Rio 2016: Sailing in the Post-Olympic Hangover
Design for a Marina and Sailing School for the 2016 Olympic Games in Rio de Janeiro

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Abstract

The two most common problems of projects for Olympic venues are that they either provide temporary infrastructures which have their use limited to the games, or they provide permanent infrastructures which are right for the competition, but have little or no use to the community outside the Olympic environment. The objective of this thesis is to investigate how the design for an Olympic venue can benefit and contribute to the city and the lifestyle of local communities in the long term, while acknowledging the local environment and the local culture.

The background for this investigation is the 2016 Olympic and Paralympic Games in Rio de Janeiro. The project aims to re-develop the existing Marina da Glória in Rio de Janeiro in order to host the sailing competitions of 2016, while focusing on the post-Olympic use of the Marina. By redeveloping the Marina the project also deals with the revitalization of the Rio de Janeiro water front and Flamengo Park, where it is situated. It addresses issues of connectivity and integration between the coast, the park and the urban fabric.

Based on the notion that a design intervention should be in tune with its context, the project applies urban and architectural design strategies that have the existing cultural and built environment of Brazil and Rio de Janeiro as a source of inspiration. These strategies - which include coastal reclamation, urban connectivity (reconnecting the park and the coast back to the city), and flexibility of compositional arrangement - provide a response to difficult context issues and to the problem of long term versus short term use. They also grant the final design a well balanced combination of formalist and functionalist aspects in the best tradition of the modern Brazilian architecture.
“It is not the strongest of the species that survive, nor the most intelligent, but the one most responsive to change.”

Charles Darwin
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1.0 Introduction

In 2016, for the first time in history, a South American city will be hosting the Olympic Games. The 2016 Olympics in Rio de Janeiro is not only an opportunity for Brazil to show the world the vitality of its emerging economy, but also a favourable circumstance and a reason to improve the urban infrastructure of the city in general. The research project consists of re-developing the existing Marina da Glória in Rio de Janeiro in order to host the sailing competitions for the Olympic Games of 2016, while focusing on the post-Olympic use of the Marina.

The Olympic and Paralympic Games of 2016 will divide the city of Rio de Janeiro into four main zones where the competitions will be taking place (figure 1). As the city prepares for the event, these areas are undergoing dramatic revitalization to receive a world wide audience of athletes and spectators. As part of the Copacabana zone, Marina da Glória will be hosting the Olympic sailing competitions while the Flamengo Park will be hosting the Olympic race walking and road cycling competitions. This project will not only deal with the re-development of the existing Marina da Glória, but also with the revitalization of Flamengo and Gloria neighbourhood, exploring issues of connectivity and integration between the city, the park and the coast.

Figure 1: Rio 2016 Olympic Master Plan

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1.1 Research Question

The research question looks primarily at how the design for an Olympic venue, which is usually aiming to cater for the needs of a short term event, can benefit and contribute to the city and the life style of local communities in the long term, while also acknowledging the local environment and the local culture. On an urban scale the research analyses how the design for the development of the waterfront can improve the urban infrastructure in general.
1.2 Aims and Objectives

The main objective of this research is to provide a design response to the problem of multi-use architecture in short term and long term situations. In the short term the design needs to attend to the requirements of an international Olympic Sailing Competition and, in the long term, it should respond to the quotidian needs of a public facility for water-based and water-side sports and recreation. The final architectural solution illustrates how the design of a Marina and Sailing School can provide for both these uses, while also acknowledging cultural heritage and local conditions.

In dealing with these questions the research also addresses the architectural issues involving the design of Olympic Marinas and Sailing Schools. It conveys examples of general spatial requirements that deal with storage, use, transport and maintenance of boats, both on land and on water, in ordinary and Olympic situations. In addition this research demonstrates the types of services that can be provided by a Marina and their plan arrangement.

In regards to the site, the research investigates the cultural heritage of Flamengo Park and Rio de Janeiro. It examines the history of the city and the park, existing architecture and urban situation, outlining the issues to consider in the development of the project. The urban context analysis gives an assessment of the park, indicating both the urban weaknesses and strengths of the Flamengo neighbourhood and the site.
2.0 Methodology

2.1 Research for Design

The research for design included conventional desk-based and empirical field-based research. The field-based research consisted of site visits accompanied by photographs and sketches. In Brazil, the field research included visits to the Grael Project and Sailing School in the city of Niteroi, and to the Marina da Glória site in Rio de Janeiro. In New Zealand the field research covered visits to the West Harbour and Oakei Marinas, both in Auckland. The site visits and the material obtained through them were crucial to the development of the project, as they provided fundamental information and a basic understanding of the site and the operation of Marinas. Aided by the field research, the initial case studies, in combination with site analysis and literature review, provided an understanding of the main issues concerning Olympic Marina design, the city of Rio de Janeiro and the Flamengo and Glória neighbourhoods.

2.2 Research by Design

The research by design methodology required a systematic and extensive use of spatial design methods and techniques to:

- analyse and interpret the brief and the site;
- generate a wide range of possible solutions;
- analyse and evaluate the possible solutions and choose the optimal one;

As the project unfolded from the initial research other architectural problems were faced. The guidance of tutors, constant analysis of the project, further research and studio critiques helped to identify and resolve new architectural problems. Eventually this process led to a satisfactory design solution that answered the research question and achieved the main objectives.
3.0 Project Outline

3.1 Brief

With 105,000 square metres, the existing Marina da Glória is located at Guanabara Bay, one of the most famous scenic landscapes of Rio de Janeiro. (figure 2)\(^3\) Besides providing a full range of nautical related services and being used as a point of departure and arrival for boats, the existing Marina is often used to host public events, such as parties, international concerts, boat exhibitions and sailing events. In 2016, for the first time in history, the Marina will be hosting the sailing competitions for the Olympic Games. To help overcome the problem of Olympic venues being underutilized or even abandoned after the games, the project aims to re-design the existing Marina in order to host the sailing competitions of 2016, focusing on the post-Olympic use of the Marina. The objective is to take the idea further and expand the use of the Marina into other activities that include a sailing school and spaces for tourism and public use.

The architectural programme is divided into three different areas that are defined by the Sailing School, the Marina services and the public spaces. Each of these areas has different requirements that can possibly overlap. The requirements for the Marina and the Sailing School can also be subdivided in temporary use for the Olympic Games and long term use as a quotidian public Marina. Even though the requirements for long term and short term are similar, it is important to establish the factors of difference. During the games there can be

approximately 10,000\(^4\) spectators, 700\(^5\) sailors, coaches and officials in the Marina. At other times, there may be as much as 900\(^6\) spectators and 100\(^7\) competitors at a South American, regional or national competition, or just a couple of hundred recreational sailors, observers and tourists on a standard weekend day.

The design for the public areas will also be part of an urban plan scheme for the development of the waterfront area. The urban plan aim is to integrate public activities with the Marina and increase the connectivity between the city and the coast.

![Figure 3: Multitude of people at an Olympic event.](image)

![Figure 4: People at a developed waterfront area (Baltimore Inner Harbour, 1970s).](image)

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7 Ibid.


3.2 Site

As a public marina, the existing Marina da Glória is part of the Flamengo Park, a public park built on reclaimed land along Guanabara Bay (figure 5). The design for the park was a collaboration project led by Maria Carlota de Macedo Soares, including the architect Affonso Reidy and the landscape designer Roberto Burle Marx.\textsuperscript{10} The park was initially built as a 3Km long vehicle corridor with 1,200,000m\textsuperscript{2} of area extending from the airport at the city centre to the beginning of Botafogo Beach in the south zone of the city.\textsuperscript{11} Besides the Marina, an Art Museum and a War Memorial are also part of the park. The location of the Marina, and its relationship with other important elements of the park, combined with the idea of the park as a connector between the city centre and the south zone of the city are an important aspect of the project. (For more information regarding the Flamengo Park refer to section 4.1.2.1 Flamengo Park).

In regards to the existing infrastructure, the site at Marina da Glória has a 3,000m\textsuperscript{2} reinforced concrete building covered by a roof of tensile structures (figure 7). Designed by the architects Amaro Machado and Duarte Belo the building was officially opened in 1979.\textsuperscript{12} The first

floor of the building is reserved for events, while the ground floor has a number of small offices occupied by tourism agencies, sailing schools and administration. In front of the building there is also a paved area and a 20 metres wide boat ramp. (For more information regarding the use of the existing infrastructure in the project refer to section 6.0 Project Development).

Figure 6: Aerial view of the site.

Figure 7: Existing building at Marina da Glória

Figure 8: Regatta at the Guanabara Bay.

34 “Campeonato Sul Americano Da Classe J24 2010.”
4.0 Literature review

4.1 Rio de Janeiro Urban Plans and Coastal Development

The Luso-Brazilian\textsuperscript{15} city of Saint Sebastian of Rio de Janeiro was founded in 1565 as a fortified stronghold at the entrance of Guanabara Bay.\textsuperscript{16} By the end of the XVI century the city started spreading towards the flat areas, which were then limited by four hills and a series of swamps, mud flats, lakes and beaches (figures 9 and 10).\textsuperscript{17}

Since its beginning the city of Rio de Janeiro has had a total of 10 urban plans as outlined below:\textsuperscript{19}

1. Beaurepaire Plan, 1843 - Urban plan that had the objective of implementing new drainage techniques, streets and plazas for the expansion of the city’s urban fabric.\textsuperscript{20} Was partially effectuated years later.\textsuperscript{21}

\begin{itemize}
  \item \textsuperscript{16}Ibid., 11.
  \item \textsuperscript{17}Gloria Kok, Rio De Janeiro Na Época Da Avenida Central (São Paulo: Bei Comunicação, 2005), 9.
  \item \textsuperscript{18}Ibid., 10.
  \item \textsuperscript{19}Verena Andreatta, Cidades Quadradas, Paraisos Circulares: Os Planos Urbanísticos Do Rio De Janeiro No Século Xix (Rio de Janeiro: Mauad, 2006), 48.
  \item \textsuperscript{20}Ibid., 50.
  \item \textsuperscript{21}Ibid., 132.
\end{itemize}
2. Improvement Commission Plan, 1875-1876 – Urban plan to remodel, embellish, and improve sanitary conditions in the city.\textsuperscript{22} Was reviewed and effectuated during the Pereira Passos Plan.\textsuperscript{23}

3. Pereira Passos Plan, 1903 – Urban Plan that reviewed and expanded the Improvement Commission Plan.\textsuperscript{24} Was entirely effectuated.\textsuperscript{25}

4. Agache Plan, 1926-1930 – Urban plan that aimed to use the application of zoning as a way to control urban expansion.\textsuperscript{26} Was not effectuated, however, it influenced future urban plans and present legislations.\textsuperscript{27}

