

# The Regeneration of Postindustrial Landscape

*The Central Térmica de Sant Adrià de Besòs*

**MSc. Sustainable Architecture and Landscape Design**

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## Abstract

For years, the former Thermal Power Plant of Sant Adrià de Besòs was the focus of a preservation fight to prevent its demolition, and only recently were the Tres Chimeneas granted heritage protection by the municipality.

This thesis looks back into the history of the power plant to understand better the identity of the landscape and the relationship that locals have built in time with the site. Based on environmental, economical and social analysis, the thesis aims to transform this post-industrial land into an urban public space. With the demand of a specific functional program, the challenge was to make this piece of land as permeable and sustainable as possible. The proposed design considers the site as a connector between Barcelona, Sant Adrià de Besos and Badalona, and a window for the city to the Mediterranean sea. The plan takes advantage of the existing landmark and its location on the coastal line of Barcelona to create a unique multidisciplinary space.

The ultimate aim of this proposal is to improve the quality of life of people and especially locals, and to add a positive social, economical and environmental impact on a regional and global scale.

**Keywords:** memory, history, post-industrial landscapes, resilience, sustainable architecture, biodiversity, climate change, experiences, radical, biodiversity, multidisciplinary, green corridors, city border, skyline, well being, community.

## Astratto

Per anni, l'ex centrale termoelettrica di Sant Adrià de Besòs è stata al centro di una lotta per la conservazione per impedirne la demolizione e solo di recente le Tres Chimeneas hanno ottenuto la protezione del patrimonio dal comune.

Questa tesi ripercorre la storia della centrale per comprendere meglio l'identità del paesaggio e il rapporto che i locali hanno costruito nel tempo con il sito. Basato su analisi ambientali, economiche e sociali, la tesi mira a trasformare questo terreno post-industriale in uno spazio pubblico urbano. Con la richiesta di un programma funzionale specifico, la sfida era rendere questo pezzo di terra il più permeabile e sostenibile possibile. Il progetto proposto considera il sito come un collegamento tra Barcellona, Sant Adrià de Besos e Badalona, e una finestra per la città sul Mar Mediterraneo. Il piano sfrutta il punto di riferimento esistente e la sua posizione sulla linea costiera di Barcellona per creare uno spazio unico.

L'obiettivo finale di questa proposta è migliorare la qualità della vita delle persone e in particolare dei locali e aggiungere un impatto sociale, economico e ambientale positivo su scala regionale e globale.

**Parole chiave:** memoria, storia, paesaggi postindustriali, resilienza, architettura sostenibile, biodiversità, cambiamento climatico, esperienze, radicale, biodiversità, multidisciplinare, corridoi verdi, confine cittadino, skyline, benessere, comunità.

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After the course with prof. Karin, curiosity drove me to Barcelona to visit the site, and it was all I needed to build a beautiful bond with the formal power plant of Sant Adrià de Besòs and choose it as the subject of my master's thesis project.

This project would not be complete without my Urban and Environmental Design Studio colleagues: Aldo Vinciguerra, Anoosh Jariyani and Andrei Rizea. It was a great pleasure working with them. I thank the Politecnico di Milano and all the professors and colleagues for being part of my journey.

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Fig. 1. The current situation of the former power plant of Sant Adrià de Besos

## Introduction

The 1970s Tres Chimeneas loom over Barcelona's north seafront as a relic of the city's industrial past. Referred to as mythical and iconic, the three chimneys of Sant Adrià de Besos on the landscape of Barcelona stand tall at 200 meters. Dating back to the 1970s, the chimneys, along with an adjacent turbine room, were part of a larger thermal power plant design. The chimneys are unique in their construction and form from a structural point of view.

Today, the site around the three chimneys is both hang-out and cultural heritage to the locals. But what most of the people don't know, is that the site hides heavy metals in its soil. The harm that the contamination is doing, is not only affecting the soil, but also public and ecosystem health. Based on those information and the fact that the city of Barcelona fell well short of the European Union's recommendation on access to green space, the thesis project suggests a remediation plan and a regeneration of the post industrial site into an urban public space.

The City of Barcelona, with its Green Infrastructure and Biodiversity Plan is implementing a range of actions to bring nature into the city. The main objectives of the thesis project are to preserve the iconic chimneys and improve the natural heritage of the city and to conserve its biodiversity. This would ultimately bring environmental and social benefits for people. The development of two urban green corridors on the main entrance axes of the site help ameliorating the connectivity between green areas as they are an important component of an urban green infrastructure and they also help boosting the city's resilience and adaptation to climate change. On an urban scale, the thesis also aims to connect the different municipalities together by designing a multifunctional path that would assure the continuity of the coastal promenade from Barcelona to Badalona.

A new mini district will include a beach park, educational buildings, cultural, leisure, and related residential facilities, taking advantage of the remains of the former power plant and existing sport facilities. All together shall build up a little town in itself.

The thesis project takes into account future water rises in order to design the sections along the site and the usage of each area in a way, so that the site is not affected by daily water fluctuations, but can withstand the rise of sea level in case of extreme weather events.

Regarding aforementioned environmental issues, the wooden structure functional buildings gather all around the chimneys and turbine hall, topped with solar panels, leaving the majority of the site surface free for the land - that once was agriculturally dominated - to regenerate.



## Climate Change

### Sea Level Rise

In the same way that the city of Barcelona cannot be understood without its coastline and without its origin as a port, its future will be determined by its ability to manage the unpredictable effects of climate change in this unique area.

Different studies show that in the coming years and how as a result of climate change variations can occur in climatic phenomena related to the sea. Due to the geographical and climatic characteristics of the area of Barcelona, the rise in average sea level may be a certain incidence, although trends are relative to the variability of maritime storms or wind and pressure variations as well playing a very relevant role.

These changes in maritime origin can have consequences on the elements that make up our coast, mainly on its beaches and infrastructure ports. In order to study the flood caused by the sea, the flood level there are 3 determining parameters:

- The localized rise in mean sea level it causes a permanent flood
- The tide and pressure changes and wind that generate potential flooding
- The effect of the swell causing extreme flooding.

The waves are currently responsible for causing major damage problems on the Barcelona coast when extreme episodes of thunderstorms occur. Climate projections indicate that, in general, there will be an increase in average sea level as a result of the melting of polar masses and thermal expansion, and that this increase will vary depending on the region. The more extreme events are predicted to be more frequent, although their magnitude will not vary much. In the case of Barcelona, which was previously associated with return periods of 50 years, it is expected to be associated

in 2050, with periods of 35 years.

As for the coast of Barcelona, although there are still few studies analyzing the concrete effect of climate change on the coastal dynamics of the area, approximations have been made showing that a triple is very likely to exist, the effect on the coast consequence of climate change: an increase of flooding, morphological changes on beaches and a major exhibition of port infrastructures.

Specifically, when it comes to beaches, it is likely to increase the risk associated with flooding, which is directly related with rising sea levels, in the middle but especially in end of century. There is also a very likely a variation in the morphology of the beaches, consequence of the changes in the trends of the waves and the increase in the level of the that will change the processes of contribution and loss of sediments of the beaches and also their orientation.

"We are the first generation to feel the impact of climate change and the last generation that can do something about it."  
\_Barack Obama

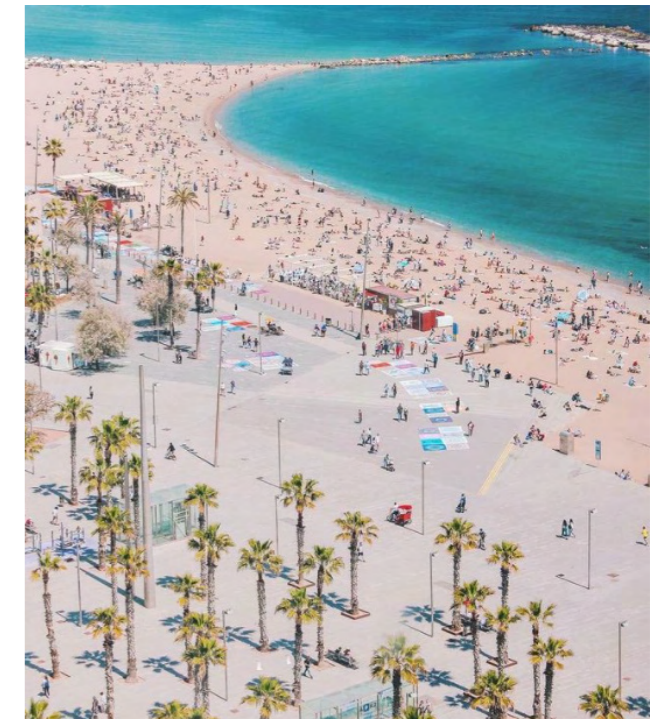


Fig. 2. The popular public beaches of barcelona

Relative to port infrastructure, the effect of climate change can have effects on the internal turmoil of the ports and can generate more episodes of infrastructure overruns. Still, with the completion of port defense works, which currently are being defined, these conditions would be reduced.

## Sea Rise Level Scenarios

Sea level rise has been analyzed by two climate change scenarios: the "committed" scenario, which corresponds to the overall reduction of emissions according to the Paris agreements (scenario RCP4.5), and the "passive" scenario which responds to the current pace of emissions continuing (RCP8.5 scenario), and for 2 time horizons:

middle and final century. In addition, another scenario has also been evaluated by 2040, the "trend" which is based on long extrapolation term, of the trend in the observed flood level historically. And finally, the scenario "more pessimistic" by the end of the century, which responds to the concern existing on the stability of ice sheets Greenland and West Antarctica (although the probability of this episode is low, the serious consequences mean not to be disposable).

The projected potential sea level rise for 2046-2065 for the different scenarios of climate change (both the most committed, as the most passive) is 0.94 m, having taking into account the rising sea level, the tide astronomical and meteorological.

Tendencies scenario would point an increase in sea level total 1.69 m for 2040.

For the year 2100, the average level increase in the sea for the purpose of change climate on our coast It is expected to be 0.46 m (scenario engaged), 0.64 m (passive scene) and 2.00 m (scenario pessimistic). If you also take into account the effect of the tide, and the changes in pressure and wind, the values would be 1.15 m, 1.33 m and 2.69 m respectively.



*The actual sea level - 2020*



*2100 | Passive stage, 0.95m rise*



*2100 | Pessimistic stage, 2.00m rise*



*5.00m rise*

*Fig. 3. The impact of the climate change on the seashore of Sant Adrià de Besòs in the future based on three different scenarios.*

In no case may these increments mean the flood of the walk area under normal waves.

If we apply the current conditions to these values of 2100 of extreme swell, and therefore we add the increase in elevation generated by storm episodes, and considering the most pessimistic scenario, the water would reach beyond the promenade on the beaches of Saint Sebastià and Saint Miquel and would reach the limit on the beaches of Barcelona and Mar Bella, possibly flooding the premises located at sand level.

Of course, the increase in sea level could mean a back-space on all beaches in the city, as it would be generating the loss of surface area of sand for users in all beaches.

To quantify more carefully this loss is necessary to develop detail studies. For example, in the framework from the MetroBs project it was estimated that for the beaches of Santo Miquel and San Sebastián would exist between the 11 m (engaged scene) and 43 m (pessimistic scenario) at the end of the century.

In all cases, the setback that most beaches may suffer in relation to their average width as a result to the average sea level rise caused by climate change, should be considered for future planning.

Some beaches such as San Sebastian can almost reach disappearance in the worst case scenario, while in others, they can suffer reductions of between 30 and 46%. It should be noted that the beaches of Barcelona are nestled and that, in case the current usable area of beaches, elements should be moved to the city, which could be raised on the beaches of the east. On the western beaches, where behind these static elements we already find streets or even buildings, the loss of surface useful beach is inevitable. Measures to adapt to change in this case are mandatory, climate change will have to be reduced in effects of the wave, introducing new elements of protection passive, or the elevation of the walking height.

However, to be able to assess the morphological changes on the beaches of Barcelona, as a result of cli

mate change, we must take into account the variations that this will cause not only by sea level rise, but also on incident waves and on the extreme episodes of thunderstorms and the dynamics of sediment transport.

The study on the risk of maritime flooding, carried out in the framework of the Climate Plan, has been prepared only from the bibliographic collection information, but no modeling has been generated that includes the different variables. That's why it's important to perform more detailed studies on the coastal dynamics of Barcelona, which includes the variable of climate change in their analysis.

A study of coastal dynamics is currently being developed of Barcelona's beaches, as part of the elaboration of the plan, strategic coastal spaces of the city (PEEL), which will serve as a basis to perform this more thorough analysis of the effects that climate change may have on the coast. In general, this new plan affects the consideration of the coastal front as a maritime-terrestrial space that is an integral part of the environment and therefore must be preserved, and in physical and economical resilience in this area, beyond the effects of cycles global economic.

There are futures that can be anticipated, but if we accept that we are living in a post-ecological era, an era known as the Anthropocene in which nature no longer exists as an archetype distinct from humankind, any imaginable future implies the physical and social transformation of the environment we inhabit, the result of the new relationships between nature and culture in the light of climate change. We are, therefore, experiencing a paradigm shift regarding the management and regulation of the coastline. In this context, Barcelona faces the challenge of redesigning its coastline in relation to its two rivers and, transversally, integrating this coastline into the city.

More importantly, this interpretation and planning must take place at the metropolitan level. Far from considering climate dynamics as a risk, they should be taken as an opportunity to reconcile the relationship of the city and its inhabitants with the sea.

# Soil Contamination

Sea Contamination Risk



Fig. 4. The mapping of the severe soil contamination that the formal power plant caused



Fig. 5. Overlapping the result of the sea level rise with the site contamination, explaining the need to clean up the site before the spread of the pollution into the sea.

