BEIRA CENTRAL STATION

CONSERVATION MANAGEMENT PLAN

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CONTENTS

BNU	*Banco Nacional Ultramarino* (National Overseas Bank)
CFM	*Caminhos de Ferro de Moçambique* (Mozambique Railways)
DSPCFTM	*Direção dos Serviços dos Portos, Caminhos de Ferro e Transportes de Moçambique* (Mozambique Ports, Railways, and Transportation Services Direction)
EBAL	*Escola de Belas Artes de Lisboa* (Lisbon School of Fine Arts)
EBAP	*Escola de Belas Artes do Porto* (Porto School of Fine Arts)

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SECTION 1

1. Introduction

According to the competition proposal, *Mozambique is a country located in southeastern Africa, bathed by the Indian Ocean to the east and bordering Tanzania to the north; Malawi and Zambia to the northwest; Zimbabwe to the west and Swaziland and South Africa to the southwest* (Figure 1.1)*. Mozambique is in the UN list of Least Developed Countries and among the poorest countries in the world (7th according to the World Bank). Still, the country has rich and extensive natural resources. The country's economy is mainly based on agriculture, but the industrial sector, mainly in the manufacture of food, beverages, chemicals, aluminum, gas and oil, is growing. The country's tourism sector is also growing. South Africa is Mozambique's main trading partner and the main source of foreign direct investment. Portugal, Brazil, Spain and Belgium are also among the most important economic partners of the country. Mozambique has three main ports (Maputo, Beira and Nacala) with railway connections with the land locked countries hinterland.*

Beira, the capital of Sofala Province in central Mozambique, is the second largest city in country, just after its capital, Maputo (Figure 1.2)*. The Beira port and the railways have become increasingly important to Mozambique, given the transport of coal and other commodities, as well as the exports and imports from the hinterland countries. The Beira port connects to the hinterland, namely Zimbabwe, Zambia, Malawi, R.D. Congo, Botswana and South Africa, being currently the second largest seaport for international transport of cargoes to and from Mozambique. The city of Beira is in full development, although it still maintains some deteriorated and problematic areas. Urban and architectonic rehabilitation of the city is needed and expected. In this context, the rehabilitation of the railway station* (Figure 1.3) *is considered a fundamental element for the citizen collective memory, as well as for the*

SECTION 1

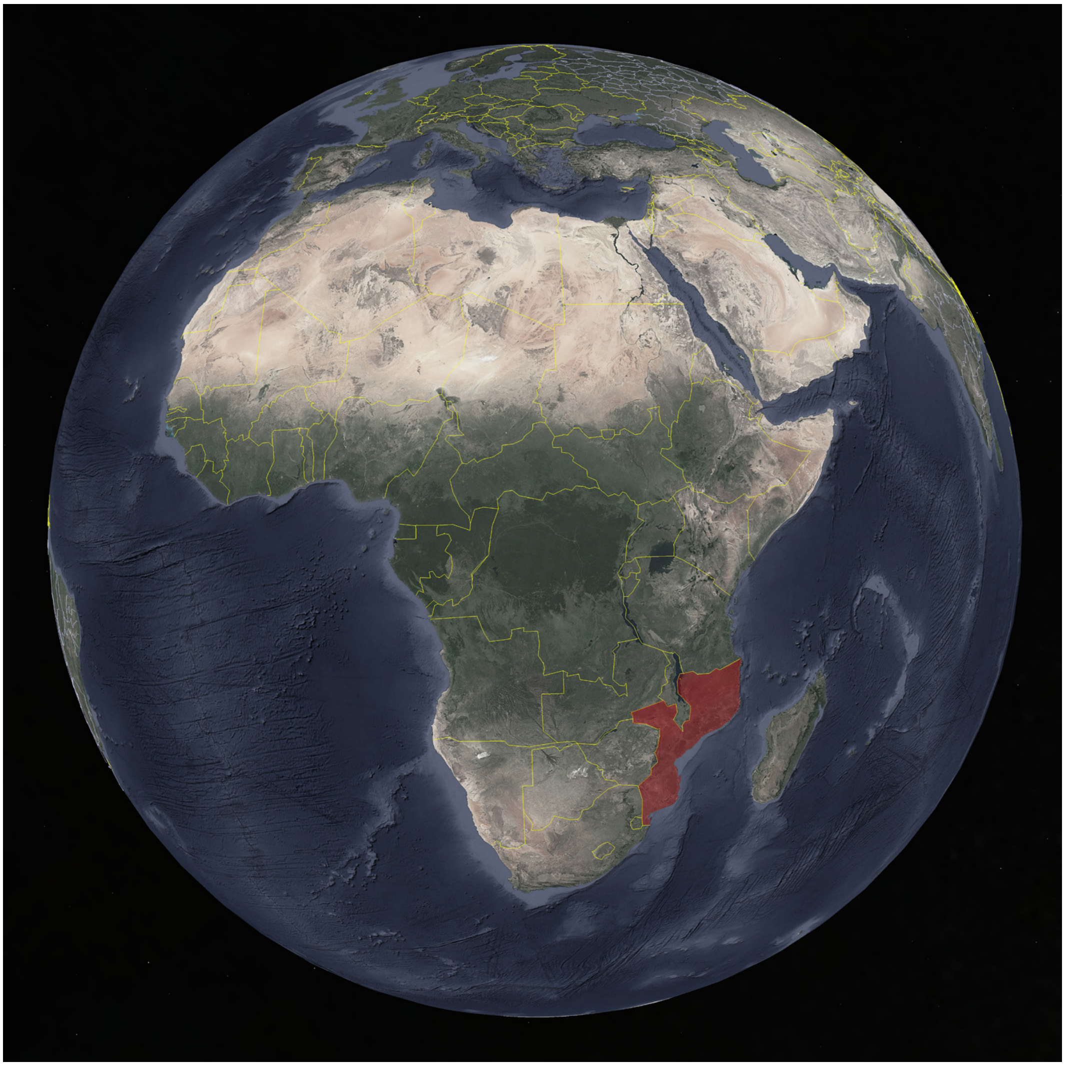

Figure 1.1 Satellite view of Africa with location of Mozambique (Google Earth Pro, 2023).

city's confidence in the future. With the increasing development of the country, urban and architectural development of the city is also expected.

(...) Beira witnessed some of the most important projects of the Modern Movement in the Colonial Portuguese Africa, namely its train station. This large monumental building results from a team of three architects (...) and interprets exemplarily the International Style langua-

Figure 1.2 Satellite view of Mozambique with location of the city of Beira (Google Earth Pro, 2023).

Figure 1.3 Satellite view of the city of Beira with location of the Central Station (Google Earth Pro, 2023).

ge. (...) The building has also an unquestionable iconic and popular dimension for the city and the country, as well as for the broader context of railway history, particularly in Africa.[1.1]

1.1 Building classification of Maputo and Beira central stations

Beira and Maputo central stations are the only railway stations among the 22 Portuguese constructions in Mozambique included in the 100 designated 20th century Portuguese engineering constructions.[1.2]

1.1 Lourenço (et. al.), 2019: 2-3.
1.2 Esteves; Tavares, 2003: 204-207.

In 2010, the Faculty of Architecture and Physical Planning of the University Eduardo Mondlane, in Maputo, together with the Italian cooperation agency, elaborated an inventory of buildings with historical, environmental or architectural value in Maputo. The purpose of this project was to enhance the built heritage of the city. Out of the 200 patrimonial buildings that were inventoried, a joint proposal with the Municipality and the Ministries of Culture, Tourism and Public Works recommended 30 for classification.[1.3] Amongst them, there was the Maputo Central Station.[1.4]

Following the same methodology, in 2013 the results of a survey of the architectural heritage of the city of Beira were presented and out of 200 buildings and public spaces inventoried, 30 were included in a list of assets to be safeguarded.[1.5] The Beira Central Station was also part of this list.[1.6]

Maputo and Beira central stations are not currently designated as heritage buildings under Mozambique regulations. It is noted that, at the moment, only one building has legal protection as national heritage in Mozambique: the chapel of the church of N'Hlamankulu. A proposal to list the Beira and the Maputo Central Stations under Mozambique regulations, corresponding to class A (i.e. *Heritage and cultural assets of high national value, including those that have the potential to contribute significantly to national research and research objectives*), launched by the team,[1.7] is ready to be submitted by their present-day holder, the

1.3 Lage, L.; Carrilho, J., 2010.
1.4 Lage, L.; Carrilho, J., 2010: 22-23.
1.5 Lage, L.; Carrilho, J. (coords.).
1.6 Lage, L.; Carrilho, J. (coords.): 10-11.
1.7 *Proposal for classification of the buildings of the Central Station of Maputo and Beira as cultural heritage*, Proposal submitted by the team to the Administration of Ports and Railways of Mozambique, 2020.

state-owned company Mozambique Railways, for consideration and approval by the Council of Ministers of the Mozambican Government.

Classification as Cultural Heritage gives these infrastructures the possibility of becoming centers for the promotion and dynamization of cultural tourism, ensuring the continuity and transferability to future generations of the values associated with them. Likewise, its classification contributes to guarantee its protection, conservation and sustainable management, in accordance with Law 10/88 of 22 December, which determines the legal protection of material and intangible assets of the Mozambican cultural heritage, together with Decree n.º 55/2016, approving the regulation on the management of cultural property.[1.8]

1.1.1 Maputo Central Station

The Maputo Central Railway Station (Figures 1.4-1.8)*, one of Mozambique's oldest public structures, was designed in 1906 by Eng. Alfredo Augusto Lisboa de Lima, director of the Lourenço Marques Railways, to replace the existing wood and zinc station. The construction of the station's main body began on January 2, 1908, and it opened on March 19, 1910. On September 22, 1913, the project for the façade of the administration body was approved, according to the design attributed to Arch. José Cristiano da Paula Ferreira da Costa. This two -story building, encompassing the station, quay and existing railway lines, opened in 1916.*

The Maputo Railway Station is a two-story historic monumental edifice, showcasing an impressive façade, composed of a main body facing Trabalhadores Square, that is built in

1.8 *Proposal for classification of the buildings of the Central Station of Maputo and Beira as cultural heritage*, Proposal submitted by the team to the Administration of Ports and Railways of Mozambique, 2020.

Figure 1.4 *Boletim dos Portos, Caminhos de Ferro e Transportes de Moçambique*, May 1966: cover (MCFM | EM, 2019).

Figure 1.5 *Boletim dos Portos, Caminhos de Ferro e Transportes de Moçambique*, January 1968: cover (MCFM | EM, 2019).

Figure 1.6 *Boletim dos Portos, Caminhos de Ferro e Transportes de Moçambique - supplement*, July 1970: cover (MCFM | EM, 2019).

Figure 1.7 *Boletim dos Portos, Caminhos de Ferro e Transportes de Moçambique*, February 1971: cover (MCFM | EM, 2019).

Figure 1.8 Maputo Central Station (EM, 2009)

Figure 1.9 Beira Central Station, (EM, 2009)

masonry and covered by 3 ornamental domes, and two side aisles. The complex houses all the services of the station and the administration of the port and railways.

The station consists of four covered longitudinal platforms connected by a transversal platform. At the front, a garden makes the transition between the outdoor areas and the private domain of the building.

Symmetrical building of eclectic decor, representative of a classical French style *influenced by the so-called* Victorian style, *it is considered one of the most beautiful railway stations in the world. Its structure is composed of masonry and steel constructive elements. The main façade has a central tower topped by a bronze dome, flanked by two smaller domes. The floors are covered in mosaic and the roofs in metal sheets. The building has only undergone maintenance interventions, thus preserving its integrity and authenticity.*[1.9]

In 2009, the magazine *Newsweek* ranked the Maputo Central Station as the seventh most beautiful railway station in the world and the first one in the African continent.[1.10] Also New York magazines *Time*[1.11] and *Travel+Leisure*[1.12] ranked the building amongst the most beautiful train stations in the world.

1.1.2 Comparative analysis of Beira and Maputo Central Stations

The relevance of these two buildings within the built heritage of Mozambique can be analyzed from different perspectives: on the one hand, the intrinsic quality of the buildings, their imposing façades, as admirable internationally recognized architectural examples, re-

1.9 *Proposal for classification of the buildings of the Central Station of Maputo and Beira as cultural heritage*, Proposal submitted by the team to the Administration of Ports and Railways of Mozambique, 2020.

1.10 *Newsweek*, January 9, 2009; Navarro, 2012.

1.11 *Time*, April 30, 2015.

1.12 Navarro, 2012.

presentative of different styles that marked their times (Figures 1.8-1.9)*; on the other hand, as an integral part of history, illustration of a certain phase of the architecture of the colonial city, from the thriving period of establishment, consolidation and evolution of the initial urban structure. One can also consider their* affective *heritage dimension, as icons of the Mozambican railways, key elements in the construction of the Mozambican national identity.*

Maputo and Beira railway stations are infrastructural complexes that still maintain their original functionality, survivals that constitute factors of added value: they are images that link collective memories, spaces for hosting countless ephemeral, public and private events. They establish a relationship of utility with the city, have a structuring weight in the emergence of its economic and social dynamics. They are, finally, emblematic buildings of Mozambique.[1.13]

1.2 Methodology of the CMP

This CMP's methodology adheres to the international conventions for intervention in heritage buildings, particularly the *Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance*[1.14] and the *Approaches to the conservation of twentieth-century cultural heritage: Madrid-New Delhi document.*[1.15] James Semple Kerr's practical guidelines in his *Conservation Plan: A Guide to the Preparation of Conservation Plans*[1.16] in addition to the methodology and structure that informed the Getty Conservation Institute's CMP for the Ea-

1.13 *Proposal for classification of the buildings of the Central Station of Maputo and Beira as cultural heritage*, Proposal submitted by the team to the Administration of Ports and Railways of Mozambique, 2020.

1.14 Australia ICOMOS, 2013.

1.15 ISC20C, 2017.

1.16 Kerr, 2013.

mes House in 2018, were also used as a reference base - with the necessary adaptations to the context of the Beira Central Station and the circumstances of this CMP's design process.

1.3 Structure of the CMP

The Conservation Management Plan (CMP) for Beira Central Station is divided into five major chapters, which are prefaced by this introduction:

- The first chapter, *Section 2 - Understanding the Place*, offers a historical reading of the Portuguese State's colonial policy in the third quarter of the twentieth century; a framing and characterization of the architecture of the Modern Movement in Mozambique, with a special emphasis on the work of its authors; and an analysis of the process of designing and building the Beira Central Station, followed by an interpretation of its historical significance;
- The second chapter, *Section 3 - Assessment of cultural significance*, sets up the values and levels of significance, as well as classifications of the Beira Central Station's elements, components, and attributes; describes and characterizes the attributes of location, function, form, fabric, and intangible values that inform the building; states the significance of the Beira Central Station; and establishes the levels of significance of its cultural heritage values;
- The third chapter, *Section 4 - Identification of factors and issues*, identifies the main natural hazards to which Mozambican territory is subject; observes the main urban planning instruments foreseen for the city of Beira and the constraints they establish for the surroundings of the Central Station of Beira; describes the elements elaborated for the process

of geometric, spatial, and building condition surveys; synthesizes the material properties, physical constraints and contemporary architectural interventions;

- The fourth chapter, *Section 5 - Conservation policies*, defines the general policies for the Beira Central Station; reports on the current process of the building classification; rethinks its socio-urban role; elaborates on structural and non-structural urgent measures and on detailed conservation policies; and recommends necessary and de-sirable measures.
- The fifth chapter, *Section 6 - Implementation and monitoring*, organizes future actions, defines a conservation strategy, and proposes a maintenance plan with a timeline.

References to the works cited in the text, transcribed from the bibliography in section 7, are included at the end of each section.

1.4 The team

The tender, the field work and the proposals for the Beira Central Station KIM project were carried out by a team of professors and researchers from Portugal and Mozambique: Paulo Lourenço, Elisiário Miranda and Maria Manuel Oliveira, from the School of Engineering and the School of Architecture, Art and Design of the University of Minho, in Guimarães, Portugal; Luís Lage, from the Faculty of Architecture and Physical Planning of the Eduardo Mondlane University, in Maputo, Mozambique; and Fernando Ferreira Mendes and Edmundo Cândido, from the Mozambique Railways, in the city of Beira, also in Mozambique. They were assisted by Javier Ortega, Estefanía Chaves, Jorge Santos, Erménio Zandamela and Alberto Barontini.

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SECTION 2

2 Understanding the place

The present section offers a historical reading of the Portuguese State's colonial policy in the third quarter of the twentieth century; a framing and characterization of the architecture of the Modern Movement in Mozambique, with a special emphasis on the work of its authors; and an analysis of the process of designing and building the Beira Central Station, followed by an interpretation of its historical significance.

2.1 The colonial policy of the *Estado Novo* regime

2.1.1 The colonial empire

During the 19th-century period of bourgeois liberalism, Portuguese colonial policy was predicated upon an integrationist and assimilationist doctrine. According to this conception, the overseas provinces were members of the Metropolis, a unified entity with common laws and economic policies. From 1878 onwards, via the de facto abolition of slavery and the end of forced labor, a liberalized labor regime was then implemented. The victory of the absolutist factions at the end of the century and the 1899 labor law led to the disappearance of the principle of equality between *indigenous* and *non-indigenous* people in the application of metropolitan laws to the inhabitants of the African colonies.

The 1910 Republican Revolution led to the replacement of the monarchic centralizing policy with a decentralizing one, a trend that was already underway via the legislative reforms implemented in the final years of the previous regime and which was duly formalized in article 67 of the text of the 1911 Constitution. Each overseas province was given financial autonomy and its own Organic Law, including special laws suited to the state of development of each province.

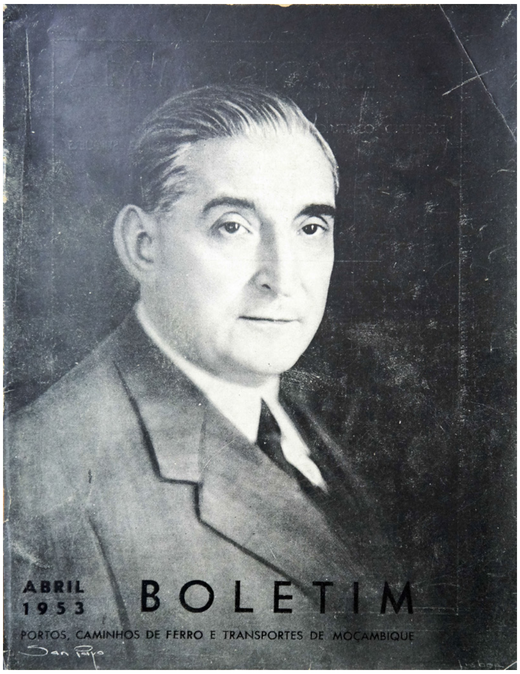


Figure 2.1 Marshal Óscar Carmona (*Boletim dos Portos, Caminhos de Ferro e Transportes de Moçambique*, April 1951, cover page | MCFM | EM, 2019).

Figure 2.2 António de Oliveira Salazar (*Boletim dos Portos, Caminhos de Ferro e Transportes de Moçambique*, April 1953: cover page | MCFM | EM, 2019).

Two subsequent events reversed this decentralizing trend. The first event was the implantation of the military dictatorship in the wake of the revolution of May 28, 1926, led by Marshal Óscar Carmona (1869-1961) (Figure 2.1) – who was the first president of the Republic under the *Estado Novo* regime –, and the subsequent consolidation of this nationalist, authoritarian and corporative regime. The second event was the appointment of António de Oliveira Salazar (1889-1970) (Figure 2.2), first as Minister of Finance (a portfolio he accumulated with the Ministry of the Colonies), and later on as head of the government, in July 1932.

The *Colonial Act* published in July 1930, later included in the Constitution of April 1933, established the creation of the Portuguese Colonial Empire. The *Colonial Act* was structured according to the French model, including the status assigned to the indigenous inhabitants, and placed the overseas territories under the direct dependence of the Ministry of Colonies

Figure 2.3 Henrique Galvão (org.) - *Portugal is no small country*, 1940 (hemerotecadigital.cm-lisboa.pt).

based in Lisbon. According to official propaganda, the Portuguese imperial territory was on a par with Europe in terms of size (Figure 2.3).

2.1.2 Universal decolonization

The end of World War II (1939-1945) triggered the process of decolonization and independence of the territories that European countries still held in Asia and Africa. Universal condemnation of any form of domination of one people by another and the recognition of the right of all colonized peoples to self-determination were enshrined in the Charter of the United Nations Organization, signed on June 26, 1945, by the UN founding countries, and in the Universal Declaration of Human Rights, adopted on December 10, 1948.

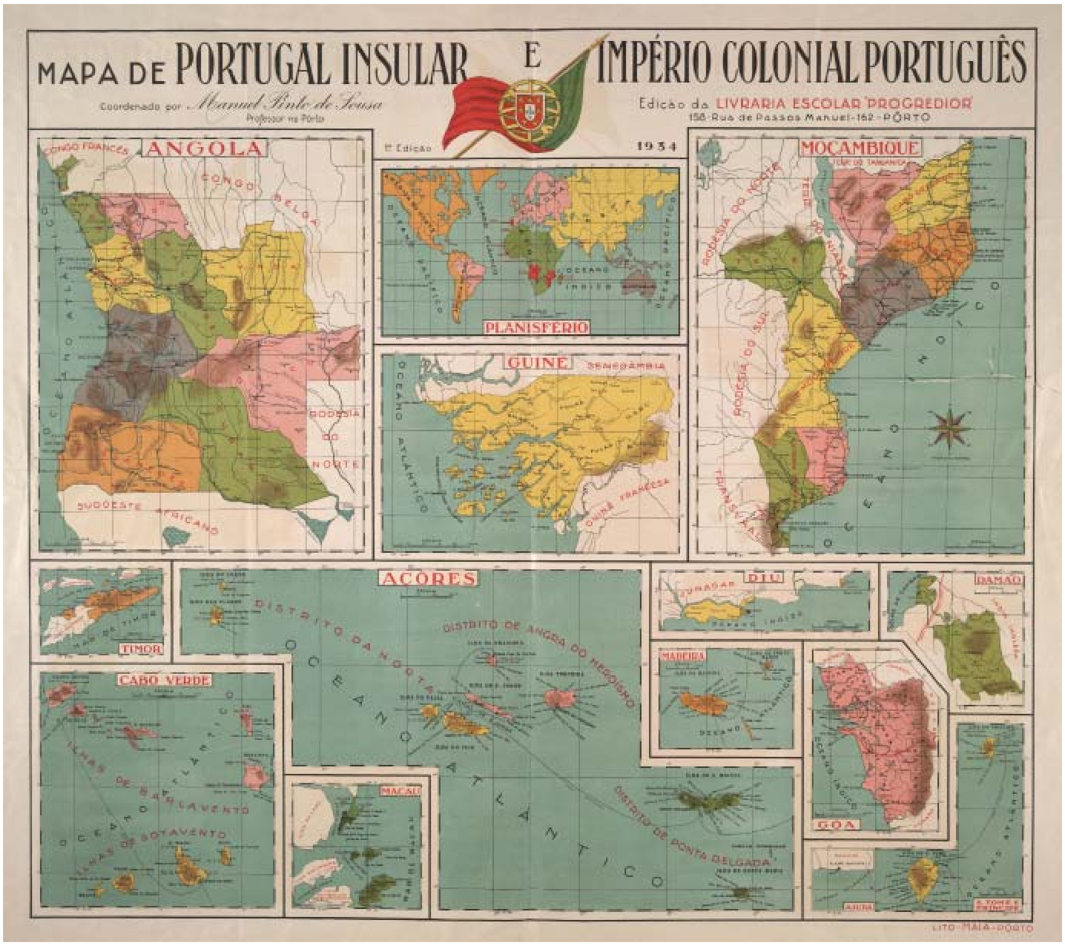


Figure 2.4 Manuel Pinto de Sousa (coord.) - *Map of Insular Portugal and the Portuguese Colonial Empire*, 1934 (bnd.bn.pt).

The first post-war independences were declared on the Asian continent, after the independence of Indonesia in 1946. The decolonizing movement also gained momentum in Africa during the 1950s and 1960s, with greater intensity after the Bandung conference in 1955 and the consequent strengthening of Afro-Asian solidarity.