5. Pilot Plan of Rio de Janeiro, 1938-1948 – Urban plan that had the objective of implementing a structure of highways (derived from the previous Agache Plan) for the expansion of the city.\textsuperscript{28} Was effectuated and marked the expansion of the city for the following 50 years.\textsuperscript{29}

6. Doxiadis Plan, 1965 – Urban Model characterized by a rectangular network of highways that would generate conditions for the city to expand infinitely.\textsuperscript{30} Was not effectuated.\textsuperscript{31}

7. Pilot Plan of Jacarepaguá, 1969 – Urban Plan based on the satellite city concept that intended to create an autonomous separated city at the southern zone of Rio de Janeiro.\textsuperscript{32} Was effectuated.\textsuperscript{33}

8. Basic Urban Plan of Rio de Janeiro, 1977 – Urban plan based on the same logic of previous plans with a scheme of territorial

\textsuperscript{22} Secretaria Municipal de Urbanismo, "Rio E Seus Planos,"
\textsuperscript{23} Kok, \textit{Rio De Janeiro Na Época Da Avenida Central}, 36.
\textsuperscript{24} Ibid., 36.
\textsuperscript{25} Andreatta, \textit{Cidades Quadradas, Paraisos Circulares: Os Planos Urbanísticos Do Rio De Janeiro No Século Xix}, 194.
\textsuperscript{26} Marília Vicente Borges, "O Zoneamento Na Cidade Do Rio De Janeiro:Gênese, Evolução E Aplicação." (Universidade Federal do Rio de Janeiro, 2007), 92.
\textsuperscript{27} Secretaria Municipal de Urbanismo, "Rio E Seus Planos."
\textsuperscript{28} Andreatta, \textit{Cidades Quadradas, Paraisos Circulares: Os Planos Urbanísticos Do Rio De Janeiro No Século Xix}, 62-64.
\textsuperscript{29} Ibid., 62.
\textsuperscript{30} Ibid., 69.
\textsuperscript{31} Ibid., 70.
\textsuperscript{32} Ibid., 71.
\textsuperscript{33} Ibid., 67.
occupation for the city and a list of guidelines for future interventions and regulations.³⁴ Was not effectuated.³⁵

9. Directing Plan, 1992 – Urban plan of zoning and land regulation.³⁶ Was effectuated and is the city’s present urban code which regulates legal aspects of land use.³⁷ Since its creation it has had many reviews and amendments.³⁸

10. Strategic Plan, 1993-2012 – Urban plan that aimed to consolidate the city as a competitive and enterprising metropolis establishing strategies that would unfold as actions and projects.³⁹ Was effectuated and to this date there are still urban actions and projects being developed under the Strategic Plan.⁴⁰

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³⁴ Ibid., 73.
³⁵ Ibid., 73.
³⁶ Ibid., 75.
³⁷ Ibid., 76-80.
³⁹ Secretaria Municipal de Urbanismo, "Rio E Seus Planos."
⁴¹ Andreatta, Porto Maravilha E O Rio De Janeiro + 6 Casos De Sucesso De Revitalização Portuária, 212.
⁴² Ibid., 220.
Since the city of Rio is located around the Guanabara Bay, to a certain extent all of the above mentioned plans involve the development of the coast. However, the literature review only discusses the Pereira Passos Plan and Rio de Janeiro Pilot Plan, as they are the plans that had direct influence on the development of the site and urban region. The Case Studies section investigates the Project Porto Maravilha which is presently being developed under the Strategic Plan, and the Appendix B section discusses the ideas behind the Agache Plan and how it influenced the general city development, even though it was not effectuated.

Figure 12: Map of the city of Rio de Janeiro showing the territorial limits of each Urban Plan. Key: 1-Beaurepaire Plan; 2-Improvement Commission Plan; 3-Pereira Passos Plan; 4-Agache Plan; 5-Pilot Plan of Rio de Janeiro; 6-Doxiadis Plan; 7-Piolo Plan of Jacarepaguá; 8-Basic Urban Plan; 9-Directing Plan; 10-Strategic Plan; 43

43 Andreatta, Cidades Quadradas, Paraisos Circulares: Os Planos Urbanísticos Do Rio De Janeiro No Século Xix, 45.
4.1.1 Pereira Passos Plan, 1903

By the end of the XIX century living conditions in the city of Rio de Janeiro were deteriorating due to population growth and epidemics of smallpox, cholera and yellow fever. With the objective of improving sanitary conditions in the city, the modernization plans of the mayor Pereira Passos incorporated actions such as the refurbishment of the port and the construction of squares and large avenues, including Beira-Mar, Rodrigues Alves and Central (figure 13). The refurbishment of the port reclaimed an area of 175,000m² that changed the coastline of Rio de Janeiro. It was constructed with land from Senado Hill, which was completely demolished, part of Castelo Hill and rubble from the houses that were pulled down for the opening of Central Avenue (figures 14 and 15). The material from the partial demolition of Castelo Hill was also used for the construction of Beira-Mar Avenue, a 5.2 kilometres landfill project in the southern zone that was initiated at the end of 1800s and continued in 1903. The new Beira-Mar Avenue facilitated access from the port to the elite-chosen southern zone, while the new Rodrigues Alves Avenue connected the port to the northern suburbs.

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Figure 13: Plan of the city of Rio de Janeiro indicating the improvement plans of Pereira Passos, 1905. Key: 1- Beira Mar Avenue; 2- Central Avenue (present Rio Branco); 3- Refurbishment of the port and Rodrigues Alves Avenue; 4- Projection of future Flamengo Park; 5- Position of future Santos Dumont Airport.

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45 Kok, Rio De Janeiro Na Época Da Avenida Central, 40-42.
46 ibid., 42.
47 ibid., 42.
50 Ibid., 144-47.
51 Andreatta, Cidades Quadradas, Paraisos Circulares: Os Planos Urbanísticos Do Rio De Janeiro No Século Xix, 195.
As a development of the urban reform of Pereira Passos, the full demolition of Castelo Hill was carried out in 1922.\textsuperscript{52} The demolition left an empty esplanade at the central zone of the city, which became a subject of discussions between city planners in the following years.\textsuperscript{53} The land from the demolition was used for the construction of Paris Square along Beira-Mar Avenue on the southern zone landfill project (figure 15).\textsuperscript{54}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure14.jpg}
\caption{Aerial view of Rio Branco Avenue (former Central Avenue) ca. 1930. On the foreground the refurbished port of Rio showing the area where the present Mauá Square is located.\textsuperscript{55}}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure15.jpg}
\caption{Paris square ca. 1940 with the recently opened esplanade of Castelo Hill at the background.\textsuperscript{56}}
\end{figure}

\textsuperscript{52} Nabil Bonduki, \textit{Affonso Eduardo Reidy} (Lisboa: Instituto Lina Bo e P.M. Bardi, 2000), 62.
\textsuperscript{53} Ibid., 62.
\textsuperscript{55} Ibid., 153.
\textsuperscript{56} Ibid., 149.
The Pilot Plan of Rio de Janeiro is essentially a plan of highways re-adapted from the Agache Plan that also tries to articulate north and south city zones, trying to avoid traffic congestion around the Central Business District. The plan included the construction of Presidente Vargas Avenue, Perimetral Avenue, Pasmado Tunnel, Leme Tunnel, and Flamengo Park amongst many other projects. The research will further discuss the history behind the design and construction of the Flamengo Park, the urban site for the project in question. (For more information regarding the development of Perimetral Avenue and its consequences refer to Appendix B.)

Andreatta, *Cidades Quadradas, Paraísos Circulares: Os Planos Urbanísticos Do Rio De Janeiro No Século Xix*, 64.

Ibid., 64-67.
4.1.2.1 Flamengo Park, 1952-1965

In 1960 when Carlos Lacerda became the new governor of the State of Guanabara (present State of Rio de Janeiro) he put his friend Carlota (Lota) de Macedo Soares in charge of the urbanization of the Gloria-Flamengo landfill, a project that was initiated in 1952 under the Pilot Plan of Rio de Janeiro with the land resulting from the levelling of Santo Antônio Hill (figure 17). In 1961 Lota invited the architect Affonso Eduardo Reidy and the landscape designer Roberto Burle Marx, along with other collaborators, to join the Work Group for the urbanization of the landfill. As director of Rio de Janeiro’s Urbanism Department, Reidy had already been previously involved in the planning of the landfill and Lota’s invitation was an opportunity to give continuity to the project. The initial objective of the landfill under the Pilot Plan was to improve traffic connection between the central and southern areas of the city by providing a highway on a narrow coastal area between the hills and the sea. The highway would connect the elevated Perimetral Avenue to the tunnels of Pasmado and Leme, providing fast traffic connectivity to the southern areas of Ipanema and Copacabana (figure 16). As the Work Group took charge, instead of just providing highways, the idea behind the Flamengo landfill project was to give the cariocas a park where they would be able to enjoy their weekends of leisure in the open air, a factor of vital importance for their mental and physical health. However, when the Work Group

Figure 17: Study and photo of the demolition of Santo Antonio Hill. The hill to be levelled is showed in yellow and the landfill area is showed in pink.

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59 Bonduki, Affonso Eduardo Reidy, 117.
60 Eliovson, The Gardens of Roberto Burle Marx, 97.
62 Ibid., 66.
63 Bonduki, Affonso Eduardo Reidy, 114.
64 Marta Iris Montero, Roberto Burle Marx. The Lyrical Landscape (Berkeley: University of California Press, 2001), 66.
65 Bonduki, Affonso Eduardo Reidy, 124.
66 Carioca is a person who is born in the city of Rio de Janeiro.
67 Bonduki, Affonso Eduardo Reidy, 127.
started the urbanization project for the park, two of the highway roads that cut the area in the middle had already started construction.  

“The Gloria-Flamengo landfill was started seven years ago during previous incumbencies, and the giant work did not seem to have other fate than opening spaces to the high-velocity roads where sixteen rows of cars would pass at a hundred kilometres per hour in front of one of the most wonderful sights in the world. This government wanted to continue this work under a less mechanized and anti-human inspiration; unfortunately two of the already started roads had to be kept, cutting the Landfill in the middle, but as to the remainder, now let’s build Brazil’s largest garden. This cut has created great problems for the Landfill’s urbanization, not only from the aesthetic point of view but also from the utilitarian one, considering the utilization of the areas and the pedestrians’ forced crossings through the rapid lanes. This was imperfectly solved by three inferior passage ways, a big bridge from the Beira-Mar Avenue to the Museum of Modern Art, and four small bridges over the hillocks.”


Figure 18: Section through one of the pedestrian crossings showing the moulding of the ground that allowed the park to be isolated from the main road

Figure 19: The “imperfectly-solved” pedestrian bridge viewed from the Museum of Modern Art

68 Ibid., 126.
69 Maria Carlota de Macedo Soares cited in ibid., 126.
The “imperfectly-solved” pedestrian bridges designed by Affonso Reidy were constructed in a very pleasant way, as if they were trying to make the stressful process of highway-crossing more enjoyable. Instead of building simple and cold straight elevated passages, Reidy designed the bridges with gently-sloped and elegant curves (figure 19). However, even with all their elegance and beauty, the pedestrian bridges do not change the fact that the park is completely disconnected from the city due to the construction of the highway.