City Reading  
Metropolitan Scale

LANDSCAPE IDENTITY  
Metropolitan Context

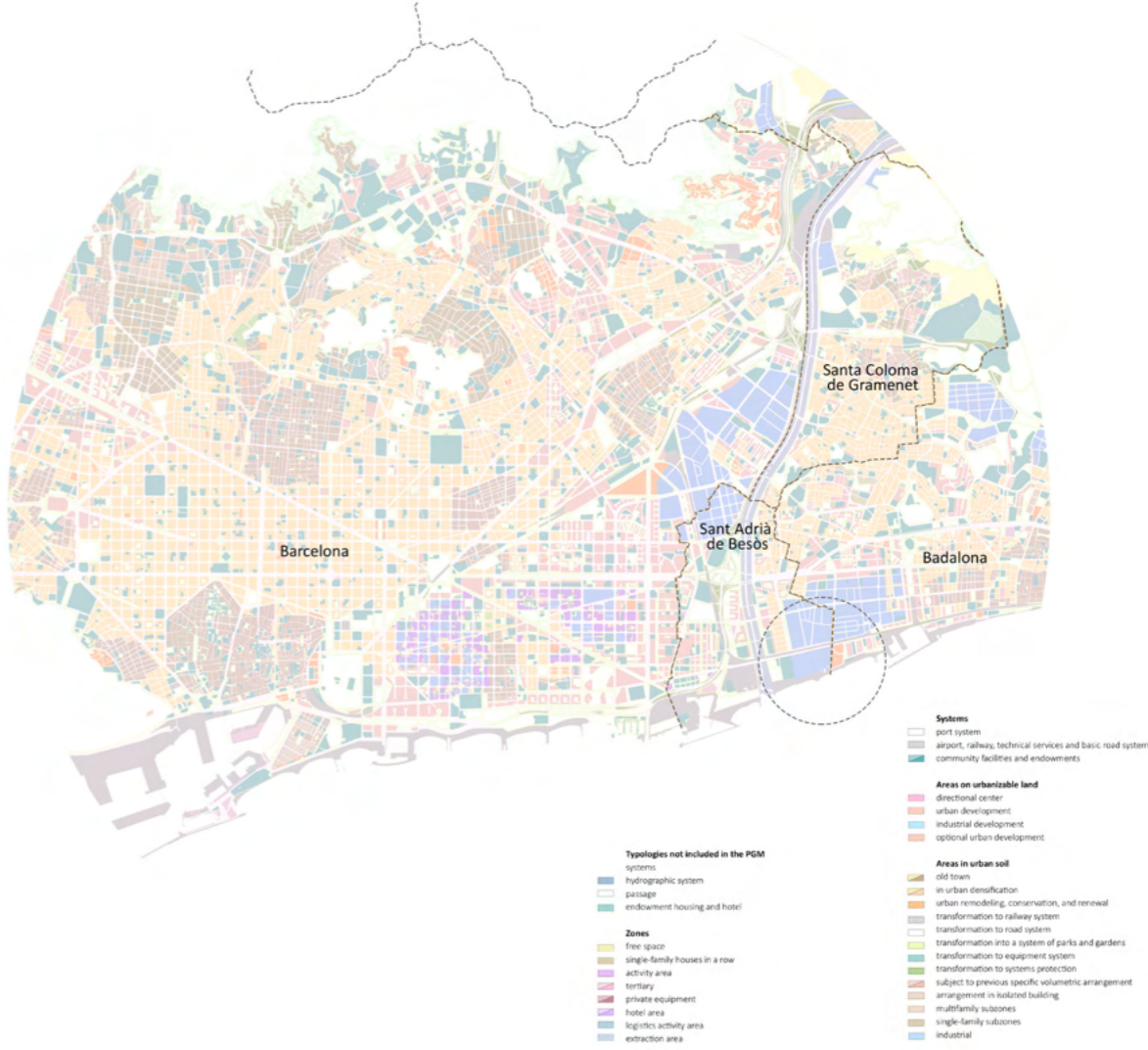


Fig. 6. The landuse map of Barcelona, showing the site in its context. This map also shows the limits of municipalities within the region.



Fig. 7. The transportation infrastructure and the main landmarks.  
El Besòs river as a natural limit.



Fig. 8. The green infrastructure in the metropolitan area.

# Waterfront Analysis

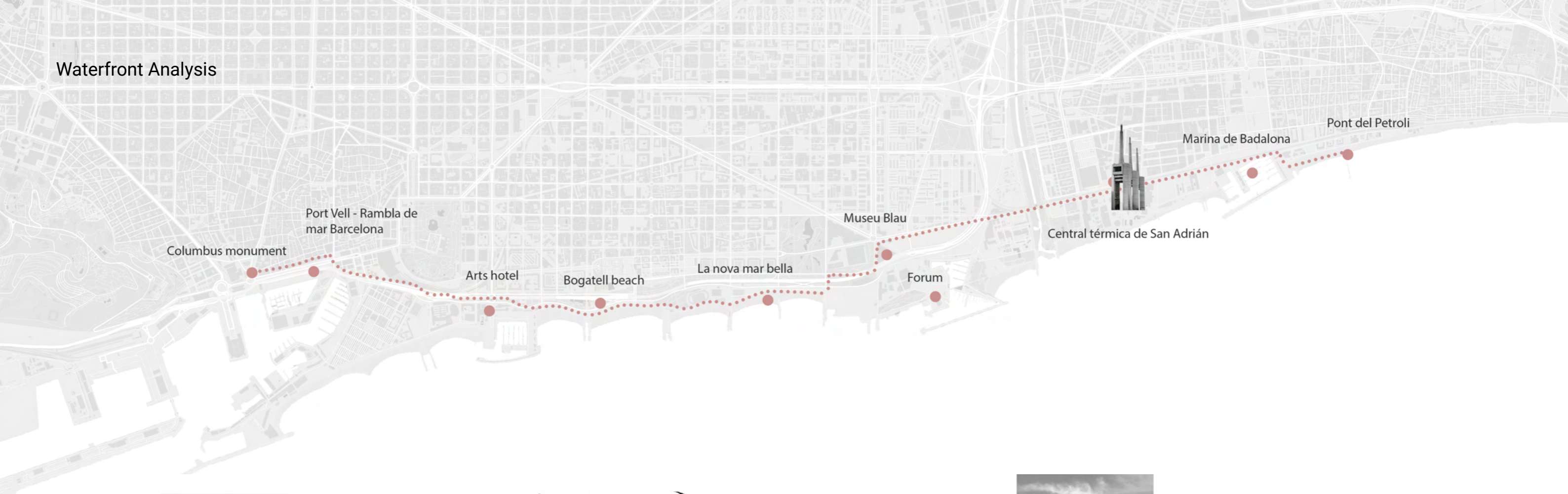


Fig. 9. The promenade experience along the seafront starting in Barcelona passing by the site and reaching Badalona.

- 1- Les 3 Xemeneies
- 2- Diagonal Zero Zero
- 3- Torre Agbar
- 4- La Sagrada Familia
- 5- Hotel Art
- 6- W Barcelona
- 7- Monjuic communication Tower

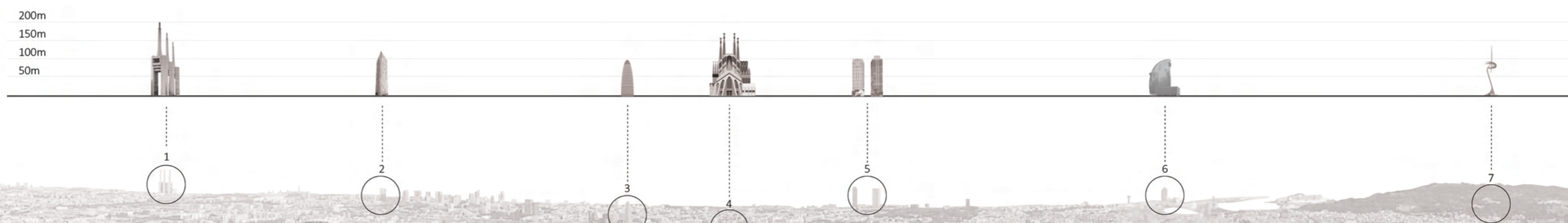


Fig. 10. View From Tibidabo - Height Comparison

## Dynamicity and Influence



This drawing is a representation of the city outline and border. All along the boulevard, the separation line is organically designed depending on the needs or uses. This makes the promenade visually and physically rich and enjoyable. This outline helps us understand the importance of the relation between the region of Barcelona and its sea.

Looking at the shoreline of Sant Adrià de Besòs we notice the lack of variability in terms of functions and design especially in the formal power plant site. Metamorphologically, it seems like the city is turning its back to the sea and not taking advantage of its mediterranean location.



The grid of the city influences the composition and the division lines of the beaches and marinas of Barcelona. The diagonal axes continue straight to the sea, forming the marina of Barcelona and the Forum port. Other central city axes extend to become separation elements between different beaches along the sea.

This analysis shows that this urban design concept does not apply in Sant Adrià de Besòs, what brings the proposed thesis project the opportunity to be the connector element between the green corridors of Sant Adrià de Besòs and the mediterranean sea.