The permanence of Portuguese rule over the eight non-self-governing territories that comprised the Portuguese Colonial Empire spread across Africa and Asia (Figure 2.4) – Guinea-Bissau, Cape Verde, São Tomé and Príncipe, Angola, Mozambique, the Portuguese State of

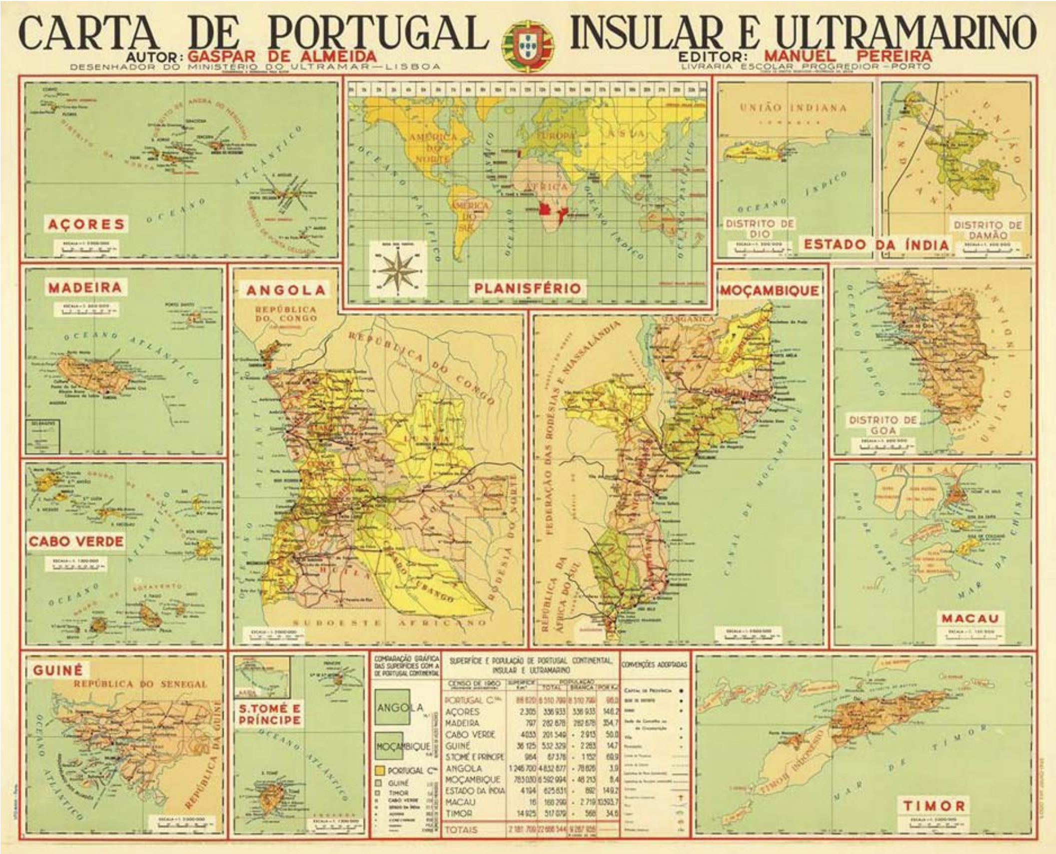


Figure 2.5 Gaspar de Almeida - *Map of Insular and Overseas Portugal*, (n.d.) (pinterest.pt).

India, Macau and Timor – led to a succession of international condemnations originating in the bloc of Afro-Asian countries. This litigation took place over a series of episodes that began after Portugal joined the UN in December 1955, when the Secretary-General of the organization questioned the Portuguese Government in July of the following year about whether it administered non-self-governing territories. The process crystallized in December 1960, with the approval of the *Declaration on the Concession to Colonial Countries and Peoples* by the 15th General Assembly of the United Nations, in which each Portuguese overseas possession is specifically referred to as a colonial territory.

2.1.3 Defending the Regime

However, Salazar had anticipated these criticisms of colonialism and structured the defense of his imperial policy through the resumption of the institutional nomenclature, monarchic and republican, and the policy of assimilation. Aware of the need to construct an operative political discourse to defend his regime, he gradually established a new utopian identity supported by changes in the legal, economic, and demographic framework: Portugal's secular nature as a pluricontinental nation, one and indivisible.

The 1951 integrationist constitutional revision established a new legal framework that semantically altered the terms and concepts upon which the regime's colonial policy was predicated. The new Constitution included the modified provisions of the abolished *Colonial Act*, now placed under the title *Do Ultramar Português* (*On Portuguese Overseas Territories*). References to both the *empire* and the *colonies* (Figure 2.4) also disappeared from the text, and were replaced by *overseas territories* and the former designation of *overseas provinces* (Figure 2.5). As a result of these modifications, the names of some official bodies were also changed: the Ministry of Colonies was renamed Ministry of Overseas Territories, and the bodies that depended on it, such as the General Agency of Colonies or the Colonial Urbanization Office, were renamed General Agency of Overseas Territories and Overseas Urbanization Office, respectively. In 1953, the *Organic Law of the Portuguese Overseas Territories* was promulgated, regulating the general regime of government of the overseas provinces, replacing the 1933 *Organic Charter of the Portuguese Colonial Empire*; in 1954, the *Statute of Indigenous Peoples* was revised, but without granting them full Portuguese citizenship. As a result, among other instability factors, such as the onset of the massacres conducted by the UPA (Union of the Populations of Angola) in Northern Angola – which on March 15, 1961,

Figure 2.6 National Secretariat of Information - *The 2nd Plan of Development, 1959-1964*, 1958: cover page.

Figure 2.7 Admiral Américo Tomás during a visit to the port of Beira (*Boletim dos Portos, Caminhos de Ferro e Transportes de Moçambique*, August 1964: cover page | MCFM | EM, 2019).

marked the beginning of the colonial / liberation war in that country –, and the appointment of Adriano Moreira (1922-2022), as Minister of Overseas Territories (in April of the same year), the *Statute of the Portuguese Indigenous Peoples off the Provinces of Guinea, Angola, and Mozambique* was finally abolished. This act, that finally ended official discrimination among all natives of the multicontinental nation, completed the legal framework of the integrationist utopia.

The defense of the regime's integrationist policy after World War II was mainly based on Portugal's economic investment in its possessions on the African continent. One of the pillars of this shift was the developmental policy – autarchic, protectionist, and of import substitution – designed by the Undersecretary of State for Industry, engineer Ferreira Dias, implemented from the mid-1940s. This policy promoted national industrialization by the large financial and industrial groups, and the country's infrastructural modernization, financed and executed under the 1st and 2nd Six-Year Development Plans (1953-1958 and 1959-1964) (Figure 2.6).

Under these programs, new public buildings were constructed in Portugal's former African overseas provinces to support colonization and population growth. New communication and natural resource exploitation infrastructures were also built, stimulating and supporting regional economic development. Images of visits by high dignitaries to these undertakings were widely used to defend the role of Portugal in Africa, such as those captured during the trip of Admiral Américo Tomás, the last President of the Republic under the *Estado Novo* regime, to Mozambique in 1964 (Figure 2.7).

The consolidation of the Portuguese presence in Africa through the colonization of vast territories with populations of metropolitan origin – an important component of the regime's political strategy – was effected via two complementary governmental policies: the creation of agricultural settlements, reproducing the rural environment of the Metropolis in the Cunene valley, in Angola, or in the Limpopo plain, in Mozambique; and the importation of the metropolitan demographic surplus via free emigration, enhanced by the economic and infrastructural development of the overseas provinces. The success of this second orientation was made possible by the progressive legal opening made throughout the 1950s. Thus, after a restrictive emigration regime that not only prevented undifferentiated immigration, but also financed the departure of families of rural settlers and allowed the entry of qualified individuals and their close relatives, succeeded a partial liberalization of movements from May

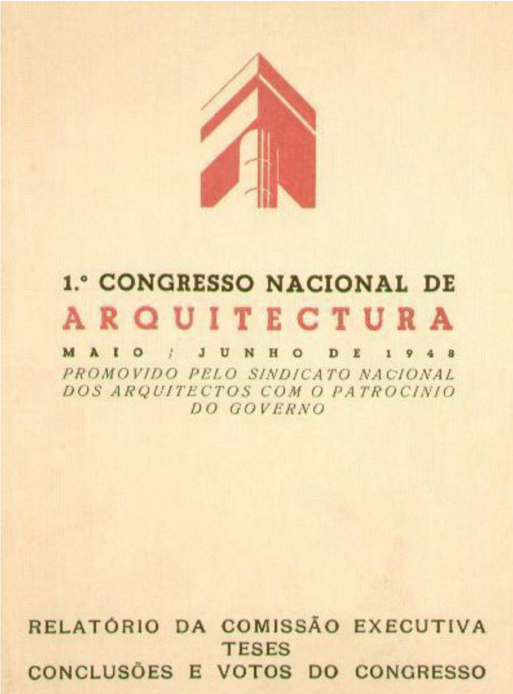


Figure 2.8 *1st National Congress of Architecture: report of the executive commission, theses, conclusions and votes of the congress*, 1948 (Tostões, 2008: cover page).

Figure 2.9 *Arquitectura*, October-December 1948: cover page.

1956 and, with the promulgation of decree no. 44171 on February 1962, the free circulation and establishment of Portuguese people within the national territory.

This latter measure enabled the regime to finally complete its defense strategy via the construction of an identity utopia based on the myth of the *pluricontinental*, *multiracial*, and *pluricultural* nation.

2.2 The Modern Movement in Mozambique

2.2.1 The 1st National Congress of Architecture

The 1st National Congress of Architecture (Figure 2.8), that took place in 1948, was originally conceived to be an apologia for the work of the *Estado Novo* and its main entrepreneur the Minister of Public Works, Engineer Duarte Pacheco. This initiative symbolically marked the defeat of the Regime's official architecture and the victory of the theses of the new generations of architects who advocated a change in methods, languages and production systems by adapting them to the new reality of the economic and social fabric and updating them in accordance with the spirit of the Modern Movement and the *Athens Charter* (1933).

Thanks to a previous achievement that allowed congress members' communications to be exempted from prior censorship, a large number of participants in the 1st National Congress – young people from a third generation of modern architects, accompanied by older elements of a second generation that had emerged in the second half of the 1930s – swiftly contested the official architecture. The most contentious theses were advocated by the ICAT, *Iniciativas Culturais Arte e Técnica* (Cultural Initiatives Art and Technique), a group of Lisbon-based professionals that included elements of all generations of modern architects, editors and owners of the renewed and updated journal *Arquitectura* (Figure 2.9). The group included Keil do Amaral (1910-1975), Alberto Pessoa (1919-1985), Hernâni Gandra (1914-1988), Celestino de Castro (1920-2007), Formosinho Sanches (1922-2004), Raúl Chorão Ramalho (1914-2002), and Francisco Castro Rodrigues (1920-2015), among others. They were accompanied in this contestation by architects from the ODAM, *Organização dos Arquitetos Modernos* (Organization of Modern Architects). They proposed *to disseminate the principles of modern architecture, to form a professional conscience, to create understanding between architects and visual artists, to oppose the amateurism that was being practiced, and, finally, to value the individual and the Portuguese society*.[2.1] Based in Porto, responsible for setting up an exhibition of modern architecture in 1947 (Figure 2.10), ODAM was composed of Arménio Losa (1908-1988), Cassiano Barbosa (1911-1998), Viana de Lima (1913-1991), João

2.1 França, 1974: 438.

Figure 2.10 *Architecture Exhibition Catalog*, 1947: 130-131 (Barbosa, 2002: 130-131).

Andresen (1920-1967), Fernando Távora (1923-2005), Fernando Eurico (b. 1922), António Matos Veloso (1923-2014), João José Tinoco (1924-1983), and Mário Acácio Couto Jorge (b.1923), among many others.

The positions expressed on the topics under discussion at the Congress, *Architecture at the National Level* and *The Portuguese Housing Problem*, had underlying opposing attitudes of subservience to the regime and active political resistance. On one side were those who, in agreement with the established power, made themselves heard by arguing that architecture should be national; on the other side there was the challenging of national values and the advocacy of solutions based on the Athens Charter, of a new design method, of a universal language and construction system based on the axioms of the International Style.[2.2]

2.2 Fernandez, 1988.

The 1st National Congress of Architecture signaled the emergence of a new generation of Portuguese professionals. Some of its members, who were disappointed with the lack of private commissions, and possibly persecuted by the political police, emigrated to the former overseas provinces of Angola and Mozambique throughout the 1950s and 1960s. Once in Africa, they designed the projects for the housing and infrastructure buildings that population growth and accelerated economic development required.

Their professional praxis was informed by the principles of the Modern Movement – use of industrial building systems, standardized materials, functional optimization and flexibility, and rigorous climatic adaptation of buildings –, providing local public entities and private developers with the tools that allowed large-scale construction in newly founded urban fabrics, or in the process of their expansion and consolidation.

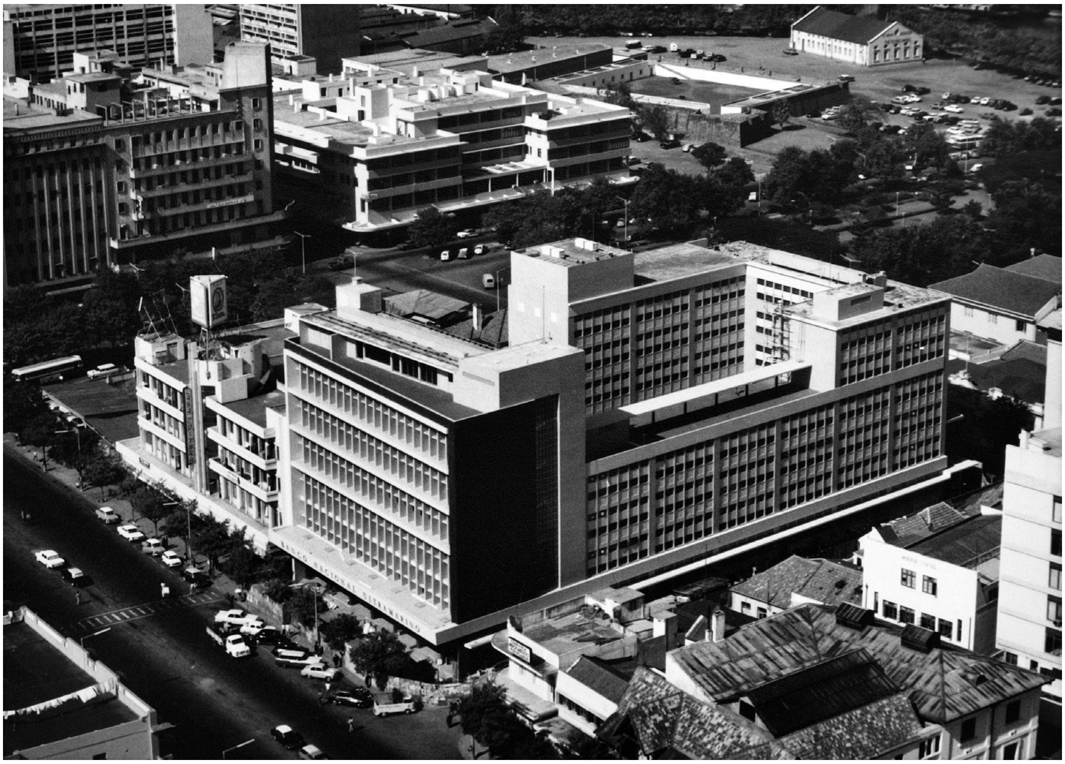
2.2.2 International references

Worldwide dissemination of the International Style and its adaptation to multiple contexts in the Southern Hemisphere created a repertoire of formal models that solved climatic and productive circumstances. Angola and Mozambique became fertile ground for the free dissemination of the new architecture, and simultaneously for the orthodox realization of its functional and constructive axioms, based on Corbusian references and on the models of the modern architectures of Latin America and South Africa.

2.2.2.1 Corbusian thought and practice

Le Corbusier's (1887-1995) principles emerged as theoretical substratum transversal to world architectural production in the post-WWII period: the role of volume, surface, and plan

Figure 2.11 BNU's Lourenço Marques branch (1954-1964) (AHCGD-FBNU | EM, 2010).



in the new architecture, three warning calls to architects that Le Corbusier announced in 1923 in *Toward an Architecture*.[2.3] Accordingly, the play of claire-obscure caused by light falling on the geometric solids acquired tropical intensity in the BNU's (Banco Nacional Ultramarino / National Overseas Bank) Lourenço Marques branch (1954-1964) (Figure 2.11), by José Gomes Bastos (1914-1991), or in the BNU's Quelimane branch (1960-1972), by Francisco José de Castro (1923-2016) (Figure 2.12).

On the other hand, the five points advocated by Le Corbusier in 1926 – *pilotis*, *toits-jardins*, *plan libre*, *fenêtre en longueur*, and *façade libre*[2.4] (piles, roof garden, free plan, ribbon

2.3 Le Corbusier, 1923.
2.4 Le Corbusier, 1995 (1929): 128.

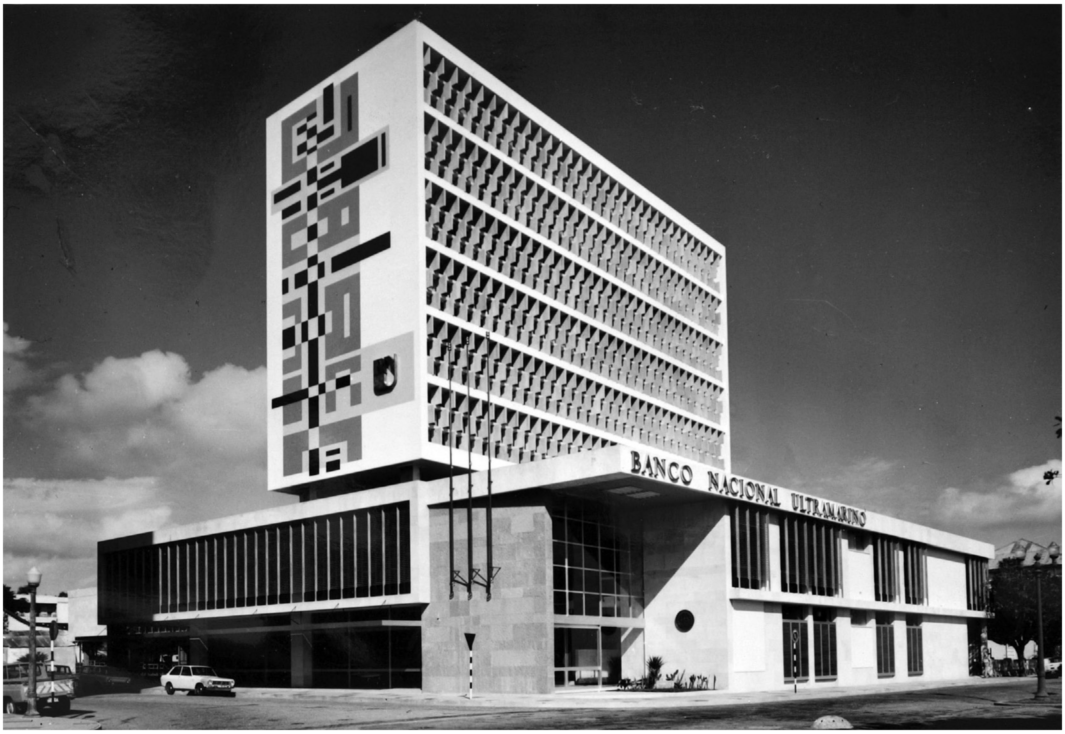


Figure 2.12 BNU's Quelimane branch, Quelimane (1960-1972) (AHCG-DFBNU | EM, 2010).

window, and free façade) -, while synchronizing modern architecture with technological progress,[2.5] structured the general organization of large modern buildings all over the world. This formal paradigm that marked the urban landscape of Mozambique's main cities, was first concretized in the building of the Ministry of Education and Public Health in Rio de Janeiro (1936-1945), designed by a team of Brazilian architects advised by Le Corbusier, composed by Lúcio Costa (1902-1998), Affonso Eduardo Reidy (1909-1964), Carlos Leão (1906-1983), Jorge Machado Moreira (1904-1992), Ernâni Vasconcelos (1909-1988) and Oscar Niemeyer (1907-2012). This is particularly visible in the work of Alberto Soeiro (b.1917), such as the Mozambique Montepio Bank's headquarters building in Lourenço Marques (1955-1959)

2.5 Siegfried Giedion, 1934, in Le Corbusier, 1995 (1934).

Figure 2.13 Montepio's Headquarters Building, Lourenço Marques (1955-1959) (EM, 2009).

Figure 2.14 Extension of the Exchange, Statistics and Historical Archives Council, Lourenço Marques (c.1960-1963) (EM, 2009).

(Figure 2.13), or in the work by Marcos Miranda Guedes (1924-2001) and Octávio Pó, such as the extension of the Exchange, Statistics and Historical Archives Council (c.1960-1963), also in Lourenço Marques (Figure 2.14).

The direct or indirect influence of the forms designed and built by Le Corbusier, such as the *brise-soleil* or the Catalan vault (or semi-vault), also played a major role in the architecture of the former Portuguese colonies in Africa during the period under study. The *brise-soleil* resulted from research into the creation of mechanisms to control the direct incidence of solar radiance on the surface of the *pan de verre* carried out by Le Corbusier throughout the 1930s, that had its first realization in the north façade of the aforementioned building of the Ministry of Education in Rio de Janeiro.

Either through direct Corbusian or Brazilian influence, in Mozambique the *brise-soleil* were applied in their multiple variants – with fixed or mobile blades, built in masonry, prefabricated concrete, or in the form of masonry, precast concrete, fiber cement, or aluminum, composed of horizontal or vertical elements, or a combination of both, or even as continuous

Figure 2.15 Saint Jorge Cine-Theater, Beira (1952-1954) (EM, 2009).

Figure 2.16 D. Francisco Barreto Industrial and Commercial School, Quelimane (1960-1963) (EM, 2009).

grids or open loggias on the façades of buildings – and extensively used for the protection of galleries or *pan de verre*.

The first use of a *brise-soleil* in Mozambique, consisted of fixed vertical anodized aluminum blades, seems to have been on the main façade of Saint Jorge Cine-Theater in Beira (1952-1954) (Figure 2.15), by João Garizo do Carmo (1917-1974). Given its suitability to the local climate, all the different variants of these sunshades were profusely applied, either built *in situ* or industrially manufactured. A distinct type of *brise-soleil* consisting of fixed blades that project perpendicularly to the south-facing façade planes to protect the glazing from the sunrise's and sunset's horizontal rays was used in the technical schools and high schools designed by Fernando Mesquita (1916-1994) in the Public Works Services, such as the D. Francisco Barreto Industrial and Commercial School, in Quelimane (1960-1963) (Figure 2.16). On the other hand, the same system was used by Francisco de Castro to conduct the dominant air currents into the interior of the building in the above mentioned BNU's Quelimane branch (Figure 2.12).

The Catalan vaults were used by Le Corbusier in a series of projects that began with the Maison Monol (1920). The Catalan vault theme was replicated in Mozambique in Nuno Craveiro Lopes (1921-1972) standard project for Sonap gas stations. It was initially designed for the Polana area in Lourenço Marques, in 1955, and subsequently built in Costa do Sol, also in Lourenço Marques, and in Montepuez, Namapa, Nametil, Porto Amélia (Figure 2.17), and in other locations in Mozambique.

Widely utilized during the 1950s, this form was employed in several projects and works such as in the Administrative Offices, in Quelimane (c.1959-1963) (Figure 2.18) or in multiple buildings also designed by João Garizo do Carmo.

Figure 2.17 Sonap gas stations, Porto Amélia (a.1955) (EM, 2010).

Figure 2.18 Administrative Offices, Quelimane (c.1959-1963) (EM, 2009).

2.2.2.2 The modern Latin American architecture

In 1943, the Museum of Modern Art (MoMA) in New York organized an exhibition *with a keen desire to know Brazilian architecture, especially their solutions for the problem of controlling heat and light on large exterior glass surfaces.*[2.6] The exhibition catalog, entitled *Brazil Builds: Architecture New and Old 1652-1942*, was the result of an exploratory trip undertaken in 1942 by architects Philip L. Goodwin, author of the texts, and G. E. Kidder Smith, author of the photographs. The publication had huge international repercussion after the end of World War II. This pioneer work would be followed by articles or special issues dedicated to Brazil in specialized international journals, as well as monographs published abroad and dedicated to the works of Oscar Niemeyer and Affonso Reidy.[2.7]

2.6 Goodwin; Smith, 1943: 7.
2.7 Segawa, 1998.

Figure 2.19 Manga Church, Beira (1954-1957) (EM, 2009).

Figure 2.20 Estoril Tourist Complex, Beira (1957-1960) (EM, 2020).

The full international dissemination of modern Brazilian architecture – including numerous buildings that at the time of the *Brazil Builds* publication were only in design or under construction – was most effectively achieved by *Modern Architecture in Brazil*. This *catalogue-raisoné* by architect Henrique E. Mindlin, published in 1956 in English, French and German, is the symbol of the success of the modern architectural production in Brazil between 1937 and 1955.

The influence of modern Latin American architecture, particularly Brazilian architecture, had a decisive influence on architecture designed and built in the former Portuguese colonies due to similar climatic and productive conditions. The direct influence of Brazilian models on some Mozambican buildings is exemplified by the formal proximity between the Pampulha Church in Belo Horizonte, Brazil (1940-1943), by Oscar Niemeyer, and the Church of the Immaculate Heart of Mary (Manga Church) in Beira (1954-1957) (Figure 2.19),

Figure 2.21 Messe hall of Monteiro & Giro Ceramics Factory, Quelimane (1956-1960) (EM, 2009).

Figure 2.22 Church of Saint Anthony of Polana, Lourenço Marques (1959-1962) (EM, 2009).

Figure 2.23 Abreu, Santos & Rocha Building, Lourenço Marques (c.1956) (EM, 2009).

by João Garizo do Carmo; or between the apartment block A of the Pedregulho Residential Complex in Rio de Janeiro, Brazil (1946-1952), by Affonso Reidy, and the motel of the Estoril Tourist Complex, also in Beira (1957-1960) (Figure 2.20), by Paulo de Melo Sampaio (1926-1968) and Marcelo Moreno Ferreira (1922-2020). But besides this direct influence there was a generalized and pragmatic adoption of the fundamental themes that inform modern Latin American architecture: technical boldness, climatic suitability, plasticity, and integration of the arts.

Beira's marshy nature and the existence of qualified engineers in Mozambique favored the creation in the city of buildings with special structures of great technical boldness that were possibly inspired by the vocabulary of modern Brazilian architecture. Such formal and structural proximity can be observed when comparing the gymnasium of the Pedregulho

Residential Complex and the parabolic roof of the main entrance hall of the Beira Central Station, as shown below.

