was selected configuration and rationalisation studies were conducted in order to develop site plans for both project sites. An iterative process with constant feedback from my mentors was used to develop a strategy to configure and rationalise the site plans for each location. The feedback I received was to use analysis for the design process; to look at what were the main elements from the initial research and how could they inform the design strategy in a multi-scalar way. This led to the goal of establishing a strategy for developing the site plan and architectural interventions using principles from the initial research and narrative in order to emphasize the importance of consistency in the project. By referencing past research and the concept of Inhabitable Walls



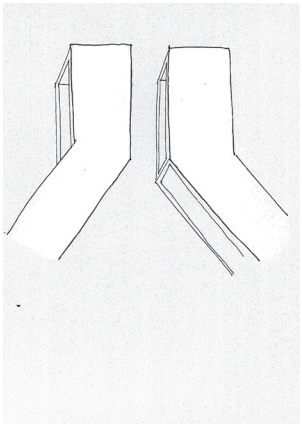
and Walls as Rooms, a strategy was established for creating territories at each site through the architectural interventions. This strategy was successful in implementing the same principles to create homogeneous site configurations in different locations in the estuary, that also responded to the specific conditions of the location. For example, the site configuration at the Red Sands location was generated from a combination of the grid of the existing forts and the principles of the Inhabitable Wall. Similarly, the regulating grid for which the Inhabitable Wall followed at Leysdown-on-Sea was generated from a combination of the shoreline and the wave breakers. By identifying the characterising elements of a site and using them as the framework for urbanisation, a successful strategy was employed in different locations while having a unifying component throughout the estuary.

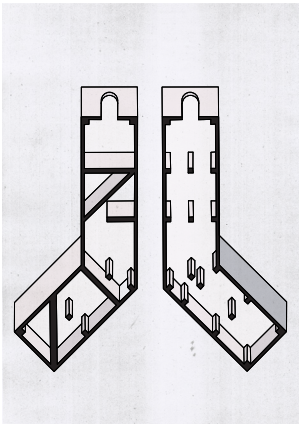
This iterative process had a tendency to air on the repetitive for the sake of repetition side - it was valuable to have feedback from the mentors in order to refocus the goal of design site configurations with a particular purpose in mind rather than a purely formal study. In the end the study was successful in producing rationalised and substantiated site configurations; however, the process likely took longer than necessary.

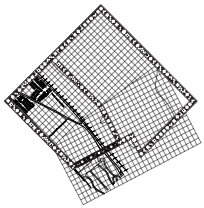
Once the configurations were established; specific interventions were selected to focus on and develop further; for Leysdown-on-Sea, the large visitor centre structure (Initial Follie Network - Axis of Memory) that straddles the land and water was chosen, and at Red Sands a large structure for residences, research and culture (Secondary Follie Network – Axis of Inhabitation) was chosen. The design and development of these structures follow the same concepts and principles of those at the territorial scale; particularly the inhabitable wall. From here, in order to move forward with the design while also staying consistent with the project narrative, I will be referencing back to the analysis of the Maunsell forts to develop the programme and structure of the new architectural interventions. (Aspect 1)

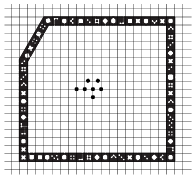
The results from my research have revealed that it is possible to effectively devise a strategy, in this case for urbanisation, that can still respond to the specifics of a site. This type of strategy can not only be valuable in urban development, but also in addressing adaptive reuse strategies, which are currently and will continue to be important in the future as sites will have to evolve to stay relevant in day-to-day life and keep up with ever-changing societal demands. Similarly, within the scope of the Delta Interventions studio that focuses on Landscapes of Coexistence in the North Sea, my research and design approaches emerged from conflicts that arose from implementing architecture in dynamic landscapes and were therefore inherently able to adapt to different scenarios. (Aspect 2)

As the focus of the studio deals with sea level rise resulting from climate change, the architectural interventions will deal with the current and future context in an integrated and designed way; designing for self-sustainability, resiliency, and with respect for the physical and societal environment. (Aspect 3) In a territory that has to increasingly deal with water, developing a strategy to coexist with water (both along the coastline and within the water) has growing relevancy that can not only be implemented in the area of study, but also other coastal areas dealing with similar difficulties.









While I personally ran into few ethical dilemmas and issues, one of the major considerations of the project was determining who would be the primary users of the buildings and how accessibility on both social and physical levels will be addressed. During my research into precedent projects that deal with sea level rise and building on the water, I found that many of the projects were built for wealthy individuals and focused on the luxury and exclusivity that could be harnessed from the idea of responding to sea level rise and climate change. One such project is "EKO Atlantic" located in Nigeria, which is described as an "entire new coastal city" as a response to coastal erosion around Lagos that is resilient to sea level rise. Based on the project description, the intention for the development is to create a high-end urban area focusing on economic growth, which will inevitably become highly sought-after properties with social-inaccessibility to lower class peoples.

Similarly, there have been project proposals for the Maunsell Sea Forts to be converted into luxury hotels, which out-right cuts down the accessibility to only those with the means to take private helicopters to the structures.

After researching projects such as these, I determined that social accessibility should be a cornerstone to the use of my project; as climate change sees no socioeconomic boundaries, then so too should the approach to climate change resiliency in the built environment. Cost-efficiency; therefore, played a role in certain design decisions, such as the modular construction method, in effort to reduce the cost of the structure and maintenance. With lower operational costs, the dwelling units can thereby be sold out at accessible amounts. (Aspect 5) Additionally, the modularization of the inhabitable units for my structure are designed to house a wide range of possible programmatic spaces. This decision was made with the intention to allow for as many "types" of people to be able to live in the structure without sacrificing their lifestyles and create a rich social urban fabric on the water.

During this process I have learned the importance of consistency in both research and design in order to develop a strong and cohesive project. Further, the development of a narrative is paramount in order to effectively communicate the ideas of the project to an audience, which is applicable not only within the academic realm but also in professional practice. The skills I have learned from this process are transferable to working in the profession and emphasize the importance of communication in architecture both verbally and through design. (Aspect 4) Additionally, the value of discussion and feedback has been reaffirmed in my personal approach to design development; by discussing my project ideas with multiple people, so far I have been able to critically reflect on my goals for the project and which aspects are most important. While the amount of input can be befuddling at some points, after processing and reflecting, each discussion normally provides a fresh perspective, reinvigorating my enthusiasm for the project.

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"In the end, I feel I have created a kind of collective memory map, attempting to highlight what lies under the watermark, what has been obliterated, what is being obliterated and what is still under threat in this indefinable and beautiful place -

where past flows into present into past in its eternal rhythm."

Estuary, 2016.