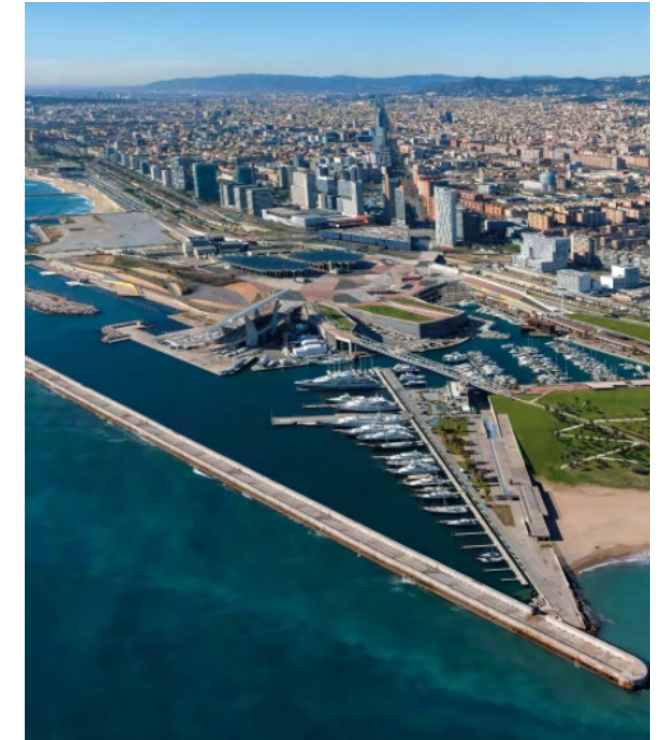


Fig. 11. Dynamic seafront of Barcelona

Fig. 12. The diagonal street extension on the sea



**LANDSCAPE IDENTITY**  
Local Context

Accessibility and Connectivity

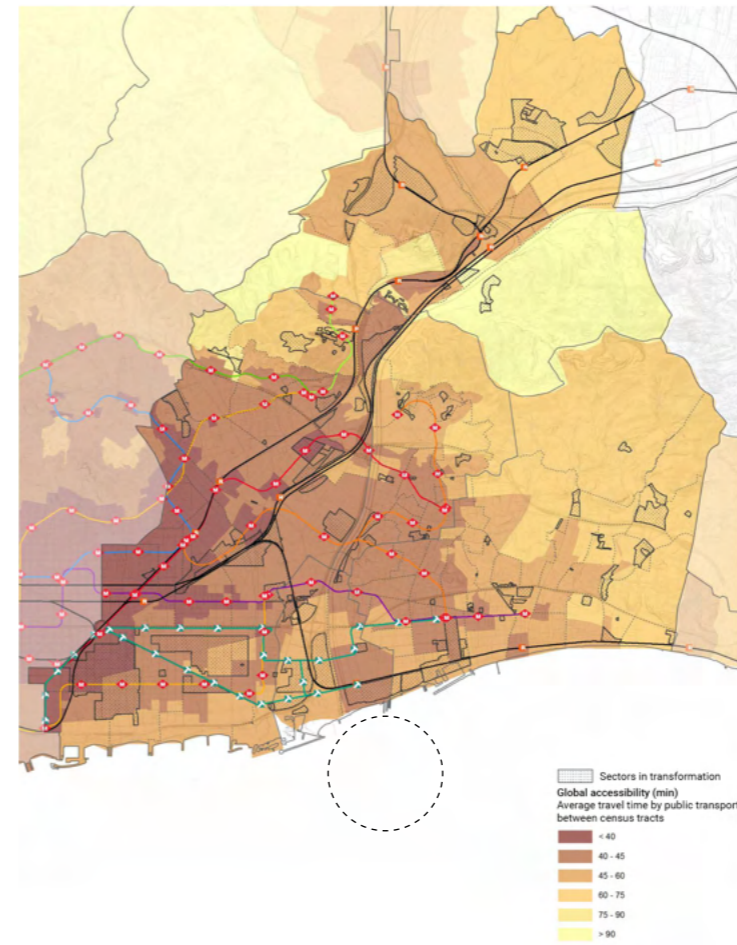


Fig. 13. Accessibility in public transportation - Sectors in transformation

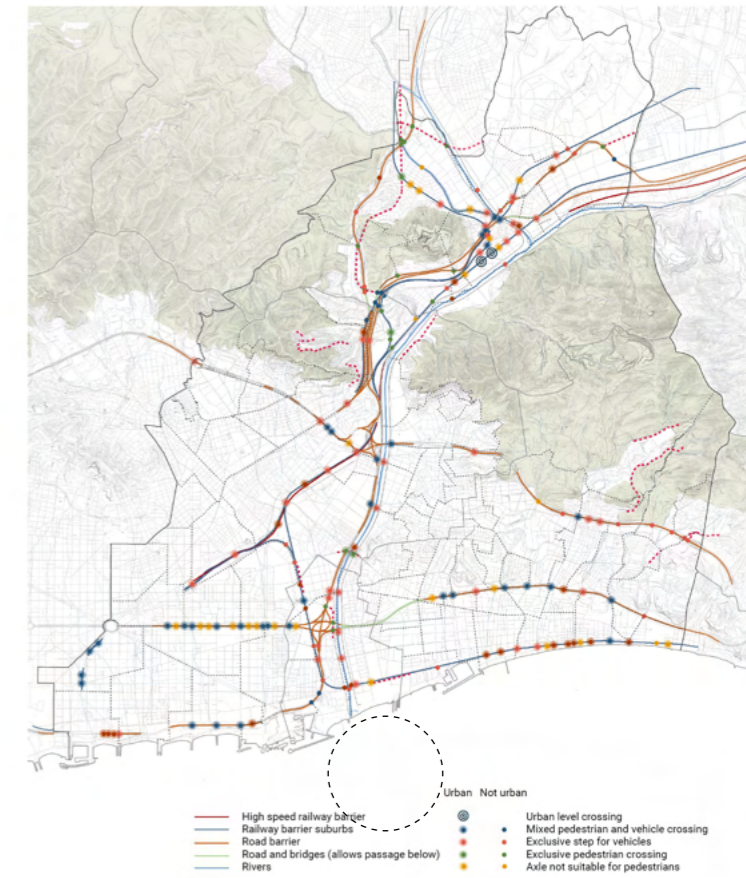


Fig. 14. Pedestrian mobility- Critical points

Productive Fabrics



Fig. 15. Trade Density, PAEs knowledge centers

Green Infrastructure

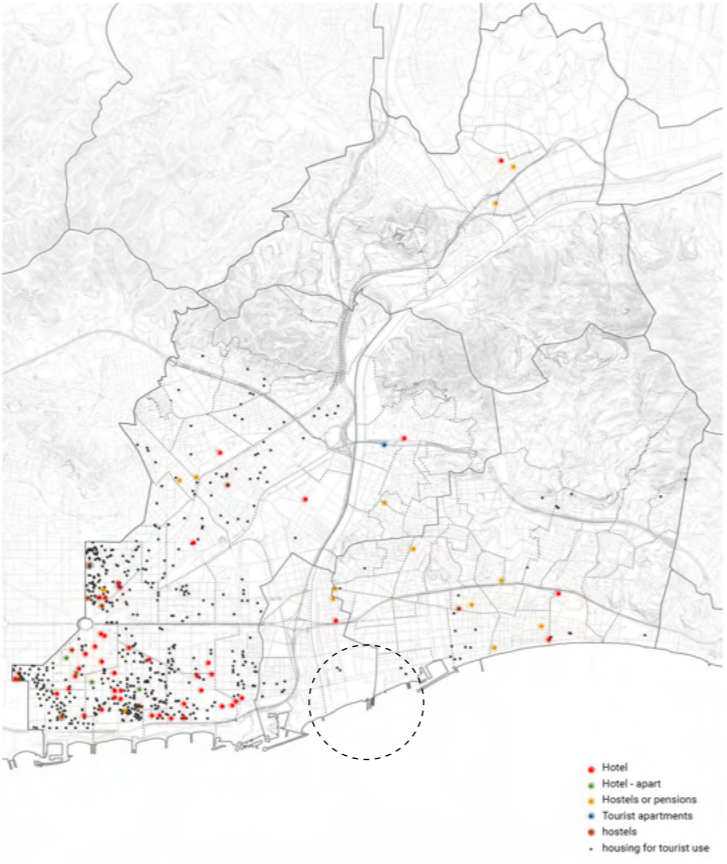


Fig. 16. Economic activities: Tourist Accommodation

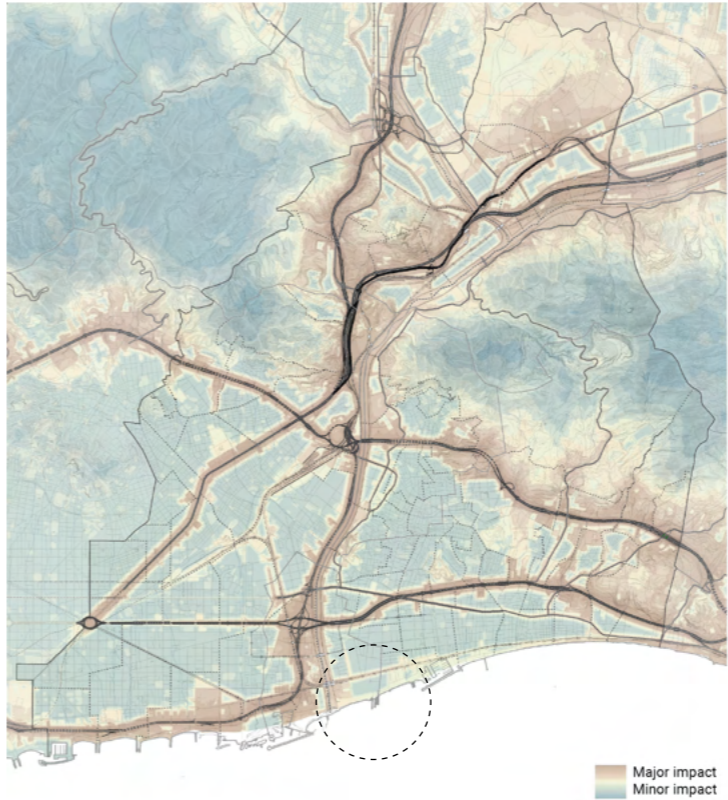


Fig. 17. Green infrastructure: Impact on infrastructure

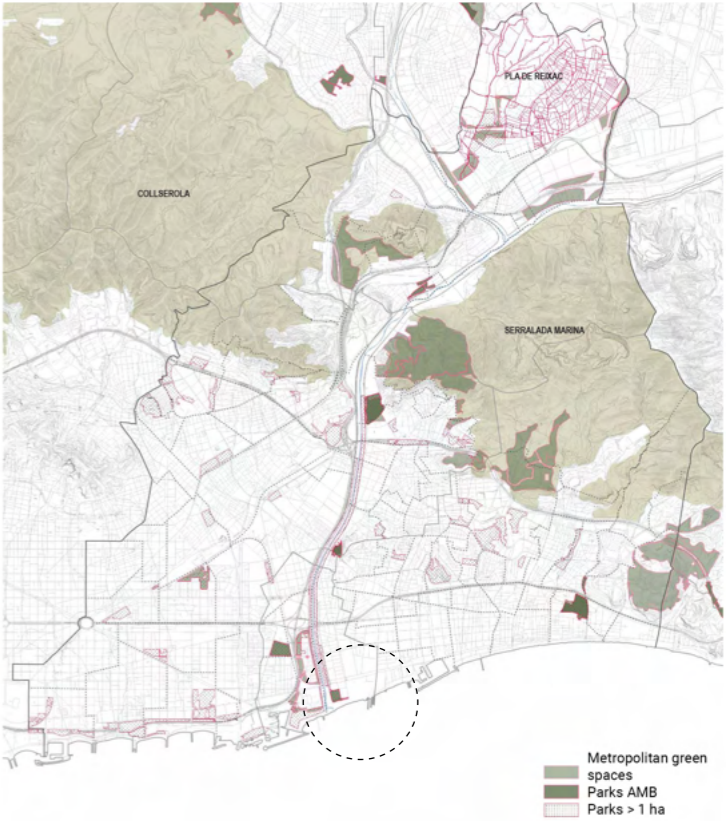


Fig. 18. Metropolitan parks and green spaces

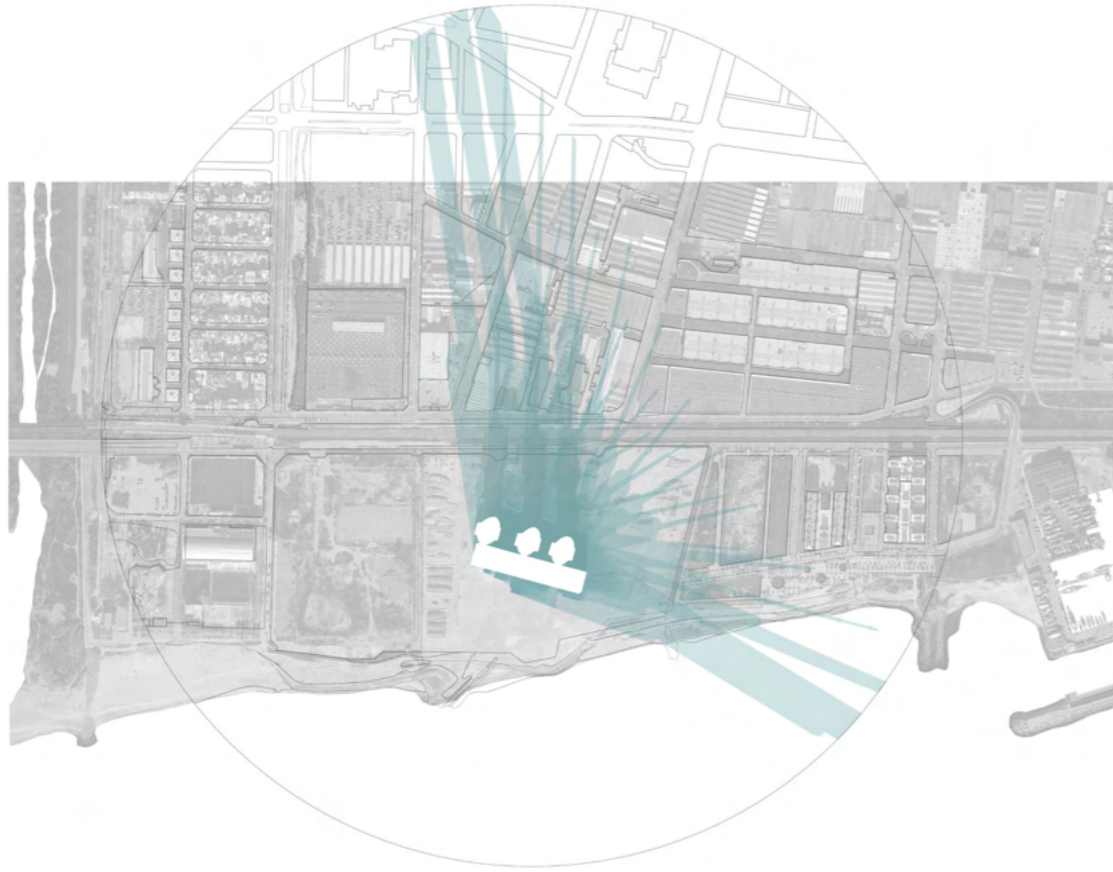


Fig. 19. Shadow study during winter

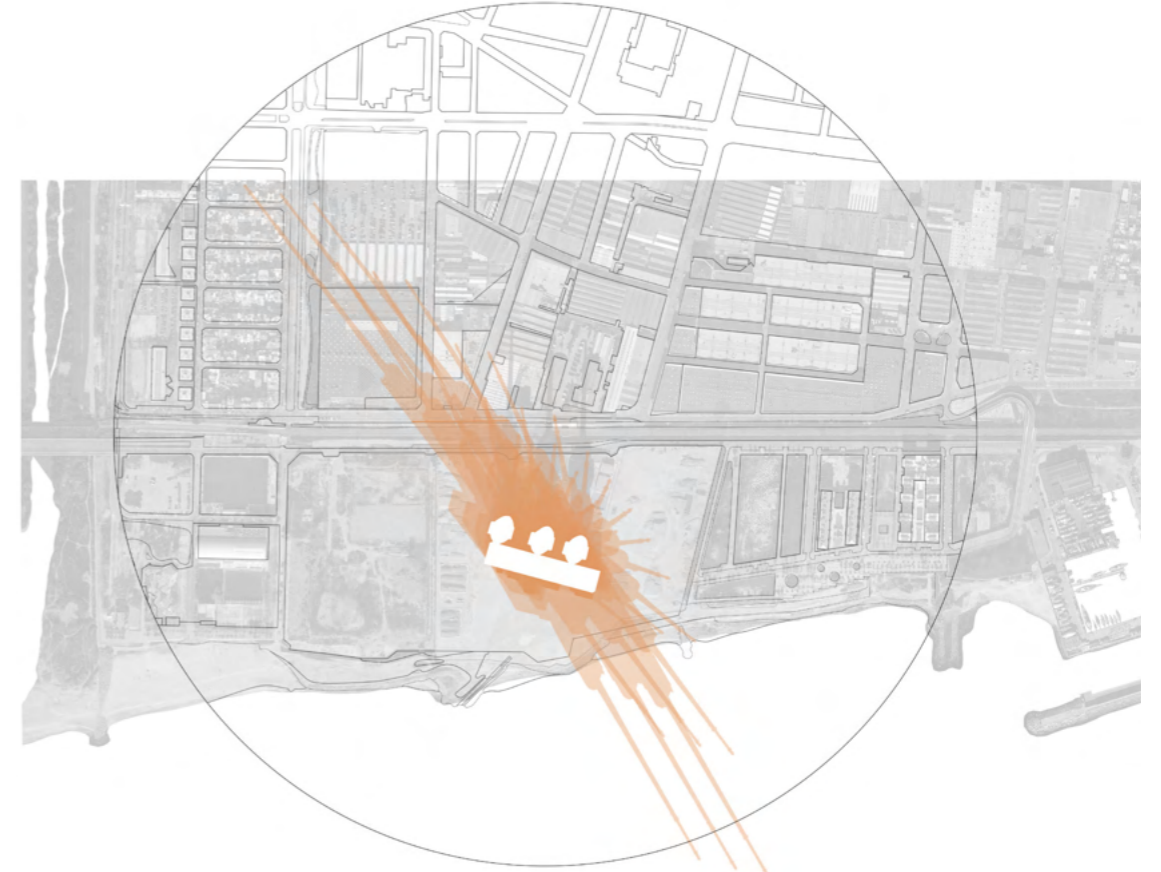


Fig. 20. Shadow study during summer

## HISTORICAL EVOLUTION

### From an agricultural hamlet to an industrial power station

Within the metropolitan area of Barcelona, specifically the area on the right hand side of the Besòs river, popularly known as "Chernobyl", lies the location of the thermal power plant site of Sant Adrià with its three, towering chimneys. But it has not always had that predominantly industrial character. At the beginning of the 20th century, Sant Adrià de Besòs had become one of the main suppliers of fruit and vegetables in Barcelona. Carreras Candi, in his General Geography of Catalonia (1910) echoes that reality, so far away today: "Its inhabitants (referring to Sant Adrià) are dedicated exclusively to agriculture, cultivating a large part of the orchard, which they irrigate with the water of the river, and produces vegetables, legumes and fruits and especially strawberries, which have a lot of output in the nearby markets of Barcelona and Badalona" (Carreras 1910). However, its close distance to Barcelona, already a growing metropolis at the time, acting as a magnet for industries, the abundance of freshwater from the Besòs river, the availability of sea water for cooling, as well as the existence of a railway to deliver the coal supply, all those characteristics made the site the favorable choice to install thermal plants that would power the region's industrial growth. José L. Muñoz describes the time as follows: "For Sant Adrià it meant entering the 20th century, modernizing and becoming more technical" (Muñoz and Segarra 2018).

It was in 1912 when the first thermal power plant was constructed and in operation for 41 years, backing up and sourcing the area with energy throughout two World Wars and the Spanish Civil War. Spain experienced a strong economic growth throughout the time of the First World War (1914-1918) and despite the economic crash of 1929, during the twenties and early thirties Sant Adrià developed various industrial businesses, such as chemicals, textile, metallurgy, construction, glass, and many more.

Barcelona's newly built city metro (Ferrocarril Metropolità) and events such as the 1929 Barcelona International Exposition, as the second global fair to be held in Barcelona, raised attractiveness and pulled gradually stronger streams of immigration towards the area, which sold as the more inexpensive choice over Barcelona, although it was still not very far from the metropolis (Casas and Márquez, 1996). During this first third of the century Sant Adrià experienced the most important growth (in relative terms), of all its modern and contemporary history, since there had never before been a number that large of families being founded and new citizens being born in Sant Adrià. The blooming of Sant Adrià's population created several neighborhoods around the power plant sites, such as La Catalana or Sant Joan Baptista (GENCAT, 2017), the latter being the one where the Tres Xemeneies are located.

*Sant Adrià had stopped being the predominantly agricultural town that it used to be during the first decade of the twentieth century, when secondary sector workers accounted for only 2 to 4% of the active population, including merely a few blacksmiths, (car) workshops and the like. In 1936, only 10% of the population devoted themselves to agriculture, farmlands receded and the share of people employed in manufacturing reached almost 60% in the same year (Casas and Márquez, 1996).*



Fig. 21. Central EEC Sant Adrià (1928)

Due to the impact of working class immigration and the conflicts that arose from its integration into a highly structured, rigidly disciplined industrial environment, a libertarian movement came up in form of the National Labor Confederation (CNT Sant Adrià), but also through the cultural formation of militants and anarchist supporters. With the legalization of the union in 1936, the CNT became part of the municipal government, opening a period of collectivization of various companies and establishments in Sant Adrià, and which meant the abolition of private business ownership, collectivizations and the self-management of committees chosen directly by the workers.

Just before the arrival of the fascist troops in Sant Adrià at the end of the 1930s, the annihilation of all trade union activity and libertarian ideology, and especially the beginning of a harsh repression of all attempts to rebuild workers' organizations, forcing them to operate in the shadows (Andreassi, 1996). During the civil war ("Guerra Civil Española") in Spain, both power plants had become military targets, with its four, about 60 meters tall chimneys, acting as reference point for Italian aviation, which supported Franco's Nationalist forces, to carry out terrible bombings over the site during the war, in order to overthrow the Second Spanish Republic. Several people died in bombings that fell over the power plant. Recently, some authors have stated that in 1939, when the republican troops had to start the retreat, the Sant Adrià thermal power plant was expressly blown up due to its undoubted strategic value due to the republican war effort (Alayo and Manubens, 2007).