When the Work Group designed the park they wanted it to be easy for people to relax outdoors, making them forget that they were surrounded by cars. This was achieved with the moulding of the ground in different levels, allowing the park to be isolated visually and acoustically from the main road (figure 18). As a consequence the view from the city to the sea was also blocked, not only by the different levels, but also by the wall of vegetation that grew throughout the years.

In regards to coastal area the project for the park included a new artificial beach more than one kilometre long and a harbour of calm waters with a pier for small boats, which was further developed into the present Marina da Glória (figure 21). On the landfill, besides lanes of fast traffic, the project included places for leisure activities such as soccer, basketball, tennis and model airplanes. Throughout the park there are also other architectural leisure-elements designed by Affonso Reidy, such as the playground pavilions of Flamengo and Viuva. The Museum of Modern Art designed by Affonso Reidy, the World War II
Memorial, as well as the gardens for the museum designed by Burle Marx, are also considered part of the park and were already built when the Work Group started the urbanization project.\textsuperscript{76}

\textsuperscript{76} Eliovson, \textit{The Gardens of Roberto Burle Marx}, 97.

\textsuperscript{77} Bonduki, \textit{Affonso Eduardo Reidy}, 128-37.
4.2 Literature Analysis and Comments

Throughout history, the coastline of Rio de Janeiro has been under constant change. Starting with the modernization of Pereira Passos, the development of the coast was never entirely finished. Because the city has such an irregular landscape with lots of mountains, mudflats, lakes and beaches, urban expansion has typically been an issue. The alternative found by city planners of the XX century was to simply annihilate these inhabitable or difficult areas, giving the city this ever changing, clay-like, mouldable character (figure 22). The continuous demolition of hills that limited urban growth meant there was a need to move land elsewhere and gave rise to urbanization projects for the new esplanades. As a result, the waterline has been pushed forward time and time again, as if the mountains were simply relocated to the coast, giving the city another piece of flat land to continue expansion. In view of this important aspect one can only wonder when the process of moulding the landscape, relocating land and reclaiming the coast will, or if it should, ever end. The Flamengo Park is just one example of this mouldable, changing character of the

Figure 22: Map of the city of Rio de Janeiro showing land reclaimed from the sea, lakes, swamps and mangroves.

Andreatta, Cidades Quadradas, Paraisos Circulares: Os Planos Urbanísticos Do Rio De Janeiro No Século Xix, 27.
city and coastline. The creation of the Park on a landfill with very precise sculptural forms and a man made harbour shows how far the moulding of the coastline can go. It gives the city, not only new spaces to be occupied, but also the possibility of shaping the coast to any form desired.

The problem of traffic connectivity, as a result of the city’s configuration, is another aspect that has been a constant issue and that has changed the city in many ways. The highway dividing Flamengo Park is just one example of the necessary evils of fast traffic access. While trying to resolve the problem of traffic connectivity direct pedestrian access to the coast and the views of the sea were also blocked. Even with the creation of beautiful pedestrian passages, the connectivity between the city, park and coast is still lost, both physically and visually. It is understandable that, while creating the park, they wanted people to forget they were surrounded by cars, but, as a consequence, they also made people on the landward side forget that they were surrounded by water.
5.0 Case studies

The case studies investigation includes projects for marinas and sailing centres designed for the Olympic Games of the past 20 years. It reviews the projects for the Barcelona Olympic Port\textsuperscript{79}, and the Qingdao Olympic Sailing Centre\textsuperscript{80}, which were respectively built for the Olympic Games of 1992 in Barcelona and 2008 in Beijing.

The Agios Kosmas Olympic Sailing Centre\textsuperscript{81} built for the 2004 Olympic Games in Athens is also a reference for this research. However, because not enough information was available regarding the design of this project, the investigation will only analyse its general area and plan configuration in the Project Development section.

The Marinas of Atlanta (1996), Sydney (2000) and London (2012) were not included in this research because these cities did not design new Marinas for the occasion of the Olympic Games, they simply used existing ones.

In regards to waterfront development, the study reviews the current project Porto Maravilha in Rio de Janeiro. This particular project was chosen, not only for its location and context, but also because it deals with similar issues of connectivity and integration between the city and the coast.


5.1 Barcelona Olympic Port, Reception and Sailing School

Designed by MBM Arquitectes (Martorell, Bohigas, Mackay and Puigdoménech) for the 1992 Olympic Games, the Barcelona Olympic Port design breaks the coast line with a square, open on one corner and protected by a curved arm (figure 23). Along the perimeter of the square the Marina design accommodates car parks, bars, restaurants, dry dock and slipways. At the entry point of the square is the reception building and, marking the north-east corner, aligned with the reception building is the sailing school. With its volumetric roof of pyramids the sailing school makes an architectural statement that is a point of reference along the coast, framing the views and guiding people through a labyrinth of boat masts.

Figure 23: Barcelona Olympic Port General Plan. Key: 1- Port reception building; 2-Boat maintenance area; 3-Car park; 4-Municipal sailing school; 5-Restaurants; 6-Commercial premises; 7-Covered dry boat storage; 8-Underground car park with access from the quayside.

Figure 24: Barcelona Municipal Sailing School.

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Because there is a full supporting system in nearby areas, providing infrastructure for boats of larger scale, the majority of the berths at the Barcelona Marina only provide for small to medium sized boats with a maximum length of 42 feet (approximately 12.8 metres). The Marina is also sunk in relation to the street level, which allowed it to have a fully covered dry berth area under the side street and surrounding public decks on the street level looking into the wharfs (figure 25). All sides of the marina have vehicle access, which is limited and controlled at the entry point (figure 26). The north-western underground car parks serve the commercial premises, while the rest of

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85 Ibid., 35.
the car parks serve the Marina only. The dry berth areas are located on opposite sides of the square with a boat maintenance area in the middle by the boat lift system. There is also one large slipway for the sailing school at the north-east corner, and three smaller slipways for the general marina around the open end of the square. The general circulation scheme was organized so as to keep boats and vehicles on the ground level, while the first floor, which is also the street level, is reserved for pedestrians only.

With regards to the Olympic Games, at the Barcelona Olympic Port, MBM architects addressed the issues of long term and short term use with different design strategies. By providing stepping platforms on the breakwater they gave the Olympic spectators a permanent grandstand that, besides being used on a daily bases by tourists and residents for bathing and fishing, can also be used for future competitions (figures 27). By also providing few strategically located access points from the street level to the wharfs, they made it possible to easily separate the two areas for future sailing events and competitions. During the Olympic Games of 1992 the Marina ground level was reserved for the athletes while the upper areas held the general public.

The Barcelona Olympic Port complex successfully combines commercial, recreational and educational activities. The surrounding viewing decks and the commercial premises put the Marina in the centre stage, creating an exciting urban area where a variety of activities take place around a labyrinth of boat masts. It is very clear that even though it was designed for the 1992 Olympics, the port also serves the city very well. It provides locals and tourists with inspiring, memorable and effective leisure spaces that can be adapted and used for future competitions.

For dealing with the spatial arrangement of Marina services in such an efficient manner, and for creating adaptable and exciting public spaces in the design, this project is a great example of a successful public Marina and serves as a point of departure for the research.

87 Ibid., 197.
88 Ibid., 197.
5.2 Qingdao Olympic Sailing Centre

Designed by the Beijing Institute of Architectural Design for the 2008 Olympic Games in Beijing, the Qingdao Olympic Sailing Centre is located by the side of the Fushan Bay of Qingdao City in the Shandong Province. With a total area of 450,000m² the centre is divided between land area, harbour and off-shore area. The land area includes the administration office, the Olympic Sailing Museum, the International Marina Shopping Plaza, the Events Centre and the Qingdao international Yacht Club. During the Olympic Games the same area provided the supporting infrastructures of game management centre, athletes’ village, media centre, logistics supply centre and other affiliated facilities (figure 28). The offshore and harbour area include the main and secondary breakwater, the olympic memorial wharf, the jetty wharf and the retaining wall reconstruction.

Figure 28: General Plan of the Qingdao Olympic Sailing Centre during the Olympics. Key: 1-Logistics supply centre; 2-Media centre; 3-Maintainance centre; 4-Olympic square; 5-Athlete’s centre; 6-Athlete’s village; 7-Game management centre; 8-Dry dock; 9-Olympic memorial wharf.

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93 Ibid.
The scale of the Qingdao Sailing Centre differs from the Barcelona Port, not only because of the scale of the city, but also because it had to host an entire Olympic infrastructure, with athletes’ accommodation and media centre due to its distance to the city of Beijing where the rest of the games were held. The general plan configuration, however, is similar to that at Barcelona, with the difference that in Qingdao one of the sides of the square was “broken” dividing the centre into 2 different outer and inner squares. The vehicle circulation is limited to one side with the other side reserved for pedestrians (figure 29). The centre also has 2 main slipways for small boats, one slipway for larger boats, 2 dry docks and one lift system. Both car parks and dry berth areas are concentrated around the central-east side of the scheme with only a few car parks on the outer southern square and a boat maintenance area by the northern dry docks. The Sailing Centre also has a light house marking the outer edge and the entry to the harbour.

![Figure 29: Qingdao Olympic Sailing Centre general circulation diagram](image)

The Qingdao Sailing Centre dealt with the Olympic Games and issues of long term and short term use by providing large public plazas where sailing boats could be parked and temporary tents could be set up (figure 30). After the games, the tents were removed and three new buildings were constructed. The new buildings are the Olympic Sailing Museum, the International Marina Shopping Plaza, and the events

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95 Ibid., 142.
centre. The building that served as the media centre during the Olympic competitions is in fact the Qingdao International Yacht Club, which has already hosted the 2007 America’s Cup and the 2008-2009 Volvo Ocean Race. The “broken” east side of the Marina is now a busy public promenade with a great mix of educational, commercial and leisure activities (figure 31).

The general design of the Qingdao Olympic Sailing Centre is extremely functional. It offers an effective and practical marina infrastructure for boats of various sizes. The separated slipways for smaller boats in the middle of the scheme are a great response to the functional demands of Olympic sailing competitions. The use of plazas with long term goals for future buildings is also a great example of how to deal with issues of long term and short term use.

For being a functional Marina of a large scale, for separating pedestrian and vehicle access and for integrating its use into the quotidian life of the city with a great mix of commercial, educational and leisure activities the Qingdao Olympic Sailing Centre is also a point of reference for this research.

