GARAGE

A Concentrated parking facility for the Port of Beirut,
solving the severe shortage of parking spaces and improve the mobility of cargo transportation from the port to the hinterland

INDEX

Abstract

This article first states the role of Beirut Port as a connecting hub in the regional trade network. Afterwards, it analyzes the key role of improving the port for domestic economic growth in Lebanon and logistics in the Mediterranean region. Subsequent chapters trace the origin and changes of the port in history, which starts from the appearance to the destruction and reconstruction experienced by the port transportation in modern times. Further, a new development plan is given under a larger city scope and the specific design content of the garage project is developed accordingly.

Introduction

As one of the important ports in the Mediterranean region, Port of Beirut is a cargo transit hub in Lebanon and even the Arab region. Every year, 6.2m tons of cargo is circulated through the port of Beirut and transported to Lebanon and surrounding areas. (Roland Berger, 2021, pp. 20–22)

But the port's logistics system faces many challenges. The previous civil war brought many problems to the port's logistics system. With the 2020 explosion, port mobility came across even more serious problems.

So, in the context of post-explosion, how to boost the logistics system of Beirut port? In order to study this problem, this paper will start from the role of the port itself, further analyze its operation function and the surrounding environment in the city, and eventually come up with a solution at the architectural level.

PART. I
RESEARCH

CHAPTER. 1
THE ROLE OF PORT OF BEIRUT

1.1 Global perspective: a hub connecting three continents

Before the explosion, POB was one of the most important logistics hubs in the eastern Mediterranean. Opened in 1894, this port was first used to import essential materials from the world and export it through Lebanese interior to the rest of the Middle East. (Akleh, 2020) It also provides a strategic link between the markets of Asia, Europe and Africa. (fig 1.1-1.2)

From this port, the coastal road travels east to Syria and Turkey, west to Israel and Egypt, and Greece and Italy on the other side of the Mediterranean. It had direct links to 56 ports on three continents and exported goods in cooperation with 300 ports around the world.

1.2 Domestic perspective: the largest and most important port

The Port of Beirut lies on the Eastern Mediterranean, in the center of Lebanon's densely populated capital Beirut. In terms of import and export trade, this is the largest free shipping and clearance point in the country, providing more than 80% of Lebanon's import and export trade every year. Since Lebanon's demand for many commodities relies heavily on imports, the port of beirut is of irreplaceable importance to Lebanon. In terms of income, the 16 terminals and large container terminals can generate over $250 million in fees each year. (Roland Berger, 2021, pp. 20–22)

The annual imports from this port are mainly metals, chemicals, automobiles, food and livestock, etc. (Analysis of Lebanon's Maritime Transport, 2015) These commodities are sorted and transported through the port logistics system, and delivered to their respective destinations through the road network throughout Lebanon and the entire region. (fig 2.1-2.2)

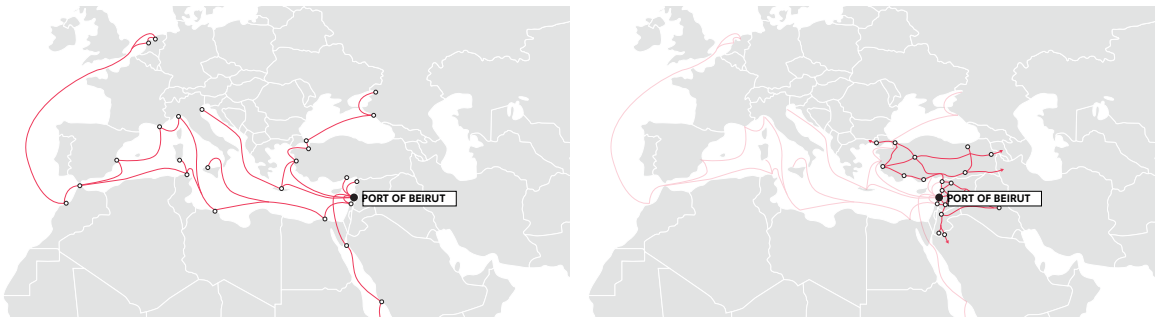


Fig 1.1-1.2 Regional connection of ports in Lebanon

1.3 The role of the port: regional connection hub

Due to its special geographical location, the port of Beirut has an important linker status: it connects sea trade on different continents, and at the same time has convenient and fast trade exchanges with ports in the eastern Mediterranean. The main status of a port at present is to supply domestic demand for imported goods, which requires the port to have efficient cargo reception and transshipment to the inland transportation capacity.

Therefore, improving the logistics mobility of this port is of great significance to Lebanon and the wider region. For intercontinental shipping in the Mediterranean region and beyond, and efficient Beirut port can speed up the efficiency of shipping between regions. For Lebanon, the improvement of the port logistics system will speed up the import and export commodities, thereby helping the country to better recover from the damage after the explosion. More importantly, when the port becomes a complete and organized logistics transhipment hub, it will provide important help at the infrastructure level for the future development of Lebanon.

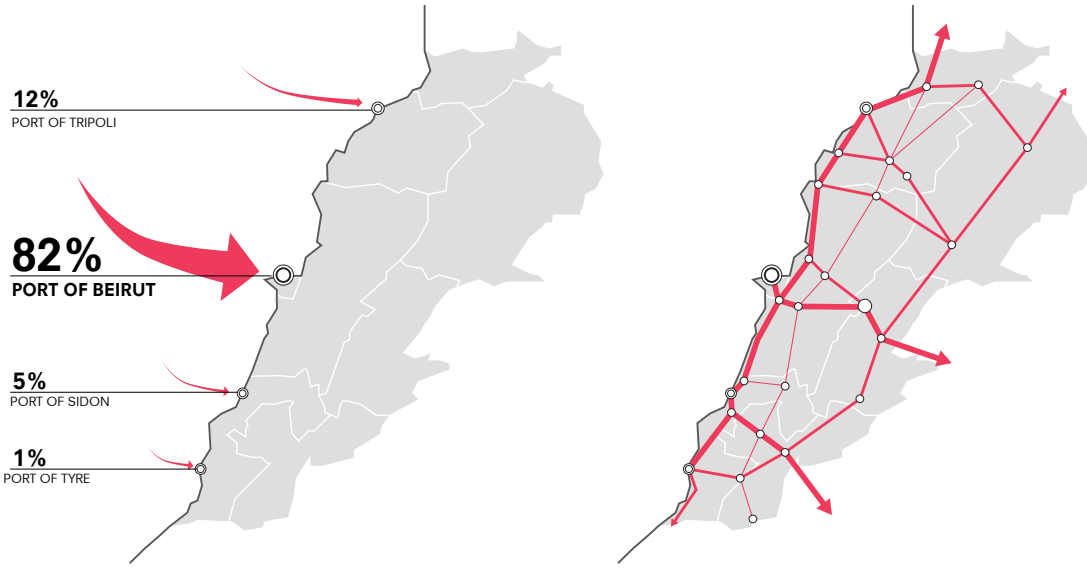


Fig 2.1-2.2 Port import and hinterland transportation network

CHAPTER. 2
PORT CONTEXT

2.1 The beginning

As early as 1500 B.C.E., the Port of Beirut, specifically, was mentioned in the Amarna Letters, correspondence between leaders of Egypt and the Turkish regions. The Port of Beirut was already a known port to traders and diplomatic envoys. Because of their expansion during the prosperous Phoenician trade, the community grew. (Suson, 2020) The modern port of Beirut was born during the industrial revolution in Europe and opened in 1894. At this time, it was already the largest seaport in the country at that time.

2.2 Mobility changes in history

Lebanon had around 408 kilometers of railway at one point. (Roland Berger, 2021, p. 28) These railways have greatly helped the logistics and passenger transportation in Lebanon, especially POB. Passengers and cargo can reach farther Syria, Jordan, Turkey and other countries through these connected railway networks, and even further to Europe. This convenient railway transportation method has been developed and prospered until 1976.

During the Lebanese Civil War, the port became the main target and suffered a lot of attacks. The Lebanese Civil War broke out in 1975. In less than a year, the trains were out of service. Soon the entire railway network fell into disrepair and was looted by militiamen and metal merchants. Most of the railroad tracks are now gone.(fig. 3) Today, all this traffic of the port depends on the road. After the Civil War, although some railroad workers tried to restore some sections of the railroad with short-term success, these attempts were ultimately unsuccessful due to a lack of regulation and operating budgets (Rust and Dreams on the Beirut-Damascus Railroad - AramcoWorld, 2021)

Fig 3 Disappearing railroad tracks in Lebanon

The port began to rebuild in 1990. Despite the 15-year civil war, the port of Beirut still ranks high in the Mediterranean due to its superior location and connectivity. Before 2020, the income here will increase by at least 11% every year, and the container transshipment will increase by at least 8%. In 2000, the new Port Authority spent US$150 million to build a new container terminal for the port. It has brought another strong impetus to the revitalization of the terminal economy and shipping.

In 2019, due to the difficulties caused by the COVID-19 pandemic, the port's shipping and tourism industries cannot maintain growth and are showing a downward trend. To make matters worse, the explosion in August 2020 put the port's operations on the verge of collapse. All the buildings were destroyed, and the port was unable to carry out its original storage and transportation operations. Since then, large-scale container storage and freight operations have been partly transferred to Tripoli, Lebanon's second largest port.