Fig. 22. Agriculture fields before the construction of the now existing thermal power plant.



Fig. 23. Central EEC Sant Adrià (1928)

## Industrial Sant Adrià under Nationalist dictatorship

With the end of the civil war, the nationalists ruled as a dictatorship over Spain from 1939 to 1975. The entry into the International Monetary Fund (IMF), the World Bank (1958), the Economic Stabilization Plan (1959) and entry into the United Nations (1955) fostered strong economic growth, and meant for Sant Adrià the preservation and further generation of industrial employment and persistent migration towards the area. The once so agriculturally dominated region had seen the primary sector vanish to just 5.38% of farming population in 1950, and further down to 1.1% in 1975 when industrialization reached its peak with nearly 14,000 workers and agriculture in the region. The site had experienced major modernization efforts throughout the sixties, the coal-fired power plants were replaced by new thermal plants that would produce less CO2 emissions, and supposedly: less air pollution.

The Sant Adrià thermal power plant, built between 1971 and 1976 on behalf of FECSA-ENDESA and which is known for its three marking chimneys, would be until this very day the highest construction of the Greater Barcelona area. The construction works on this new plant were carried out in the midst of various controversies, since FECSA began the works without municipal permission and despite the opposition of the town councils and neighborhood associations of Badalona and Sant Adrià de Besòs, which rejected a new source of pollution in the area (La Vanguardia Española, 1971). During the period of construction about one thousand seven hundred people worked at the site (Endesa Foundation, 1977).

The foundations of the chimneys consist of 40-meter-deep pylons, built using the slip formwork technique, by which concrete is poured into a continuously moving form. For the sake of coping with the lack of available space, the plant has its chimney placed right



Fig. 24. Construction of the chimneys (1971)

on top of a boiler, that was suspended from beams located 90 meters high at the top, in order to facilitate the expansions and contractions of the temperature changes they experienced between start-up and shut-down. The great height of the three chimneys, about 200 meters, was determined by the need to comply with the new environmental regulations of the time. The combination of these factors: grouping of 3 identical elements, great height and chimney on the boiler, endowed the set with a great singularity unique in all the Spanish state and very infrequent all over the world.

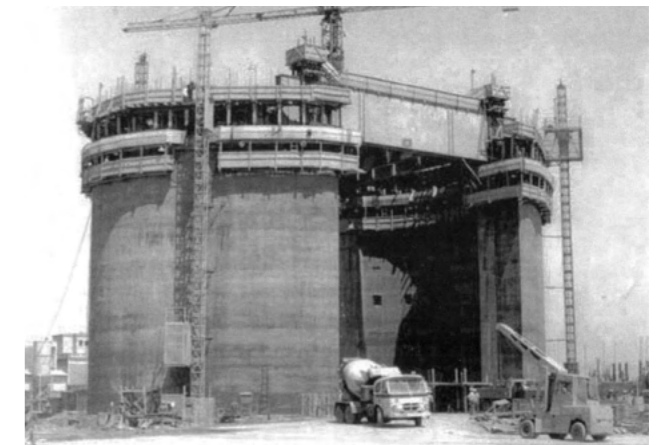


Fig. 25. Construction of the power station with the formwork system sliding the (1971)

## Sant Adrià in a post-oil era (1975-2011)

From the eighties onwards, the gradual decline of industrial activity in Sant Adrià began, while the tertiarization of its economy was accentuated. The ravages of the 1973 oil crisis and the early relocations of companies to more competitive countries forced many industries to shut down, so that by the early eighties the dominance of the service sector (51%) already exceeded the industrial sector (48%) (Vancells Roldós, 2017).

The late effects of the oil crisis in Spain led to an increase in investment effort targeting nuclear energy, with the aim of achieving less dependence on the thermal power plants, which most all operations relied upon. In the mid-1980s, with the Catalan nuclear power plants already in service (in 1985 they already accounted for 60% of the total gross energy produced). During these same years, for economic reasons and air pollution (Tejedor, 1979), several generators around the station were adapted to run on natural gas and further efforts to replace the thermal power plant around the Three Chimneys as well.

Since 2000, there have been several episodes of air pollution known as "black rain" caused by iron particles from the combustion of fuel oil. The Ombudsman of Badalona collected more than a thousand complaints from affected citizens, who unsuccessfully demanded compensation for damage to the roofing clothes and car bodies (La Vanguardia Española, 2002).

It was then when Sant Adrià experienced a series of events driven by the local population with the goal to preserve the Three Chimneys from their disappearance. The "Women of the Future", a feminist organization found in 1995 with the goal to preserve the town's signs of identity, had already managed that the municipal council of Sant Adrià de Besòs had declared several other sights as protected. On September 8, 2001, as

part of the traditional sale of cakes that the group organized to coincide with the Festa Major de Sant Adrià, a watercolor of the Three Chimneys was publicly presented, accompanied by a writing that could not have made the people's opinion on the future of the Three Chimneys any clearer:

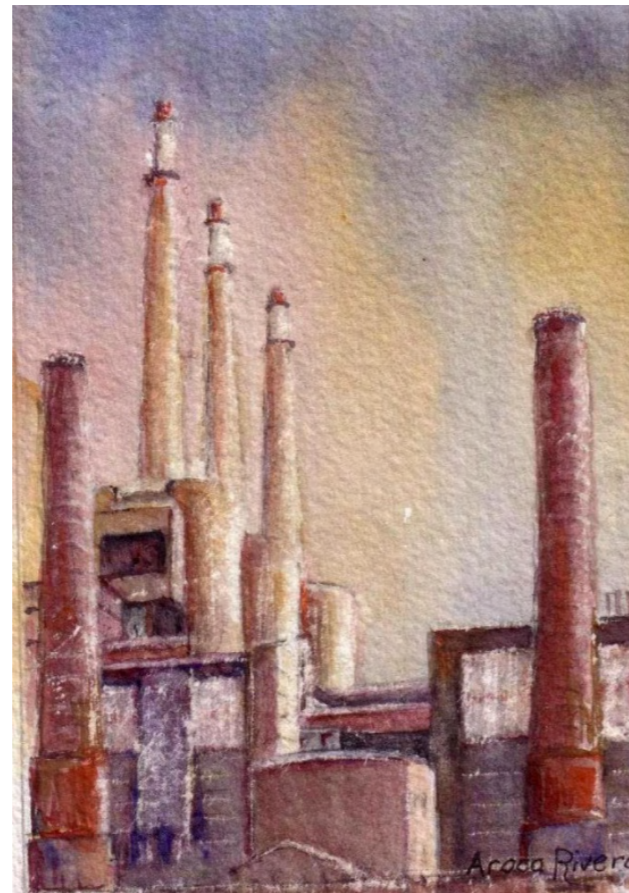


Fig.26. Watercolor by Consol Aroca Rivera (2001)

Signatures in favor of the conservation of the chimneys of the thermal power plant were collected, which the group presented at the Exhibition of Associations held in October of the same year with the request to name the Three Chimneys, Sign of Identity of Sant Adrià. Just one year later, on September 30th, 2002, the full council of Sant Adrià adopted the agreement to initiate a new file for the declaration as cultural assets of local interest the Three Chimneys of Endesa. Following the administrative procedure, the agreement was submitted to public information, opening a period for possible allegations, which Endesa Generación S.A. raised in objection against cataloging the Three Chimneys as a symbol of identity with a series of reports and until the end of 2003. The matter developed to be an ongoing struggle between the aforementioned party on the one hand side, and the Sant Adrià City Council that had commissioned a report from the Museum of Science and Technology of Catalonia to study the site's value earlier on, in 2003 on the other. In response to the allegations presented by Endesa, and more specifically, in response to the non-existence of cultural or landscape values of the Three Chimneys, the group Women of the Future presented a letter to the city council just before closing the year 2003 that is available in the Municipal Archive of Sant Adrià de Besòs today, and in which it answered to the electrical company (Vancells Roldós, 2017):

*"Now it seems that Endesa does not find any value, neither cultural nor landscape, so: Messrs. of Endesa, come by land, sea or air, from afar, far you see the three chimneys, and the first thing you say is: 'Look, Sant Adrià!'. You teach young children, 'you see that, those three chimneys, that's Sant Adrià.' You go up to Montjuïc and look for them and you get frustrated if the day is too foggy and you don't see them. Fun fact: the three chimneys*

*are just the same height as the mountain of Montjuïc, 191 m. And even more: The adrianians love them, as a claim to what this town was for many years, eminently industrial and in the same way that we fought for the Arc to be named a Sign of Identity, the metro station was called Sant Adrià or the coat of arms of Can Rigalt return to its place, in the same way we will fight to see these three chimneys, named Sign of Identity of Sant Adrià, and that Eolo, Neptú, and Endesa keep them for us "* (free translation).

In 2007 the platform for the conservation of the 3 chimneys of Sant Adrià de Besòs was founded to address the challenges that a closed power plant of such size would pose in the future (Plataforma Tres Xemeneies, 2007). Just in a year of progress, the platform gained the support of sixty cultural and social associations and entities; organized throughout 2007 and early 2008 a series of activities and events to disseminate the industrial heritage and the importance that the conservation of the Three Chimneys had for the very identity of Sant Adrià; and collected enough signatures to persuade the city council to convene a public consultation on the conservation or demolition of the plant. These events were attended by the Association of the Museum of Science and Technology and Industrial Archeology of Catalonia (AMCTAIC), which made clear to the city council, that there is a definite need to generate a compatible project for the future of the Three Chimneys, in order to navigate the transformation of the coastal area with the preservation of the most singular elements that identify the territory, the people and their history.

While the Sant Adrià thermal power plant was gradually taken down from the network to only generate energy when there was a rise in demand, the city council would conduct a series of two debates under the title "Let's talk about the three chimneys", held from 13th to 29th March 2007 and from 13th to 22th October in 2008, with the intention of encouraging the participation of both citizens and specialists in subjects such as urban planning, landscape and anthropology. Finally, the role to be played by the power plant within the collective identity of Sant Adrià de Besòs was put to the vote in November 2008, with 82.2% of the votes in favor of maintaining the three chimneys.



Fig.27. Cover of the information leaflet that the Sant Adrià city council published on the occasion of the Popular Consultation of the Three Chimneys, with its words in translation: "Do you think that the three chimneys should be preserved and reused without conditioning the municipal budget or the spaces for future facilities?". Source: Sant Adrià de Besòs City Council, Citizen Consultations ("Consulta ciutadana"), Consultation Material.

On March 14th, 2015, the Platform for the Conservation of the 3 Chimneys of Sant Adrià de Besòs organized a new day of debate at the Adriatic Athenaeum with the participation of a wide range of social agents involved. The day concluded with three priority points: the need to draft a new plan of non-degrading uses for the three chimneys, the greater involvement of supra-municipal organs and the rethinking of the seafront as a large space freed from the construction sector. The following summer, the Platform delivered 590 signatures in support of the BCIL statement.

Finally and without any allegations, on September 26, 2016 the city of Sant Adrià de Besòs cataloged the thermal power plant around the Chimneys as Good Cultural of Local Interest (BCIL). The report points out the historical value of the power station as a testimony to the energy production history of Catalonia, and for its social impact on the contemporary history of Sant Adrià de Besòs, particularly as a factor in attracting the immigration of skilled workers and their families. For this reason, the Three Chimneys have also been included in the Map of the Industrial Heritage of Catalonia drawn up by the Museum of Science and Technology of Catalonia. Secondly, the reports emphasize its architectural value, given its structurally unique construction. After the old thermal power plant has surprisingly been ceded to the municipality of Sant Adrià "free of charge", the Besòs Consortium, which is composed of the municipalities of Barcelona, Badalona, Montcada and Reixac, Santa Coloma de Gramenet and Sant Adrià, is currently in a clinch with Endesa as to who should carry the maintenance costs. Up until this date, there is no official response to the proposed transfer of the Three Chimneys, which are still in the hands of legal services.

## Sant Adrià today: Still a great opportunity but for something different?



Fig.28. View of the remainings of Sand Adria de Besos power thermal station in Barcelona.

In late summer of 2020, the Plan Director Urbanístico (PDU), i.e. an urban master plan of the three chimneys sector was approved, which reflects the will to transform both the building itself and the immediate surroundings, which has been the subject of debate for years by the town councils of Sant Adrià, Badalona and Barcelona, as well as neighborhood platforms such as "Salvem les Tres Xemeneies", in order to promote the sector as a new metropolitan area (Estévez, 2020). The commission, in this case, will be based on the expansion of the Museum of Contemporary Art in Barcelona (Xicola Pachón, 2020). Finally, and after more than a hundred years of industrial domination, it was the people of Sant Adrià de Besòs who won the Three Chimneys as a Cultural Asset of Local Interest, and thus paved the way for the site to become a memory of their liberation from its nearest heavy industrial past and but also icon of Barcelona's metropolitan nature and sustainability.



Fig.29. View of Sand Adria de Besos power thermal station in Barcelona.

## DESIGN STRATEGY

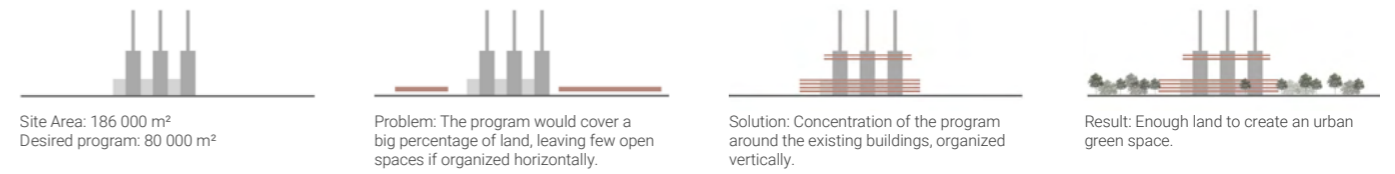


Fig. 30. Strategy master plan: Green corridors, seashore promenade, urban park, leisure, commercial and educational.