The exploration of new constructive systems adapted to local production constraints, evident in the exploitation of the structural qualities of hyperbolic paraboloids in the Mexican works of the Spanish architect Félix Candela (1910-1997) was also reflected in Mozambique in the architectural expression of structural systems composed of concrete or brick membranes, folded or curved, as in the messe hall of the Monteiro & Giro Ceramics Factory in Quelimane (1956-1960) (Figure 2.21), by Arménio Losa and Cassiano Barbosa, or in the Church of Saint Anthony of Polana (1959-1962) in Lourenço Marques (Figure 2.22), by Nuno Craveiro Lopes.

The Brazilian *cobogós*, ventilation latticework or grilles formed by industrially produced hollow ceramic or molded concrete modules, were extensively used for, among many other

Figure 2.24 Block II of the Administrative Offices, Vila Cabral (1959-1962) (EM, 2009).

Figure 2.25 Vasco Freitas houses (?), Beira (1958) (EM, 2010).

examples, the northwest façade of the Abreu, Santos & Rocha Building in Lourenço Marques (c.1956) (Figure 2.23), by Pancho Guedes (1925-2015),.

The roofs converging to a central gutter, a formal typology that became widespread in modern Brazilian architecture, and which in Portugal is known as butterfly roof, was also frequently used in Mozambican architecture. An example of this type of roofing can be found, among many others, in the Block II of the Administrative Offices in Vila Cabral (1959-1962) (Figure 2.24), by João José Tinoco (1924-1983) and Maria Carlota Quintanilha (1923-2015).

The influence of the plastic fluidity and spatial interpenetration of curved or angular forms that are characteristic of modern Brazilian architecture is present in a large number of Mozambican projects through the creation of irregular elements that are exceptional in relation to orthogonal matrices, as in the undulating panel - possibly authored by Jorge Garizo do Carmo (1927-1997) -, of the supposed Vasco Freitas houses in Beira (1958), by João Garizo do Carmo (Figure 2.25).

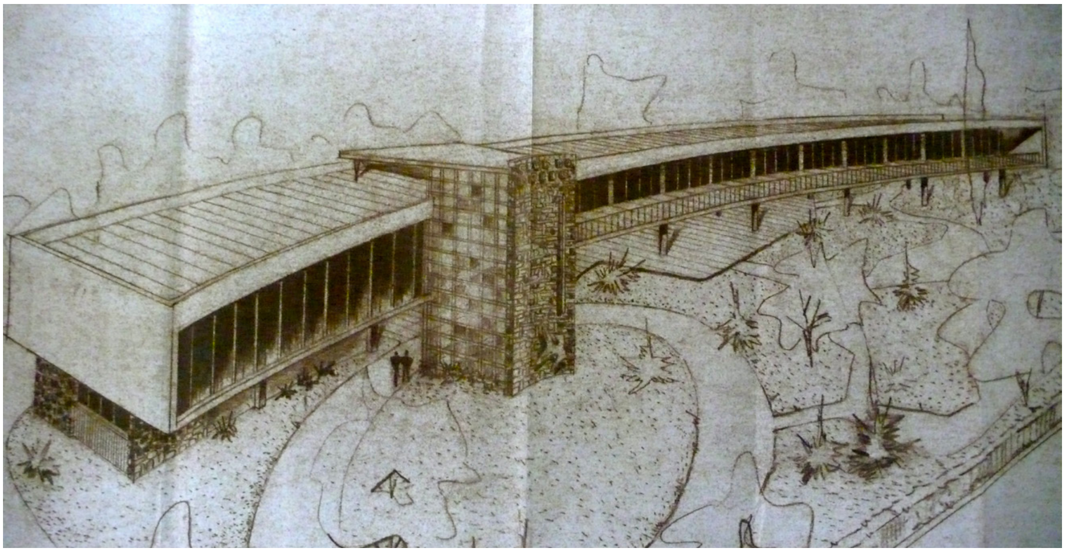


Figure 2.26 Beira Club / Automobile & Touring Club, Beira (1957-1970), project (Magalhães, 2015: 494).

This graphic theme was also a present in the landscape design of the exterior spaces of the buildings, in free and asymmetrical pictorial compositions graphically inspired by Burle Marx's (1909-1994) biomorphism, as in the design for the access point to the Beira Club, later Automobile & Touring Club in Beira (1957/1970) (Figure 2.26), by Paulo de Melo Sampaio, Marcelo Moreno Ferreira and Mário Acácio Couto Jorge.

The ceramic panels made of tile or glass mosaic included in the architectural design of the buildings were possibly influenced by the murals covering the walls of modern Mexican and Brazilian buildings. These influences can be found in numerous official or private buildings, such as in the Beira Central Station, where virtually all exterior and interior surfaces were covered with glass and ceramic mosaics or in the BNU's Lourenço Marques branch lining panel of the spiral staircase by Estrela Faria (1910-1976) (Figure 2.27). In this building, architecture and decoration were combined in a continuous plastic experience under the active coordination of José Gomes Bastos.

Figure 2.27 BNU's Lourenço Marques branch (1954-1964), lining panel of the spiral staircase (AHCGD-FBNU | EM, 2010).

2.2.2.3 The modern architecture of South Africa

In South Africa, the Modern Movement was spearheaded by Rex Distin Martienssen (1905-1942). Editor since 1932 of the *South African Architectural Record* journal, on his travels to Europe Martienssen established contacts with the European avant-garde and in 1934 became friends with Le Corbusier. Two years later, in the first pages of the second edition of his *Complete Works*, Le Corbusier published the letter he addressed to Martienssen on the occasion of the planned publication of a manifesto by the Johannesburg Group of Modern Architects, self-styled *The Transvaal Group*. The group consisted of Martienssen himself, W. Gordon McIntosh (1904-1983), John Fassler (1910-1971), and Bernard Cooke (1910-2011), among others. Between 1934 and 1936, Martienssen formed with the latter two an architectural society that produced a body of work deeply influenced by the internationalist assumptions of Walter Gropius and Le Corbusier, evident notably in the design of the house he built for himself in 1940. This work would be published in Portugal by *Arquitectura* journal in 1949, together with the translation of Le Corbusier's letter.

Rex Martienssen was a professor at the University of the Witwatersrand in Johannesburg and temporarily headed its architecture department. Upon his death in 1942, the functionalist logic of the Modern Movement was challenged in the country, but the principles and forms of his architecture prevailed in the teaching provided by that department. Besides the inevitable contacts naturally favored by the proximity between South Africa and Mozambique, the relations between their modern architectural cultures consisted in the attendance of the University of the Witwatersrand by Carlos Ivo (1918-1996) and Pancho Guedes. During his visit to South Africa in 1954, José Bastos also registered several examples of modern architecture buildings that most certainly influenced the design of his BNU's Lourenço Marques

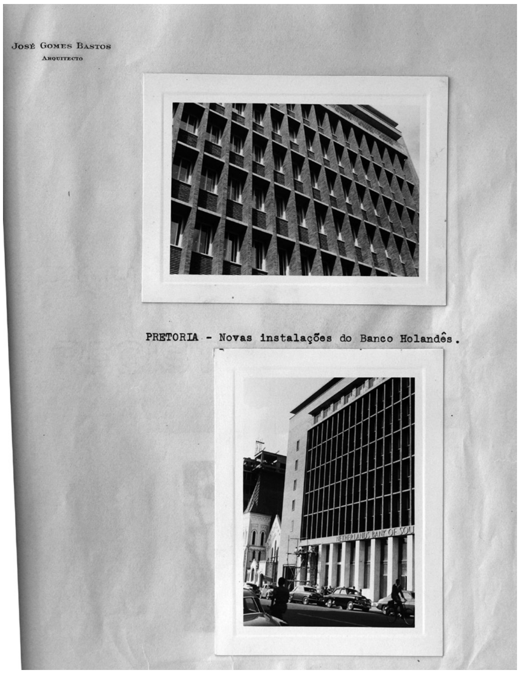


Figure 2.28 Records of José Gomes Bastos' trip to Pretoria, South Africa, 1954 (AHCGDFBNU | EM, 2010).

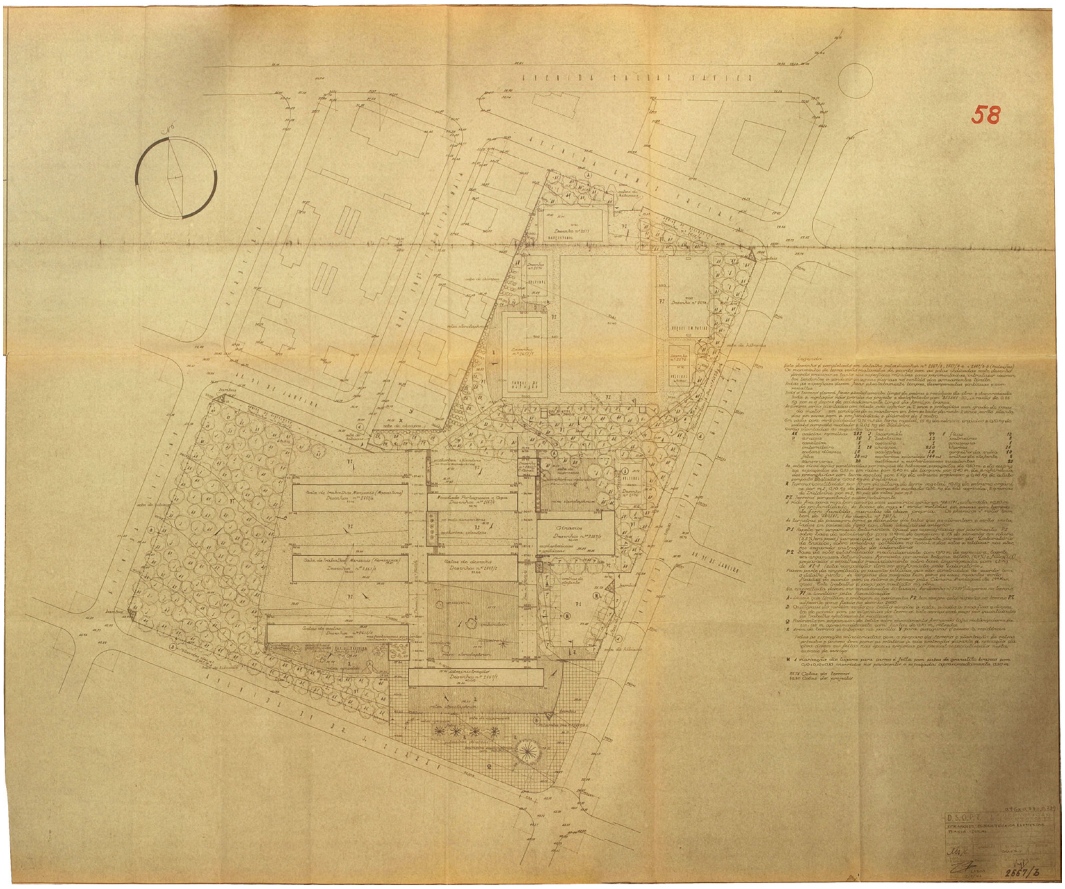
Figure 2.29 Records of José Gomes Bastos' trip to Johannesburg, South Africa, 1954 (AHCGDFBNU | EM, 2010).

branch. These photographs were included in the *Descriptive Report* of the 1954 preliminary project for the branch building (Figures 2.28-2.29).

2.2.3 A brief characterization of the Movement

Through the professional training of the architects who designed and built in the former Portuguese overseas provinces and the freedom of design allowed to them by the central Portuguese power, the ideological, technological and formal principles of the architecture of the Modern Movement formed a paradoxical operational support for the rapid infrastructure and occupation of territories undergoing rapid economic and demographic development. The modern architecture produced in Mozambique presents some dominant characteristics that should be systematized:

Figure 2.30 Governor Joaquim de Araújo Technical School, Lourenço Marques (1960-1963), project (CDIIPAD | EM, 2011).



- The architectural objects follow principles of autonomy in relation to their immediate surroundings, with implantations often oriented in a north-south direction, autonomous from the compositional systems of the urban networks that surround them. Examples are the primary, technical and high schools designed by Fernando Mesquita in the Public Works Services, such as the Governor Joaquim de Araújo Technical School, Lourenço Marques (1960-1963) (Figures 2.30),
- The volumes are composed by the aggregation of autonomous geometric solids, in compositions based on the balance of masses, according to the exterior expression of the main

Figure 2.31 Administrative Offices, Vila Cabral (1959-1962) (EM, 2009).

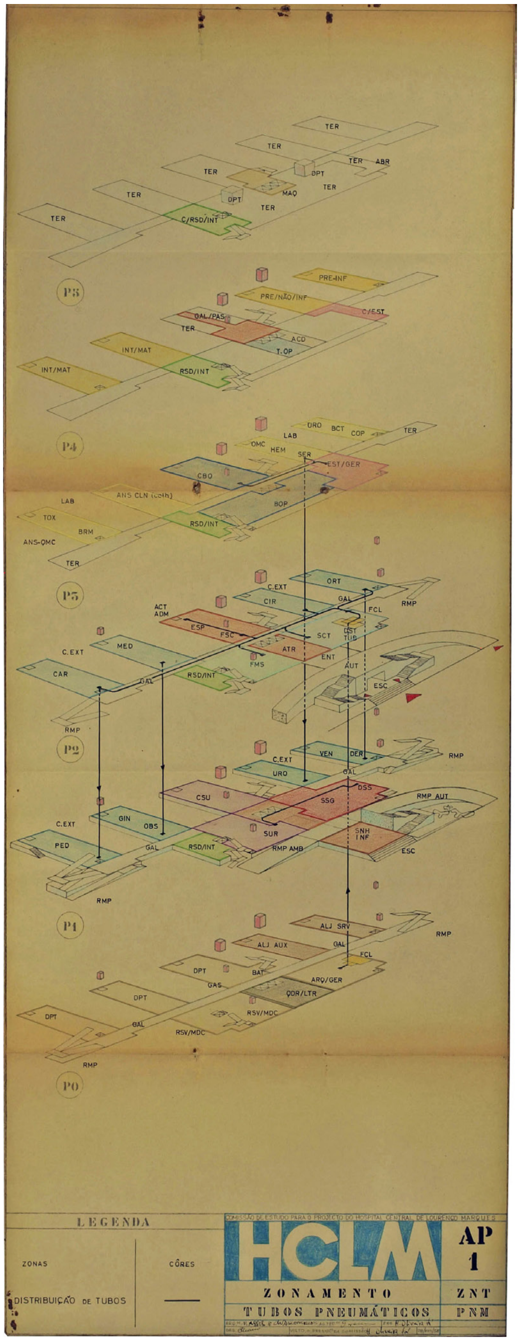
areas of the interior functional programs, as in the preceding example of the Administrative Offices of Vila Cabral (Figures 2.31);

- The exterior formal expressions derive from the shape of the openings, in which horizontal dominant openings predominate, from the asymmetrical composition of the elevations, and from the exploration of the chromatic and textural qualities of surface coatings. Examples are the buildings of the Beira Commercial Association in Beira (1955-1961) (Figure 2.32), by Paulo de Melo Sampaio and Marcelo Moreno Ferreira, or the Jossub Building in Lourenço Marques (1951) (Figure 2.33), by Pancho Guedes;
- The internal spatial compositions are governed by sequences of spatial moments, based on orthogonal compositional matrices, scaled according to abstract metrics;

Figure 2.32 Beira Commercial Association (1955-1961) (EM, 2010).

Figure 2.33 Jossub Building, Lourenço Marques (1951) (EM, 2009).

- Their functional layouts are based on the qualification and functional articulation of spaces via the hierarchical zoning of functions and circulation, sometimes establishing an effective racial segregation between European and *indigenous* zones. Example of the first is the General Hospital of the Miguel Bombarda Central Hospital, Lourenço Marques (1958-1965) (Figures 2.34), by Francisco Assis (b. 1915) and Luís Vasconcelos in the Public Works Services, and of the second is the BNU's Vila Pery branch (1955-1959) (Figures 2.35), by Paulo de Melo Sampaio;
- The structural systems are formed by autonomous support skeletons, erected with perennial materials and calculated with experimental audacity in order to optimize costs and execution deadlines. Example is the air terminal building at Sacadura Cabral Airport in Beira (1961-1968) (Figures 2.36), by Cândido Palma de Melo (1922-2003) in Directorate-General for Civil Aeronautics in Lisbon;



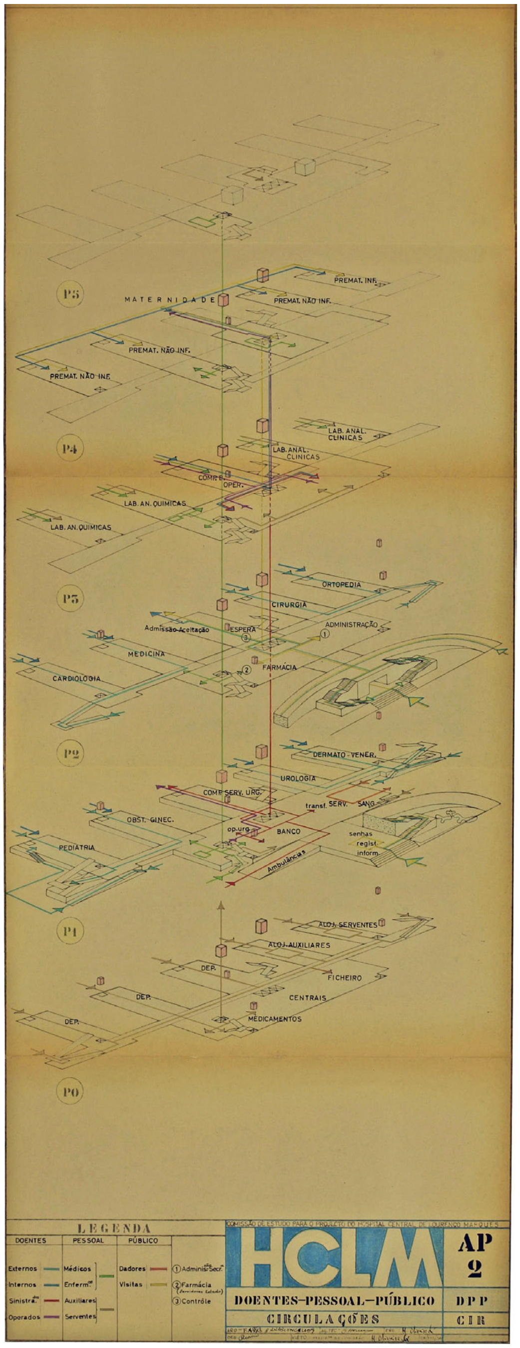
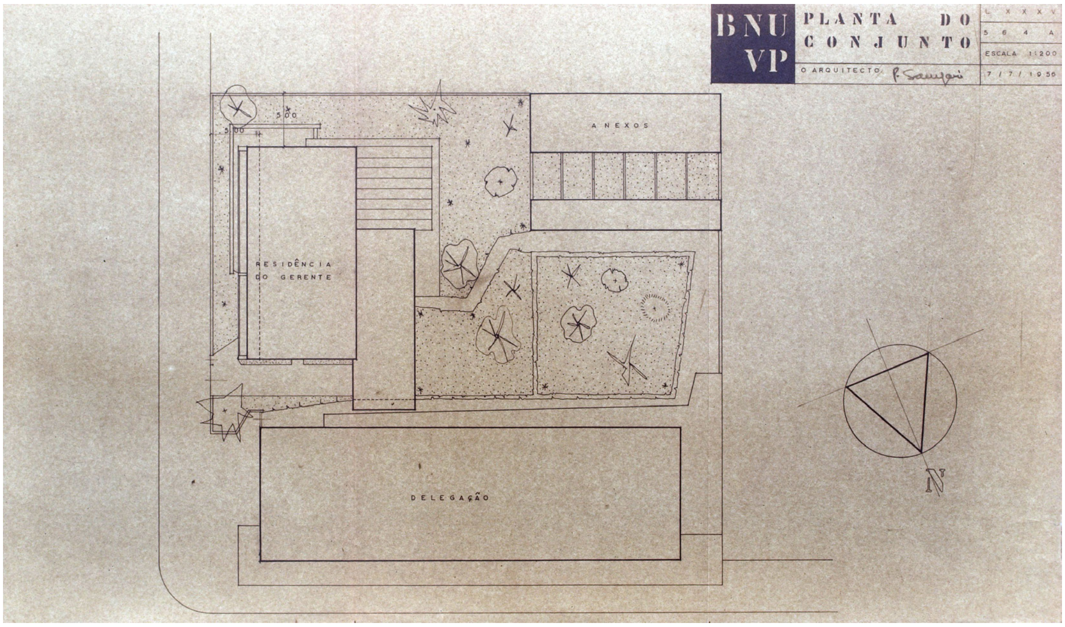


Figure 2.34 General Hospital of the Miguel Bombarda Central Hospital, Lourenço Marques (1958-1965), preliminary project (CDIIPAD | EM, 2011).

Figure 2.35 BNU's Vila Pery branch (1955-1959): the general plan shows the apartments of the bank delegation and intermediate officials at the bottom (*delegação*), the manager and administrator's houses on the top left (*residência do gerente*), and indigenous servants' houses on the top right (*anexos*) (AHCG-DFBNU | EM, 2010).



- The building systems are made up of standardized products of industrial production, occasionally articulated with locally extracted natural materials, or imported from the Metropolis. Example is the already mentioned Montegiro Commercial, Tourist and Housing Complex in Quelimane (Figures 2.37);
- The climate protections are obtained by optimization of implantations, disposition of internal spaces and use of solar protection mechanisms, such as *brise-soleil*, vertical, horizontal or both, fixed or steerable, and of transversal ventilation systems such as adjustable glass blades and grids made of ceramic or prefabricated concrete elements. Examples are the above mentioned Sacadura Cabral Airport or the Administrative Offices in Porto Amélia (1963-1966) (Figures 2.38), by João José Tinoco and Maria Carlota Quintanilha;
- The designs integrated in their genesis artistic contributions from various plastic disciplines, affirming themselves as total works of art (*Gesamtkunstwerk*). Examples are the

Figure 2.36 Sacadura Cabral Airport, Beira (1961-1968) (EM, 2018).

Figure 2.37 Montegiro Commercial, Tourist and Housing Complex, Quelimane (1954-1966) (EM, 2009).

Figure 2.38 Administrative Offices, Porto Amélia (1963-1966) (EM, 2010).

Figure 2.39 BNU's Lourenço Marques branch (1954-1964), ceramic panel by Querubim Lapa (1925-2016) (EM, 2012).

Figure 2.40 Manga Church, Beira (1954-1957), panel by Jorge Garizo do Carmo.

already mentioned BNU's Lourenço Marques branch (Figures 2.39) or the Manga Church (Figures 2.40);

- Their language affiliate the buildings with the architecture of the international Modern Movement and denote, as mentioned above, influences from Le Corbusier's work and the modern architecture of Latin America;
- The impact that the development, design, construction, and inauguration of these buildings had on the press and on colonial societies reflects the ability of these architectures, generated by the utopia of the Modern Movement, to unwittingly become symbols of the values of modernity, progress, and permanence that embodied the identity utopia of the *Estado Novo* regime.

Figure 2.41 João Garizo do Carmo (Magalhães, 2015: 257).

Figure 2.42 António Duarte Houses, Beira (EM, 2020).

Figure 2.43 Nauticus Building, Beira (1955-1957) (EM, 2009)

Figure 2.44 Episcopal Palace, Quelimane (1955-c.1961) (EM, 2010).

2.2.4 The architects of the Beira Central Station

2.2.4.1 João Garizo do Carmo

João Afonso Garizo do Carmo (Figures 2.41) was born in Beira. He was the son of architect Jaime Afonso do Carmo (work supervisor at the Mozambique Company, Director of Services of the Directorate-General for Public Works and Inspection of the Beira Railway, author of the Master Plan of the Ponta Gêa neighborhood and of the bridge project over the Chiveve River). João Afonso had two siblings: engineer Luís Garizo do Carmo, and architect, ceramist, engraver, sculptor, painter, graphic artist and filmmaker Jorge Garizo do Carmo, with whom he collaborated on several projects.

He was enrolled at EBAP between 1942 and 1949, and finished the Architecture course at EBAL in 1951. In 1948 he published in the journal *Arquitetura* the design for a chocolate factory and respective workers' quarter for the firm Altriz in Coimbra,[2.8] a project he carried out in collaboration with Bento d'Almeida (1918-1997) and Vítor Palla (1922-2006). He also published in that same journal the interior design of a café in Lisbon in co-authorship with Orlando Avelino (?-c.1974).[2.9] In Lisbon he also partnered with architect Faria da Costa (1906-1971) in several urban projects. In Porto he worked with architect Viana de Lima (1913-1991) in the Império Hotel remodeling project (1943).[2.10]

João Garizo do Carmo returned to his hometown in 1952, where he twice won the Araújo de Lacerda Architecture Award for the years 1954 - António Duarte Houses, Beira (1952-1954) (Figure 2.42) -, and 1955 - whose attribution we do not know.[2.11] He belonged to the

2.8 *Arquitectura*, January 1948: 12-16.

2.9 *Arquitectura*, October-December 1948: 3.

2.10 *Diário de Moçambique*, November 18, 1954 (http://beiraumseculo.blogspot.com).

2.11 *Notícias*, July 2, 1958: 5, 6.

Figure 2.45 Garizo do Carmo Houses, Beira (1958) (EM, 2020).