2.3 Future ambition

The main role of Beirut Port in the future is to continue to serve domestic demand rather than international demand. (The world bank, 2020)

The import of Beirut port accounts for over 80% of Lebanon's national proportion. After the explosion, the port's transportation volume dropped significantly from 3.6 million tons, in 2018, to only 1.8 million tons now. The productivity of the port has declined severely. Improving freight transportation between the port and the hinterland was the most urgent issue the port faced after the explosion. So, which mode of transport will be used for the transport of goods from ports to hinterland in the future?

The port did once have its own rail logistics network. But with the devastation of the Lebanese civil war, most of the railway has disappeared due to theft. Beirut is a city extremely dependent on vehicle traffic. The road network syste, is more realistic than rail system. Since the port has already completely relied on trucks to transport goods, using the existing road network to enhance the port's freight transfer phase rate will be the most economical and effective way to improve.

In addition to the content of transportation, Beirut also faces new opportunities because of the reconstruction after the explosion. Existing industrial areas in the port and waterfront area will receive new development. These factors will also affect the future positioning and development of the port.

CHAPTER. 3
URBAN RESEARCH

3.1 Damaged port

The loss of Port of Beirut caused by the terminal explosion in August 2020 is approximately US $350 million. (The world bank, 2020)

1. Storage
After the explosion, all warehouses were unusable, including the country's granary. Now with part of the reconstruction and repair, this area can be operated at 65% capacity. (The world bank, 2020) This has caused the terminal to lose a large number of original warehouses. As a substitute, the goods can only be placed on the ground of the terminal. The storage capacity of goods is greatly reduced.

2. Transshipment
The transshipment inside the terminal is mainly distributed in the docks along the grain silos and container terminals. Now the docks on the side of the silos is completely unusable, and the transsipment activities in this part have also been completely stopped. The container terminal has now resumed operations. After the explosion, fortunately, the holding crane serving the container ship received less damage. (Ibrahim, 2021) But the production efficiency of the container terminal is still reduced by about 50%.

3. Logistic
After the explosion, only one of the four port entrances still works. This makes an already inefficient logistics system even worse.

The port's own parking lot has long been occupied by trucks, and these are far from meeting the port's needs. The extra trucks are parked on both sides of the road leading to the port, and even in the surrounding communities. Along the road leading to the port entrance we can see roadside garages and makeshift cabins for drivers. These elements, which are supposed to focus on truck logistics, are scattered in the urban area near the entrance. Makes trucking more inefficient.

Fig 4.1-4.2 Damaged function of the port

Fig 5.1-5.6 Inefficient port entrance area

3.3 New identity for the port

The post-explosion port faces new opportunities and challenges.

After the explosion, around 30% of Beirut port's cargo volume was transfered to the port of tripoli in order to secure container cargo operations in Lebanon. And, future expansion of the port of Tripoli will continue to increase this number. (Saul, 2020) This means that the status of Beirut port as the largest maritime center in Lebanon will change.

In addition, the new port will be relocated in an area roughly half the size of the previous one. The new port will have a more intensive arrangement of warehousing and logistics functions. At the same time, the port will also cooperate with the landfill area on the other side. The newly developed agricultural school and algae power plant on the landfill area will turn it into a productive area, alleviating part of Beirut's dependence on imported goods.

As a result, today's ports need a new identity, which is a denser, more centralized shipping & land logistics transshipment hub. At the same time make a more productive part of Beirut.

CHAPTER. 4
FUTURE PROPOSAL

4.1 Urban design

Under the scope of the harbour area study, the new proposal first reserves the future expansion area on sea and land for the port to cope with the expansion demand caused by the possible increase in freight volume. The second is to add a garage project in the entrance area of the port to centrally manage and organize the trucks that come to the port to transport goods. With all freight transport functions concentrated in this new building, the public space now occupied by informal parking will be returned to the Karantina community. At the same time, the concentration of parking spaces also dredges the road connections connecting the urban expressway and the waterfront area.

With the addition of the new dogital depot and fashion office, the vitality of the estuary area around the port will also be activated. And improvements to the port's own traffic will ensure that the new waterfront's public activity areas are not disturbed by the unofficial parking of trucks.

4.2 A concentrated parking facility

The garage project is a centralized parking facility solving the severe shortage of parking spaces while improving the transportation for the port's hinterland logistics. Focus on this subject, this project will focus on the entrance area. This area is not only an material exchange place between the port and city, but also an important checkpoint for the goods logistics system.

The new garage project will provide sufficient truck parking space for the port, as well as a complex building for the officers and truck drivers.