# Theoretical Objectives

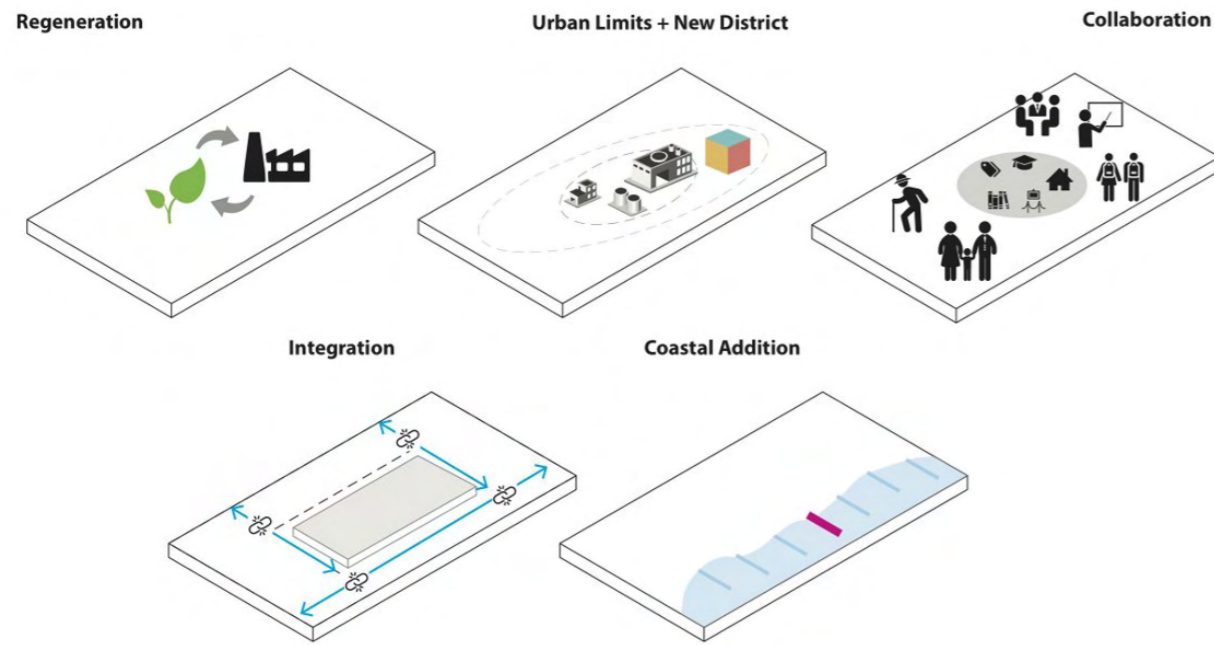


Fig. 31. Theoretical objectives diagram based on the analysis done on the site.

# Design Manifestation

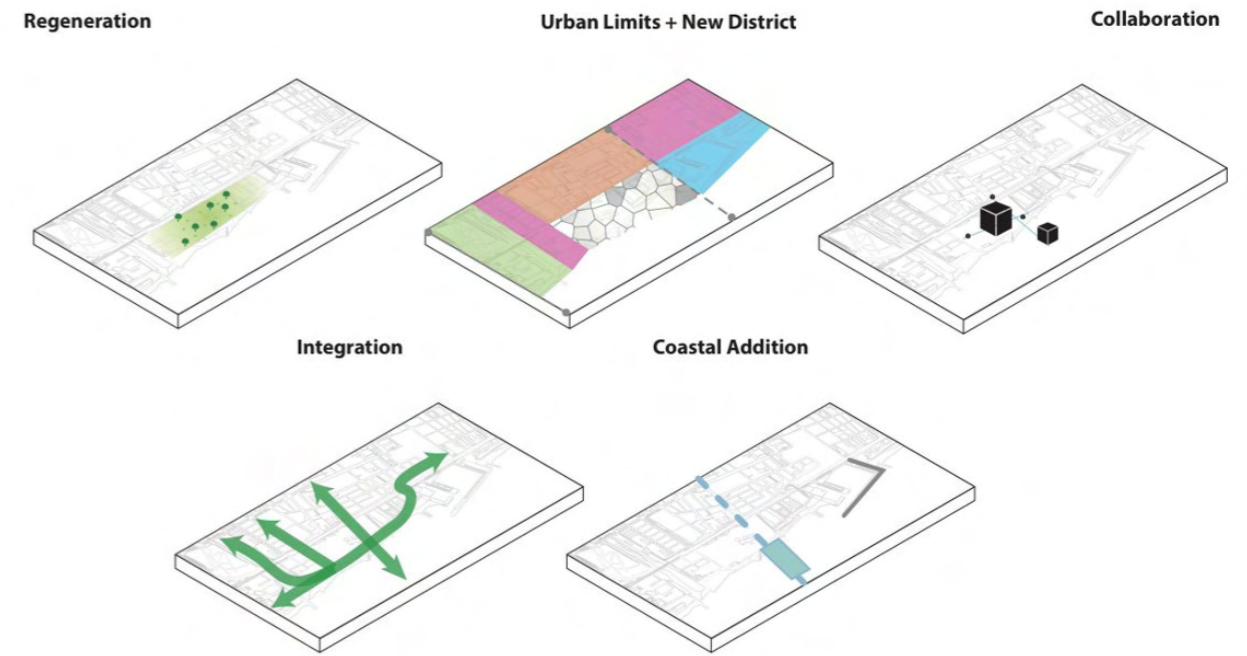


Fig. 32. Design manifestation diagrams - ways to apply the objectives

## Proposed Master Plan

The geometry follows the site's strong orientation that is made by the limit axis between the two municipalities of Sant Adrià de Besòs and Badalona, and also the existing three chimneys and the turbine room. Three important focus points are: to improve the accessibility to and from the site, to ensure the continuity of the promenade from Barcelona to Badalona, and to transform the maximum area of the site into a public urban green space.

Around the chimneys gather three rectangular shaped buildings. The students housing and the social housing are connected to the turbine room slabs by their common floors, and the building on the east side is for the visitors. The circular library serves an orientation element on the entrance of the project. Since Barcelona is the city of uniqueness and attractions, and to help the tourism sector in Sant Adria de Besòs, a hotel is placed in the upper rooms of the chimneys, connected with a bridge that once existed, looking over all Barcelona's mountains and beaches. The municipality's limit continues toward the sea, forming a pier and a platform that hosts the sea university campus that fortifies the direct relation with the water.

The architecture is concentrated around the chimneys to free the rest of the site to regenerate. First step is to leave it free of constructions, next step is to have a decontamination plan that makes this site suitable for residents and visitors. Last step is to use permeable materials for the landscape.



SCALE: 1:5000

Fig. 33. Master Plan Thesis Proposal - Sustainable Urban Design

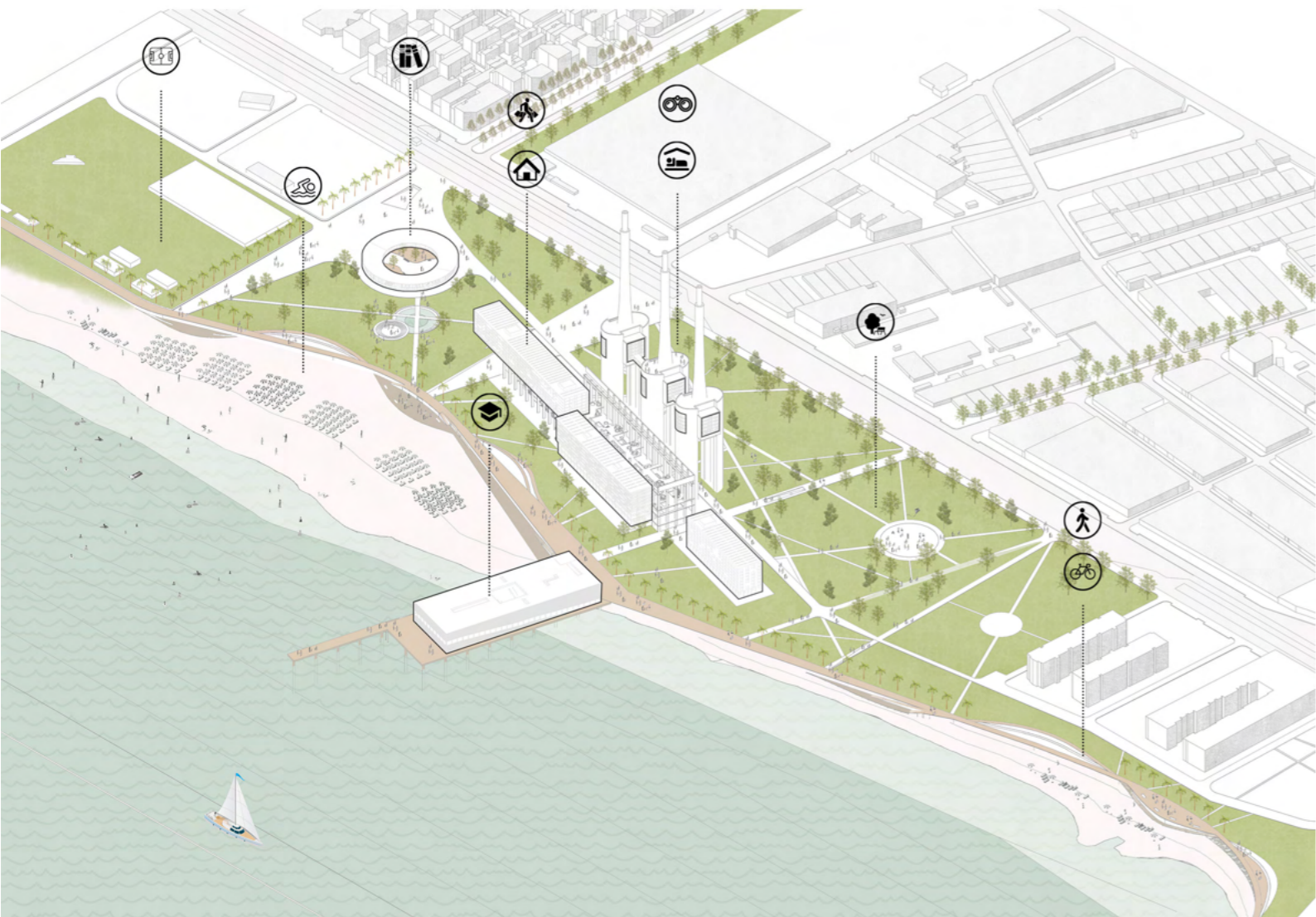


Fig. 34. Master plan thesis proposal - Program distribution



Before: The Rocks along the sea side are limiting the usage of the place by visitors. Also facing the risk that the polluted landfill is washed out into the sea.



Now: The new edge element is made of the rocks existing in the site helps create more space on the beach for recreational use. With the new beach park, the beach has been expanded, so that the sand area stretches along the entire coastline and it can now accommodate more beach goers.



Future: The new Clima-adapted profile is securing the territory against higher sea level.

Fig. 35. Master plan thesis proposal - Site section

## Rehabilitation of the Site

### Regeneration of the soil

The pollution generated by this concrete giant punished the neighbors around it for several decades. Such a serious impact that it led to the declaration of Sant Adrià as a "contaminated atmospheric zone" in 1983. The power plant consumed half of all the fuel oil in the province and that chimneys then emitted 57,000 tons of sulfur dioxide.

The power plant has stopped working years ago, but it left behind a serious soil contamination. The draft of the Urban Master Plan (PDU) recognizes that, before colonizing the extinct industrial zone, the waste must be removed and certify that the lots are in a position to build a neighborhood without involving risk from toxic waste. "The implementation of non-industrial uses requires ensuring adequate decontamination of the soil" to qualify for "residential uses", conditions.

the PDU indicates that the plot is declared contaminated: it was cleaned in case another factory was installed but it was not considered that houses would be raised, which forces to clean up more deeply.

Solution 1: (for minor pollution)  
 Step 1: Extract 1m of the surface  
 Step 2: Addition of 0.5m of gravel  
 Step 3: Cover of 0.5m of good and healthy soil

Solution 2: Bioremediation

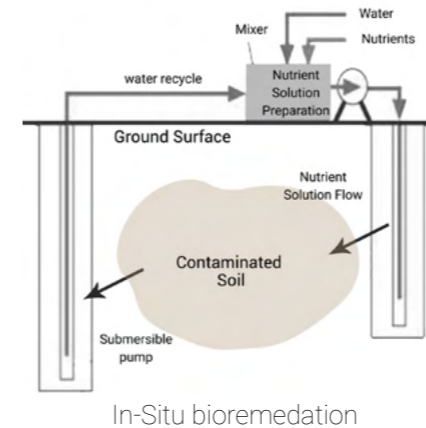
Bioremediation is one of the most economic remedial techniques presently available for treating most organic fuel based contaminants and it employed in order to transform toxic heavy metals into a less harmful state using microbes or its enzymes to clean-up polluted environment.



In-situ bioremediation of soil: 1 to 4 years  
 • Allows treatment of a large volume of soil at once.  
 • Mostly effective at sites with sandy soils.

Methods:

- \* Bioventing
- \* Injection of hydrogen peroxide or oxygen releasing compound (ORC) for aerobic treatment
- \* Injection of HRC for anaerobic treatment.



Ex-situ bioremediation of soil: 4 to 6 months  
 • Involves excavation of the contaminated soil and treating in a treatment plant located on the site or away from the site.  
 • This approach can be faster, easier to control, and used to treat a wide range of contaminants and soil types.

Methods:

- \* Slurry-phase bioremediation
- \* Solid-phase bioremediation

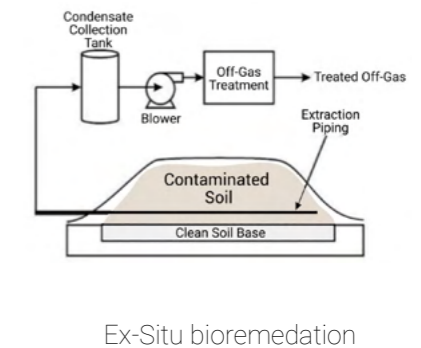


Fig. 36. Mapping of soil contamination, and proposals of bioremediation systems.

## Proposed Vegetations

Based on the native/existing species, the following are the trees and bushes that are suggested for the park. Along with the local species, the park would connect Barcelona with Badalona by connecting their palm vegetation lines along the seashore promenade.



1-Dominant trees (15-20m):  
 phoenix dactylifera  
 Quercus ilex  
 Eucaliptus



2-Stump trees (h<10m):  
 Acer campestre  
 Carpinus Betulus  
 Ilex Aquifolium  
 Olea europaea  
 Tamarix gallica  
 Pistacialentiscus  
 Schinus molle  
 Laurusnobilis



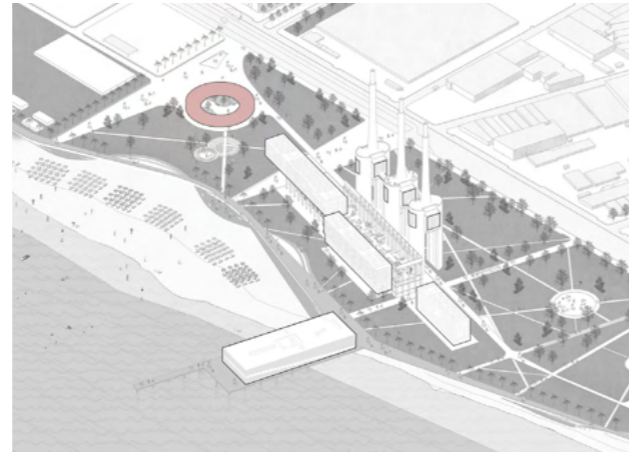
3-Shrubs:  
 arbutus unedo  
 Viburnumopulus  
 Nerinumoleander  
 Pittosporumtobira  
 Lagerstroemia indica

## PROJECT DESIGN

Fig. 37. Chosen collection of native and existing species in Barcelona

## Library and Documentation Center (specialized in Nautical)

The library and documentation center specialized in nautical, sets on the main entrance of the project. Its circular form helps guide the sense of orientation. It is located between the campus and the neighbouring residential area which makes the project more inviting. The circular library have 360 degrees view with main facilities oriented towards the chimneys and get indirect sun for a more comfortable reading embience. Lifted from the ground to keep the space for the soil to breathe, therefore it has minor impact on the landscape. To help reduce the carbon footprint, the structure is wooden with glass all around creating a private outdoor central space.