Figure 2.46 Pavilion for Permanent Exhibitions of National Economic Activities (Casa dos Bicos), Beira (1964-1966) (EM, 2020).

Aesthetic Commission of the Beira Municipality, for which he was appointed in January 1957,[2.12] and taught at the Freire de Andrade Industrial and Commercial School, having been appointed its sub-director in 1960.[2.13] In October 1962 he applied for the position of 1st class architect for the Beira Municipality,[2.14] having held the position of head of the 3rd Urbanization Section. From 1964 onwards, illness progressively prevented him from drawing, forcing him to abandon the practice of design. Between 1970 and 1972 he worked in Macau for the Ministry of Overseas. He returned to the Metropolis in 1972 and died in Cascais in 1974.

The work and thought of João Garizo do Carmo, a professional of the third generation of Portuguese modern architects, was characterized by the orthodox use of the forms and principles that shaped the international architecture of the post-World War II Modern Movement. He rejected the validity of any traditionalist nationalism and asserted the need for a modern tropical architecture, referring to the Brazilian case as an example.[2.15] The formal lexicon of his projects denotes influences that are common to the work of several Portuguese architects of the generation following the 1st National Congress of Architecture, such as the explicit architectural references to the work of Oscar Niemeyer, Le Corbusier, and Félix Candela.

His extensive architectural production was predominantly in housing programs of single-family dwellings or collective housing blocks for private clients and developers. His projects for public facilities, of quite different scales, were mostly carried out for autonomous institutions of the provincial power, and more rarely for official bodies.

2.12 *Notícias*, January 11, 1957: 5.
2.13 *Diário de Moçambique*, January 4, 1961: 7.
2.14 *Notícias*, October 25, 1962: 6.
2.15 *Diário de Moçambique*, August 26, 1955.

Figure 2.47 Francisco José de Castro (Magalhães, 2015: 275).

Figure 2.48 Cocorozis Building, Beira (1954-1955) (EM, 2009).

Figure 2.49 Diário de Moçambique Building, Beira (1954-c.1957) (EM, 2020).

Figure 2.50 Embaixador Hotel, Beira (1955-1958) (EM, 2009).

2.2.4.2 Francisco José de Castro

Francisco José Morales de los Rios de Castro (Figure 2.47) attended the Architecture Course at EBAL between 1939 and 1952, where he also completed the Urbanism Course. He graduated with a CODA project for a nautical club in Lisbon that was published in the journal *Arquitetura*.[2.16] He was awarded a scholarship to the University of Illinois, in the United States. While still a student, he attended the 1st National Congress of Architecture.[2.17] He collaborated with architects António Lino (1914-1961) in 1941, Pardal Monteiro (1897-1957) in 1943, with António Gomes Egea in 1949, and with the studio of Rui Atouguia (1917-2006) and Formosinho Sanchez (1922-2004) in 1951. In the latter office, he participated in the project for the Estacas Neighborhood, in Alvalade, Lisbon (1949-1955). He collaborated with several architects in the preparation of the Urbanization Plans of Chamusca and Salvaterra de Magos, and he also worked for the hospital building services.[2.18]

At the request of a cousin, who was the director of the construction materials company Lusalite in Beira, and fulfilling a long-cherished desire to live in Africa, he moved to Beira in September 1952. At the invitation of the Mozambique Company, he was hired to handle the detailing and monitoring of the work of the Grande Hotel, since José Luís Porto (1883-1965), the author of the original project, had abandoned the construction and returned to Portugal. In Beira, he was a high school teacher and practiced his liberal profession in partnership with engineer João Cabral. He was awarded the Araújo de Lacerda Architecture Award several times: for the Francisco Queriol House, dated 1954 (1956 award);[2.19] the José Ferreira House,

2.16 *Arquitectura*, August 1952: 9-10.
2.17 Castro, 2009-11-06; Tostões, 2008 (1948).
2.18 *Notícias*, August 13, 1958: 5.
2.19 *Notícias*, July 2, 1958: 5, 6.

Figure 2.51 Megaza Building, Beira (1955-1959) (EM, 2009).

Figure 2.52 School of the Reverend Marist Brothers, Beira (1957-1959) (EM, 2009).

Figure 2.53 Mundial Building, Beira (1959-1962) (EM, 2009).

Figure 2.54 BNU's Quelimane branch (1960-1972) (EM, 2009).

dated 1959;[2.20] and the Mundial Building, designed in partnership with Mário Acácio Couto Jorge (the 1964 award *ex-aequo*) (Figure 2.53).[2.21] In 1956, he won an architectural award at the São Paulo Biennial in Brazil for a collaborative work.[2.22] On July 19, 1961, he returned to Lisbon to take over the office of his uncle, the late architect António Lino. Although he kept his offices in Beira and traveled to Mozambique several times a year, the operation of the Portuguese office did not allow him to return to live in Africa. In Portugal, he also carried out several works, including the project for the Alvor Casino, in the Algarve, carried out in partnership with architect J. Caldeira Cabral, and which the journal *Binário* published in 1973.[2.23]

The Mozambican work of Francisco José de Castro, a professional of the third generation of Portuguese modern architects, was characterized by the orthodox application of the forms and principles of architecture of the Modern Movement, via the Corbusian production and modern Brazilian architecture. His work was supported by a clear theoretical awareness of the principles of international modern architecture and its gradual implementation in the provincial territory.[2.24]

Although he lived in Mozambique for a short period, Francisco José de Castro had an extensive architectural production that encompassed all kinds of programs and scales: from the design of the furniture for the apartments of the BNU's branch in Quelimane, to the urbanization plans of Tete and Vila Cabral. Except for occasional commissions for the municipalities of Beira and Tete, National Postal Services, Public Works Services and Mozambique Railways, his clientele was mostly composed of small private developers, large private

2.20 Castro, (19??): 1.
2.21 *Notícias*, May 14, 1964: 5, 8.
2.22 *Notícias*, August 13, 1958: 5.
2.23 *Binário*, May 1973: 191-194.
2.24 *Diário de Moçambique*, July 3, 1956: 3.

Figure 2.55 Paulo de Melo Sampaio (Magalhães, 2015: 261).

Figure 2.56 Lívio de Almeida Houses, Beira (1953-c.1957) (EM, 2009).

Figure 2.57 BNU's Vila Pery branch (1955-1959) (EM, 2010).

Figure 2.58 Matias Ferreira Houses, Beira (1956) (EM, 2010).

companies – such as Lusalite, Tabaqueira Portuguesa, Búzi, Cimentos de Moçambique, insurance companies such as Mundial Moçambique and Lusitana, the Agricultural Societies of Incomáti, Madal, Megaza and Pungué –, and by some institutions autonomous from government structures, such as the BNU or the Diocese of Beira.[2.25]

2.2.4.3 Paulo de Melo Sampaio

Paulo Eugénio de Meneses de Melo Vaz Sampaio (Figure 2.55) graduated in architecture at EBAL in 1952 with the design of a stadium for 6,000 spectators at Senhora da Hora, in Matosinhos.[2.26] In the school year 1952-1953, he attended the Urban Planning Course at the Politecnico di Milano, in Italy. He is credited with authoring, in association with the engineer Barbosa de Abreu, the preliminary design of the Igreja Matriz da Senhora da Hora, in Matosinhos (1953-1968).

Following a visit to family members living in Vila Pery, he became enthusiastic about the professional possibilities that he found in the former overseas province. In 1954, he settled in Beira, where he practiced his profession in association with engineer Lorena Birne (1909-1955), from whom he inherited the office after his death.[2.27] He worked on several projects with engineer Marcelo Moreno Ferreira, with whom he shared studio space at the Commercial Association of Beira. He won the Araújo de Lacerda Architecture Award several times: in 1957 (Teixeira de Sousa House),[2.28] 1958 (Marcelino Alves Ribeiro House) (Figure 2.61), 1962 (Mira Mar Hotel), 1967 (José Cartaxana House), 1968 (Tâmega Building) (Figure

2.25 Castro, (19??): 1-6.
2.26 *Notícias*, July 2, 1958: 6.
2.27 *Diário de Moçambique*, February 12, 1955: 1, 5.
2.28 *Notícias*, July 2, 1958: 5, 6

Figure 2.59 Railwaymen Sports Club Pavillion, Beira (1956-1961) (EM, 2019).

Figure 2.60 Montalto Building, Vila Pery (1957-1960) (EM, 2010).

Figure 2.61 Marcelino Alves Ribeiro House, Beira (1957-1958) (EM, 2010).

Figure 2.62 Building of the Municipal Administration, Land Registry Office, and Health Department, Beira (1957-1962) (EM, 2019).

2.65) and 1970 (Luís de Camões School) (Figure 2.67). In 1962, he formed the Architecture and Urbanism Office (GAU) in partnership with architect Bernardino Ramalhete (1921-2018). He worked for several public services: as a teacher at the Pero de Anaia High School, as a technical consultant for the Municipalities of Vila Pery[2.29] and Porto Amélia, and as a member of the Traffic Commission of the Municipality of Beira. Between 1962 and 1967, he was also director of the Center for Culture and Art in Beira. He was a member of the Arts and Decorations Section of the Executive Committee of the 1966 Exhibition-Fair of Chimoio.[2.30] He died in 1968, in Lisbon, of a sudden illness declared upon his return from a trip to North America.

The architectural and urbanistic work of Paulo de Melo Sampaio, a professional of the third generation of Portuguese modern architects, was shaped by the rationality of forms and principles that guide the architecture of the international Modern Movement, mainly by its matrix of European origin, despite frequent references to modern Brazilian architecture. His infrastructure buildings are rationally generated by resolving the constraints that surround and shape the architectural project:[2.31] elegantly proportioned elementary volumes and well-defined edges, chromatically worked surfaces – often incorporating murals or geometric patterns –, integration of the expression of the constructive elements in the building's design, optimization and external affirmation of the internal functional organization, asymmetric arrangement of spaces, use of standardized materials, use of mechanisms and systems for adapting buildings to the specific constraints of the tropical climate.

The architectural production of Paulo de Melo Sampaio covers a multifaceted series of programs and scales, from the decoration of commercial spaces to the design of urbaniza-

2.29 *Diário de Moçambique*, December 16, 1965: 5.
2.30 *Diário de Moçambique*, June 23, 1966: 5.
2.31 Albuquerque, 1998.

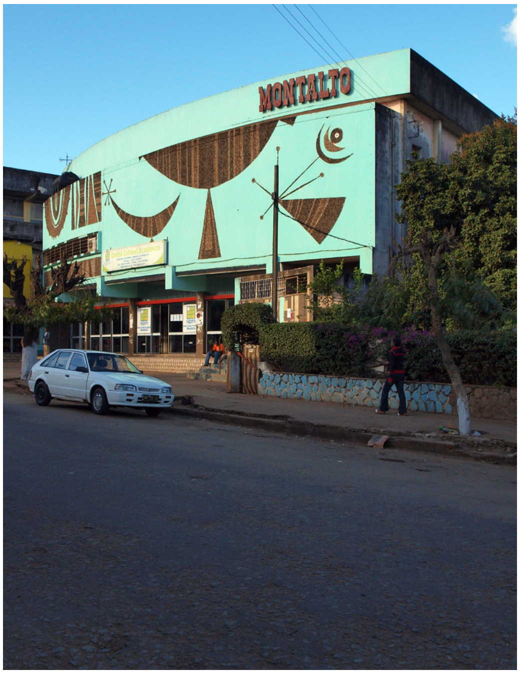


Figure 2.63 Montalto Cinema, Vila Pery (1957-1963) (EM, 2010).

Figure 2.64 Beira Club / Automobile & Touring Club, Beira (1957 / 1970) (EM, 2009).

Figure 2.65 Tâmega Buiding, Beira (1958-1966) (EM, 2009).

Figure 2.66 Railway Station, Vila Pery (1959-1966) (EM, 2010).

Figure 2.67 Luís de Camões School, Beira (1959-1967) (EM, 2009).

Figure 2.68 Tranquilidade de Moçambique Building, Beira (1962-c.1965) (EM, 2019).

Figure 2.69 Pemba Cinema, Porto Amélia (1963) (EM, 2010).

tion plans. He worked for a mixed clientele ranging from private individuals and companies to official bodies such as municipalities, the Public Works Services, and mainly the Mozambique Railways. His large-scale work from the early 1960s onwards expanded exponentially with the creation of GAU, which after his death changed its name to Architecture, Urbanism, and Interior Design Office (GAUD). In addition to his works in Mozambique, with special emphasis on the large number of buildings designed for the cities of Beira and Vila Pery, he also designed exhibition halls for Italy and Malawi.

2.3 The making of the Beira Central Station

2.3.1 The origin of the city of Beira

At the end of the colonial period, the city of Beira was the second largest urban center in Mozambique and the capital of the district of Manica and Sofala. Located on the east coast of Africa and facing the Indian Ocean, on the left bank of the mouths of the Pungué and Búzi rivers, the city sits at low elevations, on a tongue of sand separated from the continent by a marshy arm of the sea, the Chiveve, on which there was a small native settlement called Bangué.

In 1882, Lieutenant Colonel Joaquim Carlos Paiva de Andrada (1846-1928) presented a long exposition to the Geographical Society of Lisbon, in which he proposed the effective occupation of the province's hinterland. This change in the administrative system of Portuguese East Africa led the Society to propose the creation of a military command at the mouth of the Pungué to cover the territory from Manica to the sea. Following this proposal, the district of Manica was then established by the decree of June 14, 1884.

The settlement of Aruângua was created by decree on July 27, 1887. A military expedition docked at Ponta Chiveve on August 19, 1887, and the military post was inaugurated the following day. It was given the name Beira in honor of D. Luís Filipe, Prince of Beira and heir to the throne of Portugal, born that same year, 1887. In 1888, the village was elevated to the category of town, and in 1891 the construction of the port began (Figure 2.100). In 1892, it became the capital of the district of Sofala and the seat of the government of Manica and Sofala, and was subsequently elevated to the category of city, in July 1907, during the visit of the Prince of Beira.

As the administrative headquarters and urban hub of a vast territory under concession to the second Company of Mozambique, a company of mixed English and Portuguese capital, the city underwent rapid economic and demographic growth that mainly derived from its privileged geographical location. Situated in the heart of the province and equipped with a seaport, the city of Beira was the terminus of several communication routes serving the territory's' hinterland and the bordering countries of Central and Southern Africa.

2.3.2 The Beira urbanization plans

The administrative, commercial, and residential areas of Beira City initially expanded on the left side of the Chiveve River along the ocean coast, while the port and railway facilities occupied the right side, developing northward along the Pungué's bank. The city's railway port area has remained, until today, autonomous from the municipal institutions, governed only by its specific master plans. This is how we find it in the different urbanistic projects that were elaborated and sometimes implemented throughout the colonial era.

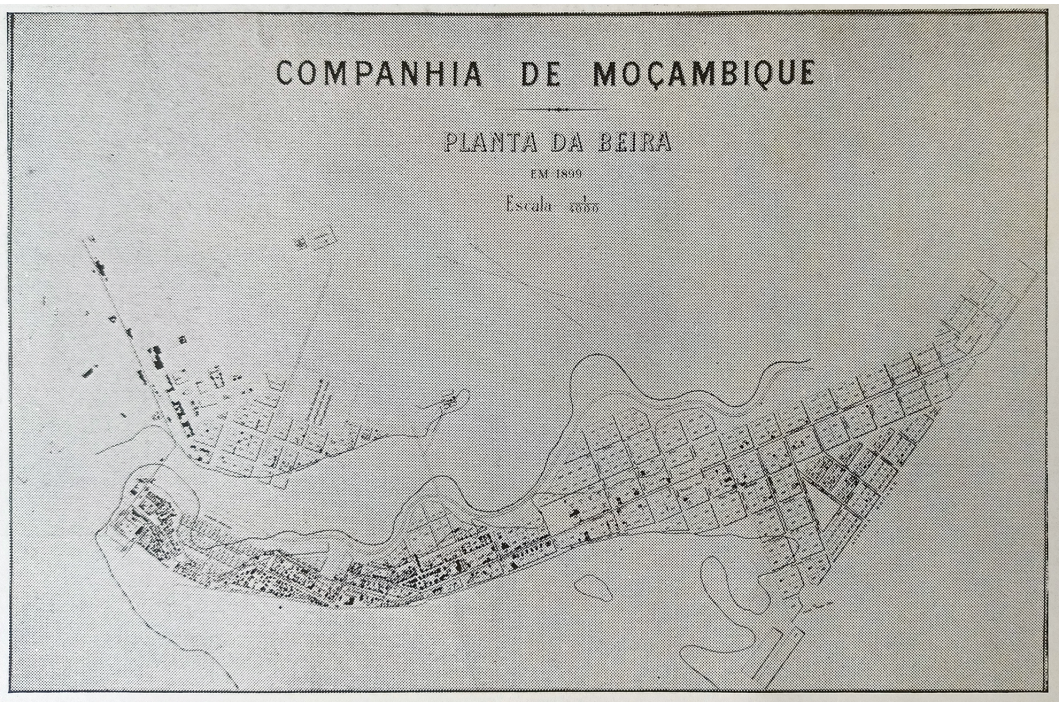


Figure 2.70 *Plan of the City of Beira*, 1899 (Silveira, c.1956: 264).

The initial settlement had been organized according to the directives of Lieutenant Luís Inácio, the first commander of the military post, and had the shape of a regular urban mesh, composed of square or triangular streets and blocks that followed the contour of the beach. The first plan for Beira (Figure 2.70) was designed in 1899 by military engineer Joaquim José Machado (1847-1925), first governor of the second Company of Mozambique and coauthor of the Lourenço Marques Expansion Plan (1887-1892). The plan proposed the expansion of the existing urban fabric via the creation of several orthogonal urban grids expanding southeastward along the coast and on the right side of the Chiveve, near the port and the railway station. This plan would be the main structuring element of the city's growth until the mid-20th century.

Figure 2.71 *Geographical situation of Beira and distribution of some peripheral areas considered in the urbanization* (Alegre; Porto, 1946: 70-71).

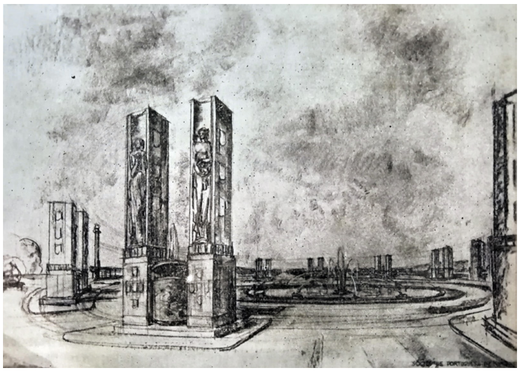
Figure 2.72 *General plan of the urbanization of the city* (Alegre; Porto, 1946: 8-9).

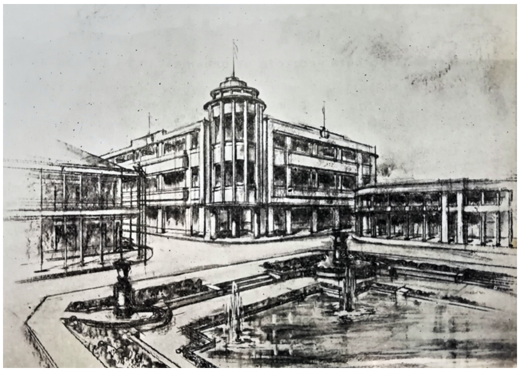
In 1943, the Municipality of Beira launched a competition to present proposals for the urbanization of the city, which had as the winner the Preliminary Urbanization Project of Beira (Figures 2.71-2.75), authored by architect José Luís Porto and engineer Joaquim Ribeiro Alegre, integrating the Portuguese Development Company. In 1946, the final version of the Urbanization Project was presented, and was approved by ministerial dispatch in 1948. The plan integrates the existing orthogonal urban grids, expanding the city southwestwards, on an embankment reclaimed from the sea, northeastwards, parallel to the railway line, and eastwards, along the coast. Its composition derives from the French formal urbanism, with large perpendicular and radial avenues that define regular blocks and visual axes scenographically articulated in monumental squares with public *Art Déco* buildings (Figures 2.74-

Figure 2.73 *Perspective of the entire urbanization of the city of Beira, according to the preliminary project of the Sociedade Portuguesa de Fomento ranked first in the competition opened by the City Council on January 23, 1943* (Alegre; Porto, 1946: 32-33).

Figure 2.74 *Overall view of Dr. Vieira Machado Square destined to be, due to its situation in relation to the Government Palace, the European residential area, the Macúti and the Ocean, the representative center of the city* (Alegre; Porto, 1946: 48-49).

Figure 2.75 *Perspective of an urban arrangement in the administrative area to enhance the City Hall and the post office building, providing them with the ease that aesthetics and traffic demand* (Alegre; Porto, 1946: 8081).





2.75). The main lines of this plan were implemented in the early 1950s, although the design proposed for the areas to be reclaimed from the sea and from the Chiveve remained to be completed.

The General Regulating Plan for the City of Beira (1961-1963), later designed by the municipal architect Carlos Veiga Camelo (1930-2020), basically proposed the arrangement of the former airfield expanse (left vacant by the transfer of the airport to Alto da Manga), the resolution of access and road decongestion problems, and the definition of the city's future expansion areas. Subsequently, the Regulating Plan of the Beira Urban Region, carried out in the city in 1966 by technicians from the Itinerant Urbanization Office of the Ministry of Overseas (architects Leopoldo de Almeida and António Teixeira Veloso, along with designer Virgílio Nunes Martinho), in collaboration with technicians from the Municipality of Beira, had a more territorial character, covering above all the northern suburban area of the city.

2.3.3 The Beira Railway

The Beira Railway line was created by decree of the Portuguese government in November 1889, which bound the first Company of Mozambique to build and operate a railway link between the coast and the western border of its territory.

The decree of the majestic concession of the second Company of Mozambique signed on February 11, 1891, and the commitments made with England under the boundary treaty of 11 June of the same year, reaffirmed the obligation to build a railway linking the port of Beira to the African hinterland. The Beira Railway line was built between 1892 and February 4, 1898, by the Beira Railway Company, Limited and the Beira Junction Railway (Port Beira to Fontesville), Limited, both subsidiary companies of the British South Africa Company, owned

Figure 2.76 Route of the Beira Railway line in Mozambican territory over charts from the Cartographic Service of the Portuguese Army, 1962.

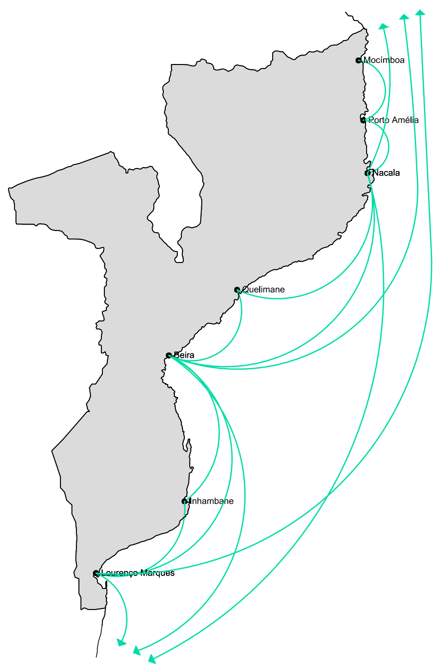
by Cecil Rhodes. This line, built according to the *Decauville* system, with a gauge of 0.607 m, was 339 km long and connected the city of Beira to Umtali, at a distance of 6 km from the Rhodesian border (Figure 2.76). On July 10, 1900, the gauge was extended to 1.067 m (3.65 ft), the same gauge used on the remaining line to Salisbury, as well as on the South African railway system.

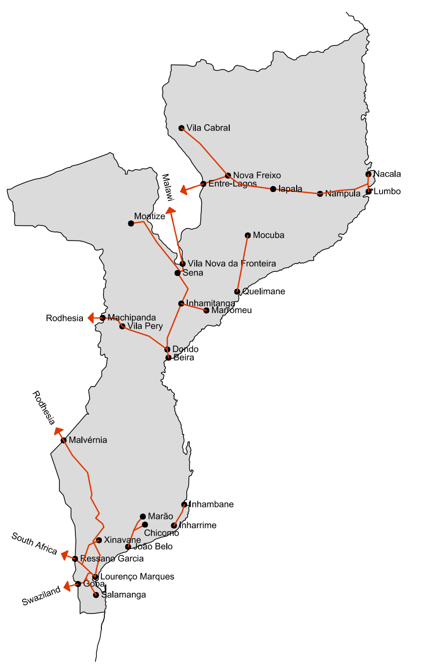
Upon termination of the concession of the territories of Manica and Sofala to Company of Mozambique (1892-1942), and after their transfer to the direct administration of the Portuguese State, and in compliance with the Capital Nationalization Law of 1943 – according to which some strategic industries and public services had to hold 60% Portuguese capital –, the Port of Beira was purchased on January 1, 1949, with funds from a Central Government loan to the former province of Mozambique that had been granted in 1947.[2.32] The Beira Railway line was purchased directly by the Ministry of Finance of the Metropolitan Government on April 1 of the same year.[2.33] Both infrastructures were assigned to the administration of the Ports, Railways and Transport Services of Mozambique, which began exercising it on the following October 1.