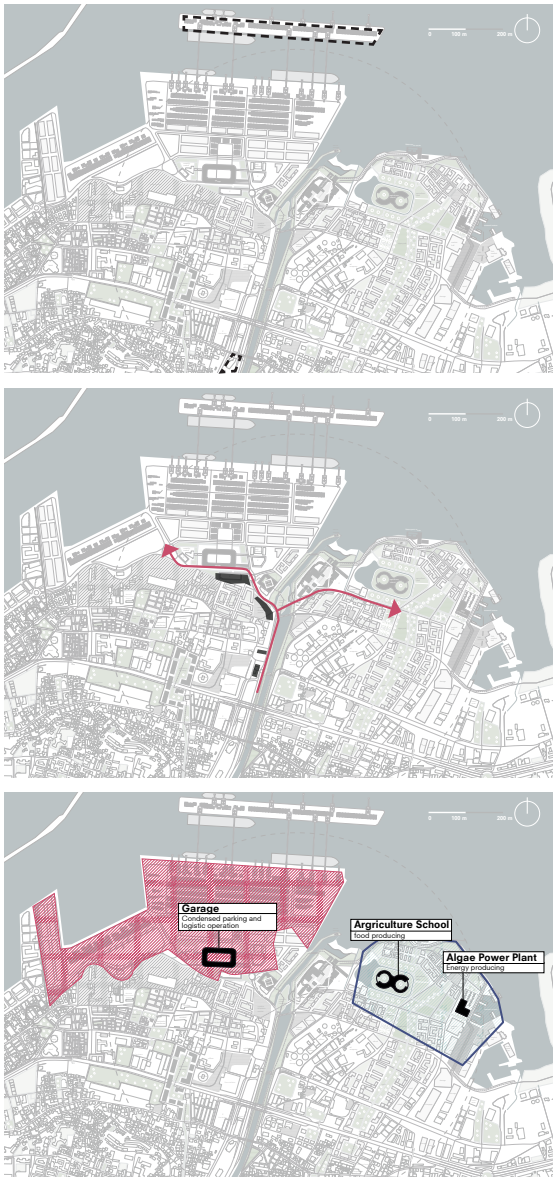


Fig 6.1-6.3 Future urban proposal

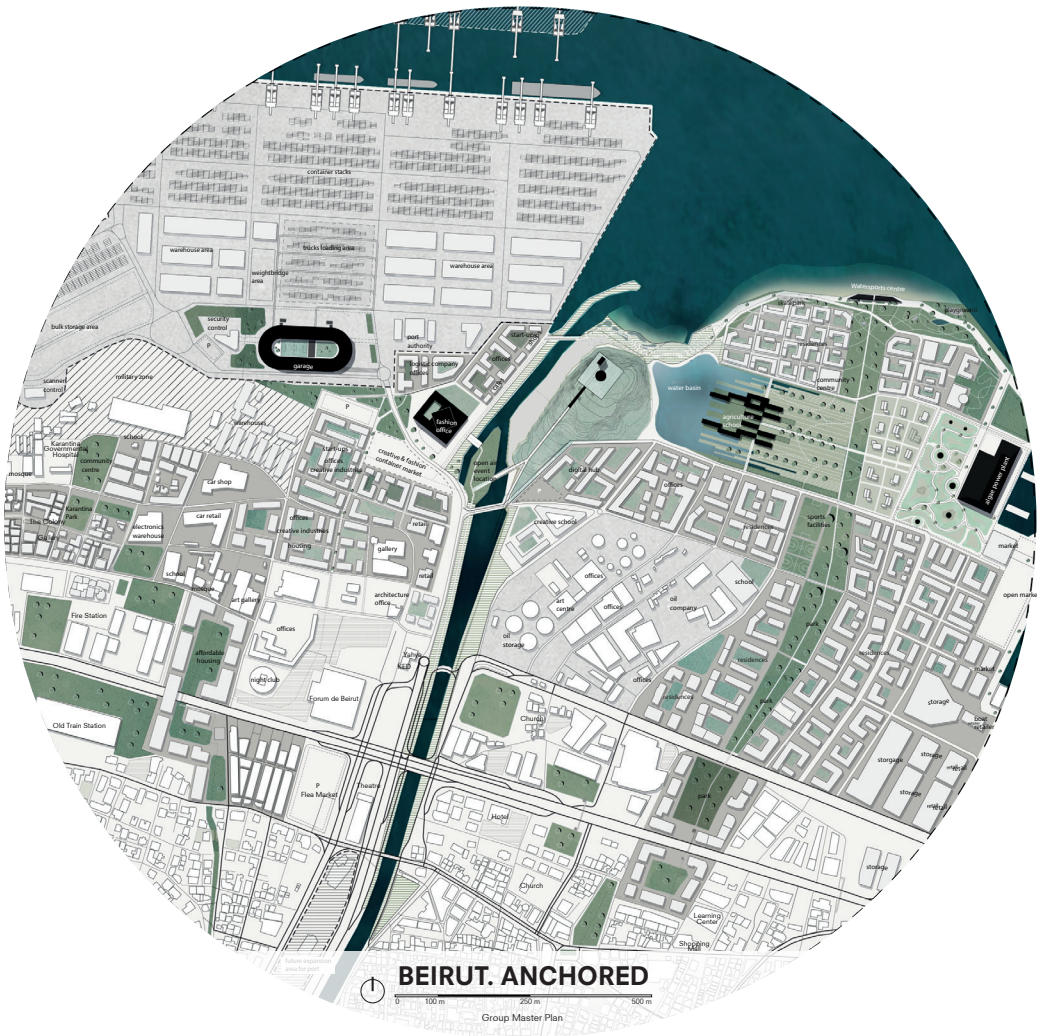
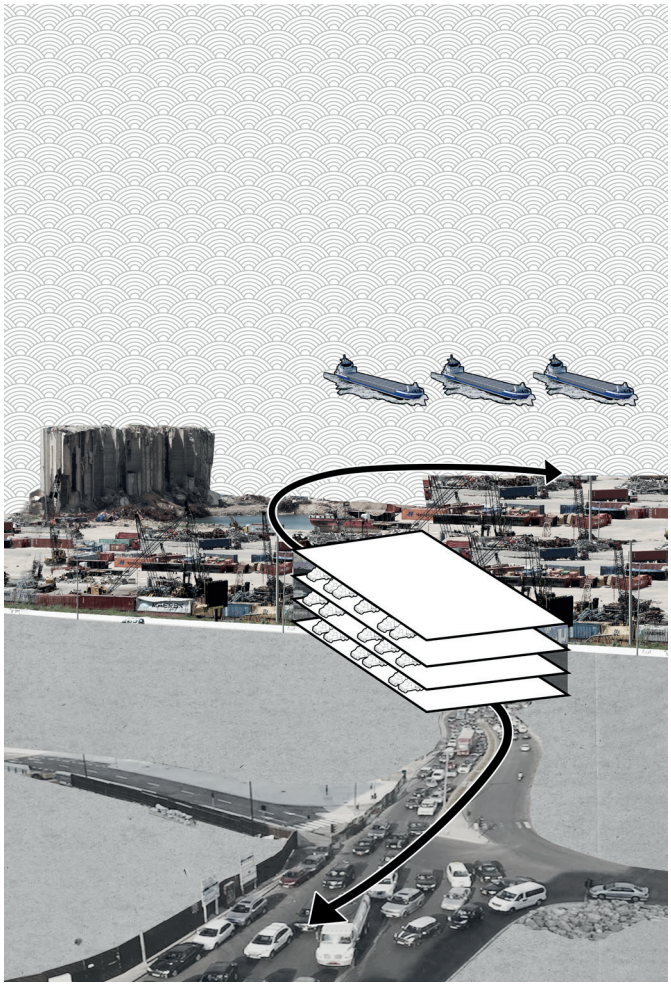


Fig 7 Future urban proposal



PART. II
PROJECT DESIGN

CHAPTER. 5
DESIGN INPUT

5.1 Program

Among the new requirements of the port, functions such as warehousing, container stacking, ship cargo loading and truck loading are included. The new garage project focuses on the functions of parking, logistics management. Since the loading and unloading function requires the assistance of large-scale machinery, they will be arranged in the outdoor area.

More specifically, in the garage building area, it will include 15% logistics management, 80% truck parking and 5% motel. Among them, logistics management mainly serves various managers and logistics activities, including office staff's offices, bulk cargo loading and unloading areas, and logistics-related checkpoints. The trucks parking part mainly includes truck parking spaces, offices of trucking companies, and truck-related maintenance and repair workshops. Motels are mainly motel rooms for drivers to live for a short time.

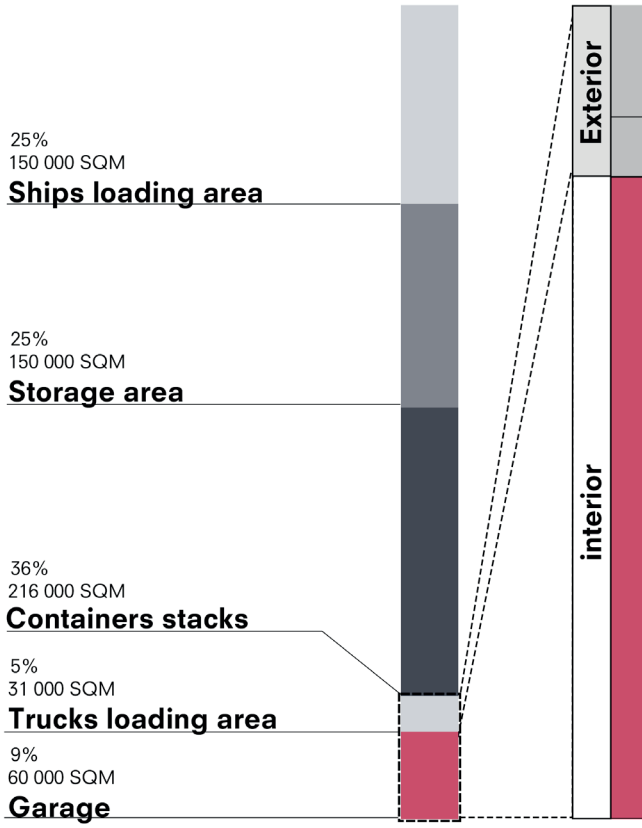
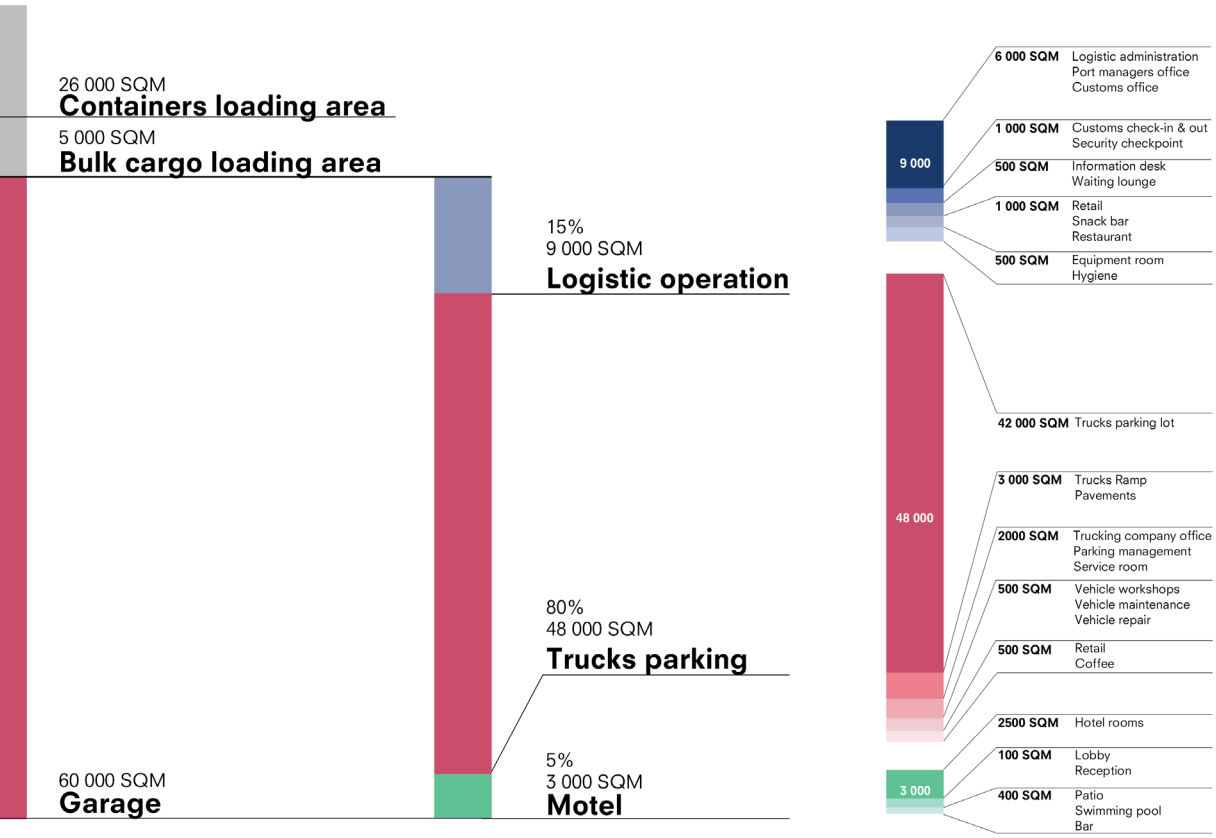


Fig 8 Program of the port and the project


26 000 SQM
Containers loading area
5 000 SQM
Bulk cargo loading area
15%
9 000 SQM
Logistic operation
80%
48 000 SQM
Trucks parking
5%
3 000 SQM
Motel
60 000 SQM
Garage
9 000
6 000 SQM Logistic administration
Port managers office
Customs office
1 000 SQM Customs check-in & out
Security checkpoint
500 SQM Information desk
Waiting lounge
1 000 SQM Retail
Snack bar
Restaurant
500 SQM Equipment room
Hygiene
48 000
42 000 SQM Trucks parking lot
3 000 SQM Trucks Ramp
Pavements
2000 SQM Trucking company office
Parking management
Service room
500 SQM Vehicle workshops
Vehicle maintenance
Vehicle repair
500 SQM Retail
Coffee
3 000
2500 SQM Hotel rooms
100 SQM Lobby
Reception
400 SQM Patio
Swimming pool
Bar

5.2 Site intervention

Taking into account the existing buildings and port logistics, the new entrance area will be divided into 5 areas, each with different functions. (fig 10) And the garage project site will be located in the center plot. In terms of function, it may cooperate with the original port management buildings around it, so it needs to ensure good pedestrian accessibility; at the same time, the logistics function inside the project is closely related to the container loading and unloading area. Therefore, the two plots need to be designed uniformly in the streamline organization.