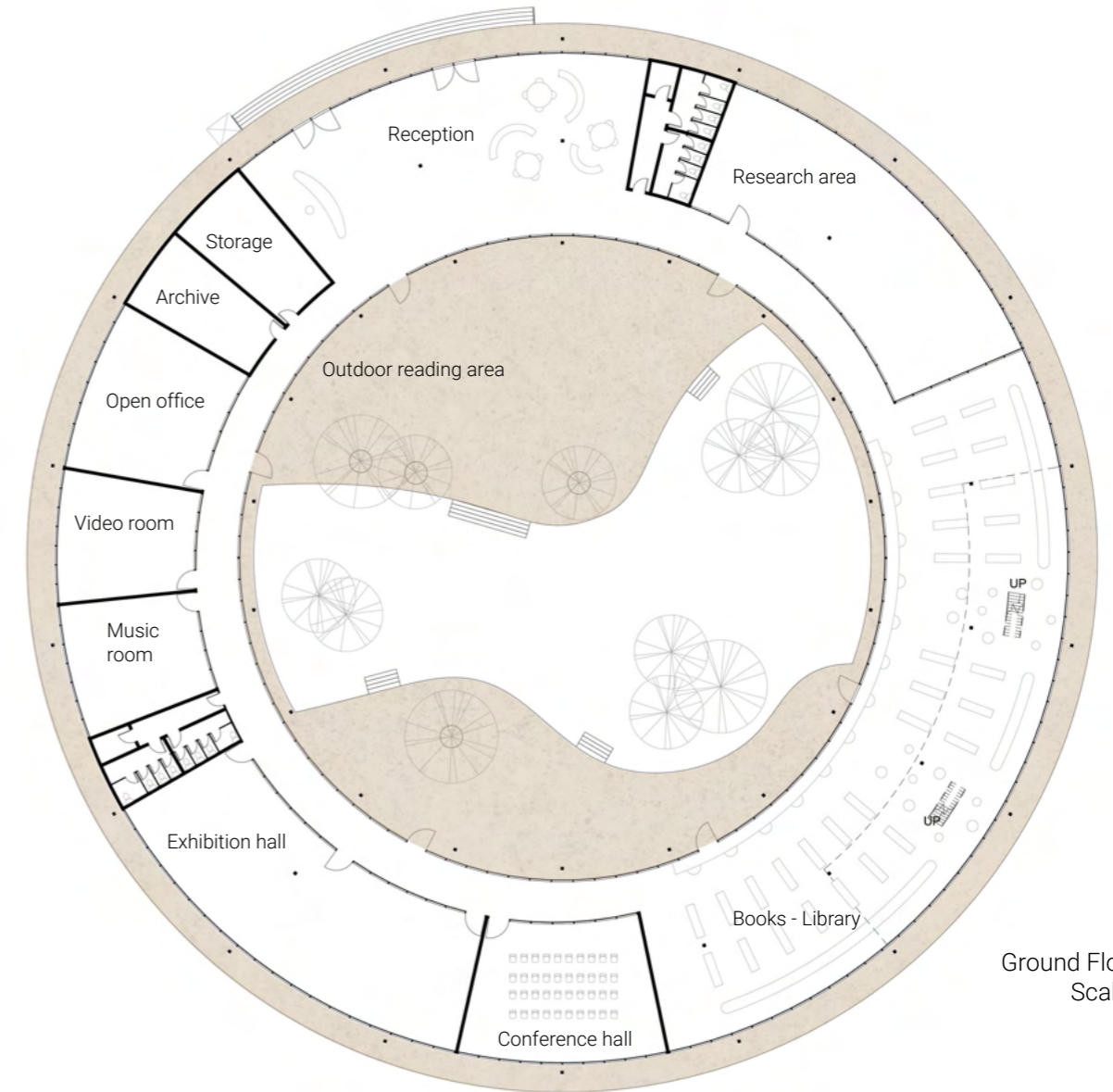


Section  
Scale 1:500



Elevation  
Scale 1:500

Fig. 38. Location of the library, section and facade.



Ground Floor Plan  
Scale 1:500



Fig. 39. Plan and Perspective section of the Library..

## Students Residence

The students residence building takes advantage of the existing turbine room as an extension for the common spaces. The Building has commercial stores in the first two floors for an easier and a more sustainable lifestyle for students. The long side of the building is facing the beach, slightly rotated to match the site's orientation. On the long side are the rooms to get the best of the view and sunlight. On the northern part are the common rooms and services. The building has two vertical connections of elevators and emergency escapes. To help reduce the carbon footprint, the building is covered with a green roof and an area of 3000 m<sup>2</sup> of solar panels. The structure is wooden and modular for a more flexible and sustainable future.

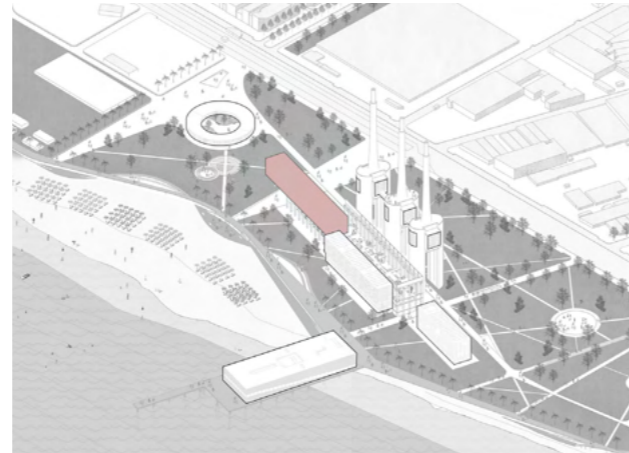


Fig. 40. Location of the Students housing building - 3D presentation of moments of the facade.

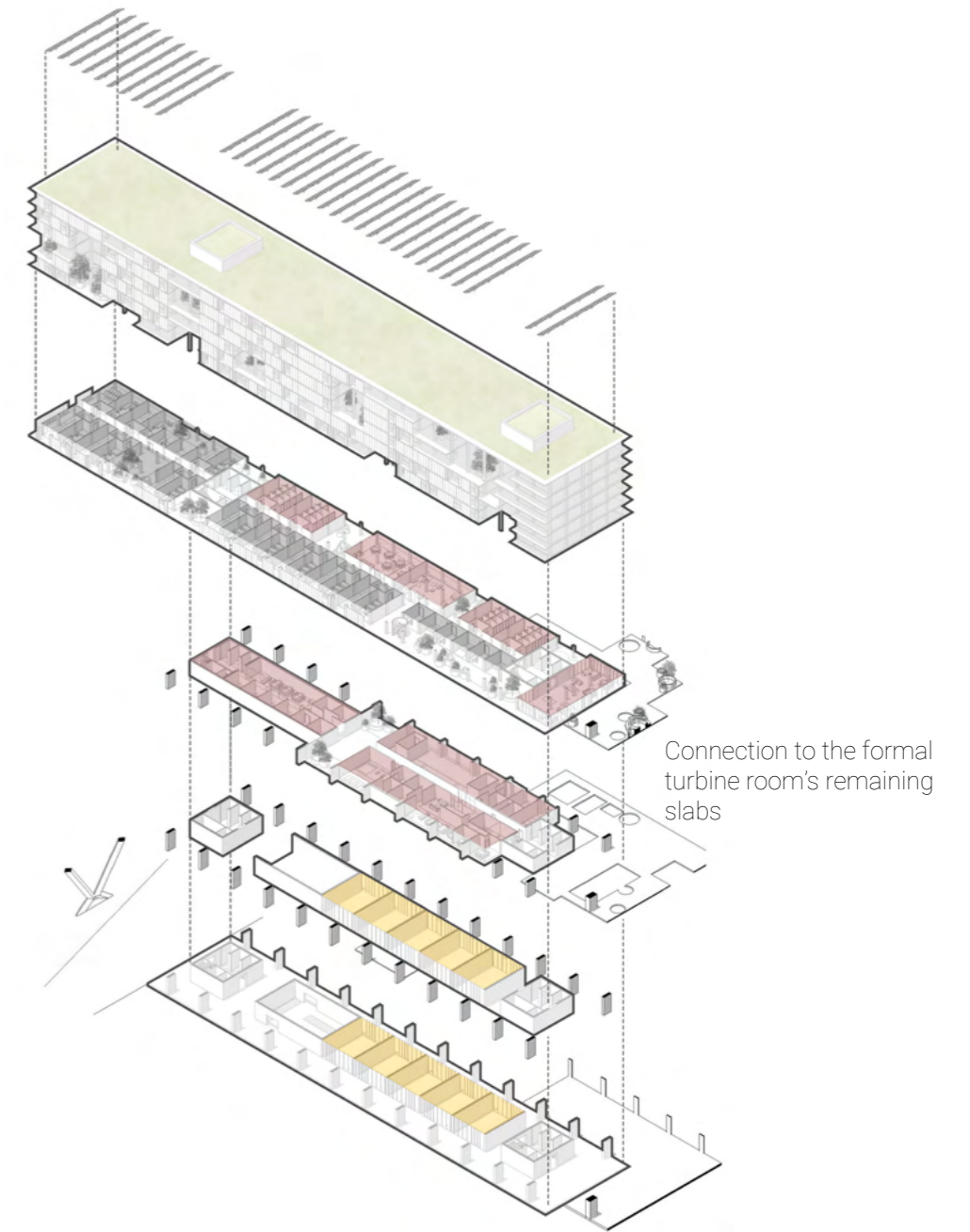


Fig. 41. Exploded architecture diagram of the residential building.

The ground floor and first floor consist of the commercial part of the project that includes:

- A canteen
- Private shops and services (spread, retail, commercial, gastronomic, etc)
- Bike storage.

Between the commercial and the residential, a common floor includes:

- Reception/administration
- Shared rooms: dining, TV, reading, study spaces, home gym, etc.
- Laundry
- General storage
- Technical installations

The typical floor organization is changing from a floor to another, that gives a dynamicity in the facade but the content is the same:

- 70 Single bedrooms
- 140 Double bedrooms
- 1 Kitchen and eating area for every 15 rooms
- 1 Gathering room
- 1 Lounge connected to the turbine slabs

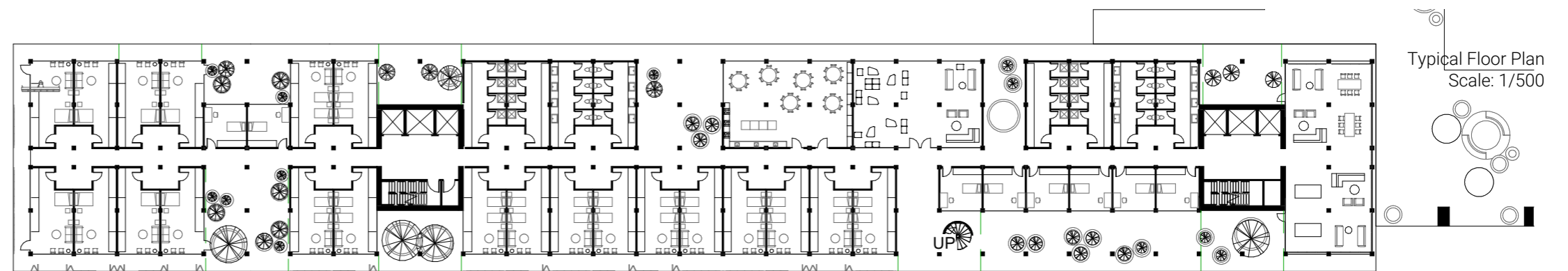
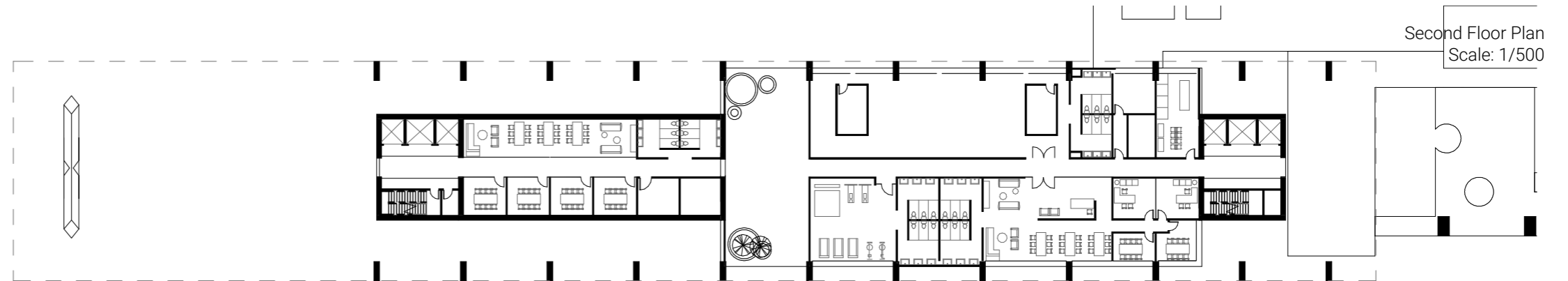
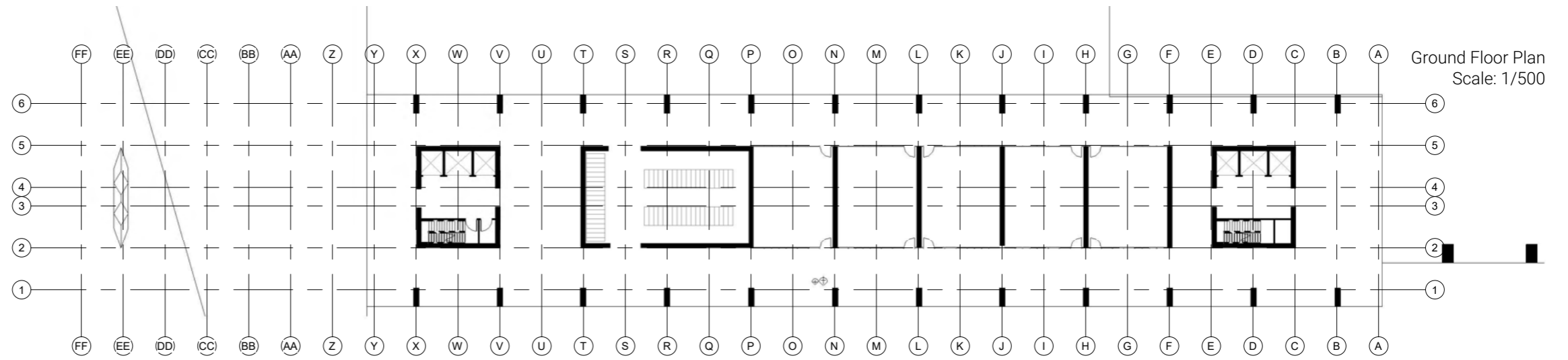
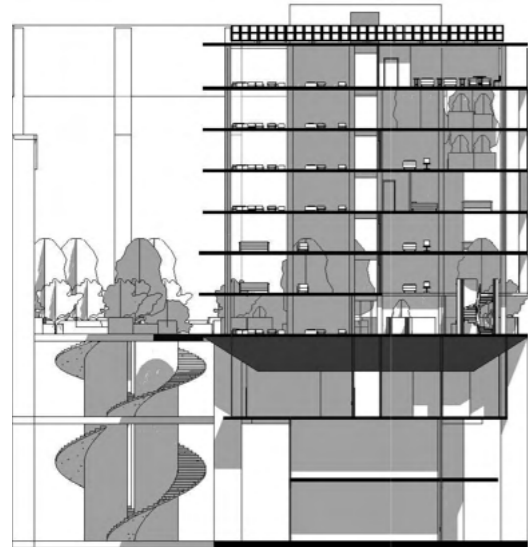


Fig. 42. Architectural plans and section of the students housing building.