98 “Qingdao International Yacht Club,”
99 “Qingdao Olympic Sailing Museum.”
5.3 Project Porto Maravilha, Rio de Janeiro

Besides the 2016 Olympic Games, Brazil is also hosting the 2014 FIFA World Cup. As the city is currently preparing itself to host both events, there has been a lot of discussion regarding the development of the waterfront area. As part of the Strategic Plan the Project Porto Maravilha, which is already under construction, will redevelop the port of Rio de Janeiro, which has been abandoned for many decades, partially due to the construction of the elevated Perimetral Avenue (for more information regarding the construction of Perimetral Avenue refer to Appendix C). The Project will refurbish the abandoned port area with urban actions that will bring new living, working, transport, and leisure options for the local communities. The Museum of Tomorrow, designed by the renowned Spanish architect, Santiago Calatrava, is also part of the project (figure 35). The design for the museum includes an innovative structure with wings that open to capture sunlight, showcasing science and sustainability.

The project will unfold under two central actions of urban intervention and port refurbishment. The urban intervention will improve the general infrastructure of the areas surrounding the port which will receive new urban furniture and new supply systems of water, sewage, telephone, power and gas. The intervention will also improve the existing road network in order to increase the connection between the city and the port. The elevated Perimetral Avenue which presently blocks the view and segregates the port from the city (figure 32) will be partially demolished and replaced with an underground

Figure 32: Mauá Square and the elevated Perimetral Avenue separating the city from the port.

103 Andreattta, Porto Maravilha E O Rio De Janeiro + 6 Casos De Sucesso De Revitalização Portuária, 221-22.
104 Ibid., 221-25.
105 Ibid., 226.
tunnel (figures 33 and 34). The result will be a better perspective of the port front, with increased connectivity between the city and the coast.\textsuperscript{106} The existing Mauá Square will be reconnected with the port, and the Museum of Tomorrow, which will be built on the wharf in front of the square, will help to consolidate the central axis and focus of the area. In addition to the Museum of Tomorrow, the port refurbishment will also include a new Museum of Art, the new Central Bank headquarters and projects of restoration for historic buildings.\textsuperscript{107}

\begin{figure}[h]
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\caption{Map showing the section of Perimetral Avenue to be demolished and the new tunnel.}
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\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{fig34.png}
\caption{Artist’s impression of the new tunnel and port area.}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{fig35.png}
\caption{Artist’s impression of the new Mauá square and Museum of Tomorrow.}
\end{figure}

The Project Porto Maravilha is ample, complex and a great example of how a port revitalisation project can successfully deal with issues of tourism, social inclusion, cultural heritage, sustainability, road network development and coastal connectivity. As the project is also located on the Guanabara Bay and relatively close to the site, it is of great relevance to the design of the new Marina da Glória. The design response to the issue of connectivity in particular served as an example and inspiration for the development of the project.

\textsuperscript{106} Ibid., 228.
\textsuperscript{107} Ibid., 231.
\textsuperscript{108} Ibid., 228.
\textsuperscript{109} Ibid., 230.
6.0 Project Development

6.1 Site

6.1.1 Reinventing the site

The research project was initiated by a study of the areas occupied by the Olympic Marinas of Barcelona, Agios Kosmas and Qingdao which were built in similar circumstances. The study outlined the total area that should be provided for the development of the project, in particular the proportion of wet area to dry area that should be kept, which is usually 50-50 varying by a small amount, depending on other facilities provided by the Marina (figure 36). Following the study, an analysis of the site at Marina da Glória revealed that the existing area is not sufficient. With approximately 158,000m$^2$, the present Marina has the capacity to store a total of 340 boats$^{110}$, including wet and dry berths. By comparison a Marina such as Agios Kosmas, which was designed for the 2004 Olympic Games in Athens, has a large area of 407,000m$^2$ and the capacity to store 1,000 boats.$^{111}$ Even though the Gloria harbour encloses a significant area, it is not ideal to use the other side of the harbour for the development of the Marina for different

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reasons. Firstly, the World War II Memorial, the Modern Art Museum and the Airport all occupy a large area around the harbour, making it difficult to develop a Marina in such close proximity to these very different and delicate uses. Secondly, the circular shape of the harbour makes it impractical to organise the boat berths. Finally, the distance between both sides of the harbour is quite significant (approximately 500 metres) and boats on berths close to the airport would need the supporting infrastructure provided by the main building on the other side. Faced with this scenario, it was necessary to extend the site so that it would provide a larger area for the development of the new Marina and Sailing School. The idea behind the project was also to provide the community with something new that they could keep as a result of the Olympic Games coming to the city. In this case, using the existing area of the Flamengo Park and taking away from the community was not an option. Considering the history of the city with its ever changing, mouldable coastline, the possibility of reclaiming land became the most suitable alternative and a natural option.

In order to extend the site and the harbour area, it was necessary to find a shape that would suit and respect the existing lines of Flamengo Park and the elegant curved shapes designed by Roberto Burle Marx. The design processes that led to a solution to this question were extensive and did not exclude any possibilities. Even squared
shapes that completely ignored the site geometry created by Roberto Burle Marx were attempted (figure 37-K). Each new attempt to create a suitable shape, regardless of how aesthetically incompatible the attempt was, only helped the process, revealing further aspects for consideration.

The first few attempts especially revealed the advantages and disadvantages of having a centralized shape as opposed to a decentralized one. The centralized shape, with the protecting arm extending from the beach side, (figure 37 - all except B), would concentrate the Marina on only one side of the harbour and facilitate further planning issues. The decentralized option, with the protecting arm extending from the airport side, (figure 37-B), would divide the Marina into two separated areas and also lead to further planning problems due to proximity to the airport. In consideration of both scenarios, further design attempts were made in favour of the centralized option.

The different shapes created were also analysed in terms of total area and proportions of wet to dry area. The Nautical Chart of the Guanabara Bay provided further information, revealing an area in which no anchoring is allowed due to airport use, with airplanes constantly landing and taking off. In this case, besides respecting the curved lines of Roberto Burle Marx and having the protective arm extending from the southern beach side, the shape created should also respect the no anchoring limits of the Nautical Chart.

In the end of this process, three options that satisfied the above mentioned aspects (respecting the curved lines, respecting the no anchoring limits and having the protective arm extending from the southern side) were selected (figure 37 - H, J and L). In order to identify which of these options would best suit the project, the three “finalist shapes” where then analysed in relation to the general context of the beach, in relation to each other and in relation to the original shape created by Burle Marx (figure 38).

The final selection was made in favour of shape L, which was the one that best answered all the above mentioned aspects, while also keeping the ideal proportion of wet to dry area. It changed the coastline with long curved lines that extended the site with a protective arm.
coming from the beach side, keeping the Marina centralized on one side of the harbour. The general composition of the shape in relation to the existing coastline and the fact that it had its outer edge defined by the no anchoring limits also helped to set this particular shape apart from the others. With approximately 418,000m² of total area, 46% of that being wet area, the new geometry expanded the harbour area, while also respecting the curved lines of Roberto Burle Marx and the no anchoring limits set by the Nautical Chart.

Figure 39: The reinvented site with 418,000m² of total area and 192,000m² of wet area

Figure 40: Model photograph showing the reinvented site.
6.1.2 Site Analysis

It is interesting to note that due to the remodelling of the coast which took place at the very beginning of the design process, the site analysis had to be put on hold. Certainly an initial analysis had to be made in order to inform the remodelling of the site that was discussed in the previous section. However, a complete and thorough site and urban analysis could only be carried out once the new site was established.

As was mentioned before, the site is located at Flamengo Park, a public park built on a landfill along the coast of Guanabara Bay. Because the original purpose of the landfill was to provide a corridor for vehicles, the park has a long and narrow configuration, as if it were a green corridor connecting the airport to Botafogo Beach. However, because it is divided by highways, the long green strip remains separated from the rest of the city (figure 41). The few pedestrian bridges along the length of the park only provide access over the motorway; they do not physically re-connect the park to the urban fabric. The green coastal strip remains isolated and people only go there if they want to utilise the recreational facilities the park has to offer. Regardless of its long and narrow configuration, which is typical of spaces that act as connectors, due to the separation imposed by the motorway the park remains simply a destination.

Figure 41: Analysis of site and Flamengo Park showing the fast traffic lanes that separate the park from the city and the pedestrian bridges scattered along the length of the park
While dealing with the issue of building a relaxation space next to the motorway, the Work Group also designed the park and some of the traffic islands with different ground levels so as to separate the park visually and acoustically from the motorway. However, as it blocks the views from the motorway, the different ground levels and the tall vegetation also block the view from the city to the coast. From various points along Beira Mar Avenue it is almost impossible to see any sign of a coastline or understand what is on the other side of the motorway (figure 42). The pedestrian accesses points seem like bridges to nowhere as it is not possible to see where they lead. The only pedestrians that utilise these bridges are the ones who know that there is a park on the other side. Because the park has almost no visual connection with the city, it fails in offering the pedestrian a point of curiosity or a hint to let them know there is a beautiful recreational park, a beach and a Marina across the motorway. The only place that someone can get the slightest hint of what is on the other side is from the middle of the Paris Square (figure 42-2). From that point, partially due to the height of the monument and partially due to the purposely designed opening in the

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*Montero, Roberto Burle Marx. The Lyrical Landscape, 66.*
vegetation, it is possible to see the Memorial to the World War II Dead Soldiers. But the Marina and the carefully reinvented site remain completely hidden behind layers of vehicle lanes, traffic islands, pedestrian bridges and trees.

Another significant aspect of the site in terms of urban connection is the line of green historic plazas that could potentially create a link between the city centre and the Flamengo Park (figure 43). From the corner intersection between Rio Branco Avenue and Beira Mar Avenue all the way down to Gloria Hotel there is a corridor of green squares running parallel with the Flamengo Park. These squares were built in a landfill project at the beginning of the XX century prior to the Flamengo Landfill. Starting with the Monroe Square on the corner of Rio Branco Avenue, the connection goes through Mahatma Gandhi Square, Marshal Deodoro Square, Paris Square and Glória Square, finishing at Luis de Camões Square. Because Rio Branco Avenue is one of the most prominent Avenues of Rio de Janeiro CBD, this green corridor can be seen as a continuation and important connection between the city centre and the Central-South zones. However, due to the construction of the motorway, once again there is no physical or visual connection between the historic green plazas and the Flamengo Park. Since the Park is essentially a destination and the squares form connections, there is an immense opportunity for these spaces to benefit from each other.