The site is adjacent to the high-density residential community karantina. The new project needs to take into account the noise and exhaust from blocking truck stops. Therefore, it is necessary to maintain a certain distance from the community, and arrange noisy functions such as truck ramps on the side away from the community, and set up some greenery to block noise.

The new project needs to consider different users to organize an integrated streamline system. This includes the flow of the logistics manager, the flow for trucks getting into the truck garage, and the express flow directly go to the loading area. (fig 11.1-11.2)

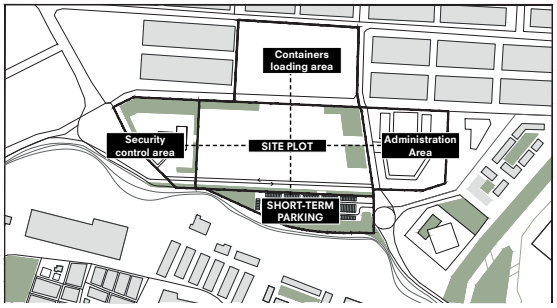


Fig 9 Site division of port entrance area

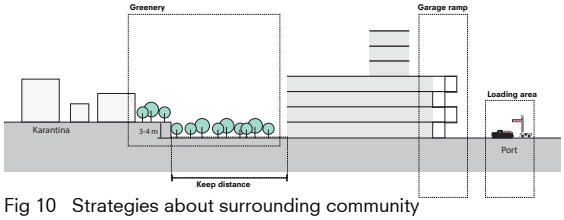


Fig 10 Strategies about surrounding community

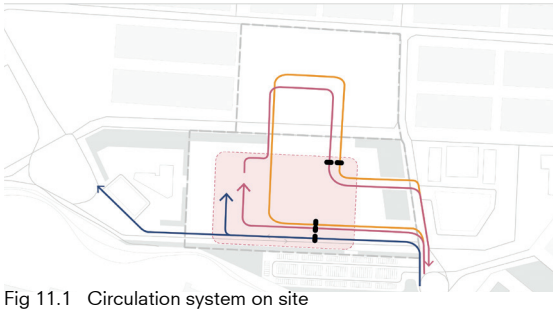


Fig 11.1 Circulation system on site

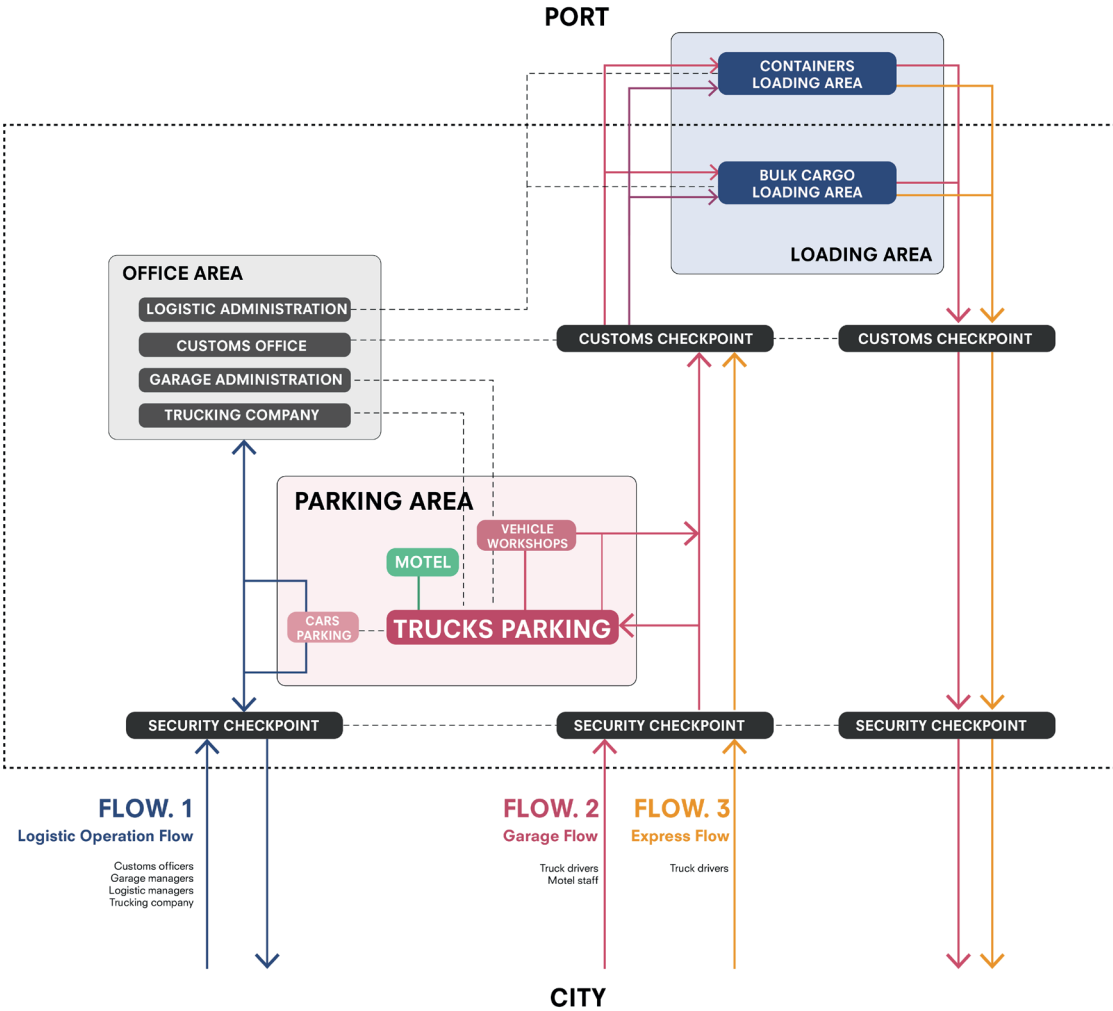
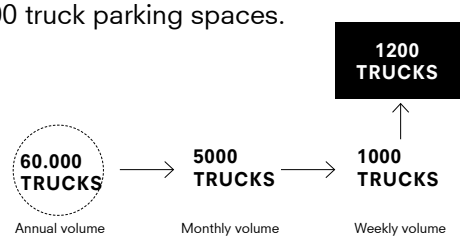


Fig 11.2 Circulation system

5.3 Capacity

According to the annual number of freight trucks at the port, it can be concluded that about 1,000 trucks enter and leave the port every week. Taking into account that the specific numbers will fluctuate around this data, the new project will provide a total of 1,200 truck parking spaces.