## Social Housing

The program includes social housing to avoid gentrification of the area. The housing area acts as a connector between the surrounding neighbourhoods, attracting people from outside.

Its permeable ground floor grants an easy cross-through movements of visitors and also it reduces the impact on the soil.

The building acts as a second skin for the existing turbine room, having the houses on the beach side and the shared rooms on the opposite side that extend to reach the platforms from the 3rd floor. The green roof has 2000 m<sup>2</sup> of solar panels to generate the most of the energy consumption of the building. The residential area benefits from the beautiful view on the beach and the park.

For the shading, the facade is partially covered by the planters where the added plantation will cover even more areas. The slabs extend to the outside, creating a shading element in addition to the wooden vertical shaders that protects from the south western side.

The 10 stories building offers 18 shops for gastronomy, retail and other commercial uses in the first three floors. On the upper floors it contains:

30 apartments for 6 inhabitants

15 apartments for 4 inhabitants

15 apartments for 2 inhabitants

In addition, in the third and the seventh floor, a side of the plan accommodates shared rooms such as laundry, Library, TV room, gym and a multipurpose area.

The composition of the social housing and the visitors have the same concept of organization, therefore in this thesis the drawings show the social housing drawings only.

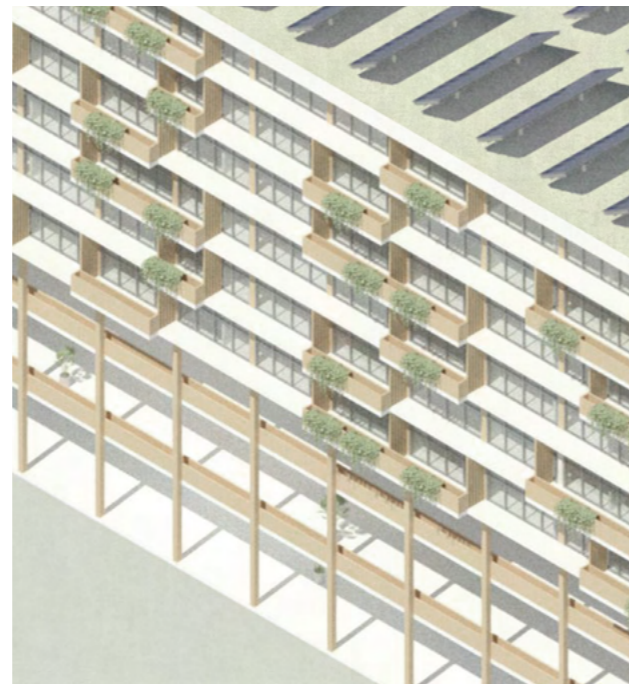
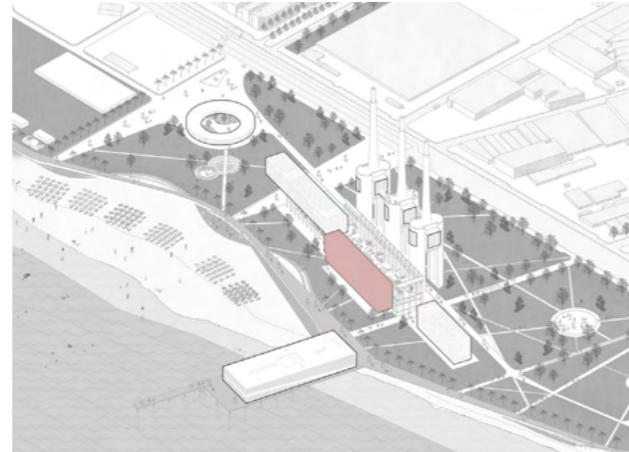


Fig. 43. S. Housing position-facade 3D representation

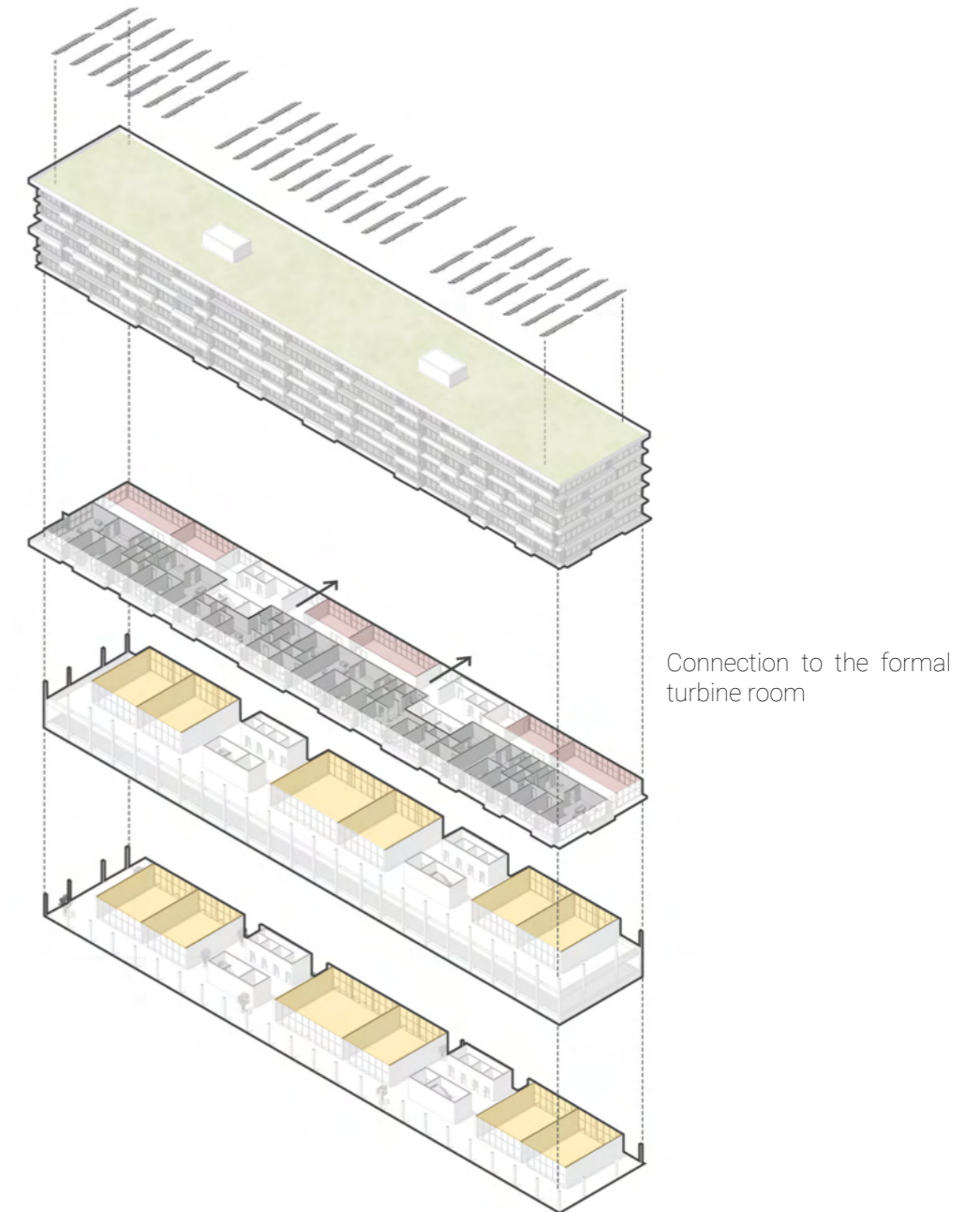
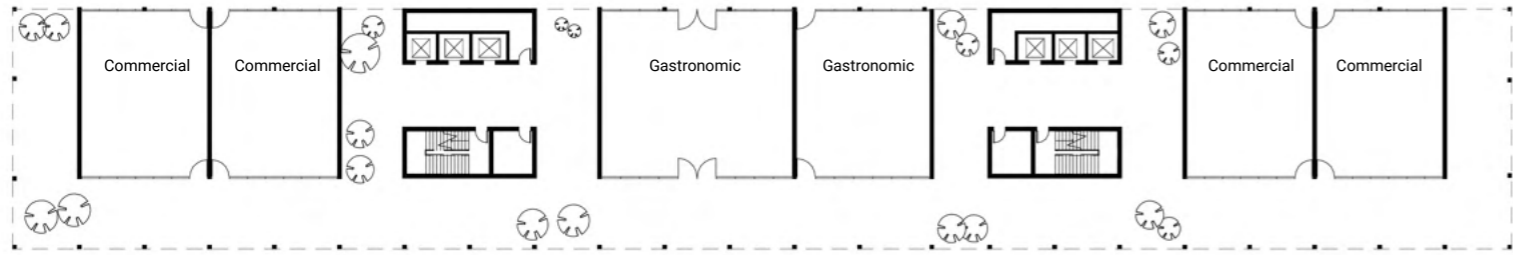


Fig. 44. Exploded architecture diagram of the social housing building.



Ground Floor Plan  
Scale: 1/500



Typical Floor Plan  
Scale: 1/500



South Elevation  
Scale: 1/500

Fig. 45. Architectural drawings of the social housing.



Fig. 46. 3D View from the common recreational slab, the social housing on the left, students housing on the right

# Hotel

About 70% of Barcelona's economy directly or indirectly is based upon tourism. But this sector is weak in Sant Adrià de Besòs due to the lack of attractions and the important presence of industrial activities. People have already a nostalgic feeling when it comes to the chimneys, so why not bringing people up there for an experience.

People of Barcelona and tourists seek for the best views of Barcelona from the top of the surrounding peaks to watch the sunset and the beautiful urban design that Barcelona has.

The thesis project proposes a hotel in the upper part of the chimneys, where they can enjoy the view, dine and spend a night looking over Barcelona and the beach.

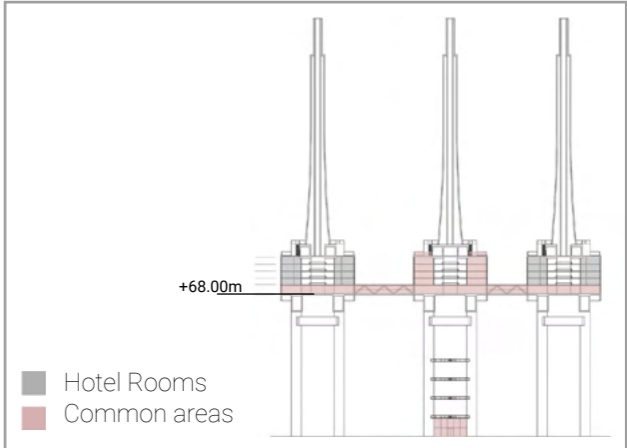
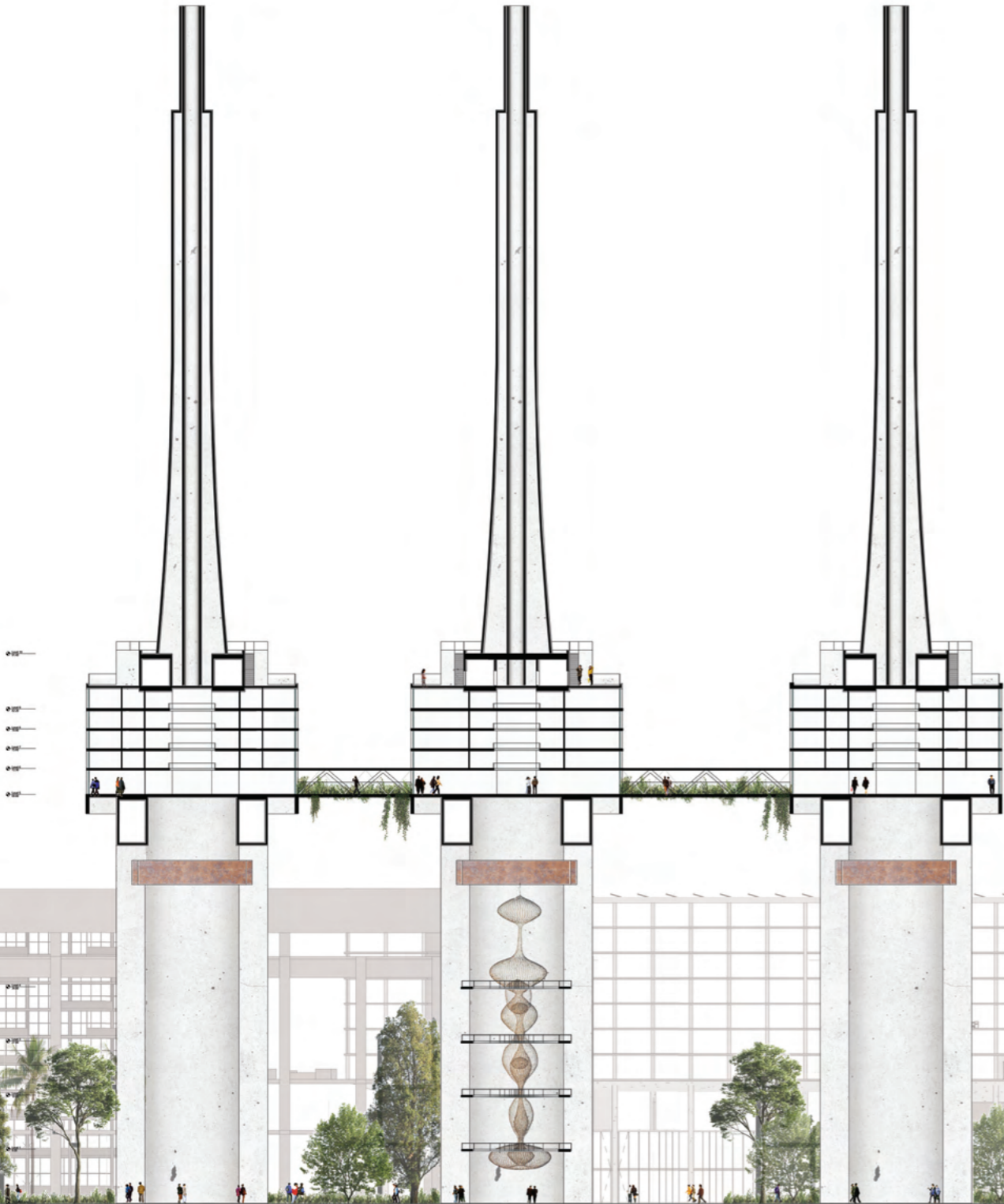
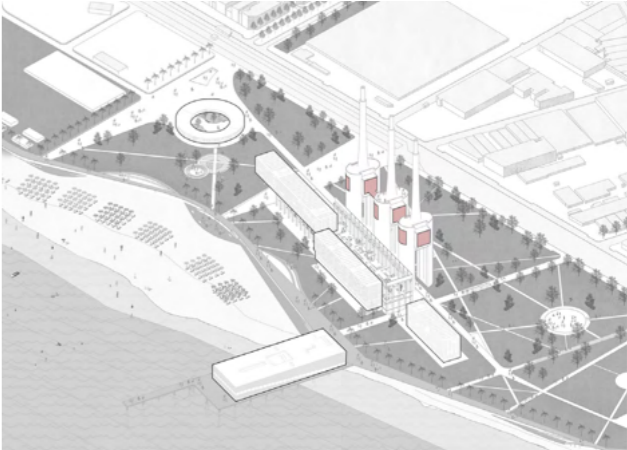
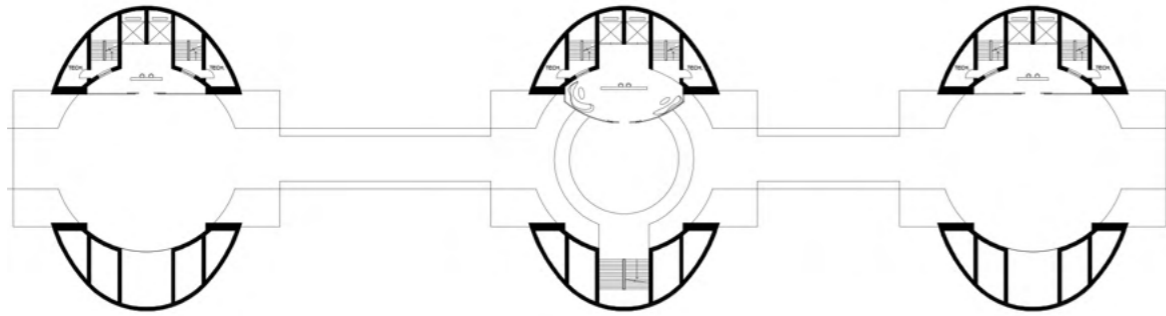