Figure 43: Line of green squares that could potentially connect the city centre with Flamengo Park. Key: 1- 4th of July Square; 2- Monroe Square; 3- Mahatma Gandhi Square; 4- Marshall Deodoro Square; 5- Paris Square; 6- Glória Square; 7- Luis de Camões Square;

The reinvention of the site extended the land creating a peninsula positioned opposite to the airport. The limits of the peninsula coincide with the no anchoring limits of the Nautical Chart, which are defined by the airport flight paths. In this case, besides being under airplanes constantly landing and taking off, the peninsula also offers magnificent views of the Sugar Loaf Mountain, Corcovado Mountain,

Figure 44: Aerial views showing the location of landmarks that can be seen from the site.\textsuperscript{114}

Outeiro da Glória Church, the city of Niterói, the Modern Art Museum and the Monument to the World War II Dead Soldiers with the backdrop of the skyscrapers of Rio de Janeiro CBD (figures 44 and 45). However, due to level changes, and the tall vegetation of the Flamengo Park, at ground level the view back to the site is limited to the coastal area around the harbour and the airport. The peninsula extension also divided the existing harbour into two bays, expanding the available coastline area for the Marina boat berths and ramps. On the south side the peninsula also has a strong connection with the Flamengo Park and beach.

In summary, the site’s main weakness can be seen in the lack of physical and visual connection with the urban fabric. On the other hand the site’s main strength is the reinvented shape, which provides outstanding views of the city and the bay, an ideal configuration for the development of a large scale marina, and strong connections with the Flamengo Park and beach. The line of historic plazas can also be considered a strength since it provides an opportunity to link the site to Rio de Janeiro CBD.
6.2 Master Plan

6.2.1 Programme

Once the strengths and weaknesses of the site were examined it was necessary to research in more depth the programme to be implanted. As previously mentioned the programme was separated into three main, overlapping areas which included the Marina, the Sailing School and the public spaces. These areas were also further subdivided in temporary use for the Olympic Games and long term use as a quotidian public Marina. The following table outlines the requirements for the Marina, the Sailing School and the Olympic Sailing Competitions, highlighting the areas in common and the points of difference. The requirements for the sailing school were based on the Grael Project in the city of Niterói, Brazil, which was visited earlier in the year.

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Before starting the development of the building form and architectural response, the programme was further analysed in the three main areas of Marina, Sailing School and public areas, to distinguish the functional connections that were essential for the project and the ones that were flexible and could be adapted. These connections are indicated on the following diagram (figure 46) as major and minor adjacencies.

Figure 46: Bubble diagram highlighting major and minor adjacencies within the programme
6.2.2 Zoning

Following the programme research, a general zoning plan was established to define the areas that should be reserved for the public and the park, and the areas that should be reserved for the Marina and the Sailing School. Because the southern zone has better connection opportunities, with a peninsula that has the potential to be the most desirable space in the site, the area was reserved for the public and the park (figure 47). As a consequence the northern area, which is surrounded by the protected coastline, was reserved for the Marina and the Sailing School. The area reserved for the marina has approximately 120,000m$^2$ and can be compared with the marina services area of the Qingdao Olympic Sailing Centre, which has approximately 150,000m$^2$ (figure 48).

An analysis of the marina service areas of the Barcelona Olympic Port was not included because its scale is not compatible with the scale of the project in question.

Figure 47: Site Plan areas reserved for the Marina services and the Park

Figure 48: Qingdao Olympic Sailing Centre. Approximately 150,000m$^2$ occupied by the marina services.
6.2.3 Concept Design Response

Before arriving at a conceptual design response, an investigation was undertaken in order to explore form, functional requirements and possible solutions for the project. As discussed in the previous section the investigation explored ideas based on the three main uses of Marina, Sailing School and public spaces. Because the site has such distinctive geometry, it was a driving force and major influence on the shape of the buildings. At this stage it was foreseen that the final solution should have the site, the landscape and the buildings complementing each other in a well balanced and synchronized composition. Besides providing a “chameleon” infrastructure that would serve the Olympics in the short term and benefit the city in the long term, the design response should also reinforce the curved geometry of the site and provide ways of re-connecting the city and the coastline.

The conceptual design response consists of two distinctive boomerang-shaped, interlocking volumes that embrace the city and the harbour, forming a semi open courtyard that invites people to the coast (figure 49). While the northern volume accommodates the Marina and the Sailing School, which are essentially long term functions, the southern volume combines long and short term uses in a public events building that will become the Olympic legacy. Inspired by the ideas of the Project Porto Maravilha (section 5.3), the central courtyard also opens to a ground level green carpet that extends over the highways to physically and visually reconnect the city to the coast. The green carpet connection combined with the inviting shape of the buildings will serve as a magnet and design feature bringing residents and Olympic spectators from the city to the site.

Figure 49: Conceptual design response with the two boomerang-shaped buildings and the green carpet central courtyard making the connection over the highways.
6.2.4 Concept Design Process

6.2.4.1 Formal Investigation

As previously mentioned the process that led to the concept design response consisted of a formal investigation that explored spatial compositions of the possible solutions for the project (figure 50). Besides the functional aspects, the objective of the investigation was to find a solution that would emphasize the geometry of the site and provide a means of connecting the city back to the coast. Based on the case studies of the Qingdao Olympic Sailing Centre (section 5.2) and the Barcelona Olympic Port (section 5.1), the formal investigation already considered the placement of different slipways for the public, the sailing school and the marina on strategic positions of the site. Even though it was foreseen that the final solution should complement the geometry of the site, partly due to the imposing geometry of the existing building, the possibility of having right angled volumes was not dismissed. In fact, while trying to maintain the existing building and its orthogonal geometry, the initial exploration attempts helped to provide a better understanding of the site’s form and scale outlining the possible spatial compositions that could be created and where the volumes could be located.

Figure 50: Volumetric investigation showing the design process
The first attempt to occupy the site, (figure 50-A) followed the geometry of the existing building defining an area around the coast that would be dedicated to the marina. The building volumes were organized according to a rigid, straight grid, forming an enclosed central courtyard. At the south end the idea was to create individual buildings to serve as grandstands during the Olympic Games, and which would transform into tourist destinations and events area afterwards. On the first level spectators would be able to watch the Olympic sailing, race walking and road cycling competitions with an infrastructure of bars and restaurants, while the ground level would be reserved for the sailing athletes for preparing and keeping boats and equipment. After the games these buildings would become shops, cafes, art galleries, conference centres, tourist agencies, bars and restaurants, to create an events and leisure centre by the coast with outstanding views of the city, in a solution similar to the one adopted by the Barcelona Olympic Port.

Continuing that idea, the following attempt (figure 50-B) divided the previous three northern volumes into four and started opening the central courtyard. The southern volumes also moved away from the rigid, straight grid to follow a fluid, curved line.

Because the southern volumes were so small in relation to the scale of the park, the next attempt (figure 50-C) connected the volumes together to create a long narrow building that acts as a buffer between the park and the marina. The southern building continued following a free flowing form, but still did not emphasize the shape of the site. The north-east volume also turned to a horizontal orientation, dividing the central courtyard in two.

On the next attempt the long volume took the shape of an arch in an attempt to interact with the geometry of the site, while also reducing the size of the courtyards and the area to be occupied by the marina (figure 50-D). The northern buildings remained aligned to the rigid, straight grid of the existing building and started combining to form L-shaped volumes, rather than simple rectangular ones. However, since the scheme did not provide a means of connection with the city, nor did it emphasize the geometry of the site, the formal investigation kept moving forward.

The final attempt turned away from the existing building and combined the northern volumes to form a fluid scheme consisting of two interlocking buildings with the same geometry (figure 50-E). The buildings were organized in such a way as to create two primary, well defined external spaces; one on the city side and one the harbour side (figure 51). The interlocking aspect of the volumes allowed these spaces to be interconnected, flowing from the city to the harbour through a central narrow gap. Besides forming complex and fluid spaces, the scheme also defined and protected the spaces by the coastline, reinforcing and interacting with the shape of the site and providing a means of connection with the city. The geometry used to generate the building form simply followed the geometry of the site which combines
converging lines that gently curve at intersecting corners (figure 52). Far from arbitrary, the geometry derives from the non anchoring limits of the nautical chart (section 3.1) and the curved lines of Roberto Burle Marx (section 2.3.1.2). At this point the formal investigation reached its objective of site emphasis and connectivity and the design proceeded to explore possibilities within this scheme.

Due to its restricting aspect, incompatibility with the chosen scheme and minimal significance in the site, the existing building was dismissed from the project altogether.

Figure 51: The final volumetric attempt with the interlocking buildings defining two primary external spaces interconnected by a secondary one

Figure 52: The geometry that generated the building form
6.2.4.2 Functional Investigation

The next step consisted of investigating the geometry of the volumes and the spaces formed by this geometry to identify an optimal position for the volumes and a spatial arrangement that would not only suit, but also complement and respond to the needs of the city, the site and the programme. As previously mentioned the geometry used to generate the building form combined converging lines that gently curve at intersecting corners. The functional investigation moved the focal points of the converging lines to examine the consequence of this movement in relation to the organization of the external spaces and the programme (figure 53).

The relocation of the focal points made the form of the buildings open and close accordingly. As a consequence, the central gap which connected the two primary spaces started changing as well. With a minor adjustment on the angle of the southern building, the interconnecting gap became part of the primary external spaces in such a way that there were no longer two central, primary spaces interconnected by a secondary one, but rather two primary spaces with overlapping boundaries (figure 53-A and 53-D). In addition, the opening of the southern volume also made the primary space on the city side become more defined and inviting, as if the buildings were two open arms waiting to embrace people (figure 53-B and 53-D). Based on these aspects, the investigation identified an existing node in the urban fabric which became the focal point for the west wing of both volumes (figure 53-D). The circular node is a memorial to President Getúlio Vargas, at Luís de Camões Square on the other side of the highway (figure 54).

Besides exploring the formation of central spaces on the concave side of the buildings, the geometry analysis also investigated the coastal spaces in relation to public and private functions and in relation to access. The bubble and zoning diagrams (sections 6.2.1 and 6.2.2 respectively) had already allocated the marina and the sailing school to
the northern volume and the public spaces, including events area, tourism agencies, bars and restaurants, to the southern volume. In this case, from a functional perspective, the northern volume would have to define a private coastal area while the southern volume could be open to the public.

The changes in the angle of the northern building, particularly in relation to the site edge and the concave side of the southern building, made the coastal spaces become more, or less defined (figure 53). Having its east wing almost parallel to the coastline, with the focal point coinciding with the concave curve of the southern building helped to define a private coastal area to be occupied by the marina (figure 53-C). Based on this idea, in relation to public and private spaces, two options were analysed (figure 55). The first option completely separated the two areas, with the private marina by the interior harbour and the public activity area by the urban area. The second option placed the marina on the public area, making the coastal space less defined.
area by the exterior coastline (figure 55-A). The second option integrated public and private, with a semi private area by the central gap in the middle of the scheme (figure 55-B). Since the idea behind the project was to integrate different functions to an otherwise underutilised Marina facility, similarly to the solutions adopted by the Barcelona Olympic Port and the Qingdao Olympic Sailing Centre (sections 2.4.2 and 2.4.3), the second option became the answer.