2.3.4 The Mozambique Ports, Railways and Transport Services

The Administration of Mozambique Ports, Railways and Transport Services (in short CFM, *Caminhos de Ferro de Moçambique*), were created on July 6, 1929, and regulated on August 22, 1931, on the initiative of the Governor-General of Mozambique, Lieutenant Colonel José Cabral (1879-1956), and of its first director, Major Engineer Francisco Pinto Teixeira (1887-1983). Its immediate mission was to unify, in a sole provincial organism, a number of services previously autonomous, relating to the exploration, construction and administration of the ports and railways of the former Portuguese overseas province: the administrations of the ports and railways of Lourenço Marques, Inhambane, Mozambique and Quelimane. The objective expressed in the legal diploma of its regulation was to serve the economy of Mozambique by putting together *a vast and complex organization that includes, in its most diverse and multiple ways of serving the community interests, transport by rail, road and air and also the unified administration of the ports served by such a system, foreheads of natural penetration fronts in the hinterland, both for the development of the natural resources of our territory and also to serve the economy of neighboring countries*.[2.34]

2.32 *Boletim Geral das Colónias*, May 1949: 139.
2.33 *Boletim Geral das Colónias*, May 1949: 133-134.
2.34 Decree N°. 315 of August 22, 1931.





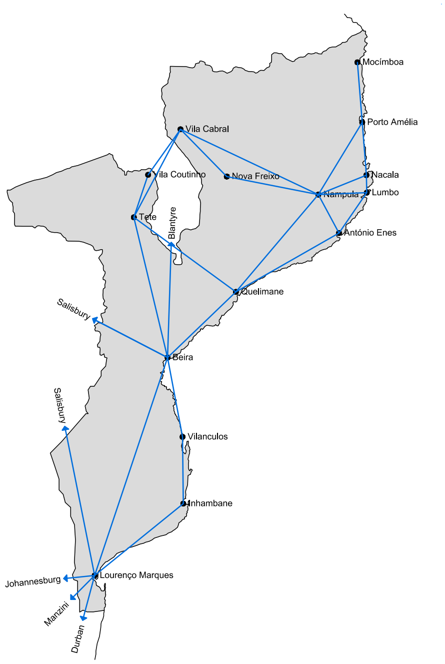


Figure 2.77 CFM transport network c.1970: ports.

Figure 2.78 CFM transport network c.1970: railways.

Figure 2.79 CFM transport network c.1970: road motor services.

Figure 2.80 CFM transport network c.1970: aviation.

Under the supervision of CFM, the road motor transport was created in January 1930 and the Department of Air Transport of Mozambique (DETA, *Divisão de Exploração dos Transportes Aéreos*) in August 1936, beginning to operate in December 22, 1937. For about forty years, until the end of the colonial period, the transportation network in Mozambique was coordinated and administrated by a single entity, organized according to a structure of complementary networks: ports, railways, road motor services, and aviation (Figures 2.77-2.80).

The railways in Mozambique constituted a discontinuous network of three autonomous systems – South, Center, and North – perpendicular to the coast of the Indian Ocean, linked to each other only through circulation on the railway networks of neighboring countries. Each of these systems was served by one of the territory's three international seaports: Lourenço Marques, Beira, and Nacala.

Beira Central Station, headquarter of Beira Railway and head of the Centre system of the Mozambican railways, connected the city and its seaport with the African hinterland through three railroad lines that had their terminus there: the Beira Railway, the Trans-Zambezia Railway (TZR), and the Tete Railway (Figure 2.81). Two of these lines connected to Tete and Salisbury, in Rhodesia, and were operated by the CFM; the third line terminated at Port Herald, in Malawi, and belonged to TZR, a private company with international capital whose majority of shares was bought in 1967 by the Portuguese State.[2.35] The articulation of these three lines with the Central African railway network made it possible to directly or indirectly connect the port of Beira to Northern Rhodesia, the Belgian Congo, Bechuanaland, South Africa, and to the port of Lobito in Angola via the Benguela Railway.

2.35 *Gazeta dos Caminhos de Ferro*, June 16, 1967: 106.

Figure 2.81 Trans-Zambezia Railway advertisement (Nogueira, 1966: 14).

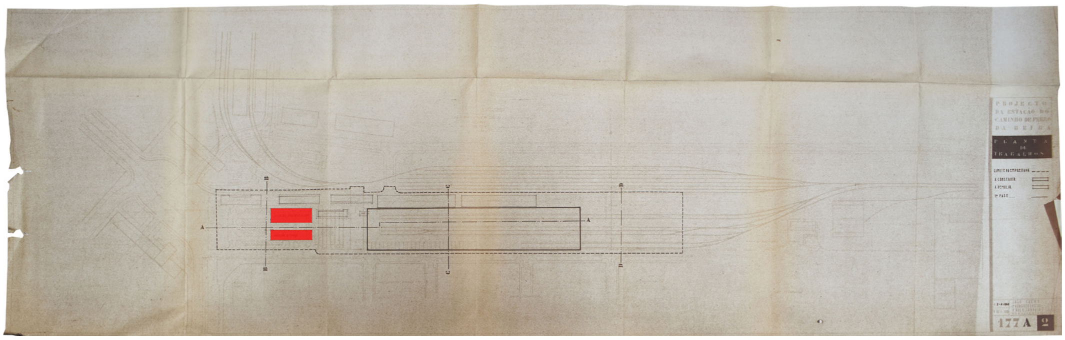


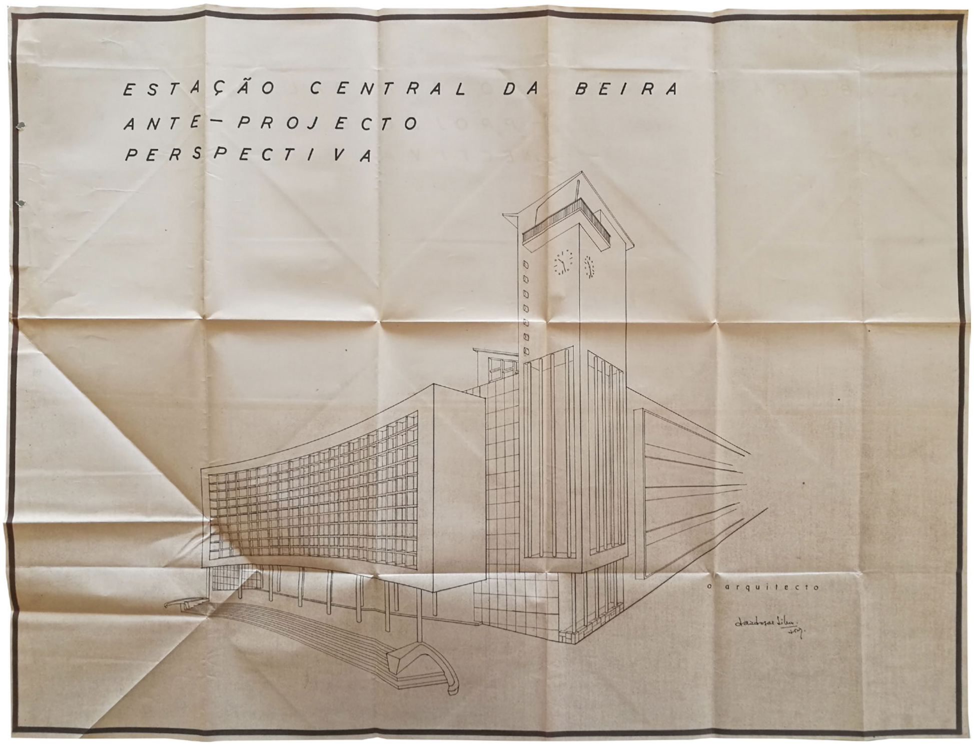
Figure 2.82 *Beira Railway Station Project, Plan of Works, April 3, 1960* -the location of the Beira Railway building's foundations is indicated in red (DEPE).

After the assignment of the administration of Beira Railways to CFM in 1947 the organization undertook a vast program to improve the received facilities: in addition to the works to increase the capacity of the port, it was necessary to renew the entire superstructure of the Beira Railway line by rectifying its route and using heavier rails, to reacquire all the rolling stock and traction equipment (locomotives, railcars, carriages, freight cars, and wagons), to replace or rebuild all the buildings (stations, warehouses, workshops, social facilities, staff residences, etc.), to build a goods station at Munhava, and to construct a new terminus station and headquarter for the port and the Beira Railway administration.

2.3.5 The design of the Beira Central Station

The first initiative to build a permanent railway station in Beira City, meant to replace the existing temporary construction made of wood, cast iron, and zinc, was undertaken between 1930 and 1938 by Beira Railways. However, the construction was interrupted at the foundation level due to the imminent outbreak of World War II (Figure 2.82).

The design for a modern building was assigned in 1954 to architect Manuel Júlio Barbosa e Silva, a railway employee residing in the city. For the preliminary design, dated May 8, 1956 (Figure 2.83), it was necessary to consult the heads of all the services that were to be



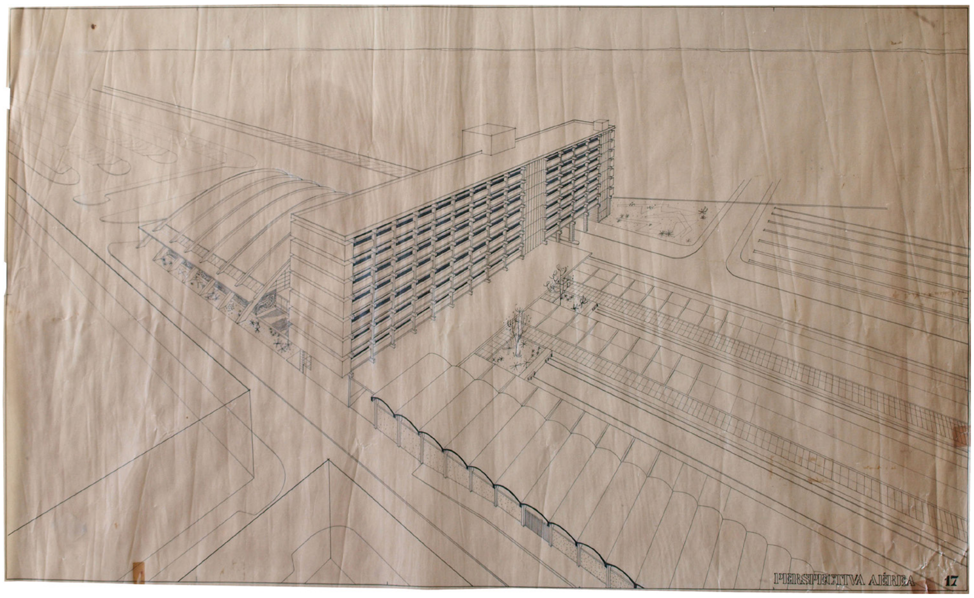


Figure 2.83 *Beira Central Station, Preliminary Project, Perspective*, 1956 - Manuel Júlio Barbosa e Silva (AHU | EM, 2019).

Figure 2.84 *Aerial Perspective*, architecture competition? (ECB | EM, 2009).

housed in the new building, since no program had yet been drafted. The implementation of this preliminary project followed the alignment of the foundations of the failed Beira Railway station, which were expected to be demolished because they did not fit the proposed design. Although neither the Mozambican General Government nor the Municipality of Beira objected to its continuation, this preliminary project received unfavorable information and advice from the governmental bodies in Lisbon on November 14 of that same year.

On the initiative of the railway administration, technical support of the Beira municipal services was requested for the selection of a new project for the station building. On September 2, 1957, an architectural competition was opened to define the exterior expression of the new Central Station building.[2.36] The presentation of the main and side elevations and the overall perspective were requested. This competition had only one submission by the architect Paulo de Melo Sampaio (Figure 2.84). Under the coordination of Bernardino Ramalhete, architect from the Municipality of Beira, a team was then formed to design the station's preliminary project. The team comprised three architects living in the city and practicing their liberal profession there: João Garizo do Carmo, Francisco José de Castro, and Paulo de Melo Sampaio.[2.37]

After signing the contract on February 16, 1959, the team of architects delivered a preliminary project with drawings dated April 18 of that same year, suggesting thirteen possible architectural solutions for the complex – and giving clear preference to the last of the proposals. This study was approved by the administration of the CFM and in September 1959 received the favorable opinion of the governmental services in Lisbon – albeit with minor

2.36 *Notícias*, November 11, 1957: 5.
2.37 Ramalhete, December 29, 2011.

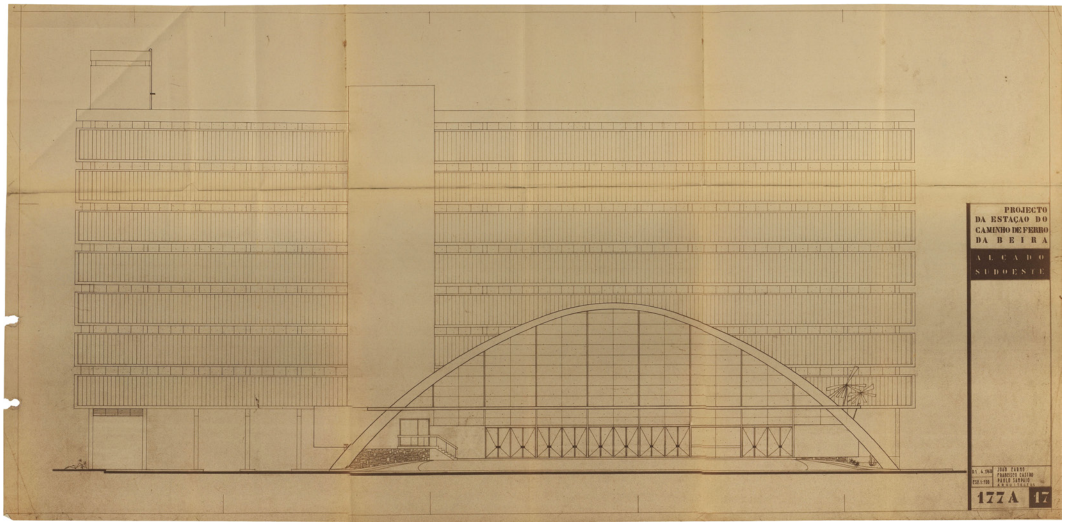


Figure 2.85 *Project of the Beira Railway Station, Southwest Elevation*, April 1, 1960 (CDIIPAD | EM, 2010).

objections, namely regarding the nakedness of the external walls of the elevator volume. Authorization was also given for the execution of the definitive project and subsequent launching of the construction tender. Approval by ministerial dispatch was granted on the 9th of the following month,[2.38] while the project for construction, with drawings dated April 1, 1960 (Figure 2.85), was approved by the services of the Ministry of Finance on June 17, 1961. The supervision of the work, as well as the development of the project in detail drawings, was the responsibility of architect Paulo de Melo Sampaio.[2.39]

The reinforced concrete (Figure 2.86) and foundation projects – the first with drawings dated March 25 and 30, and April 2, 1960, and the second dated July 24, 1961 – were executed by the engineer Marcelo Moreno Ferreira. The electrical installation project, including lighting and sockets, signaling, telephones, electric clocks, elevators and other special installations was signed by electrical engineer Borges Coelho, dated January 1961.

2.38 *Notícias*, October 15, 1959: 1.

2.39 *Boletim dos Portos, Caminhos de Ferro e Transportes de Moçambique*, October 1966: 19-26.

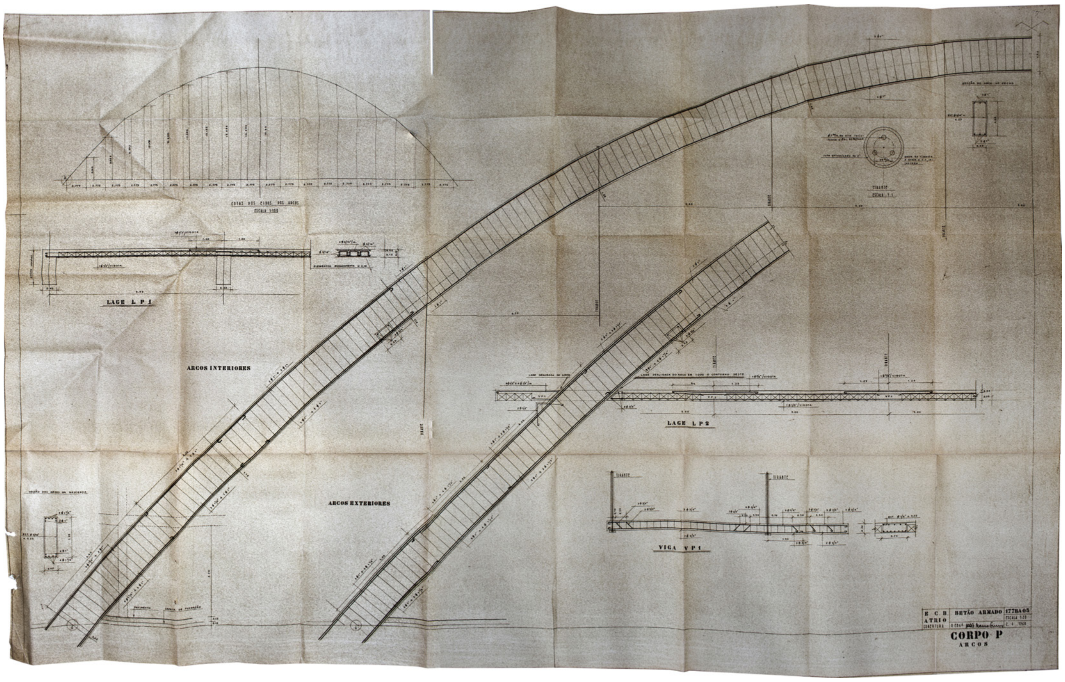


Figure 2.86 *E.C.B., Reinforced Concrete Project*, April 2, 1960 (DEPE).

2.3.6 The construction of the Beira Central Station

The tender for the construction of the Beira Central Railway Station Building was launched in March 1961,[2.40] with the opening of bids scheduled for July 3 of that same year. However, the opening of the proposals of the nine competing builders was postponed for 60 days due to a delay in the supply of the foundations project,[2.41] and only took place on October 3 of that same year.[2.42] In mid-1962, the Minister of Finance of the Central Government announced the award of the contract to Eticol, Empresa de Transportes Indústria e Construções, Lda.[2.43] The

2.40 *Diário de Moçambique*, March 4, 1961: 6.
2.41 *Diário de Moçambique*, August 18, 1961: 2.
2.42 *Boletim dos Portos, Caminhos de Ferro e Transportes de Moçambique*, October 1961: 28.
2.43 *Boletim Geral do Ultramar*, August-September 1962: 258.

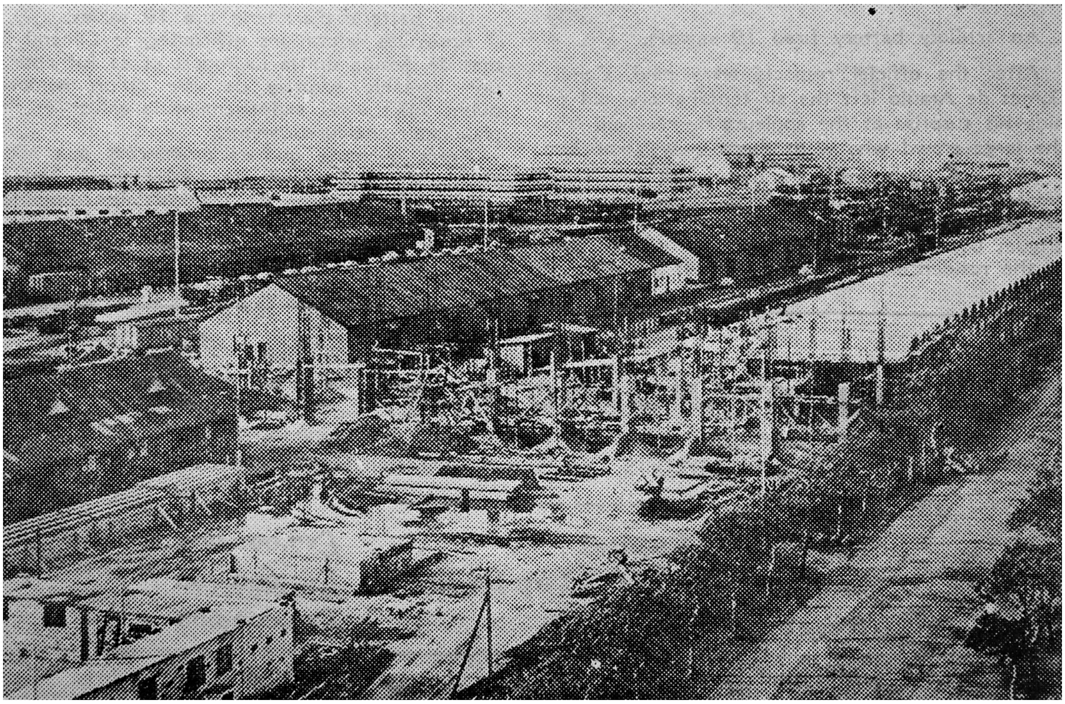


Figure 2.87 Beira Central Station under construction, 1963 (*Boletim dos Portos, Caminhos de Ferro e Transportes de Moçambique*, September 1963: 21 (MCFM | EM, 2019).

Figure 2.88 Beira Central Station under construction, 1964 (MCFM | EM, 2019).

contract between Eticol and Beira Railway was signed in January 1963.[2.1] At that moment, the driving of the concrete piles that form the building's foundations was already underway.[2.2]

The work had started with the building of a warehouse for the construction site, on October 10, 1962.[2.3] It then continued in the northeast area of the complex, with the construction of the platform area's command building and adjacent platform (Figure 2.87). These works were completed on December 31, 1963, and the new station immediately went into operation.[2.4]

The structural skeleton of the administration block was erected in April 1964 (Figure 2.88). In August of the same year the passage atrium housed an exhibition of scale models of the ports, buildings, and social works, among other CFM developments, intended to mark the visit of the President of the Portuguese Republic, Admiral Américo Tomás (1894-1987), to the city of Beira (Figure 2.89). The completion of the last three concrete arches of the public atrium, the traditional ceremony of raising the roof beam to mark the completion of the carcass work (*pau de fileira*) and the beginning of the finishing stages occurred on the last weekend of September 1964.[2.5] The roof slab for the third and final platform, executed within a period of month, was completed in November of the same year. At that time, the parabolic arches were already demolded and work was underway on the construction of the restaurant and of the concrete slab over the access to the public atrium. At the end of December, the

2.1 *Notícias*, January 29, 1963: 5.
2.2 *Notícias*, February 12, 1963: 5.
2.3 *Notícias*, October 19, 1962: 5.
2.4 *Boletim dos Portos, Caminhos de Ferro e Transportes de Moçambique*, January 1964: 17.
2.5 *Notícias*, September 29, 1964: 5.

Figure 2.89 Exhibition of scale models in the passage atrium of the Beira Central Station under construction, July 1964 (*Boletim dos Portos, Caminhos de Ferro e Transportes de Moçambique*, July 1964: 21 | MCFM | EM, 2019).

last slab of the building was cemented, covering the restaurant, and the station's platform number 2 was then opened for operation (Figure 2.90).[2.6]

After the first winning tenderer gave up the enterprise and transferred it to Empresa de Construções Civis & Industriais, Lda, the finishing stages were then carried out. In April 1965 began the demolition of the foundations of the projected Beira Railway station and

2.6 *Diário de Moçambique*, December 23, 1964: 10.

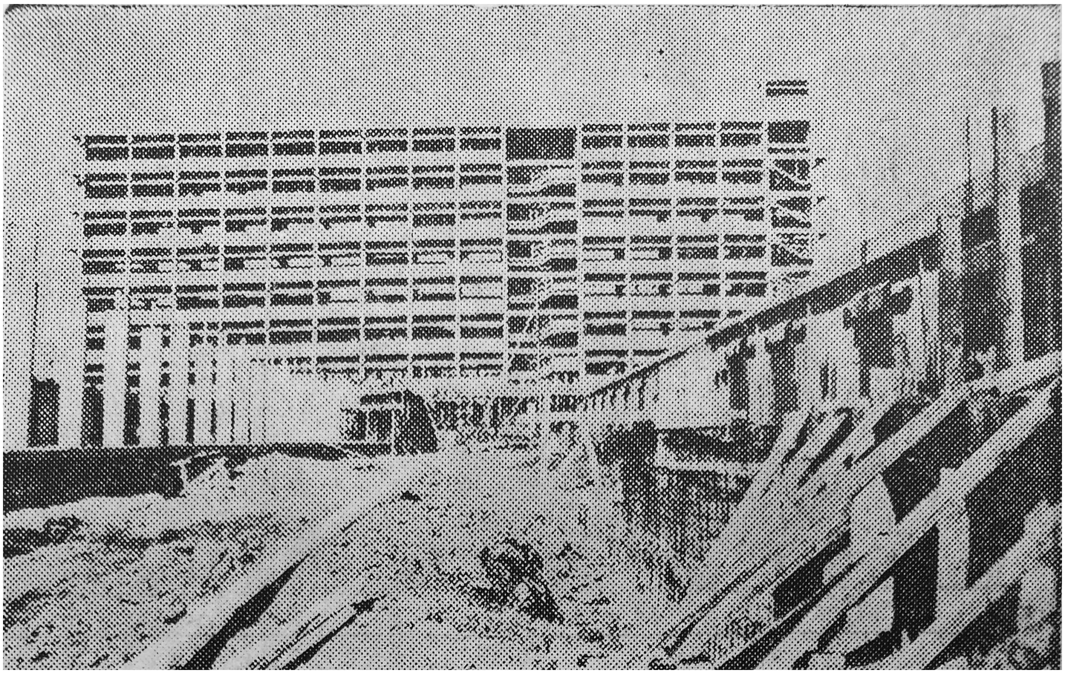


Figure 2.90 Beira Central Station under construction, September 1964 (*Notícias*, July 15, 1964: 5).

office building, in order to free up the area intended for the parking lot.[2.7] This work had to use explosives due to the enormous resistance of the reinforced concrete of the foundations.