The trucks involved in port freight are mainly divided into three sizes. Among them, medium and large trucks are the most popular. Therefore, the number of parking spaces for these two types of vehicles is relatively large in terms of quantity ratio. The calculation process shown in the table below shows that in order to accommodate these trucks, the building requires at least 34 000SQM of parking space. (fig 13)

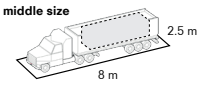
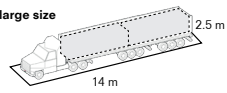
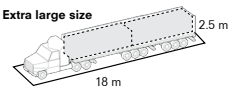
Truck size	middle size 	large size 	Extra large size 
Truck number	**600**	**500**	**100**
Parking space	8 x 2.5 x 600 = **12000 sqm**	14 x 2.5 x 500 = **17500 sqm**	18 x 2.5 x 100 = **4500 sqm**

Fig 12 Parking space calculation

Site placement

The total area of the site is 38.400 sqm. As city codes require coverage to be less than 70%, the floor area of this project shall not exceed 26.800 sqm. Therefore this project needs to be transformed into a multi-storey car park to meet all functional requirements. At the same time, because large trucks need a very huge ramp to access the higher floor. This ramp is economical enough to build at least 4-5 floors. Therefore, the entire building will be around 5 storeys high in the parking area. (fig 14.1-14.3)

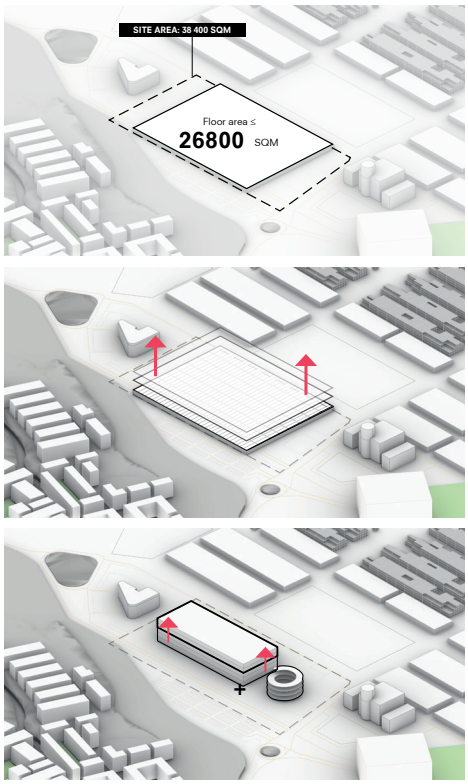


Fig 13.1-13.3 Building volume on site

5.4 Massing development

How to combine parking spaces and truck ramps is an important issue in form development. In the following cases, the relationship between lanes and parking areas can be summarized from separation to unity. (fig 15)

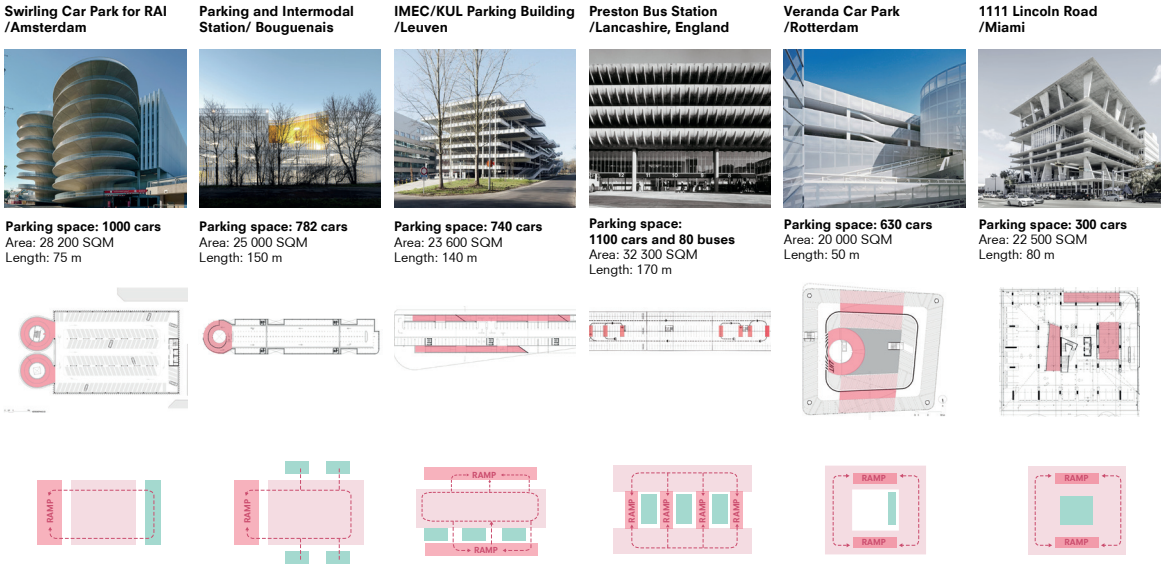


Fig 14 Case study and progeam analysis

Subsequent massing options from 1 to 10 followed this pattern, trying to find the most suitable model for the site. It can be seen that the more integrated the relationship between the ramp and the parking area, the more concentrated the indoor space of the building can be used, such as the9th and 10th. (fig 16)

At the same time, since the architectural shapes of these options have become a ring, the organization of the ramp will enrich the space of the inner courtyard of the building and interact with the functions in the courtyard. This gives the project the potential for more space to develop.

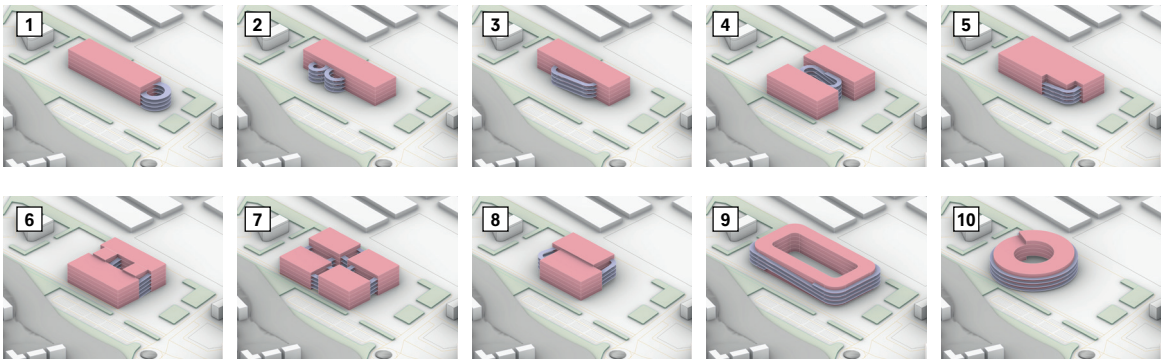


Fig 15 Massing development

Considering that a complete round loop would increase the truck's lane width, the final solution was No. 9. This orientation eventually places the ramp on the inside of the building to isolate the noise. The functions of the Motel will be arranged above the parking lot. (fig 17)