In regards to access to the public and private areas two options were explored (figure 56). Because the central gap is a dominant part of the scheme, the first option placed the entry of the entire complex at that point with the entry of the marina to the left and the entry for the public space to the right, through a void in the southern volume (figure 56-A). However, because this solution would bring complications in terms of organization and security, the second option placed the entry for the marina at the centre of the northern volume, while the central gap remained the entry for the public area (figure 56-B). In this case, during normal operation hours, the central, semi private, area can be occupied by the marina and integrated to the public space, and at night time, when the marina gates close the entire area becomes public (figure 57).

Figure 56: Access analysis.

Following the establishment of public, private and semi private areas, the functional investigation proceeded to define circulation routes and use for the various spaces within the scheme. In order to reserve the central city side courtyard for pedestrians, the vehicle access routes were placed around the perimeter of the site (figure 58). The three different boat ramps were located at northwest, northeast and south to serve the marina, the sailing school and the public
respectively. The position of the boat ramps affected the location of nearly everything else in the scheme. The sailing school, the Marina shed, the boat repair area, the boat lift system and the car park were all positioned according to the ramps to facilitate vehicle and boat circulation. In addition to the boat ramps, a commercial pier was placed along the peninsula so that commercial charters, constantly departing and arriving with tourists, would not interfere with other boats parked in berths further inside the harbour. The position of the commercial pier also affected the location of the tourism agencies within the public building.

Figure 57: The organization of public and private areas at night time when the marina gates are closed.

Figure 58: Master Plan. Key: 1- Marina shed and shops; 2- Marina administration and accommodation; 3- Gym and health facility; 4- Sailing School; 5- Boat maintenance area; 6-Boat lift system; 7- Events and exhibition; 8- Tourism agencies, bars and restaurants; 9- Commercial pier; 10- Public car park;
6.2.4.3 Urban Connection

The form of the inviting courtyard, combined with the ideas of the Project Porto Maravilha (section 5.3), and the potential to create a link between the city and the coast (section 6.1.2) inspired the design to generate an urban connection over the highways. The connection consists of a green carpet which follows the form of the buildings volumes and the focal point of the existing urban fabric (figure 59). It works as a physical and visual connection which was lacking between the city and the Flamengo Park, taking the existing highways through underground tunnels so that pedestrians on the city side can finally see and easily access the coast. Combined with the inviting form of the buildings, the green carpet connection will help to attract residents and Olympic spectators from the city to the site.

Figure 59: The green carpet connection.
6.3 Architecture

After the formal and functional investigations, which established a general conceptual volumetric form on the site, the project proceeded to develop the architecture within that form. However, because part of the research question involved acknowledging the local cultural heritage, before initiating the architectural investigation, research on the local architecture was undertaken.

6.3.1 Cultural Heritage Architectural Investigation

The cultural heritage investigated three significant Brazilian architectural examples which have programmatic and contextual characteristics that are relevant to this project. The objective of the investigation was to identify the common and distinctive architectural elements of these works which can be incorporated into the project to help answer the research problem. The Museum of Modern Art of Rio de Janeiro and the Museum of Contemporary Art of Niterói were chosen for being prominent coastal projects along the Guanabara Bay. The Ibirapuera Project in São Paulo was chosen for also being an architectural project for an urban park. The other common characteristic between the works mentioned and the project in question is that they also deal with gathering and distribution of crowds.
6.3.1.1 Museum of Contemporary Art

Designed by the architect Oscar Niemeyer the Museum of Contemporary Art of Niterói floats above a coastal cliff by the Guanabara Bay (figure 60). The reinforced concrete “...saucer like volume is cantilevered out from a stout central stalk, 9 meters in diameter, like a flower growing over the fantastic landscape.”\textsuperscript{115} The main gallery space by the sculptural upper volume is accessed by a free flowing, elegant and curvaceous concrete ramp that emerges from the ground like a ribbon. The partly sunk lower level of the museum hosts an auditorium, a bar and restaurant, archives, technical facilities and storage spaces.\textsuperscript{116} Because of its size and limited space for artwork the Museum is frequently criticised for not being able to host large exhibitions. As a consequence residents tend to visit the Museum for parties and lectures held in the basement more often then they visit it for the exhibitions. But, due to its sculptural and emblematic aspect, the construction of the museum helped to re-establish the city’s image as a tourist destination and is now Niterói’s landmark.\textsuperscript{117}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure60.jpg}
\caption{The Museum of Contemporary Art floating above the bay and the curvaceous ramp that gives access to the main gallery.\textsuperscript{118}}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure61.jpg}
\caption{Oscar Niemeyer sketches for the museum.\textsuperscript{119}}
\end{figure}

\textsuperscript{115} Styliane Philippou, Oscar Niemeyer: Curves of Irreverence (New Haven: Yale University Press, 2008), 371.
\textsuperscript{116} Ibid., 372.
\textsuperscript{117} Ibid., 371.
\textsuperscript{119} Philippou, Oscar Niemeyer: Curves of Irreverence, 370.
Figure 62: Plans for the Museum of Contemporary Art of Niterói. Key: 1- Gallery; 2- Ramp; 3- Auditorium; 4- Restaurant; 5- Bar; 6- Archives; 7- Kitchen; 8- Reception; 9- Administration;120

120 Ibid., 373.
6.3.1.2 Museum of Modern Art

The Museum of Modern Art of Rio de Janeiro was designed by Affonso Eduardo Reidy. The gardens for the museum, which are also part of the Flamengo Park, were designed by Roberto Burle Marx. The museum complex is composed of three perpendicularly intercepted volumes that comprise the theatre, the school block and the exhibition gallery (figure 63). Because of its location, which could potentially interfere with the surrounding natural and built environment, the building was kept horizontal and low to allow continuity of the views to the Guanabara Bay, Flamengo Park and the Sugar Loaf (figure 64). The design for the exhibition gallery consists of a transparent, rectangular volume raised from the ground by an array of concrete v-columns and accessed by a dramatic spiral staircase (figure 66). The use of a hollow and transparent structure allowed the surrounding gardens to flow through the museum, integrating it into the landscape.\footnote{Bonduki, \textit{Affonso Eduardo Reidy}, 164.} The design for the exhibition gallery consists of a transparent, rectangular volume raised from the ground by an array of concrete v-columns and accessed by a dramatic spiral staircase (figure 66). The use of a hollow and transparent structure allowed the surrounding gardens to flow through the museum, integrating it into the landscape.\footnote{Ibid., 164.}

\footnote{\textquoteleft\textquoteleft Especial 4 – Porto Alegre Já Foi Dubai, Antes Mesmo De Dubai.\textquoteright\textquoteright}
To the south-east of the exhibition gallery, the solid and squared school block includes a courtyard, classrooms, administration offices and rooms for the reception, storage and preparation of exhibitions. In the courtyard a public ramp gives access to the terrace garden, where there is a bar and a restaurant with fascinating views of Guanabara Bay and the Sugar Loaf (figures 67 and 68).

The eastern edge of the museum complex includes a sculptural, curved concrete volume which accommodates a theatre with a thousand seats (figure 64). A covered passageway delineated by a solid variation of the v-columns makes the connection between the theatre and the main exhibition block.

One year earlier, when designing a project for the Brazil-Paraguay School, Reidy also incorporated the v-shaped columns in a design solution incredibly similar to the Museum of Modern Art (figure 69). Like the Museum of Modern Art, the Brazil-Paraguay School also consists of a transparent, rectangular volume raised from the ground by a framework of v-columns. Even though they are not identical, the similarity between the two projects shows that the design for the

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124 Bonduki, Affonso Eduardo Reidy, 169.
126 Bonduki, Affonso Eduardo Reidy, 166.
museum is not necessarily attached to its function. Besides being elegant, the distinctive structure also makes the building adaptable so that it can easily work with different programmes, such as a Museum or a School.

Figure 67: The school courtyard with the ramp to the terrace garden on the left.

Figure 68: The school block garden terrace.

Figure 69: The Museum of Modern Art of Rio de Janeiro (on the left) and the Brazil-Paraguay School.127

127 Ibid., 160.
6.3.1.3 Ibirapuera Park Complex

The Ibirapuera Park Complex was a collaboration project between Oscar Niemeyer and Roberto Burle Marx for the celebration of the 400 years of the foundation of São Paulo city.\textsuperscript{128} The idea behind the complex was to create a new city focus on cultural activities, hosting large scale exhibitions and fairs, as well as a variety of cultural events.\textsuperscript{129} Unfortunately, the original project, with the gardens designed by Burle Marx, was not constructed (figure 70).

![Figure 70: The original gardens designed by Burle Marx.\textsuperscript{130}](image)

The present scheme consists of a 650 metres long limbed concrete marquee floating above the central esplanade and linking five volumes together (figures 71 and 72). The volumes comprise the Pavilion of Industries, the Pavilion of Nations, the Pavilion of States, the Pavilion of Arts and the auditorium.\textsuperscript{131} Underneath the marquee a curved glass volume also hosts the Museum of Modern Art of São Paulo. The long marquee works as a cultural and social gathering centre, widely used by tourists and residents for walking, bike riding, skate boarding, public performances, cultural events and exhibitions (figure 74).

The Pavilion of Industries, the Pavilion of Nations and the Pavilion of States are long and highly horizontal, rectangular volumes elevated from the ground (figures 75 and 76). On the north façade all three buildings incorporate the use of different solar control methods such as perforated screens or louvers, which give them texture and character. The Pavilion of Arts and the auditorium are sculptural, concrete volumes with white and smooth surfaces that sit solidly on the

\textsuperscript{128} Philippou, \textit{Oscar Niemeyer: Curves of Irreverence}, 164.
\textsuperscript{129} Ibid., 164.
\textsuperscript{130} Ibid., 164.
\textsuperscript{131} Ibid., 165.
ground (figure 77). Even though they have different external aspects, all five volumes have in common the integration of space and structure and the extensive use of ramps.

Figure 71: Ibirapuera Complex aerial view. Key: 1- Pavilion of Nations; 2- Pavilion of States; 3- Marquee; 4- Auditorium; 5- Pavilion of Arts; 6- Pavilion of Industries;

Figure 72: Aerial view showing the Pavilion of Industries at the back, the Pavilion of Arts, and the auditorium in the foreground.132

Figure 73: The Museum of Modern Art underneath the marquee.133


“Bienal De Arte De São Paulo.”


Futagawa, Oscar Niemeyer Form and Space, 71-76.
6.3.2 Architectural Design Process

The architectural heritage research identified four basic elements that had both functional and formal value to this brief. They were incorporated into the design and slowly developed into the final solution. They were the ramp, the staircases, the structure and the façade.