On April 19, 1965, in order to free the square opposite the station from constructions, the various railway services were moved to the upper floors of the administration block. The Services of Track and Works and the Improvement Brigade were the first to be transferred, to the 7th and 8th floors, respectively.[2.8] The Accounting, Supervisory and Treasury services began operating on the 6th floor of the new facilities on May 15.[2.9] The offices of the CFM and Beira Railway boards began moving on May 21,[2.10] and the Beira Railway directorate was

2.7 *Diário de Moçambique*, April 12, 1965: 2.
2.8 *Diário de Moçambique*, April 21, 1965: 2
2.9 *Diário de Moçambique*, May 15, 1965: 2.
2.10 *Diário de Moçambique*, May 22, 1965: 3.

installed on the 4th floor on May 24.[2.11] The Movement, Traffic and Fares service began to move to the 3rd floor on June 15,[2.12] and the Fees and Dispatches section was moved only at the end of that month.[2.13] The moves of the railway services to the upper floors of the administration block occurred while the finishing work on the ground floor and the opposite square continued.[2.14] The demolition of the old Movement, Traffic and Fares building concluded the clearing of virtually all of the land allocated to the new station and adjoining external spaces.[2.15]

In early June was announced the awarding of the restaurant-bar operation,[2.16] and on June 19th, a tender was launched for the rental of the remaining commercial spaces in the public atrium, whose interior designs, under the responsibility of the contractors, had to be submitted to the Beira Railway for approval.[2.17] On August 17th, a new tender was launched for the remaining commercial establishments, with a deadline of August 30th to receive bids.[2.18]

On June 10th, the freight elevator started working for the public and employees while waiting for the three main elevators,[2.19] which began to be assembled in early August. The three elevators and the freight elevator were manufactured by Comportel–Companhia Portuguesa de Elevadores and assembled by two technicians from the city of Porto. In addition to the cabins' careful interior finish, they featured technical innovations detailed in the *Diário de Moçambique*: automatic control panel for the three main elevator machines, automatic

2.11 *Diário de Moçambique*, June 2, 1965: 7.
2.12 *Diário de Moçambique*, June 16, 1965: 2.
2.13 *Diário de Moçambique*, June 27, 1965: 2.
2.14 *Diário de Moçambique*, June 2, 1965: 17.
2.15 *Diário de Moçambique*, July 11, 1965: 3.
2.16 *Diário de Moçambique*, June 2, 1965: 2.
2.17 *Diário de Moçambique*, June 19, 1965: 12.
2.18 *Diário de Moçambique*, August 17, 1965: 3.
2.19 *Diário de Moçambique*, June 9, 1965: 3.

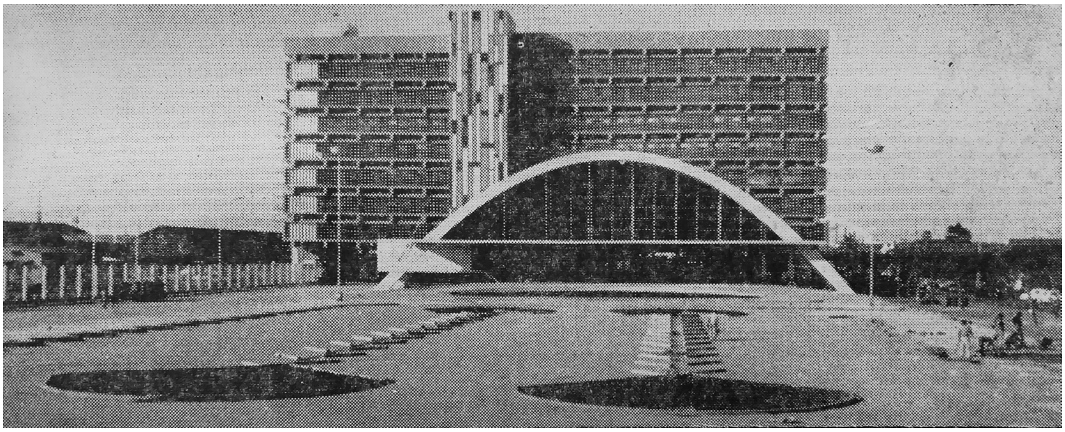


Figure 2.91 *This work of the largest railway station in the entire national territory has scheduled for tomorrow the date of delivery to the Railway, by the contractor company (Diário de Moçambique*, October 7, 1965: 1).

doors, photoelectric cells, and a parachute system.[2.20] The Beira company Simel, Lda. supplied both the elevators and the complex's electrical installation.[2.21]

By the end of August 1965, the Chiveve embankment was being completed to open a new access road to the port facilities and the avenue that extends inland to Munhava. At the same time, warehouse no. 3 was being partially demolished to make way for the road that would connect the access to the port and rail facilities – under the administration block – and the aforementioned avenue.[2.22]

In order to design the panel named *Triagem* (Triage), artist Jorge Garizo do Carmo arrived in Beira on September 4, 1965. The panel, executed in vitreous mosaic manufactured in Angola by Vidrul, occupies three fronts of the public atrium.[2.23]

In October 7, 1965, the newspaper *Diário de Moçambique* reported the conclusion of the construction of the parking lot (Figure 2.91) and the delivery of the work to the CFM.[2.24] On

2.20 *Diário de Moçambique*, August 2, 1965: 2.
2.21 *Diário de Moçambique*, October 1, 1966: 12.
2.22 *Diário de Moçambique*, August 25, 1965: 2.
2.23 *Diário de Moçambique*, September 5, 1965: 13.
2.24 *Diário de Moçambique*, October 7, 1965: 1.

Figure 2.92 Visit of the Overseas Minister to the Beira Central Station, December 5, 1965 (*Diário de Moçambique*, December 6, 1966: 1).

October 26th, 1965, the last phase of the work began with the demolition of the remaining section of warehouse no. 3, an old wooden and zinc construction about half a century old.[2.25] With the entry into operation on December 6th of the Munhava goods station, and the transfer to the new infrastructure of the sections that operated in the old warehouses no. 3, 4 and 5, the demolition process of the remaining buildings began,[2.26] which would be completed on January 10, 1966.[2.27]

On December 5, 1965, the station was visited by the then Minister of Overseas Territories, Dr. Silva Cunha. During his visit, the minister could observe an exhibition of scale models

2.25 *Diário de Moçambique*, October 27, 1965: 2.
2.26 *Diário de Moçambique*, December 3, 1965: 3
2.27 *Diário de Moçambique*, January 11, 1966-01: 2.

Figure 2.93 *The area that the circle delimits did not deserve to be framed in the urban design of the square and is waiting, incomprehensibly, for someone to solve its urbanization* (...). (*Diário de Moçambique*, October 16, 1965: 2).

of works carried out by the railways along the line, from Beira to the border, displayed in the administration session room (Figure 2.92).[2.28]

On December 11th, the two bars in the salient volume of the atrium opened to the public, while the restaurant, to be operated by the CFM, was expected to start operating within a few weeks.[2.29] On January 7th, 1966, the barber store installed in one of the compartments

2.28 *Diário de Moçambique*, December 5, 1965: 2.
2.29 *Diário de Moçambique*, December 7, 1965: 3.

Figure 2.94 Inauguration of the Beira Central Station, October 1, 1966 (*Boletim dos Portos, Caminhos de Ferro e Transportes de Moçambique*, October 1966: 19 | MCFM | EM, 2019).

of the section of stores opened to the public;[2.30] on the 20th, the three public telephones installed next to the tobacconist's shop began to operate;[2.31] and on the 29th, the police station located at the southwestern top of the platform area's command building, next to the ramp to João de Resende Street, opened to the public.[2.32]

The urban arrangement of Manuel António de Sousa Square, a junction of the city's road structure with the port and the Chiveve, was not considered in the contract for the station (Figure 2.93).[2.33] The works for its arrangement, designed by the Public Works Services of Lourenço Marques, were underway in April 1966 under the responsibility of the Municipality.[2.34] Finally, the statue entitled *Espelho* (Mirror), by the sculptor Maria Alice Mealha (b.1925), was almost completed at the end of the following September.[2.35]

2.30 *Diário de Moçambique*, January 6, 1966: 2.
2.31 *Diário de Moçambique*, January 21, 1966: 2.
2.32 *Diário de Moçambique*, January 30, 1966: 3.
2.33 *Diário de Moçambique*, October 16, 1965: 2.
2.34 *Diário de Moçambique*, April 30, 1966: 2.
2.35 *Diário de Moçambique*, September 22, 1966: 2.

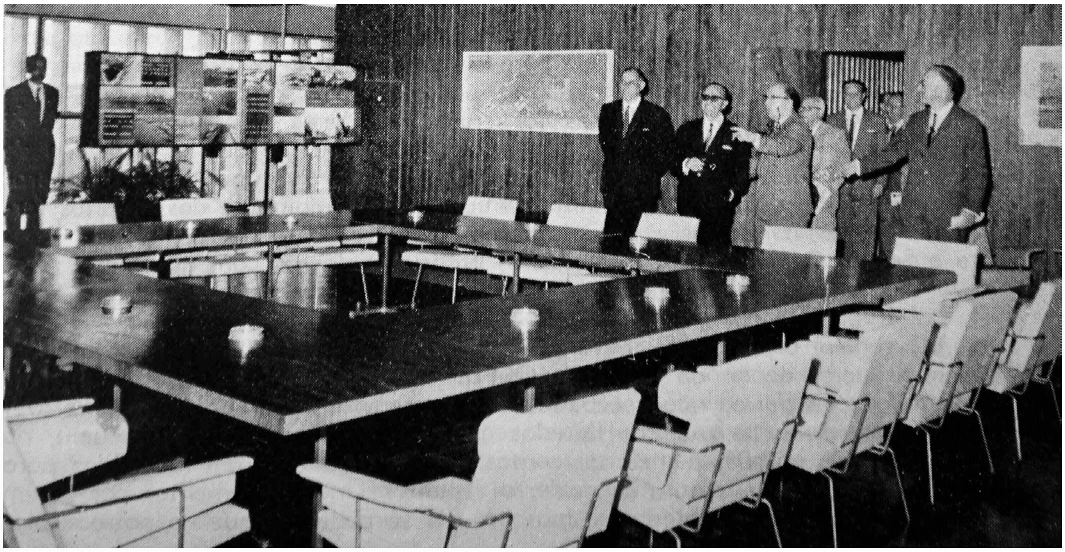


Figure 2.95 Inauguration of the Beira Central Station, October 1, 1966 (*Boletim dos Portos, Caminhos de Ferro e Transportes de Moçambique*, October 1966: 23 | MCFM | EM, 2019).

The inauguration ceremony for the Beira Central Station taking place on October 1st in the presence of the governor-general of the former province, general Costa Almeida[2.36] (Figures 2.94-2.95). The program of the inauguration also included the opening of other CFM undertakings: the Munhava Goods Station on the outskirts of Beira, 155 houses for railway workers in Manga, Dondo, Gondola, Vila Pery, Vila Machado, Manica and Machipanda, as well as the inauguration of the new Vila Pery railway station, a building that was also designed by Paulo de Melo Sampaio.

2.3.7 The significance of the Beira Central Station during the colonial period

The construction of a complex with the scale of the Central Station – at the time the largest railway station in the country and currently a landmark of the city of Beira – was an affirmation of the economic importance of the city and the CFM, both at the district and pro-

2.36 *Gazeta dos Caminhos de Ferro*, October 1, 1966: 269.

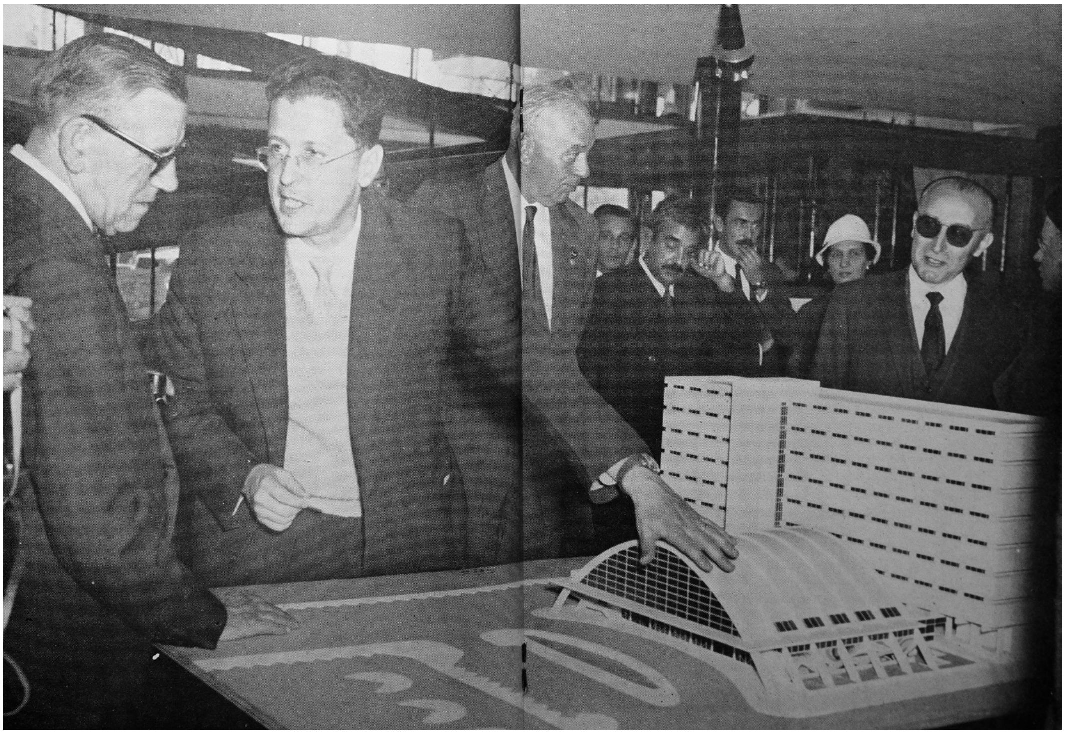


Figure 2.96 Scale model of the Station at the 1st Central Africa Trade Fair, Bulavaio, Rhodesia, May 1960 (*Boletim dos Portos, Caminhos de Ferro e Transportes de Moçambique*, May 1960: 26-27 | MCFM | EM, 2019).

vincial level, and also at the national and continental level. The series of events surrounding the process of its construction illustrates the priority given to this infrastructure within the overall colonial policy of the time: the purchase by the Metropolitan Central Government of the Port of Beira, of the Beira Railway, and later on of most of the shares of the Trans-Zambezia Railway; the signing in 1950 of a convention between Portugal and Great Britain aimed at optimizing the operation of the Port of Beira and the railways that served it; the exhibition of the scale model of the new building in a prominent place in the pavilion designed by João José Tinoco for the representation of CFM in the 1960 edition of the Central Africa Trade Fair in Bulavaio, Rhodesia (Figure 2.96) - which was solemnly visited by the British Queen Mother in May of the same year -, and the exhibition of the scale model, starting in July 1961, in the

Figure 2.97 40th anniversary of the National Revolution commemorative postage stamp, 1966.

window of the DETA terminal in Beira City; the visit in August 1964 of the President of the Portuguese Republic, Admiral Américo Tomás, to the works in the station and to the exhibition inside the public atrium that presented the undertakings of the CFM administration (as well as the praising comments he dedicated to the dimension and architectonic quality of the scale model of the station and of the work in construction); the visit of the Minister of Overseas on December 5, 1965, to the station and to the exhibition of scale models of the undertakings carried out by the Beira Railway; the choice of October 1, 1966, for the inauguration of the complex, coinciding with the 17th anniversary of the passage of the port administration to the Portuguese State; the inclusion of the ceremony in the commemorations of the 40th anniversary of the National Revolution of 1926, the founding moment of

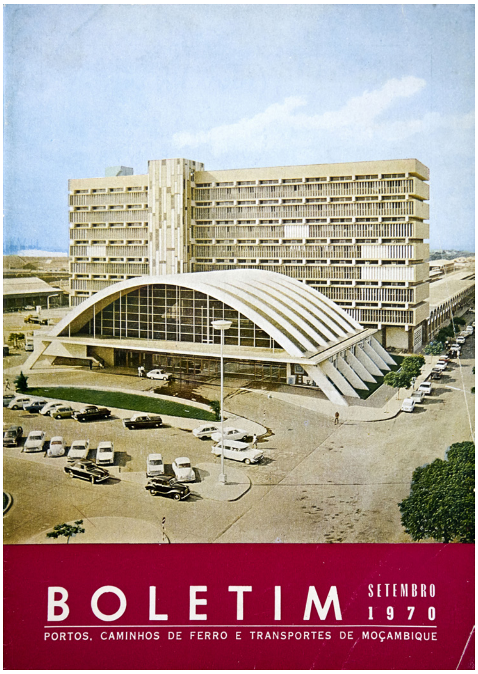


Figure 2.98 *Boletim dos Portos, Caminhos de Ferro e Transportes de Moçambique*, June 1966: cover (MCFM | EM, 2019).

Figure 2.99 *Boletim dos Portos, Caminhos de Ferro e Transportes de Moçambique*, October 1966: cover (MCFM | EM, 2019).

Figure 2.100 *Boletim dos Portos, Caminhos de Ferro e Transportes de Moçambique*, June 1967: cover (MCFM | EM, 2019).

Figure 2.101 *Boletim dos Portos, Caminhos de Ferro e Transportes de Moçambique*, September 1970: co-ver (MCFM | EM, 2019).

the *Estado Novo* regime; and the choice of the station, together with the António Enes High School in Lourenço Marques, to illustrate the stamp dedicated to Mozambique in the philatelic issue designed by Alberto Cutileiro (1915-2003), promoted by the Ministry of Overseas, in celebration of that revolution (Figure 2.97).

As the materialization of the developmentalist policy of the Portuguese Metropolitan Government, the Beira Central Station represented, better than any other building in Mozambique, the meeting of two opposing utopias in a common enterprise: the principles, methods, and languages characteristic of the architecture of the Modern Movement supporting, through the achievements of the CFM (Figures 2.98-2.101), the survival of the identity utopia of the *Estado Novo* regime.

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SECTION 3

3 Assessment of cultural significance

The present section sets up the values and levels of significance, as well as classifications of the Beira Central Station's elements, components, and attributes; describes and characterizes the attributes of location, function, form, fabric, and intangible values that inform the building; states the significance of the Beira Central Station; and establishes the levels of significance of its cultural heritage values.

3.1 Values and levels of significance

The *Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance,* defines cultural significance as *aesthetic, historic, scientific, social or spiritual value for past, present or future generations. Cultural significance is embodied in the* place *itself, its* fabric*,* setting*,* use*,* associations*,* meanings*, records,* related places *and* related objects.[3.1]

Significance is a simple concept. Its purpose is to help identify and assess the attributes which make a place of value to us and to our society. An understanding of it is therefore basic to any planning process. Once the significance of a place is understood, informed policy decisions can be made which will enable significance to be retained, revealed or, at least, impaired as little as possible. A clear understanding of the nature and level of the significance of a place will not only suggest constraints on future action, it will also introduce flexibility by identifying areas which can be adapted or developed with greater freedom.[3.2]

The *Burra Charter*, which provided a well-established international methodology and the criteria to identify key aspects that provide the meaning to the place in its current context, is

3.1 Australia ICOMOS, 2013: 2.

3.2 Kerr, 2013.

LEVEL OF SIGNIFICANCE		DEFINITION	RECOMMENDED ACTIONS
A	exceptional significance	These elements are essential to the significance of the place. They play a crucial role in supporting this significance.	Reveal, maintain and enhance significance through meticulous reservation ,conservation, restoration and reconstruction.
B	high significance	These elements are of high significance. They play an important but not necessarily crucial role in supporting the significance of the place.	Reveal ,maintain and enhance significance but some adaptation and supplementary reconstruction may be considered to accommodate future compatible uses.
C	moderate significance	These elements are of moderate significance and provide support to elements or functions of higher significance. They play a role in supporting the significance of the place but may be inadequate in their current configuration or use.	Reveal, maintain and enhance significance but acceptable options may subject to consensual agreement based on expert analysis ,include alteration or removal in whole or in part.
D	low significance	These elements are low of significance. They play a minor role in supporting the significance of the place or may have been compromised by later changes.	Interventions ,alterations or demolishing may be appropriate.
INT	intrusive	This relates to an item or component that obscures, impedes, diminishes, or otherwise damages the significance of an element or its component parts.	Alter ,remove, demolish.

Table 3.1 Table of levels of significance (Burke (et. al.), 2018).

ATTRIBUTES THAT CONTRIBUTE TO THE LEVEL OF SIGNIFICANCE

LOCATION

Setting, views and relationships between the site elements.

FUNCTION

Current and former uses, activities, and practices.

FORM

Design, details, spaces, configuration, scale, and character of the place.

FABRIC

Physical material, landscape elements, interiors, related contents and collections, artifacts, documentation (archives and records), and subsurface archaeological remain.

INTANGIBLE VALUES

Traditions, associations, meanings, techniques, and management systems; the spirit, experience, and feeling of the place, which is often passed through oral tradition and social practices or events.

Table 3.2 Table of attributes that contribute to the level of significance (Burke (et. al.), 2018).

used to assess both tangible and intangible qualities of the place. The analysis is based on the documentary evidence previously described in Section 2.

As shown above, the *Burra Charter* defines five cultural values for a place: *aesthetic, historic, scientific, social or spiritual*. In this Conservation Management Plan, the cultural heritage significance has been assessed using four of the Burra Charter's values – *aesthetic*, *historic*, *scientific* and *social*. This classification assesses the significance of each element using a common scale of five levels - *exceptional*, *high*, *moderate*, *low* and *intrusive* (Table 3.1). Intrusive elements are those that interfere with the understanding of the Beira Central Station original design, impact the intended patterns of spatial organization, views, and/or contrast with the intended palette of material.

3.1.1 Heritage values

Based on the level of significance, this section serves as the foundation for the policies that specify conservation strategies for individual elements and components.

Historic value. The historic value is present in places that are representative of an historic movement, an important event or activity and when they are associated to a relevant person or group of people. This value is more significative for the places that maintain evidence of the relation with the historic value attributed and the setting does not present relevant modification from the original.

Aesthetic value. Aesthetic value is related to the human answer to visual and not visual aspects of the place, so it is not just based on physical elements but also aspects of sensory perception. Concepts as beauty, formal aesthetic ideas, creativeness or art are evaluated to define the significance of the place.

Scientific value. Scientific value refers to the information content of a place and its ability to reveal more about an aspect of the past through examination or investigation of the place. The relative scientific value of a place is likely to depend on the importance of the information or data involved, on its rarity, quality or representativeness, and its potential to contribute further important information about the place itself or a type or class of place or to address important research questions.

Social value. Social value is assessed analyzing the importance that the place has for the local community or a cultural group and the symbolic meaning both cultural and social that it holds for them.

3.1.2 Elements, components and attributes

In this subsection, that is based upon the corresponding subsection of the Eames House Conservation Management Plan,[3.3] the expressions elements, components and attributes are central to the significance assessment procedure. The terminologies and their meanings are as follow:

3.3 Burke (et. al.), 2018.

Element. The term element is used to define the functional areas with an independent character, which correspond to each of the specific roles performed: public atrium, platform's area and command building, and administration block.

Component. The term component is used to define parts of an element, for instance the roof is a component of the administration block.

Attributes. The term is used to define the five aspects of the elements and components of the complex that contribute to demonstrating its heritage significance, individually or in amalgamation. The aspects are *location*, *function*, *form*, *fabric*, and *intangible values* (Table 3.2). The process of assessing significance involves identifying and evaluating key attributes of the Beira Central Station using both the historical evidence (in the research) and the evidence of the site itself (in its physical elements and components).

Attributes can have a variety of heritage values. Considering the architectural form, the Beira Central Station has aesthetic and also historic value. Different attributes may also have different levels of value. For example, original mosaic tiles are detached in some sections of the walls. The authentic mosaic tiles have historic value, but they can be replaced with mosaic tiles of the same make, specification, size and color which reinstates aesthetic and fabric values.