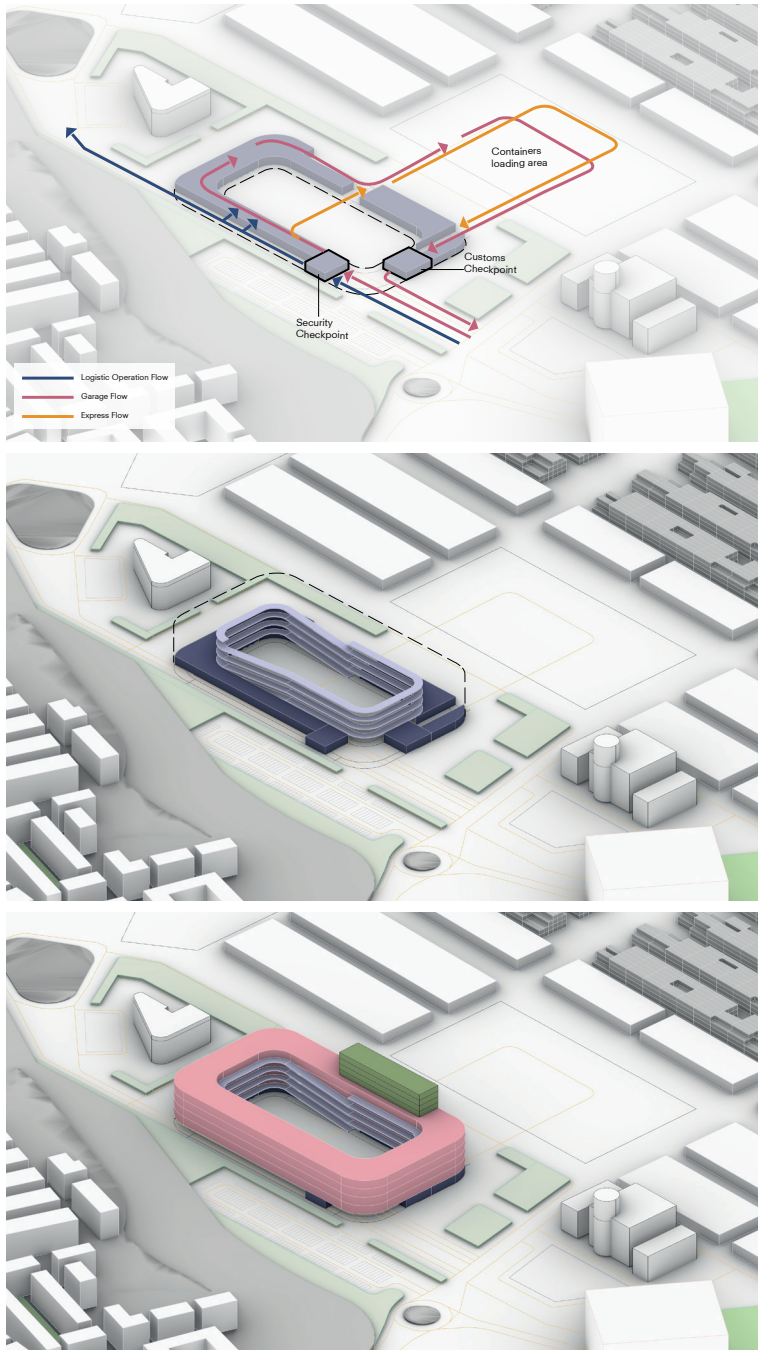


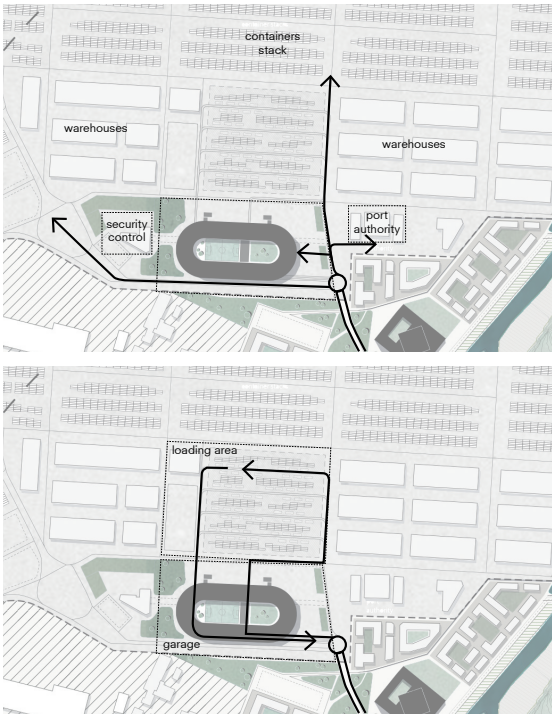
Fig 16 Final massing development

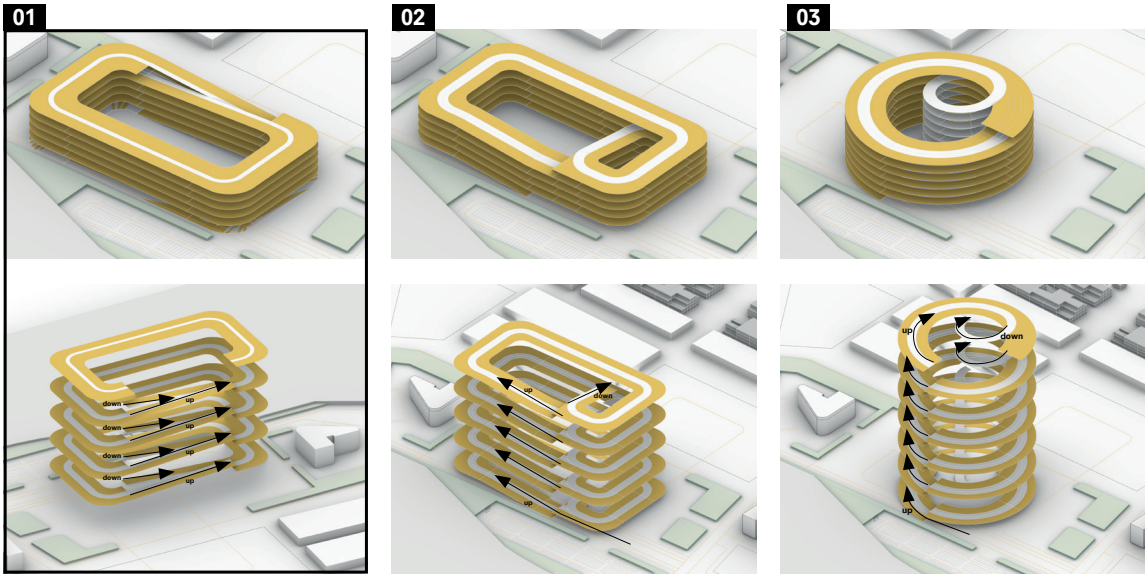
CHAPTER. 6
ORGANIZATION

6.1 Circulation system

The Garage project required the separation and reorganization of office personnel and truck freight flows within the port. On the site, the port staff will follow the planned road network to enter the port interior, or the office area in the garage. Trucks, on the other hand, will only move within the garage project and the loading area.

The flow of truck freight will naturally shape the interior space of this project. Through the comparison of different schemes (pic), it can be found that the first option can concentrate all lane spaces more efficiently, and does not provide the most flat parking spaces for trucks. Therefore, this direction was finally chosen as the future development direction.

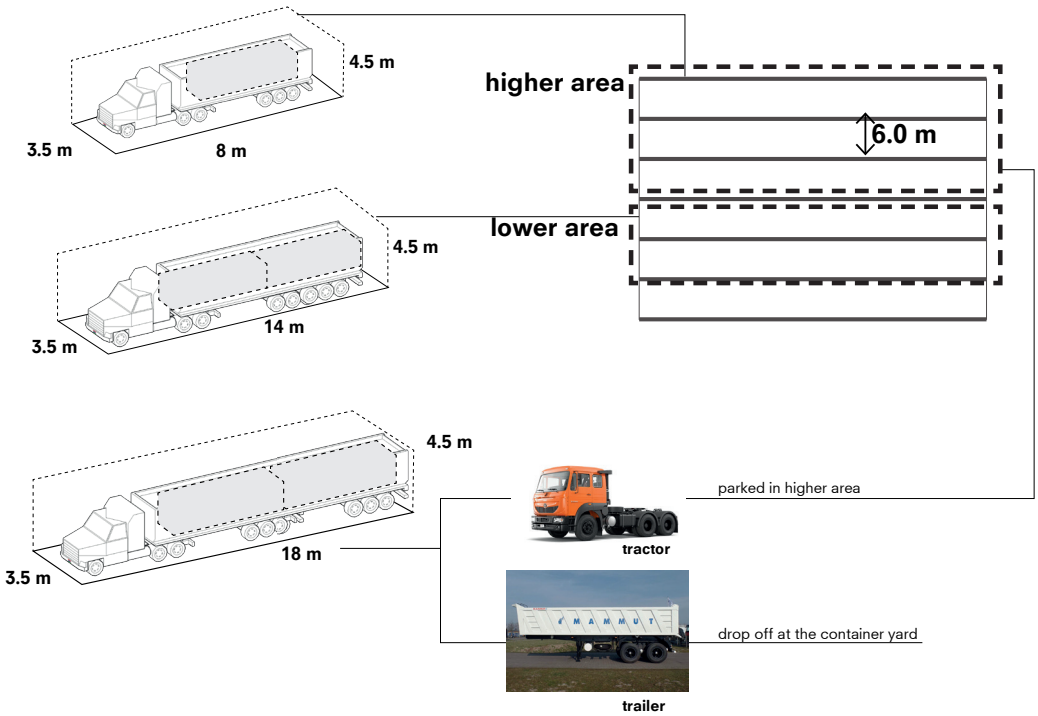




6.2 Parking manuvering

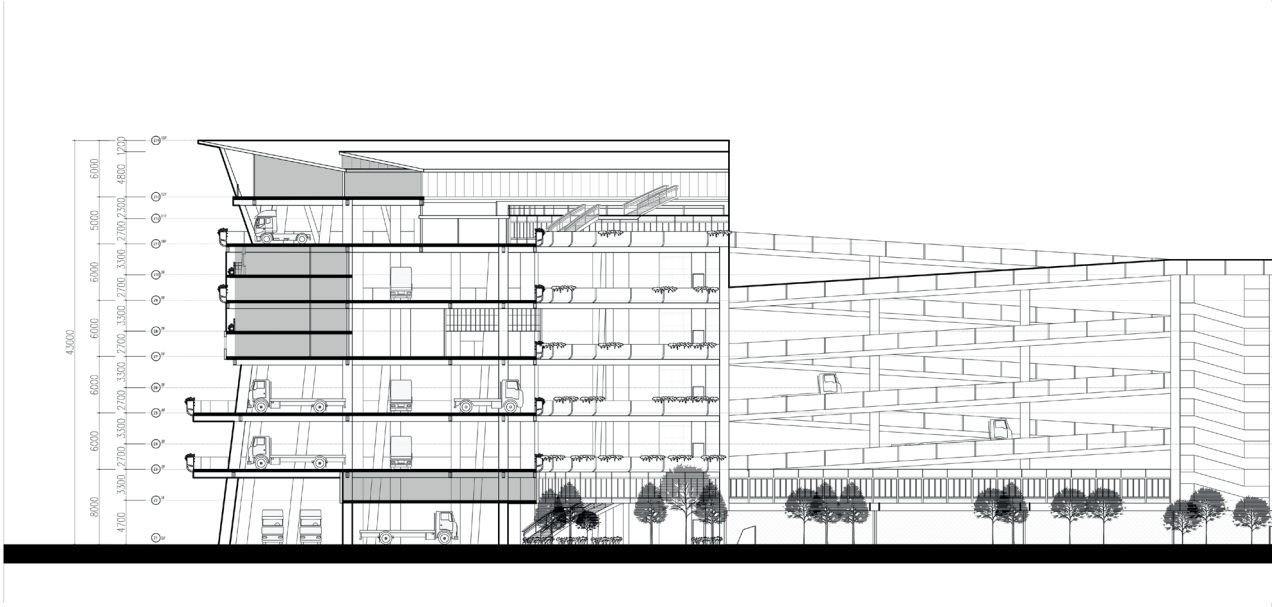
According to the regulations of the local government in Lebanon, trucks used for cargo transportation will not exceed 18.75m. Trucks within this size range can be divided into three categories according to length. The parking operation inside the Garage project will be divided into upper and lower parts. The upper layer is the parking space for small trucks, and the lower layer is for medium-sized trucks.