6.3.2.1 Ramp

Inspired by the heritage research the first move of the architectural design process was to incorporate the use of ramps to the public events building. Besides being part of the Brazilian architectural heritage, the ramps were also adopted because of their elegance and inviting aspect, which tend to draw people to a building, while also dealing with vertical circulation. Initially the design for the events building incorporated a long and curved double concrete ramp that gently lifted from the ground and reached its highest point just after the middle of the building, where it turned into a continuous flat roof and viewing terrace (figure 78). However, as the design developed, the upper ramp was eliminated to facilitate access and allow continuity of the façade (figure 79). The design for the concrete ramp was also developed from the previously mentioned idea of having the second level dedicated to the Olympic spectators and the ground level dedicated to the athletes (section 6.2.3.1). This way the ramp leads the spectators directly to the viewing terrace, leaving the entire ground level for the athletes and the preparation of boats (figure 80). After the games, besides providing direct access to the terrace, the ramp will continue the function of the Flamengo Park and be used by the general public for walking, bike riding, skating, and jogging.

Figure 78: Exploration model showing the initial curved double ramp.
Figure 79: Exploration model showing the developed ramp design.

Figure 80: Conceptual section through the atrium of the public events building during the Olympic Games.

Figure 81: Conceptual section through the atrium of the public events building after the Olympic Games.
6.3.2.2 Staircase

Due to the considerable length of the public events building, apart from the ramp, it was necessary to incorporate a vertical circulation system that would give rhythm to the building and also work as a point of reference to guide visitors. The initial attempt incorporated external, vertical circulation shafts that punctuated the southern façade every 100 metres (figure 82). The idea behind the external shafts was to add a vertical element to the otherwise highly horizontal scheme and also inform the location of atriums and vertical connections. However, as the design developed and the structural system was incorporated, the building gained additional vertical elements, transparency and lightness. At that point the external circulation shafts started contradicting the lightness of the design and, as a consequence, the staircases were moved to the side of the atriums in the interior of the building (figure 83). This way the vertical circulation system works together with the atriums, punctuating the building and guiding visitors. As the design progressed, the central curve also became the most prominent area of the building to be used for events and exhibitions, and also as an entry point. In this case, instead of adding a rectangular staircase to that area, as was done to the rest of the building, a sculptural spiral staircase was added, inspired by the design of the Museum of Modern Art. The spiral staircase was incorporated not only for being an extremely elegant element that is part of the Brazilian cultural heritage, but also because of its monumental aspect adding a sense of importance to that particular access and surrounding spaces.

Figure 82: Exploration model showing the initial vertical circulation system with a series of external shafts that punctuated the southern façade at every 100 metres.
In the private Marina building the vertical circulation did not follow the same system of the public events building due to the difference in building use. In that case instead of being pre-established, the circulation was organized according to the plan and organization of spaces for the Marina and the Sailing School.

Figure 83: Diagrammatical plan of vertical circulation systems showing the location of the atriums and staircases in the Public Events Building.
6.3.2.3 Structure

After the development of a public ramp and viewing terrace for the public events building, a structural investigation was initiated. The starting point for the investigation was Reidy’s design for the Museum of Modern Art in comparison with the Brazil-Paraguay School, which show how a shed-like structure can be both light and adaptable at the same time (refer section 3.5.1.2). Since the research question looks primarily at the problem of long term and short term use, an adaptable shed structure that also acknowledges the local architectural heritage became the ideal solution. As a consequence, distinctive column design and structural repetition, which are characteristic of Reidy’s projects, became the base for the structural investigation. Because the Marina building and the public events building have different uses and different attributes at this stage the structural investigation concerned the public events building only.

The first step of the investigation consisted of developing a structural grid that would not only make the building structurally sound but also set a proportionate rhythm to the general layout arrangement. In combination with the ramp and the viewing terrace the column grid would also transform the building into an enormous and adaptable events shed. Due to the extensive length of the building, 20 metres structural bays were established as being appropriate both structurally and in relation to the general length of the building. After the grid was established, a series of sectional models were constructed to explore column design possibilities (figure 84). Besides exploring the formal aspects that would set the columns as architectural features, the models also aimed at finding a solution that would reference the building form and make the building light and penetrable, welcoming the public.

Figure 84: Exploration models and their respective diagrammatical sections.

The first model and column design attempt consisted of a central, wide column that extended its sides forming a single structural piece that served as both a column and a beam (figure 84-A). On the first floor the same structure was repeated, but on a smaller scale. Even though this solution was elegant and made the building light, the two
different structures for the top and bottom levels were not ideal as they treated the levels as different parts, instead of connecting the building as a whole. In addition the overall shape of the column did not make any reference to the building form.

The following attempt, consisted of symmetrical boomerang shaped pieces that have one wing as a column and the other wing on the ground as a continuous wall (figure 84-B). Even though this attempt clearly referenced the building form, the column repetition on both sides of the building was excessive and the continuous walls on the ground could, potentially, create future problems with circulation.

The third and last attempt consisted of refining the previous attempt to a final solution. On the southern side the boomerang-shaped piece was kept, however, instead of having one wing on the ground as a wall, its edge was lifted to hold the terrace overhang (figure 84-C). The result is an elegant v-shaped column that makes reference to the building form and to the Museum of Modern Art, while also holding both the terrace and the roof. On the northern side a simple tapering column replaced the previous boomerang piece, eliminating the excessive symmetrical repetition. As a consequence the refined attempt generated a light and penetrable structure that works as an architectural feature while also making reference to the building form. Since these were the objectives, the structural investigation came to an end.

The next step involved adapting the column design and structural repetition to the pre established grid in a way that would suit the tapering and curved limits of the building. Because of the varying widths caused by the tapering form, the columns could not be exactly the same and had to be adapted. As a result a system was developed to design each individual v-column with the same base but different inclinations depending on the width of the building section (figure 85). Even though the initial idea was based on structural repetition, the slight variation in the columns contributed to the architecture of the building, suggesting movement and physically expressing the journey from one side to the other. In addition the small difference in the column angles also works as a reference to guide the visitors through the building.

Figure 85: Exploration model and diagrammatical sections across the Public Events Building showing the different angles of the v-columns.
6.3.2.4 Façade

Following the structural exploration it was necessary to develop a form of solar control for both the events and Marina buildings. Even though the two buildings are different and have different uses, together they form an entire complex and for that reason they should also have similarities. Inspired by the Pavilion of States at the Ibirapuera Complex (section 6.3.1.4) a perforated northern façade was developed as the common element that bonds the two buildings together, making them read as a whole complex (figure 86). On the public events building the perforated façade was lifted from the ground to provide solar control and keep the building permeable and open to the public. On the Marina building, besides touching the ground to convey privacy, the perforated façade is also operable to open to the boat garage and workshops inside. In addition, the perforated northern façades also provide smooth and continuous surfaces that reinforce the concave and convex aspects of the buildings.

Figure 86: Exploration model showing the perforated northern façades as the common element that bonds the two buildings together.
7.0 Conclusion

7.1 Critical Appraisal of Final Design

The objective of the Rio 2016 project was to investigate how the design for an Olympic venue, which is typically temporary, could contribute to the city in the long term and also acknowledge the local culture. This was proposed to be achieved through urban and architectural design strategies that would be first identified as a set of principles, and then tried out, analysed and refined using research-by-design. As the project progressed, the strategies were developed under the topics of Site, Master Plan and Architecture.

7.1.1 Site

The distinctive geometry of the reinvented site acknowledged the local environment and became a driving force and major influence on the development of the project. With a total of approximately 418,000m$^2$, including wet and dry areas, the new site changed the coastline with curved lines that respected the existing geometry of Flamengo Park and the no anchoring limits set by the Nautical Chart. By extending the protective arm from the southern beach side it was possible to centralize the Marina on only one side of the harbour, while providing a connection with the beach. Besides generating a secondary bay inside the harbour and increasing the coastline perimeter to be used by the Marina, the protective arm also works as a peninsula that can be accessed by the public and provide magnificent views of the city, Guanabara Bay and the Sugar Loaf. Because the limits of the peninsula coincide with the no anchoring limits of the Nautical Chart, which are defined by the airport flight paths, from the peninsula the public will also be able to observe airplanes constantly landing and taking off.

Instead of taking away from the existing park, the reinvention of the site through land reclamation provided the city with a new and accessible coastal area that will be the heart of the Olympic Sailing competitions and will also be utilised by tourists and residents for a wide range of different recreational activities after the Games are finished.

7.1.2 Master Plan

The master plan represented the starting point in dealing with the issues of long term and short term use. By separating one building with long term functions and the other with similar and corresponding short and long term functions, it became easier to deal with planning and design issues. The association of the already existing long term function of the Marina as an events centre, combined with the short
term Olympic Games, made it possible to create one single building entirely dedicated to large scale events. As a consequence, the other building, hosting the Marina and the Sailing School, did not have to deal with issues regarding the short term Olympics and could be designed specifically for long term use only.

The site analysis revealed a connectivity issue between the city and Flamengo Park, which was overcome by the green carpet connection and the building volumes. The two boomerang-shaped, interlocking buildings embrace the city and the harbour, generating complex and fluid spaces that attract people to the coast. While their convex side define and protect the spaces by the coastline, with their concave sides the buildings create well defined central courtyards that have the ability to draw and retain crowds. The complex arrangement adds interest and curiosity to the journey from the city to the peninsula with courtyards opening and closing, hiding and revealing what is beyond the buildings. Besides becoming an historic plaza dedicated to the Olympic Games, in combination with the green carpet connection the central courtyard also becomes the main pedestrian access point between the city and Flamengo Park. By taking the existing highways that separate the park through underground tunnels it was possible to visually and physically reconnect the park and the coast back to the city.

The establishment of public, private and semi private areas, with different access points, allowed for integration of functions within the scheme while also providing security for the Marina and the Sailing School. The three strategically positioned boat ramps also facilitate boat circulation, ensuring that the Olympics and future sailing competitions do not interfere with the everyday use of the Marina. The positioning of the commercial pier along the peninsula provides easy access, arrival and departure of tourism boats without disturbing other vessels in the harbour.

7.1.3 Architecture

To help answer the research question, especially in regards to acknowledgement of the local culture, the architecture looked at three existing Brazilian projects for guidance. The projects were the Museum of Modern Art of Rio de Janeiro, the Museum of Contemporary Art of Niteroi and the Ibirapuera Park in São Paulo. By referencing architectural elements from these buildings the final project establishes a healthy relationship with the local architecture, attending to the demands of the Olympic sailing competitions while also benefiting and contributing to the city on the long term. The ramp on the Public Events building, in combination with the central courtyard, works as a magnet, attracting people to the building and the site. It was incorporated into the project for being a distinctive Brazilian architectural element found on all three of the projects studied. While it deals with the problem of circulation, leading people directly to the grandstands on the terrace,
the ramp also gives the building a sculptural and elegant appearance. After the Olympic Games the ramp will give tourists and residents an enjoyable public space to appreciate the views, walk, jog, skate and bike ride.