The attributes of Beira Central Station are tangible and intangible. For example, the intangible attributes lie on the artistic quality of the murals and sculptures, on the conceptual principles that rule its architectonic design or on the symbolic role it played in the economic,

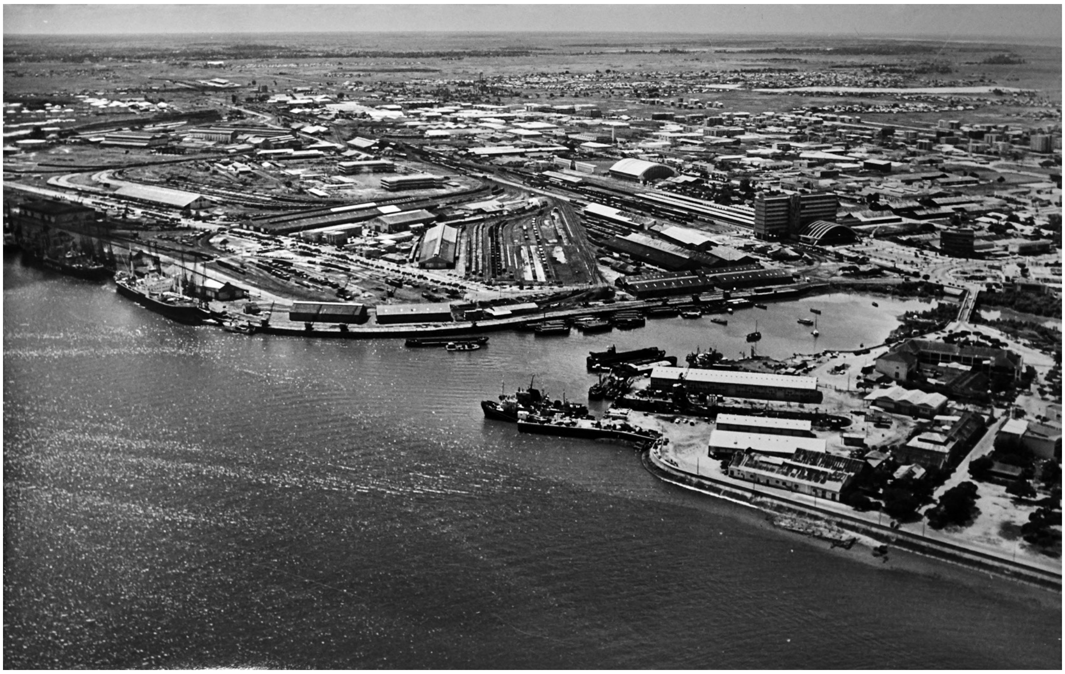


Figure 3.1 Beira's port and railway facilities in the colonial period (MC-FM | EM, 2019)

Figure 3.2 Beira's port and railway facilities in the colonial period (MC-FM | EM, 2019) social and political context of the time. Attributes have different degrees of importance based on their relevance in contributing to what is deemed significant.

3.2 Attributes description and characterization

The Beira Central Station will be described and characterized in this section following the five heritage significance values above mentioned: *location*, *function*, *form*, *fabric*, and *intangible values* (Table 3.2).

3.2.1 Location

The Beira Central Station is located in the right bank of the Chiveve, in an area occupied by the port and railway facilities of the city (Figures 3.1-3.2). This area, with an urban design initially defined by Joaquim José Machado's 1899 plan, it was consolidated by the 1943 Preliminary Urbanization Project and the 1946 Urbanization Project for Beira, authored by José Luís Porto and Joaquim Ribeiro Alegre. In both plans the design proposed for the station building was U-shaped: the main front faced Manuel António de Sousa Square, now Mozambique Railway Square, a node of articulation of two urban grids of different orientations, while the inner space of the "U" bordered the railway channel. Barbosa e Silva's preliminary design followed this same setting and volume. According to the new design by the team of architects, of the existing railway facilities, only the layout of the lines was maintained, albeit shortened in length. In order to make room for the parking lot and the new construction, the old station, the bar, the customs house, warehouses no. 1 to 5, the Movement, Traffic and Fares building were demolished, as well as the Telegraph and Telephone Lines buildings,

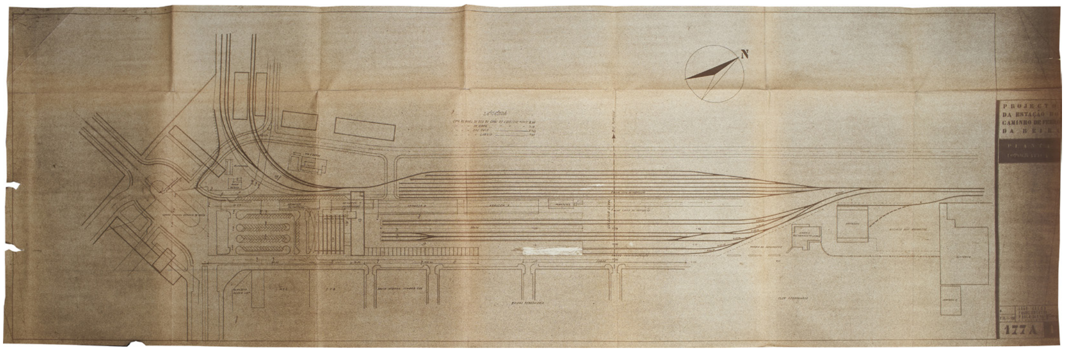
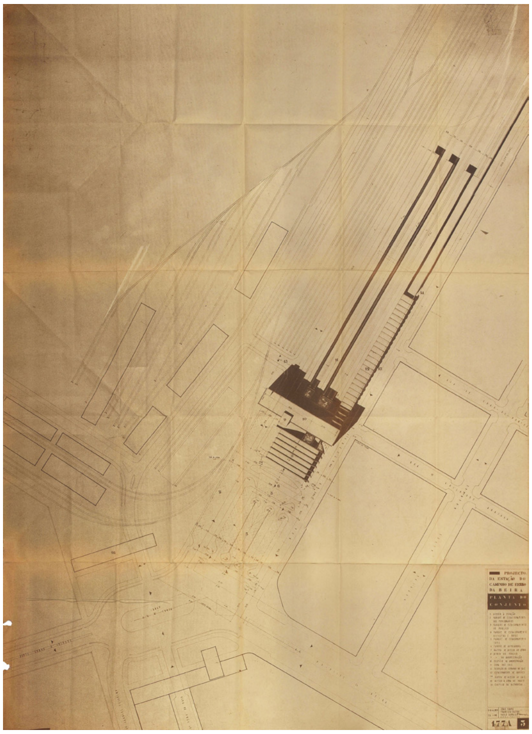
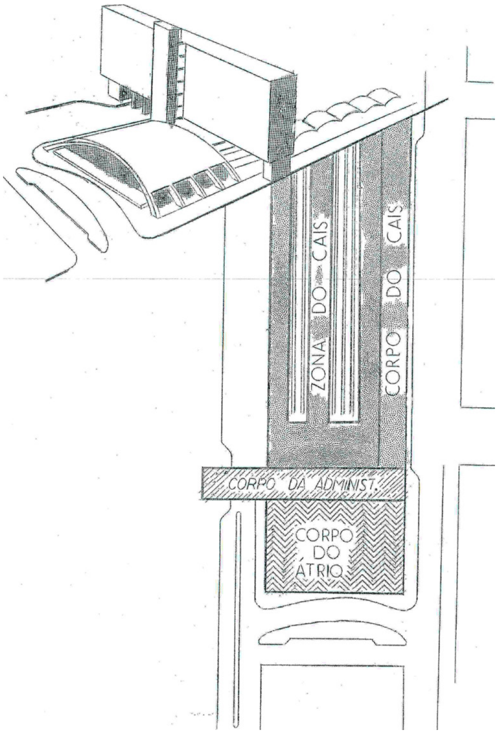


Figure 3.3 *Project of the Beira Railway Station, Topographic plan*, n.d. (DEPE)

Figure 3.4 *Beira Railway Station Preliminary Project, General Plan*, April 15, 1959 (CDIIPAD | EM, 2010)

Figure 3.5 *Beira Central Station Justificatory and Descriptive Report*, n.d. (CDIIPAD)





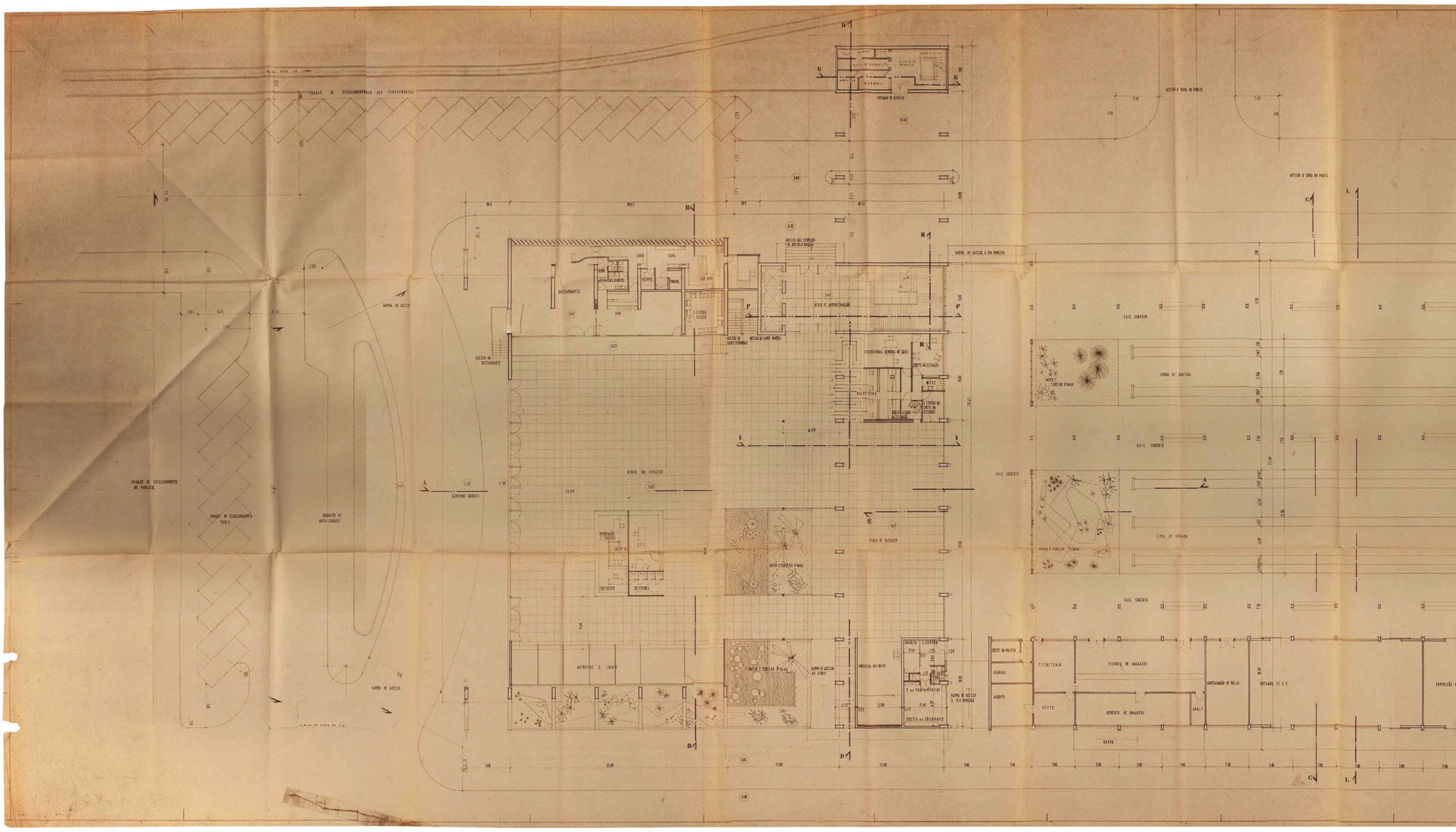
the carriage shed and, as we have seen, the foundations of the Beira Railway station and administration complex.

The new project maintained the orientation of the building to the collateral cardinal points, but the main body was set back from Manuel António de Sousa Square, opening a large plaza for parking between the two. The general shape of the new site lost the “U” symmetry of Porto and Alegre’s plan and of Barbosa e Silva’s preliminary design in favor of an asymmetric “L”-shaped layout of the built volumes. Two urban fronts were defined: to the southwest, opposite the parking lot and Manuel António de Sousa Square, and to the southeast, along João de Resende Street. This setting allowed for visual continuity between the platforms area and the port facilities, and simultaneously formalized the limit and the main access to the port-railway complex (Figures 3.3-3.4).

3.2.2 Function

The complex was surrounded by a large external support area, a distribution hub for access movements to the port and its various areas. In the final project, the surrounding urban spaces were the object of a proposal to structure the circulation of motor vehicles, bicycles and pedestrians. The parking areas for employees and the public, the bus stop and cab parking spaces were also designed.

As the architectural expression of the command center of a vast transport network, the general program for the new Beira Central Station sought to resolve two complementary functional needs in the same building complex: the replacement of the existing precarious and inadequate railway facilities, a long-standing desire of the local population, and the concentration in a single building of the port administration services and of the Beira Railway,



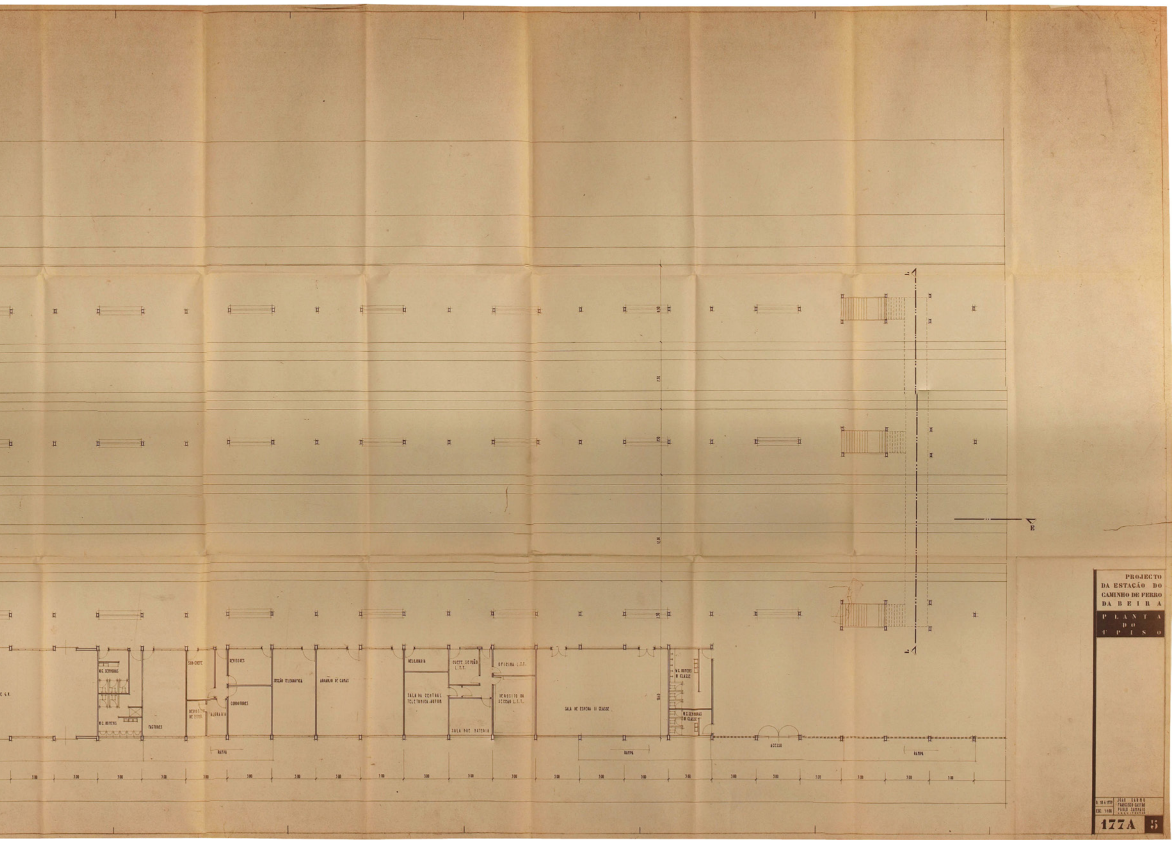
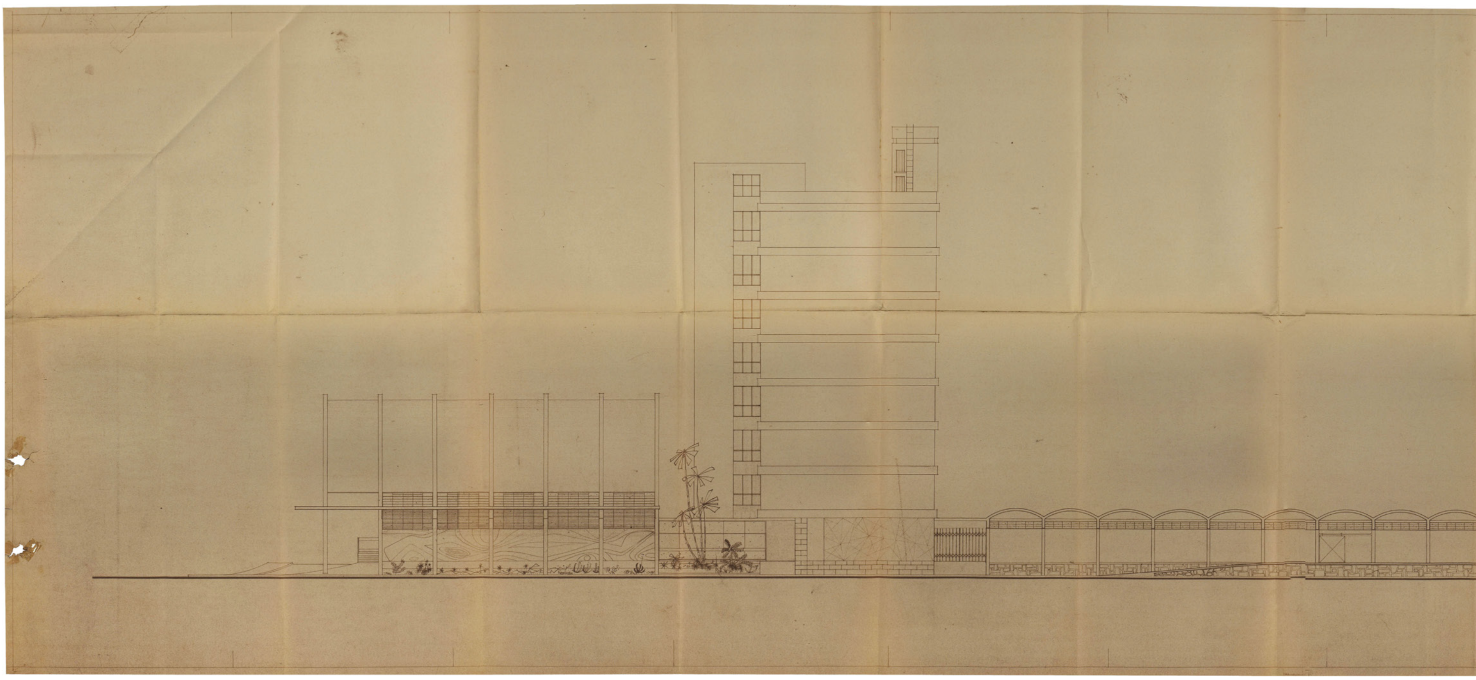
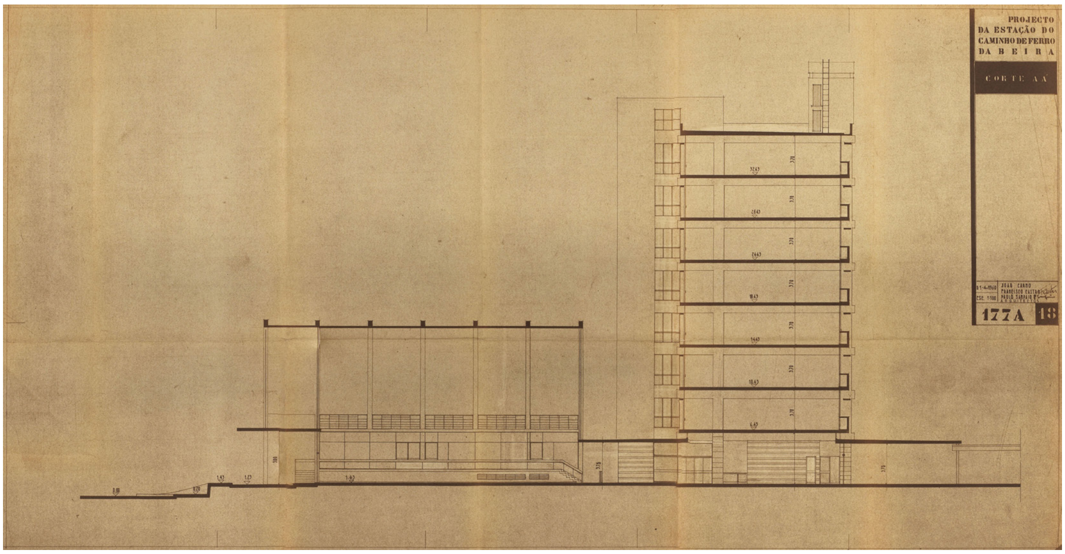


Figure 3.6 *Beira Railway Station Preliminary Project, 1st Floor Plan, April 18, 1959* (CDIIPAD | EM, 2010)

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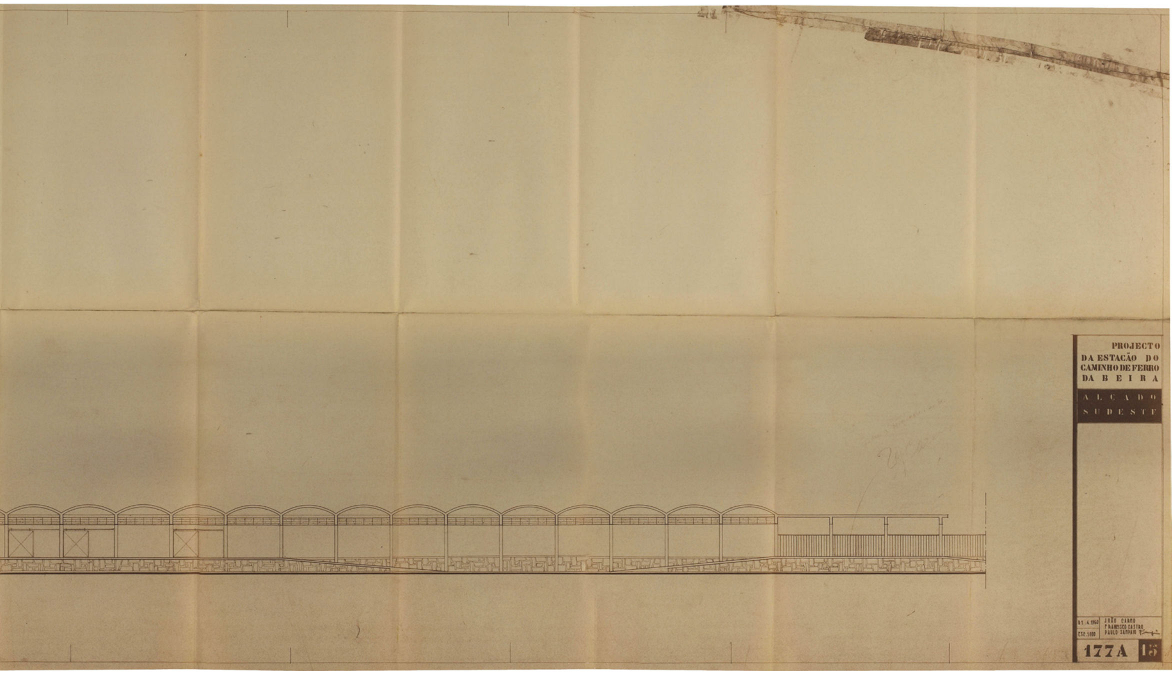


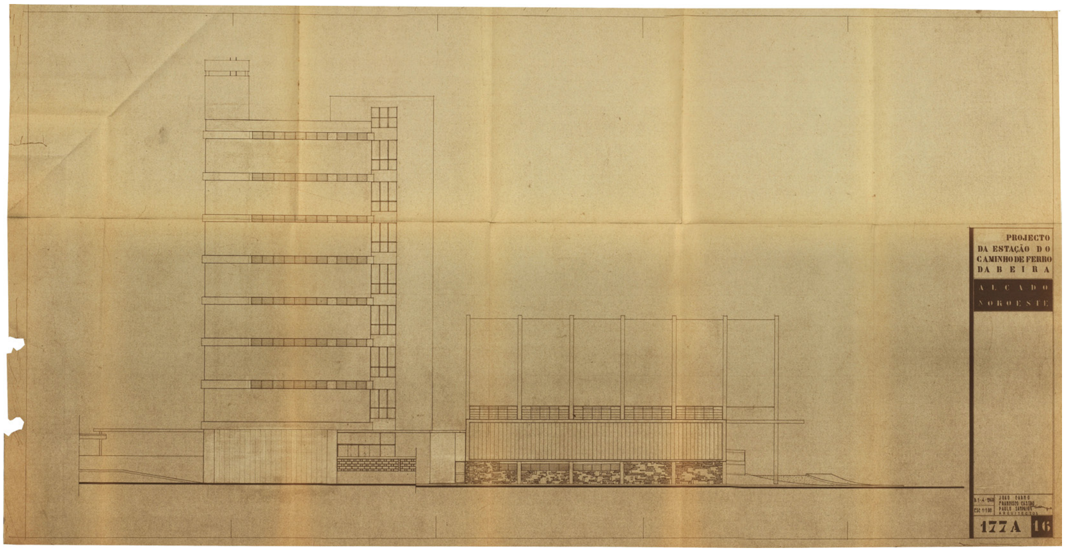


Figure 3.7 *Beira Railway Station Project, Southeast Elevation, April 1, 1960* (CDIIPAD | EM, 2010)

Figure 3.8 *Beira Railway Station Project, Section AA', April 1, 1960* (CDIIPAD | EM, 2010)

Figure 3.9 *Beira Railway Station Project, Northwest Elevation, April 1, 1960* (CDIIPAD | EM, 2010)

Figure 3.10 Beira Central Station, public atrium and administration blocks (EM, 2019)

Figure 3.11 Beira Central Station, public atrium (EM, 2019) hitherto dispersed among several temporary facilities. To this end, scientific design methodologies were used to optimize the operational organization of the three distinct areas that make up the port and railway complex.