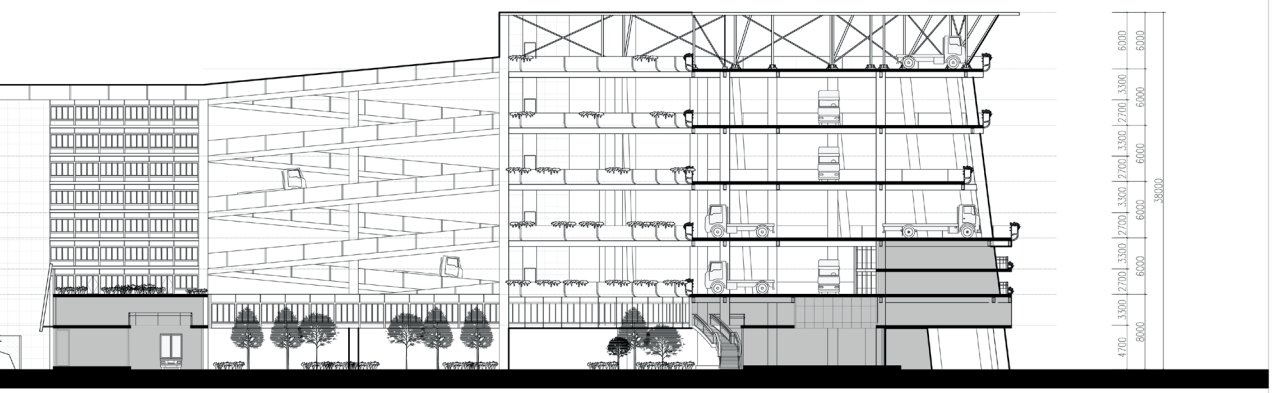
Large trucks will park the trailer part on the site, while the trantor part can park in the parking spaces on the higher floors of the building.

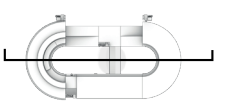


6.3 function layout

Throughout the building, logistics control will be located close to the ground floor to monitor and manage truck logistics. Garage management is located on the upper level of the garage to free up enough lower space for truck parking. At the top would be a motel for truck drivers. The Motel faces Beirut's CBD and the newly built office and dogital depot on the east side of the port for good views..







parking management

logistic operation

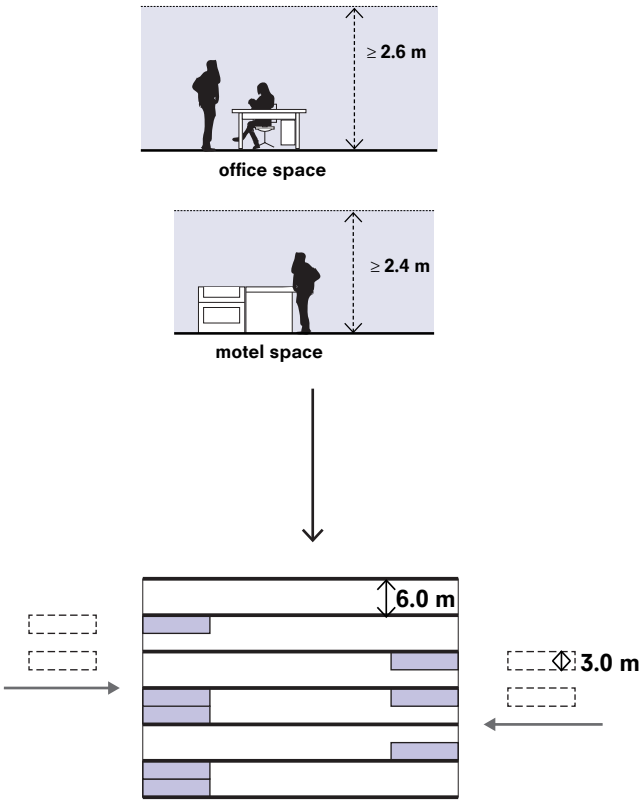
motel

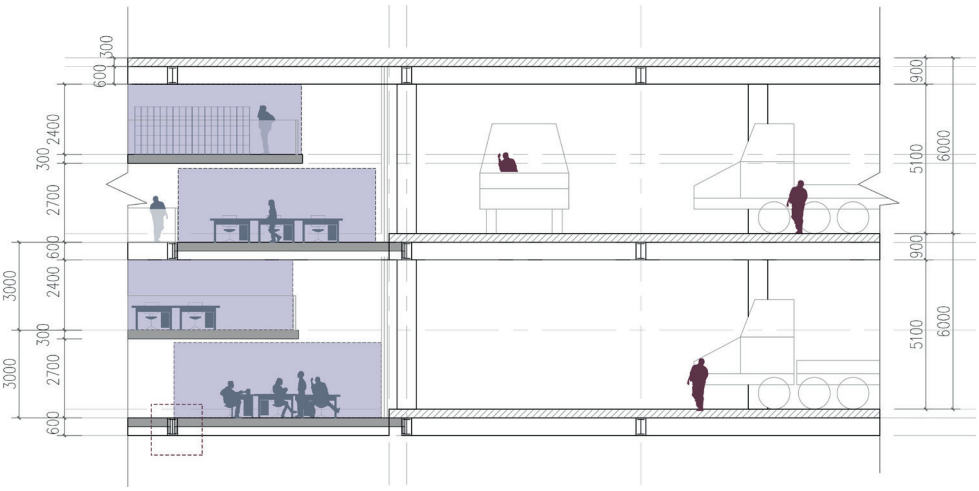
CHAPTER. 7 IMPLEMENT

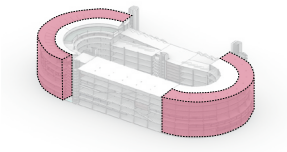
7.1 Space design

Since the height of the space occupied by the passenger car is almost twice that of the human space, a natural multiple relationship is formed between the truck space and the human space. With this relationship, the space frame formed by the truck is a large fixed frame, and the human space is a “small box” interspersed inside. Since it is attached to a fixed frame, all human-scale spaces can be divided into modules of similar size. These modules can be combined more freely within the larger building.

In the future, the function of some part of the building can be changed based on the new demand.(fig 17)