The staircases and the atriums punctuate and give rhythm to the events building, working as a point of reference to guide visitors. Because of their position inside the atriums, the staircases work as focal points, drawing people to the building and up the terrace. Under the central curve the monumental spiral staircase emphasizes the building’s central access, while also adding a sense of importance to the space.

The structural design was the most important strategy in regards to the issue of long term and short term use. Inspired by the Museum of Modern Art, it transformed the events building into an adaptable marquee. The light and penetrable structure, with V-shaped columns on the southern side and simple tapering columns on the northern side, makes reference to the building form and to the columns designed by Reidy. Far from being a problem, the slight variation in the columns became a feature that integrates structural and architectural design, suggesting movement and emphasizing the journey through the building. Besides making it float above the bay, the distinctive structure also allows the building to have free plans with ample possibilities of space arrangements. Even though it was designed to be an events centre, due to its adaptable character, should the need arise, the building also could easily and successfully provide for other uses, such as a sports centre or a university for example.

The perforated northern façades were inspired by Niemeyer’s design for the Pavilion of States at the Ibirapuera Park in São Paulo. Besides providing solar control, the façades unify the buildings, making them read as a complex rather than two distinctive and separate volumes. Being smooth and continuous surfaces, the façades reinforce the curved and sculptural aspect of the buildings, thus paying homage to the architectural style which has earned Brazil worldwide recognition. For their sleek and dramatic qualities, the façades are the finishing touch in this project. They grant the final design the fine balancing of functionalist and formalist aspects, so characteristic of the modern Brazilian architectural style.
7.2 Summary

The research question asked how the design for an Olympic venue could contribute to the city and to the lifestyle of local communities in the long term, while also acknowledging the local environment and the local culture. The question was based on a very direct notion that a design intervention for a developed urban area should be in tune with the existing context. For that reason the project incorporated design strategies from the existing urban and architectural environment. Given the final solution, it is interesting to notice that the answer to the question was in fact in the question itself.

The acknowledgement of the local culture was done, both socially and architecturally. The original design of the park played a significant role and was the starting point for the development of the entire project. The existing Museum of Modern Art, as an example of multi-use architecture, inspired the development of the public events building and, as a consequence, the design makes explicit reference to it. Since events were already an integral part of the site and the lifestyle of the city, a permanent and adaptable events marquee became a plausible solution. Besides acknowledging the local environment and making reference to the museum across the harbour, the events marquee also provides a design response to the problem of long term and short term use, with an architecture that is not necessarily solidified in its function and that can receive different uses if needed in the future.

The literature review and site analysis revealed the problem of connectivity between the city and Flamengo Park. This problem was overcome by the green carpet which reconnected the park back to the city, allowing easy, safe and pleasant pedestrian access. In combination with the building form the green carpet also strengthened the relationship between the city and the coast. The idea for the connection was taken from the Project Porto Maravilha which was investigated under the case studies.

7.3 Future Research

The set of principles that led this project strongly emphasized the local cultural heritage (including the design and architecture tradition). For that reason the design rules that were discovered and applied may not work well in other cultural contexts. But beyond the particularities of the local culture, it can be said that there was one overall rule: the association of similar requirements for the programme, the site and the Olympic competitions is what helped arriving at a convincing solution.

As a suggestion for further research, I would propose analogous projects in other regional and national traditions, whenever the key problem is post-event use, so typically associated with Olympic and other high-level international sporting competitions.
Appendix A Technical Information

Definitions

**Beam**-
The maximum width of a vessel (figure 87).\(^{138}\)

![Figure 87: Beam of a boat](image)

**Berth (wet)/Boat Slip**-
“A water surface area, delineated by either floating or fixed dock structures, for the purposes of embarking, disembarking, and the wet storage of recreational boats.”\(^{139}\)

**Boat Ramp/Slipway**-
“A sloped surface designed for launching and retrieving boats and other water craft to and from the water.”\(^{140}\)

**Dry Berth/ Dry boat storage**-
A designated space for the storage of boats or other water vessels on land. Can be organised either vertically on stack systems, or horizontally on storage yards.

**Dry Dock**-
A basin that can be flooded and pumped dry to repair vessels.\(^{141}\)

**Finger Pier/Slip Finger**-

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\(^{139}\) Bill Curry, *Layout and Design Guidelines for Marina Berthing Facilities (California Department of Boating and Waterways, 2005)*, 1.

\(^{140}\) Ibid., 2.

A fixed or floating finger-like structure, usually attached perpendicular to a main walkway that provides pedestrian access to the berth (figure 88).  

![Figure 88: Walkway and slip finger](image)

**LOA-**  
Length overall. Is the maximum length of a vessel.  

**Marina-**  
“A recreational boating facility on a coastal or inland waterfront that provides facilities and services for the wet and/or dry storage of boats, as well as embarking and disembarking of boat operators and passengers.”  

**Pier-**  
A fixed or floating structure, that extends over the water providing access.  

**Walkway-**  
A fixed or floating structure, to which finger piers are attached, that defines individual berths and provides pedestrian access (figure 88).  

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145 Ibid., 5.  
146 Ibid., 7.
Olympic Sailing Classes

Based on the International Sailing Federation release for London 2012, the Olympics Sailing Classes are:¹⁴⁷

- Men’s One Person Dinghy – Laser
- Men’s One Person Dinghy Heavy – Finn
- Men’s Two Person Dinghy – 470
- Men’s Two Person Dinghy High Performance – 49er
- Men’s Windsurfer – RS:X
- Men’s Keelboat – Star
- Women’s One Person Dinghy – Laser Radial
- Women’s Two Person Dinghy – 470
- Women’s Keelboat Match Racing – Elliott 6m
- Women’s Windsurfer – RS:X

### Olympic Sailing Boats Measurements¹⁴⁸

<table>
<thead>
<tr>
<th>LOA</th>
<th>Beam</th>
<th>Height¹⁴⁹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finn Dinghy</td>
<td>4.50m</td>
<td>1.47m</td>
</tr>
<tr>
<td>Laser Standard</td>
<td>4.00m</td>
<td>1.42m</td>
</tr>
<tr>
<td>Laser Radial</td>
<td>4.23m</td>
<td>1.37m</td>
</tr>
<tr>
<td>470</td>
<td>4.70m</td>
<td>1.68m</td>
</tr>
<tr>
<td>49er</td>
<td>4.87m</td>
<td>1.75m</td>
</tr>
<tr>
<td>Star</td>
<td>6.92m</td>
<td>1.73m</td>
</tr>
<tr>
<td>Elliot 6m¹⁵⁰</td>
<td>6.00m</td>
<td>2.35m</td>
</tr>
<tr>
<td>RS:X¹⁵¹</td>
<td>2.86m</td>
<td>0.93m</td>
</tr>
</tbody>
</table>

¹⁴⁹ The table refers to the approximate overall height of the boat when it is put together including the sail and the mast, not including the centreboard.
¹⁵¹ Royce, Sailing Illustrated: The Sailor’s Bible since 1956., 27.
Appendix B: Agache Plan

In 1927, after delivering a series of conferences around Brazil, the French Urbanist Alfred Agache went to Rio de Janeiro and organized a team of specialists to formulate an urban renewal plan for the city.\(^{152}\) Besides a few experienced engineers and architects, Agache’s team also included the young architect Affonso Eduardo Reidy, who was a student of the National School of Fine Arts of Rio de Janeiro at the time.\(^{153}\)

Agache’s plan established that Rio had two major functions as a “politico-administrative capital, on the one hand, and an economic hub, a commercial and industrial market and a port, on the other.”\(^ {154}\) The plan divided the city in five different urban zones: Central and commercial, industrial and port, residential, suburban and rural.\(^{155}\) However, due to the rising tide of Brazilian nationalism and the economic crisis of the 1930s, Agache’s plans were not carried out.\(^{156}\) Nevertheless, Agache’s plans and the application of zoning as a way to control urban land use were adapted for the first Building Code of 1937 and still influence urban legislations to this date.\(^ {157}\)


\(^{153}\) Bonduki, Affonso Eduardo Reidy, 62.


\(^{156}\) Underwood, “Alfred Agache, French Sociology, and Modern Urbanism in France and Brazil,” 158.

Appendix C: Perimetral Avenue

In 1938 the newly formed City Plan Commission and City Plan Technical Services were responsible for continuing the urban studies and plans proposed by Alfred Agache, and for readapting them to the city’s new conditions. The Technical Services team, which included Affonso Reidy, was in charge of redeveloping Agache’s proposals for critical areas, such as the esplanades of Castelo and Santo Antônio, and the Glória-Flamengo landfill, which were carried out under the Pilot Plan of Rio de Janeiro.

At that time Reidy was put in charge of the development of the Castelo Esplanade. When he proposed his plan, even though he acknowledged Agache’s contribution, Reidy also made references to the principles of Le Corbusier, with whom he had contact in 1936 during the project for the Ministry of Education and Health.

Reidy understood that the city of Rio de Janeiro had three well defined zones of North, Central and South and that, due to the city’s configuration, the connection between them was distant, sinuous and difficult. The only connection between the northern and southern zones was through the central area which was hardly sufficient for local traffic. In view of the problem Reidy adopted Le Corbusier’s principle of the separation of fast traffic from local traffic and proposed an elevated highway, cutting the central zone through Castelo esplanade. The elevated highway, which was called Perimetral Avenue, connected Mauá Plaza (at the Central-North zone) to Santos Dumont Airport and Beira-Mar Avenue, improving fast traffic connectivity between northern and southern areas of the central city.

During the following years, Perimetral Avenue was slowly extended to connect to further north areas of the city along Rodrigues Alves Avenue, eventually connecting to the Rio-Niteroi Bridge. The Avenue still holds centre stage in discussions about the urban plan of Rio de Janeiro as it blocks the views and separates the port area from the rest of the city. The current project, Porto Maravilha, aims to recuperate the port of Rio, an important area where tourists arrive from cruise ships and which has been abandoned for years, partially due to the construction of Perimetral Avenue.

158 Bonduki, Affonso Eduardo Reidy, 62.
159 Ibid., 62.
160 Ibid., 62.
161 Ibid., 63.
162 Ibid., 64.
163 Ibid., 64.
Appendix D: Final Presentation Drawings

Figure 89: Perspective view of complex from North-East piers

Figure 90: Perspective view of complex from central courtyard
Figure 91: Perspective view of Events Building from the South side

Figure 92: Perspective view of Events Building from the East side

Figure 93: Perspective view of Events Building from the central curve (deck level)
Figure 94: Site Plan

Figure 95: Circulation Diagrams

Figure 96: Olympic Zoning Diagrams. Ground and Mezzanine Levels on the left; Deck Level on the right;
Figure 97: Deck Level Plan

Figure 98: Mezzanine Level Plan

Figure 99: Ground Level Plan
Figure 100: Section A-A

Figure 101: Section B-B (during the Olympics)

Figure 102: Section B-B (after the Olympics)

Figure 103: Site Model
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