Fig. 47. Positioning of the hotel - Conceptual and architectural sections

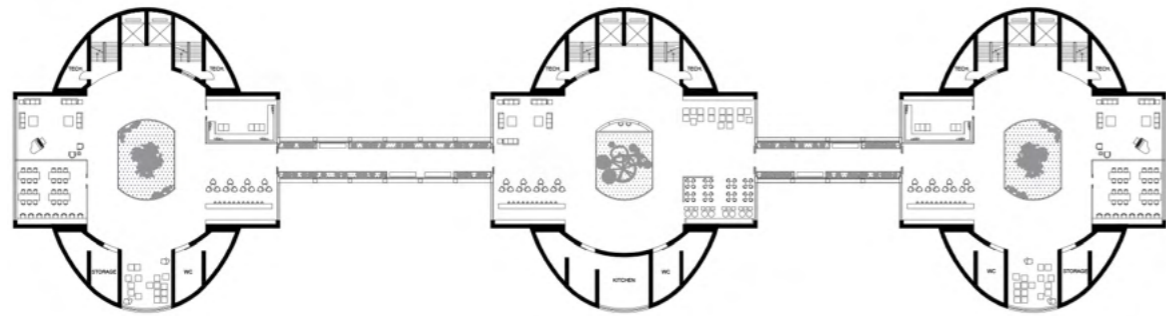
The ground floor has only a reception room to guide people up to the hotel where they will be welcomed. Each chimney has two emergency staircases and two elevators. The hotel is accessible from the central chimney.



Ground Floor Plan  
Scale: 1/1000

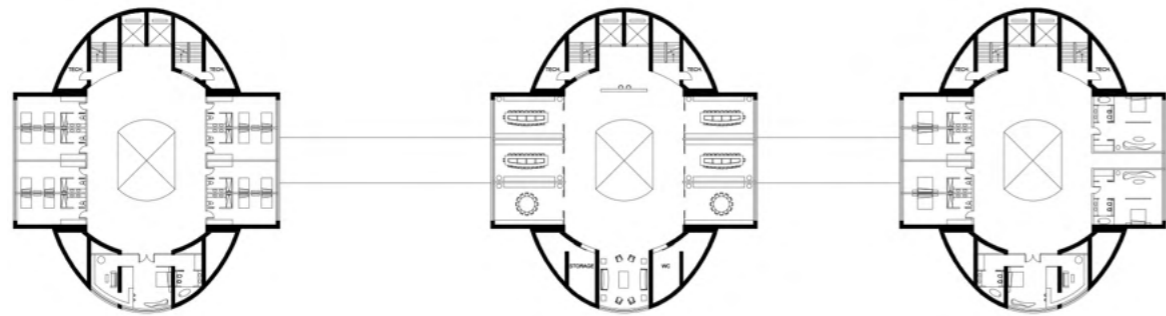
The first hotel floor and the whole central chimney have:

- Entrance hall
- Reception/administration
- Living rooms: TV, reading, study spaces.
- Home gym
- 6 Meeting rooms
- 3 Dining rooms
- Laundry
- Storage



Common Floor  
Scale: 1/1000

The two lateral chimneys have:  
32 double rooms  
24 single rooms  
8 suites  
And are connected with bridges on the common floor.



Typical Floor  
Scale: 1/1000

Fig. 48. Architectural drawings of hotel.



Fig. 49. 3D View from the main entrance of the project.

## Site Section

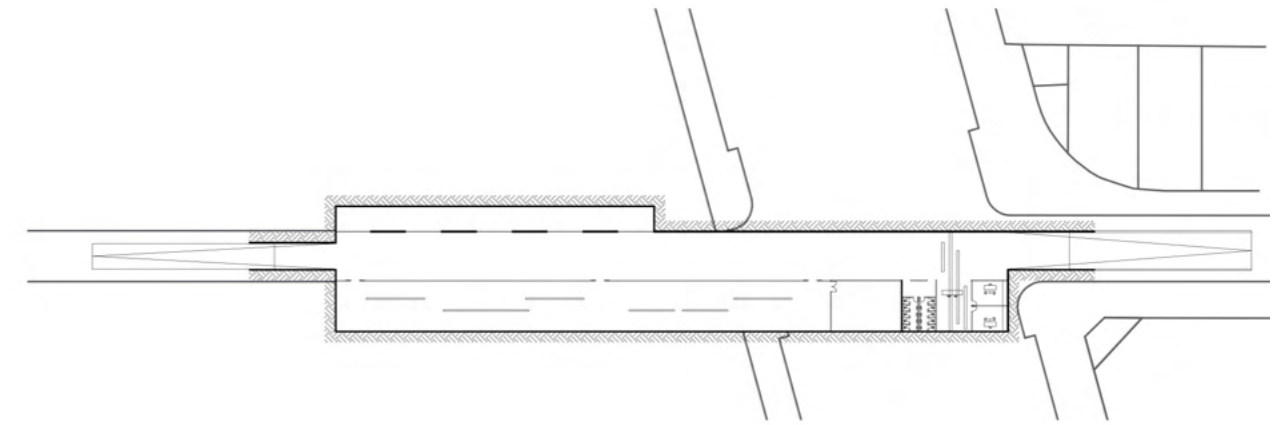
One of the issues that the site has is the accessibility. As a solution for the main axis entering the site, a crossing underground path is proposed where people can enjoy an exhibition/museum about the formal power plant, that gives a double function for the path. A ceiling with openings brings the light in for a safer feeling and permit people to perceive the chimneys even before reaching the site. After crossing underground, people walk besides the monumental chimneys and enjoy the park until they reach the pier. The dynamicity of the experience is rich in all dimensions.



The street section is improved in a way that gives every user its own space and leave a line for parking spaces around the site to avoid a big surface of land for cars.



Transversal Section  
Scale: 1/1500

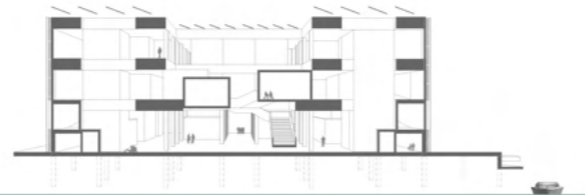
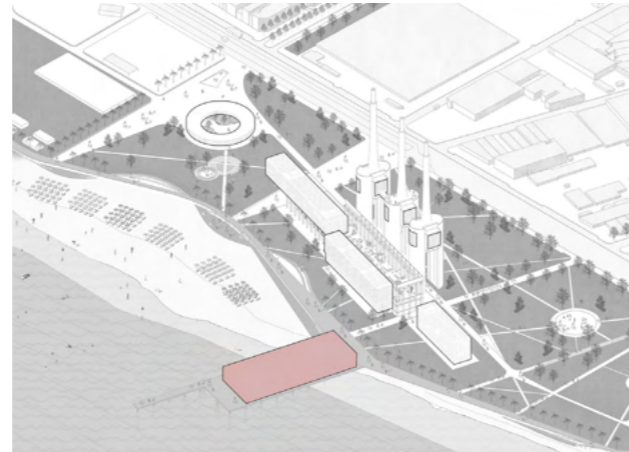


Underground Path/Museum Plan  
Scale: 1/1500

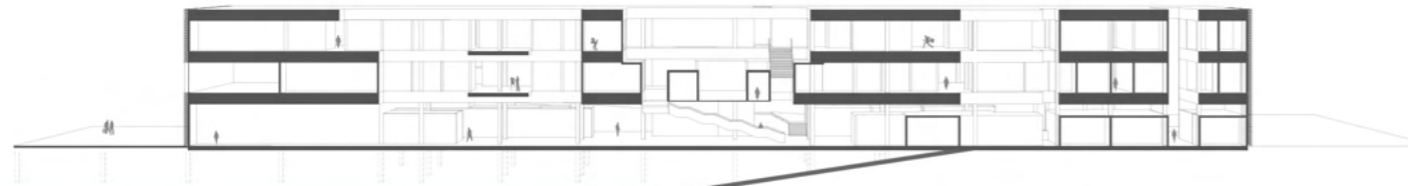
Fig. 50. Transversal site - details of the underground path.

## Sea-Related Education Facility

The busy activity of Barcelona port, in consonance with the worldwide growth of sea transport, asks for specifically trained workforces. Nowadays sea-related higher education is split in separated curricula and universities. The Sea Campus concentrate them in order to exploit their synergies. This educational building shares some commercial and recreational spaces with the other buildings. Built on water, the university extends its platform to create a public pier accessible to all users. As a sustainable approach, the roof is covered with solar panels to generate the maximum green energy possible. In addition, the facades are wrapped up with a mesh layer that permits the filtered light to get inside from all sides which reduces the energy consumption.



Transversal Section  
Scale: 1/1000



Longitudinal Section  
Scale: 1/1000

Fig. 51. Positioning key plan - Sections of the university.



Fig. 52. 3D View of the university and the pier.

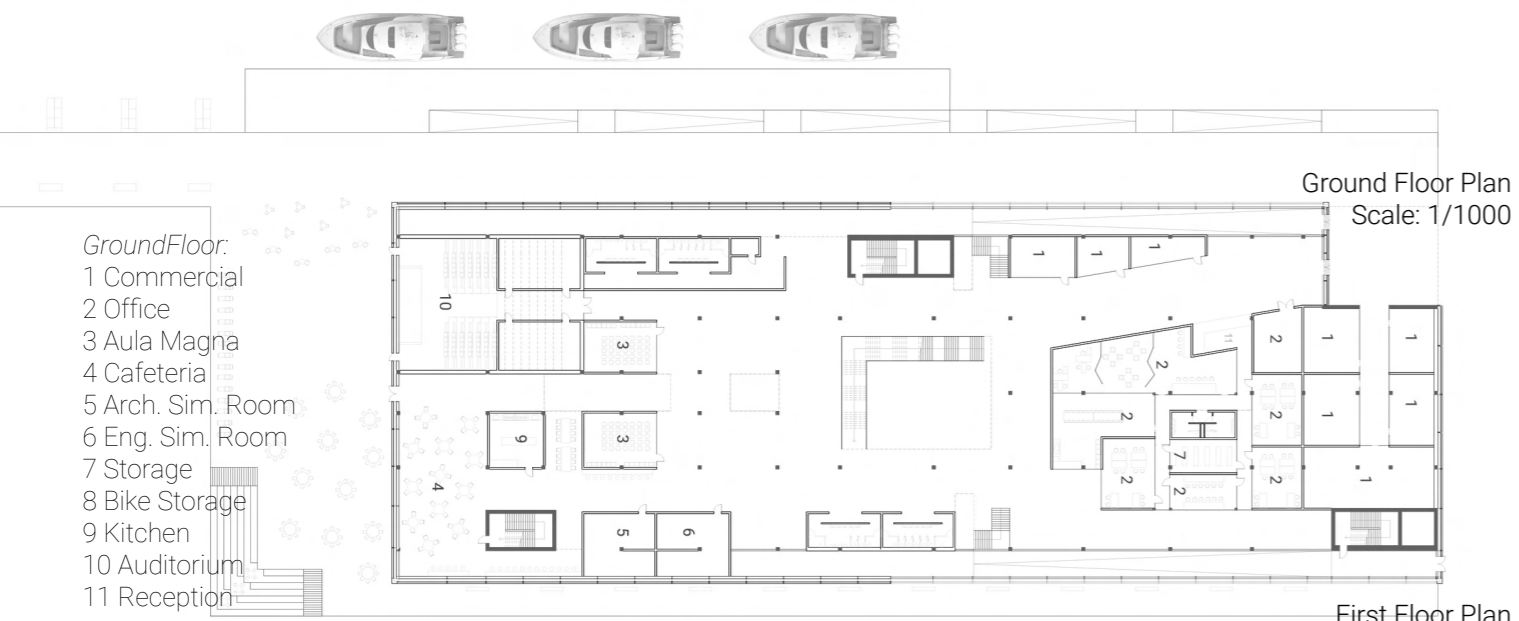


Fig. 53. Architectural drawings of the university building.



Fig. 54. View of the project from the sea.

## Vision

"Modern urban life style is associated with chronic stress, insufficient physical activity and exposure to anthropogenic environmental hazards. Urban green spaces can promote mental and physical health, and reduce morbidity and mortality in urban residents by providing psychological relaxation and stress alleviation, stimulating social cohesion, supporting physical activity, and reducing exposure to air pollutants, noise and excessive heat."

-World Health Organization

A former industrial region at the border of the El Besos ecological corridor calls for opportunity to interweave yet differentiate the site from the diverse identities that constitute Barcelona's character. A multi-disciplinary hub of nautical data, production, leisure, commercial and residential spaces works as a theoretical framework for envisioning the new district as a global port: a coastal re-development that ecologically and socially bonds with its surroundings inviting different user groups to live, work and play. The design re-qualifies the area from a physical, environmental, social and cultural point of view (requalification of: the built, the void and the relationship with the existing urban landscape).

The project is a result of a sustainable and resilient approach that is in every stage of the design. Starting by the decontamination of the soil, the reuse of the existing buildings, the usage of wood structure and solar panels, also by designing the buildings in a compacted way and with minimum footprint. As shown in the city analysis, people of Sant Adrià de Besò lack the access to green and recreational spaces. For that reason, the importance is given to create this urban green park on the beach, opening the city to the sea.

**PROTECTING OUR PLANET IS EVERYONE'S RESPONSABILITY**



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