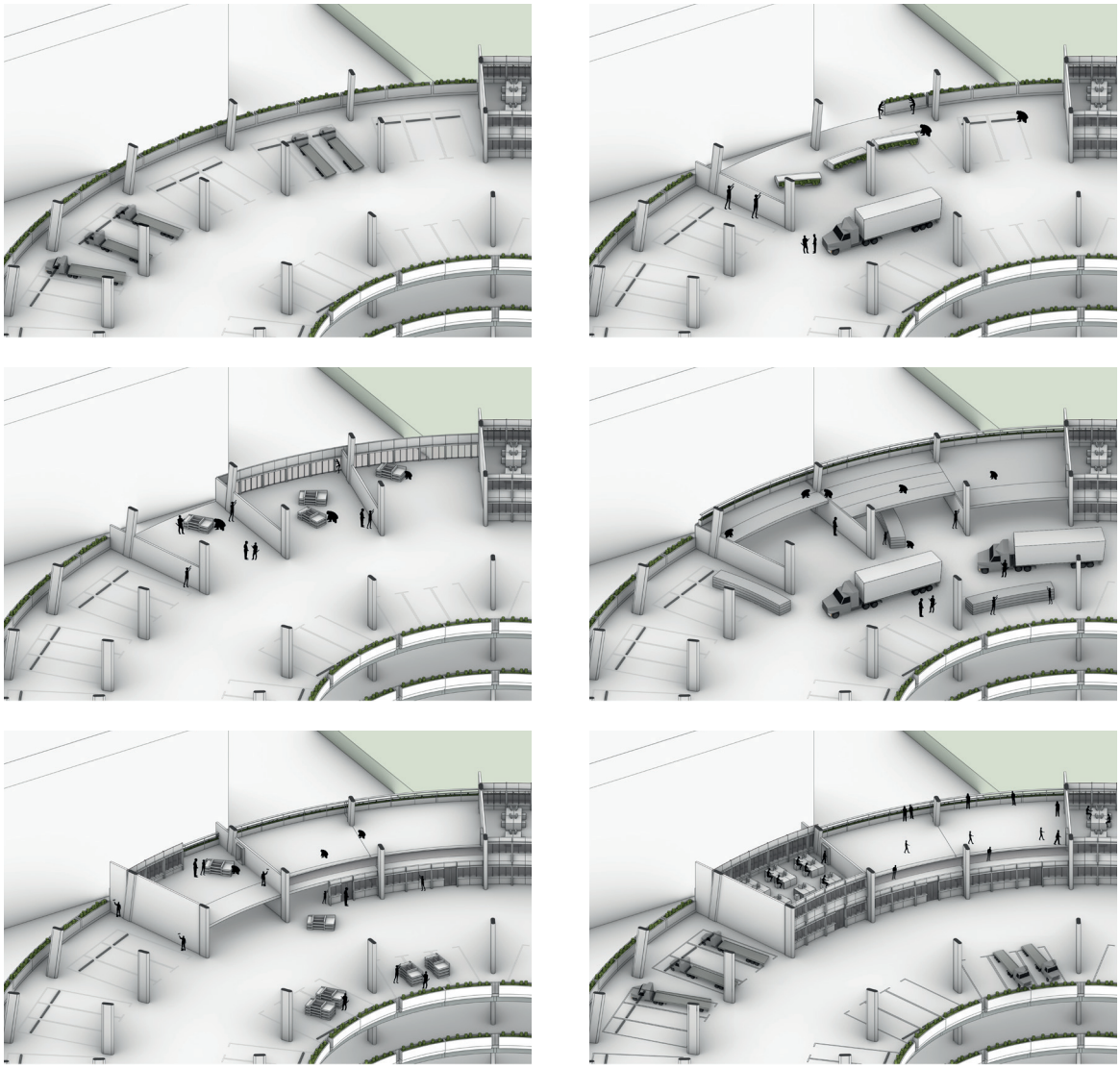


Fig 17 Changable construction

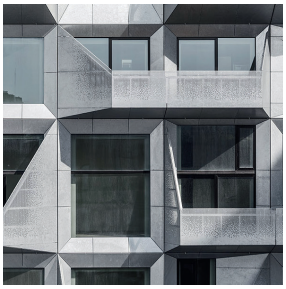
7.2 façade design

The façade design needs to respond to the local weather conditions in Beirut and the characteristics of the port where the project is located.

Beirut's local summer is very hot, with plenty of sunshine, and it is close to the ocean, and the air is relatively humid. The building needs to consider the construction of facade shading and natural ventilation, while the side facing the sea needs to pay attention to preventing material erosion caused by sea breeze. Most local buildings in Beirut use vertical shading and horizontal shading. The project involved will refer to these strategies and implement corresponding sun visors on different facades.

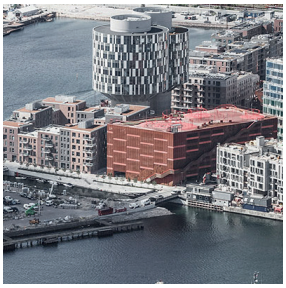
Taking into account the industrial infrastructure characteristics of the port, the facade of the new building will mainly use metal materials or solar panels. Use materials with obvious industrial flavor to reflect the infrastructure characteristics of the garage itself.

COBE
The Silo



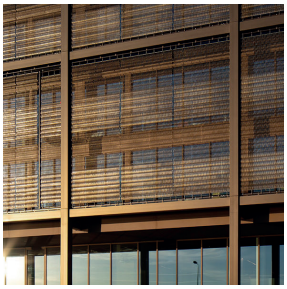
galvanized steel

JAJA Architect
Parl n'Play



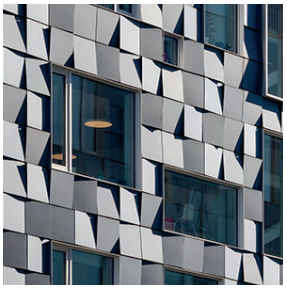
corroded steel plate

atelier d'architecture King Kong
Dock G6 Hotel

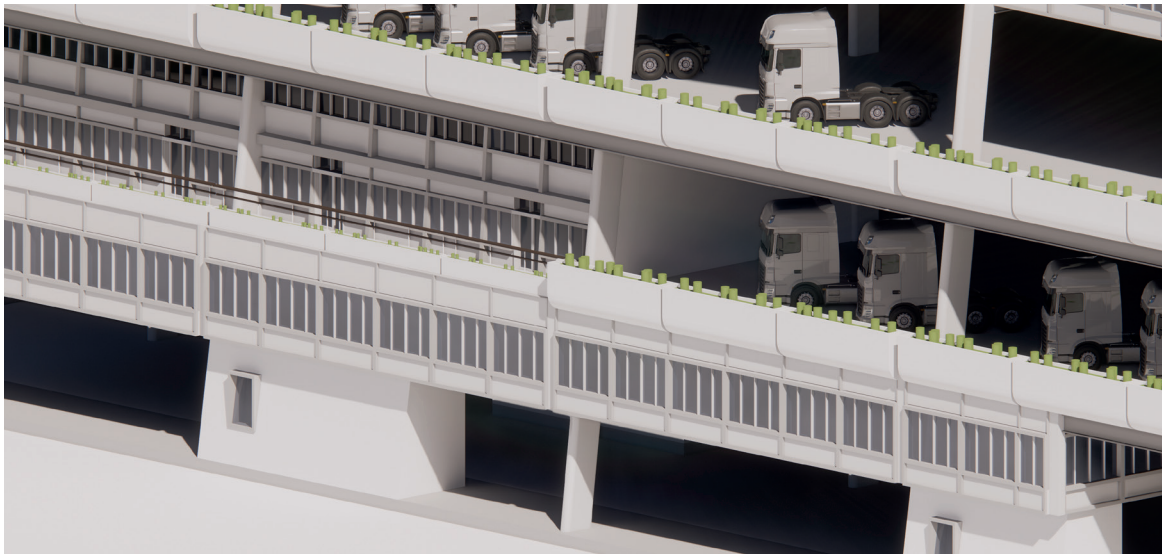


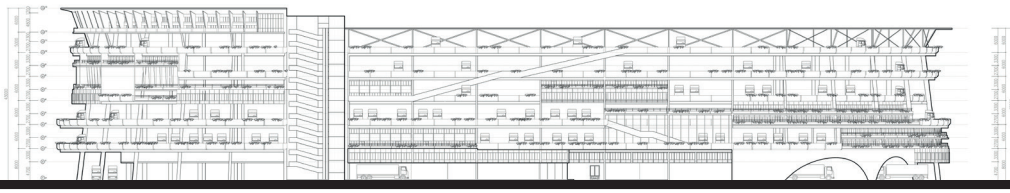
metal mesh

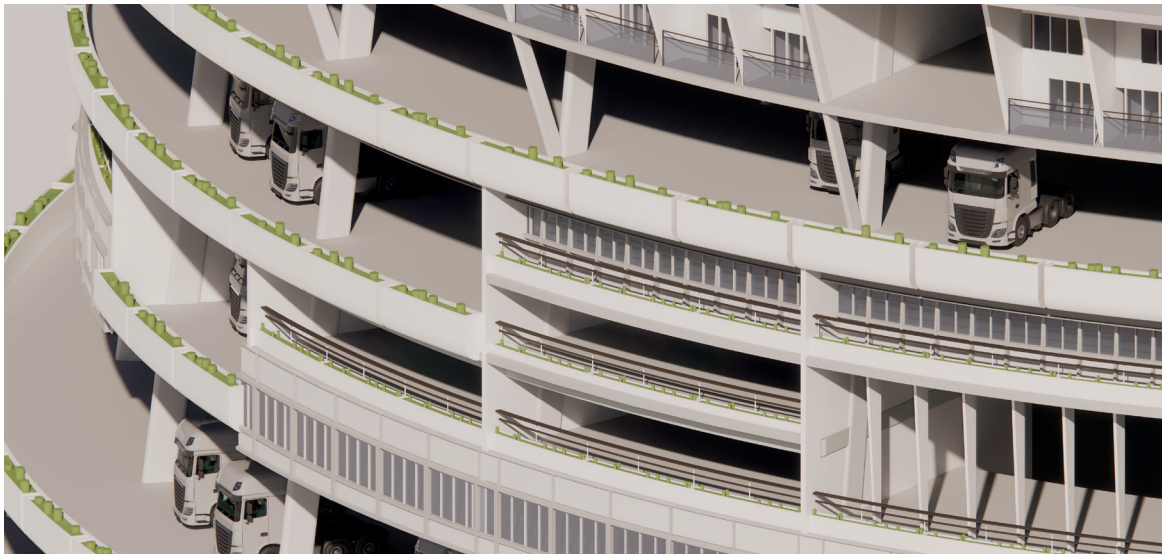
C.F. Møller Architects
Copenhagen International School

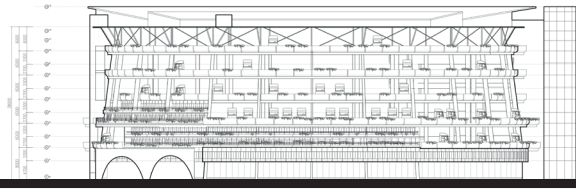


solar panels









CONCLUSION

The Port of Beirut is of great significance for freight transport in Lebanon and surrounding areas. However, due to the civil war and the explosion in 2020, the logistics and transportation system of the port has always been in a state of destruction and has not been effectively built.

This article concentrates the parking space through a centralized garage, and then realizes the integration and improvement of the port logistics system. Under this theme, the capacity of the port and the logistics system have had an important impact on the design and development of the project. In addition, the design requirements of the truck ramp in the parking lot also brought a lot of constraints and opportunities to the garage. Under the final shape, the ring-shaped building tries to integrate the ramp space and the parking space together to achieve efficient use of the interior space.

The garage project is an intervention to improve the centralized parking space and logistics transfer system for the port. It also provides an architectural solution in response to the logistics mobility problem in Beirut.

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