Orthodoxly ruled by the axiom that *form follows function*, the complex volumetric organization of the Beira Central Station derived from the subdivision of the two primary functional zones required by the brief – station and administration – into three areas of distinct functional character: the public atrium, the platforms area and command building and the administration block (Figure 3.5). The assignment of an autonomous design area to each of the three architects of the team was decided by drawing lots and reflected this tripartite structuring of the program: the public atrium was thus designed by Francisco José de Castro, the platforms area and command building by João Garizo do Carmo, and the administration block by Paulo de Melo Sampaio. To these internal functional areas corresponded several autonomous geometric solids arranged according to an asymmetric compositional matrix.

3.2.3 Form

The interior design of the ground floor of the railway complex is primarily structured by the arrangement of the various external volumes and the transition spaces between them, together with the resolution of the program in circumscribed functional areas and of the staff and public circulations in well characterized spaces. Although there is spatial continuity at the ground floor level between the public atrium, the administration block and the platforms area (Figure 3.6), the autonomy of each of the main volumes is perceived via the physical separation between them, an articulation resolved in two moments of transition, two spatial strips with 10 m wide and 3.75 m of ceiling height (Figures 3.7-3.9).

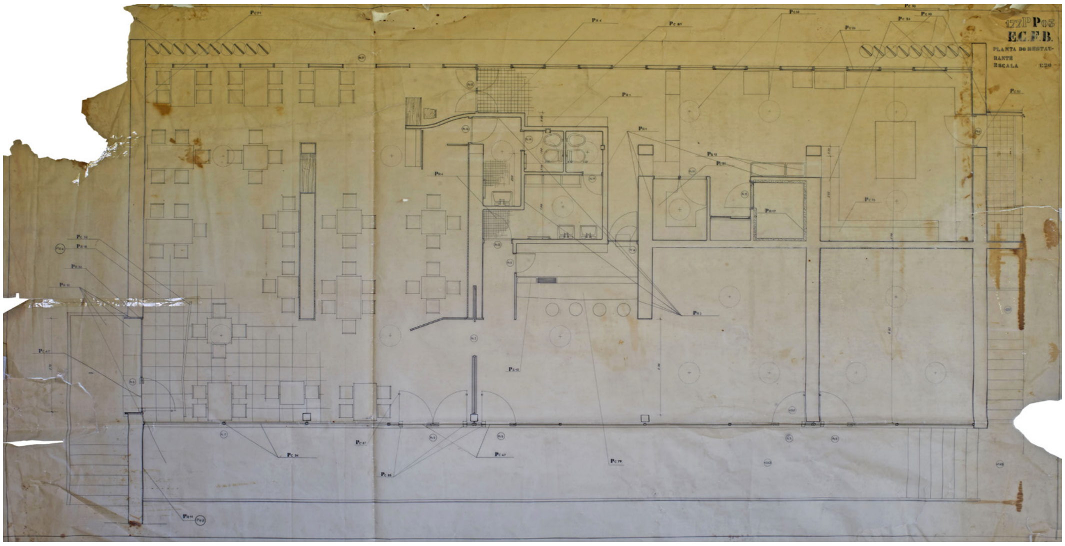


Figure 3.12 Beira Central Station, public atrium, commercial spaces front (EM, 2009)

Figure 3.13 *ECFB, Restaurant floor plan,* April 1960 (ECB)

The public atrium block consists of a parabolic volume measuring 55,40 m x 25,40 m, covered by a vaulted membrane with partially glazed tops, set on the longitudinal axis of the opposite square. Supported by inverted parabolic arches, the curved reinforced concrete membrane rests, on the southeast front, on a rectangular base covered with a continuous mural of polychrome glass mosaic, enclosing the commercial spaces; on the northwest front, it ends on a suspended rectangular prism, glazed and protected by vertical *brise-soleil*, containing the restaurant and the station bar. Both prisms are intersected by the structural arches and unified by a horizontal slab suspended by steel beams from the first two structural arches, forming a deep porch along the entire length of the main entrance. Fronted by two symmetrical ramps, the main access to the public atrium is through doors arranged along the entire length of the porch (Figure 3.10), while a secondary access, opening directly onto João de Resende Street, allows rapid ingress of passengers from the station's platforms.

Inside, the public atrium has the form of a vaulted nave with a span of about 45 m, flanked by two rows of glazed compartments with autonomous roofs, above which the concrete vault begins (Figure 3.11). It was planned that these compartments would contain, to the southeast, the commercial spaces of hairdresser, barber, travel agency and tour and safari agency (Figure 3.12); to the northwest, served by a gallery 1.20 m above ground level, the first-class waiting room, the bar, the restaurant room (with a second direct access from the outside), the pantry and the kitchen (also with direct service access from the outside) (Figure 3.13). These last spaces overlap with the public toilets, placed on the lower floor, with access via their own interior staircases. In an uncovered kiosk with 10 m of frontage, implemented decentrally under the vaulted nave, there were the tobacconist, the timetable display, the clock and the public telephones (Figure 3.14).

Figure 3.14 Beira Central Station, public atrium, tobacconist (EM, 2009)

Figure 3.15 Beira Central Station, public atrium, patio / water mirror (EM, 2010)

Figure 3.16 Beira Central Station, public atrium, patio / water mirror (EM, 2010)

Figure 3.17 Beira Central Station, transversal path (EM, 2009)

Figure 3.18 . Beira Central Station, exit to João de Resende Street (EM, 2009)

Figure 3.19 . Beira Central Station, passage atrium, ticket office (EM, 2009)

Figure 3.20 Beira Central Station, passage atrium (EM, 2009)

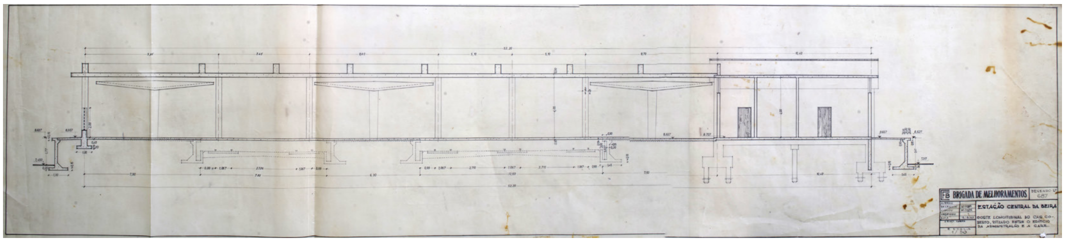


Figure 3.21 *Beira Central Station, longitudinal section of the covered platform, located between the administration building and the station,* August 13, 1963 (ECB)

Figure 3.22 Beira Central Station, second transition space and command building (EM, 2019)

Figure 3.23 Beira Central Station, second transition space from platforms area (EM, 2019)

The public atrium is separated from the passage atrium, under the administration block, by the lower flat roof of a first transition space. This space is defined by a flat slab of reinforced concrete supported on one side by round pilasters and suspended on the other side by steel beams embedded in the design of the large frame that encloses the northeast top of the atrium. The ceiling of this interspersed space opens onto a patio / water mirror, on which an isolated sculpture rests, an opening for lighting and ventilation (Figures 3.15-3.16).

The ceiling height rises to 5 m under the administration block, creating a horizontal window for lighting and ventilation, enclosed by glass shutters, between the ceiling of this block and the slab of the transition space. Tangential to this space there is a 3 m wide path that coincides with the projection on the ground floor of the galleries of the upper floors (Figure 3.17). This transversal axis connects the entrance to the administration atrium, located on the ground floor of the volume containing the main stairs and elevators, with the opposite public exit onto João Resende Street, via a ramp that flanks a second patio / exterior water mirror. This ramp is separated from the interior by an undulating grid of prefabricated concrete elements (Figure 3.18).

The passage atrium beneath the administration block constitutes a space rhythmically cadenced by rectangular ceramic-tiled pilasters supporting plastered beams. This atrium is flanked by two two-story areas: the ticket office and the stationmaster's rooms to the northwest; and the former Rhodesia Railways agency and first aid station compartments to the southeast. Decorative murals of colored glass mosaic punctuate each of the fronts of this transitional space (Figures 3.19-3.20).

Access to the departure platform area from the passage atrium is made under a second transition space constituted by a flat concrete slab supported by an independent structure of

Figure 3.24 Beira Central Station, platforms area and command building (EM, 2019)

Figure 3.25 Beira Central Station, platforms area (EM, 2019)

Figure 3.26 *Partial elevation of the platforms area*, April 1960 (ECB | EM, 2009)

Figure 3.27 Beira Central Station, platforms area command building opposite the railway lines (EM, 2019)

Figure 3.28 Beira Central Station, platforms area command building opposite João de Resende Street (EM, 2019)

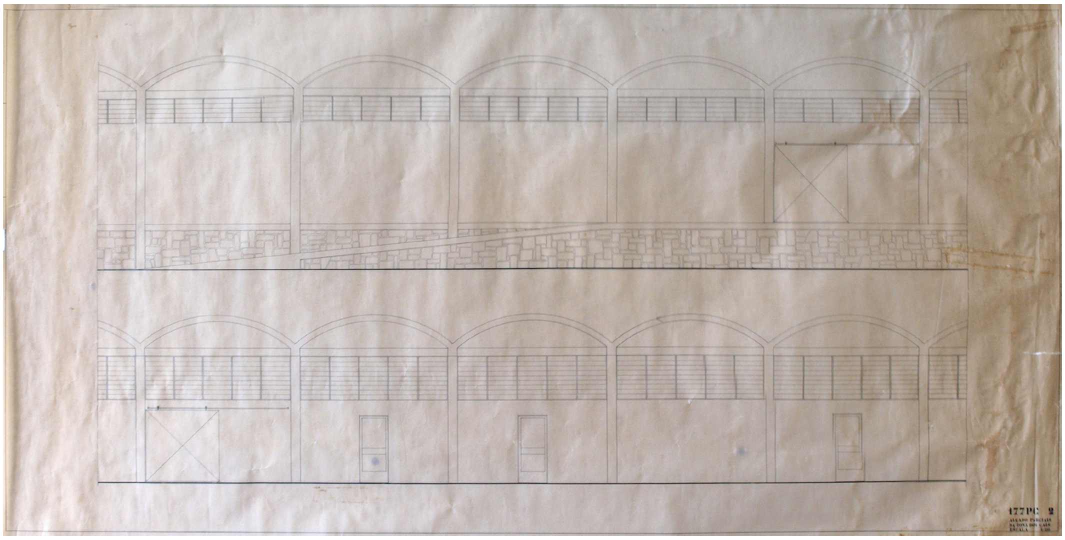


Figure 3.29 Beira Central Station, public atrium and administration blocks (EM, 2009)

Figure 3.30 Beira Central Station, administration block (EM, 2009) pilasters (round on the administration side and rectangular on the platform side) supporting inverted beams. The spacing of this grid of columns and beams establishes the transition between the metric system of units of length that governs the dimensioning of the new building, and the imperial system of measures established by the gauge of the pre-existing railway line (Figures 3.21-3.23).

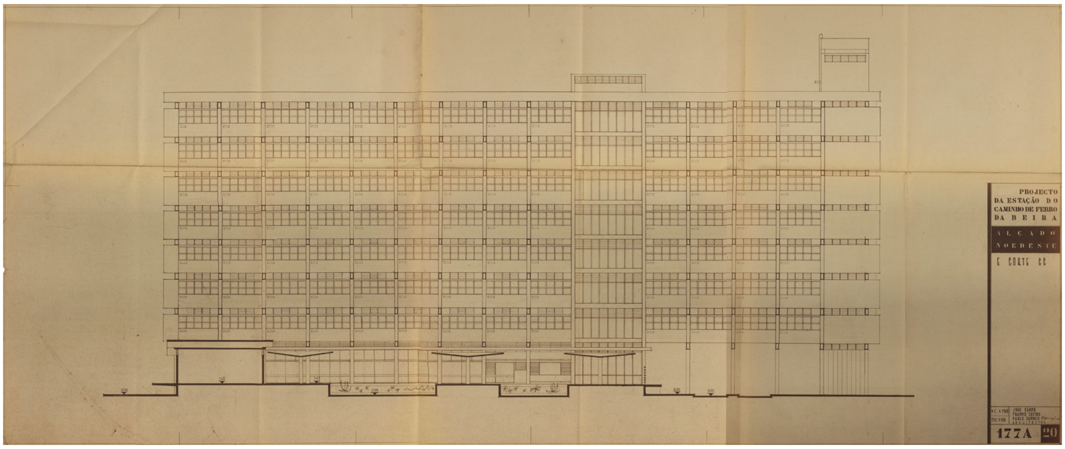
Under this roof, or at its limit, ends the platforms area's command building and the two departure lines and the three arrival lines, completed by two patios / water mirrors, as well as the three platforms: two with 7.5 m and one with 8.5 m wide, and the respective porches. These three porches are made of butterfly-shaped apparent reinforced concrete slabs; each porch is supported by 51 central columns with oblique profile, spaced 5 m from each other from axis to axis (Figures 3.24-3.25).

The platforms area's command building, which separates the station from João de Resende Street, is formed by a sequence of twenty-seven modules, each 5 m long by 10 m wide, with their intermediate limits defined by recessed pillars covered with glass mosaic and by plastered beams with protruding tops. These modules are covered by flat lower slabs and arched upper semi-vaults – except the first span to the southwest, which dips below the transition slab between the body of the platforms and the administration volume. The semi-vaults project in a cantilever girder over João de Resende Street, defining a shallow covering close to the building's southeast façade. The horizontality of the major elevations of this building is vertically marked by the rhythm of the successive pilasters, beams and semi-vaults, and is ensured by the subdivision of each module's wall s in a sequence of horizontal bands with different covering and closing materials: irregular stone foundation overcoming the difference in elevation between the sidewalk and the platforms opposite João Resende Street; glass

Figure 3.31 Beira Central Station, administration block (EM, 2009)

Figure 3.32 Beira Central Station, administration block (EM, 2019)

Figure 3.33 *Beira Railway Station Project, Northeast Elevation and Section CC*, April 1, 1960 (CDIIPAD | EM, 2010)



mosaic wainscoting at the full height of the doors and gates; plastered and painted masonry from the lintels of doors and gates to the sill of the skylights, enclosed with horizontal glass slates; and painted plaster on the tops of the lower roofs' flat slabs (Figures 3.26-3.28).

Inside this building, compartmentalized according to entire modules, multiples and sub-multiples of the exterior volumetric and structural unit, were concentrated the functional sectors in which the station's railway services were subdivided. Directly opening to the contiguous covered platform were the public utility services (customs, police, first-aid post, luggage storage, and public toilets), the platforms area's command services (deputy station-master, telegraph, railway managers, conductors, ticket inspectors, arrival and dispatch of high-speed merchandise, arrangement of berths and telegraph section), the internal services (telephone exchange, telegraph and telephone lines and transformers) and, finishing off the northeast top of the building, the third-class waiting room and respective sanitary support facilities, segregated spaces reserved for *indigenous* passengers.

The administration block meant to house the services related to the management of the railway and the port of Beira is shaped as a rectangular prism measuring 78.40 m x 16.50 m, forming the asymmetrical backdrop of the opposite square (Figure 3.29).

This building has a ground floor of 5.20 m of ceiling height and is predominantly hollow and based on rectangular pilasters in the northwest and southeast gables and along the entire southwestern front; it is made up of the superposition of eight smaller rectangular prisms, corresponding to the seven upper floors with 4 m of ceiling height and the roof platband. These volumes are interspersed with voids enclosed by recessed frames in relation to the façade planes and crossed by transverse beams with protruding tops, highlighted by the coating plaster's red color and smooth texture.

Figure 3.34 Beira Central Station, administration block, main staircase (EM, 2009)

Figure 3.35 Beira Central Station, administration block, main staircase (EM, 2009)

Figure 3.36 Beira Central Station, administration block, floor atrium (EM, 2009)

The larger elevations of the prisms have extensive continuous *fenêtres en longueur* that are protected by vertical brise-soleils on the main elevation; on the rear elevation, these openings are interspersed with masonry piers, plastered solar protection canopies and pilasters covered in glass mosaic. The two top elevations and the first section of the seven lower prisms on the northwest side of the rear elevation are enclosed and covered with glass mosaic, as is the entire upper prism that finishes the top of the building and forms the roof platband (Figures 3.30-3.33).

A rectangular volume containing the elevators and the main staircase marks the vertical communications of the building on the two larger façades: on the main elevation it is a protruding volume of greater height (which houses the engine room of the main elevators on the roof), asymmetrically located between the administration block and the public atrium body. It is coated on the main elevation with a mural of geometric patterns executed with polychrome glass mosaics (Figures 3.29-3.30), and on the rear elevation it takes on the form of a vertical glazing that interrupts, at the full height of the façade, the horizontality of the *fenêtres en longueur*, the intercalary *nembos* and the solar protection canopies (Figures 3.32-3.33).

The main accesses to the upper floors of the administration block start from the administration atrium, with entrance via the portico of access to port facilities through the main staircase (sized according to German regulations for a maximum of 420 users) (Figures 3.34-3.35) and by the three elevators contained in the cross-sectional volume (Figure 3.36). The service accesses are made by a volume located at the northwest top of the building, with entrance via the same portico, and containing the following: on the ground floor, a secondary atrium, a compartment for the guards, a garbage room and the general electricity switchboards; at the full height of the building, the secondary staircases, serving about 100

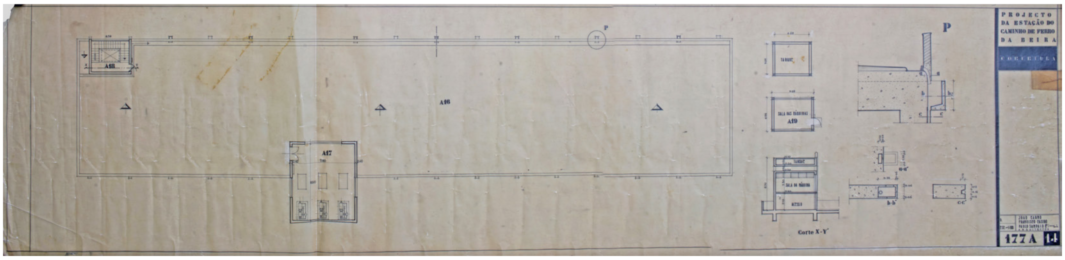


Figure 3.37 *Beira Railway Station Project, Roof Plan* (ECB)

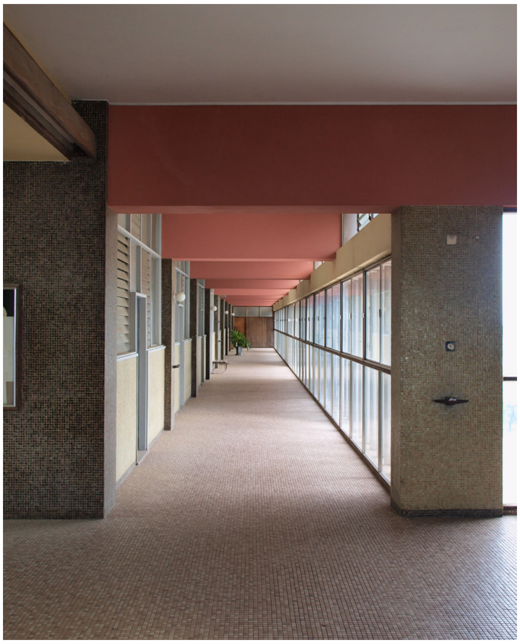


Figure 3.38 Beira Central Station, administration block, gallery (EM, 2009)

Figure 3.39 Beira Central Station, administration block, gallery (EM, 2010)

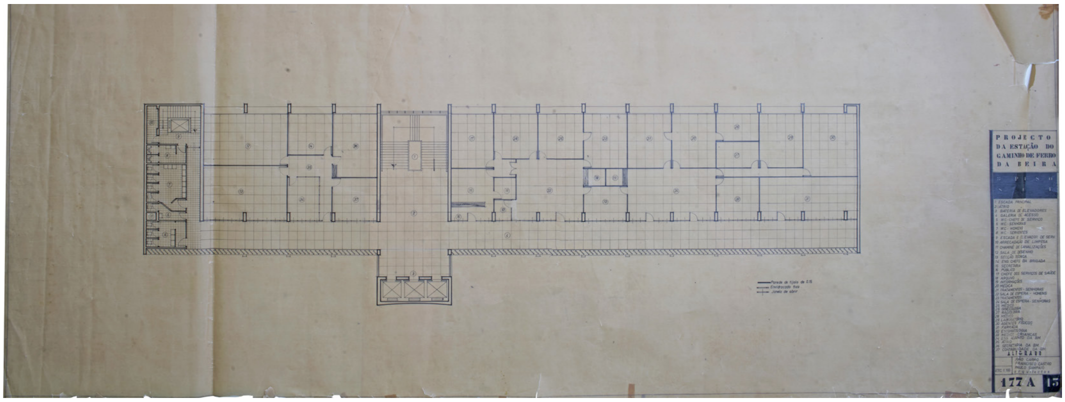


Figure 3.40 *Beira Railway Station Project, 8th floor* (ECB)

people, the freight elevator, the garbage chimney, and the plumbing shaft; on each of the floors, the sanitary facilities and support storage room; and on the roof, the freight elevator engine room and the cistern (Figure 3.37).

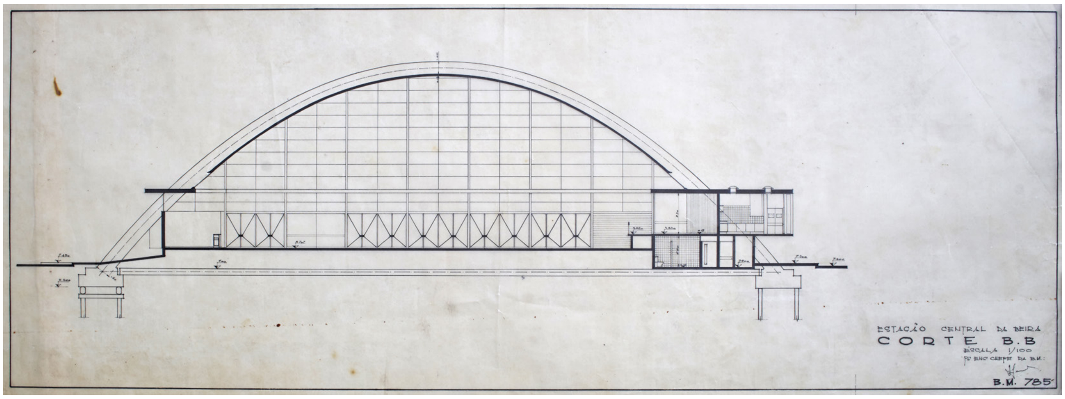
Inside each of the seven floors of the administration building, a 3 m wide glazed gallery, set along the southwest façade, connects the vertical accesses and sanitary facilities and gives access to the various work spaces (Figure 3.38-3.39). According to the project, the compartmentalization of the administration block would be carried out with standardized metallic partitions to allow for multiple spatial configurations according to service needs. These areas would thus constitute vast free-plan surfaces, an organizational flexibility enabled by the autonomy of the support structure in relation to the closing elements (Figure 3.40). It was also planned that the services related to the management of the railway and port of Beira would initially occupy the usable areas – approximately 715 m2 per floor – of the seven upper floors of the administration building: Movement Service on floors 2 and 3, Port and Railway Operating Directorate of Beira on floor 4, Accounting, Inspection and Treasury Service on floors 5 and 6, Track and Works Service on floor 7, and Health Section on floor 8.

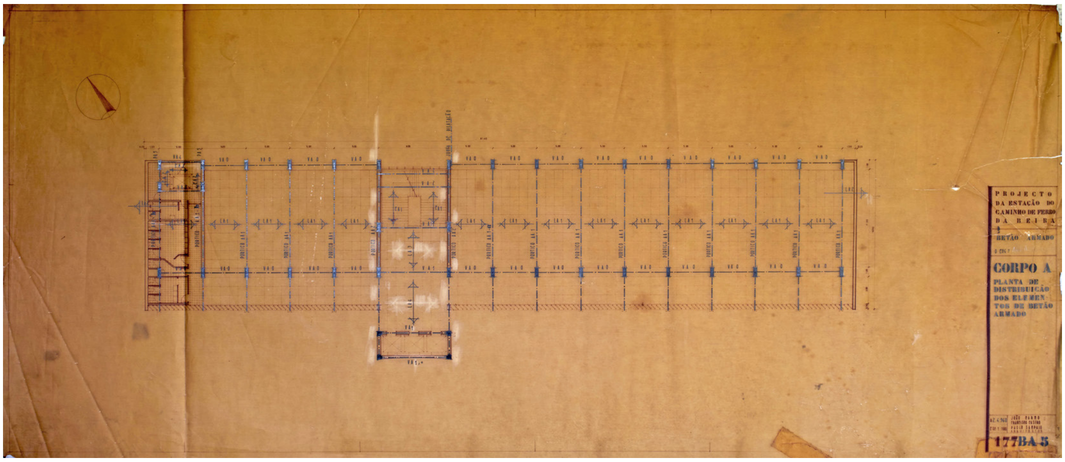
3.2.4 Fabric

3.2.4.1 Modulation and structure

In the construction of the structure of the Beira Central Station complex standard industrially produced building systems and materials were predominantly used.

Due to the unstable nature of the city's terrain, the building was founded on prefabricated reinforced concrete piles driven into the compacted sand (public atrium and administration blocks) or alternating layers of sand and clay (platforms area and command building). In the





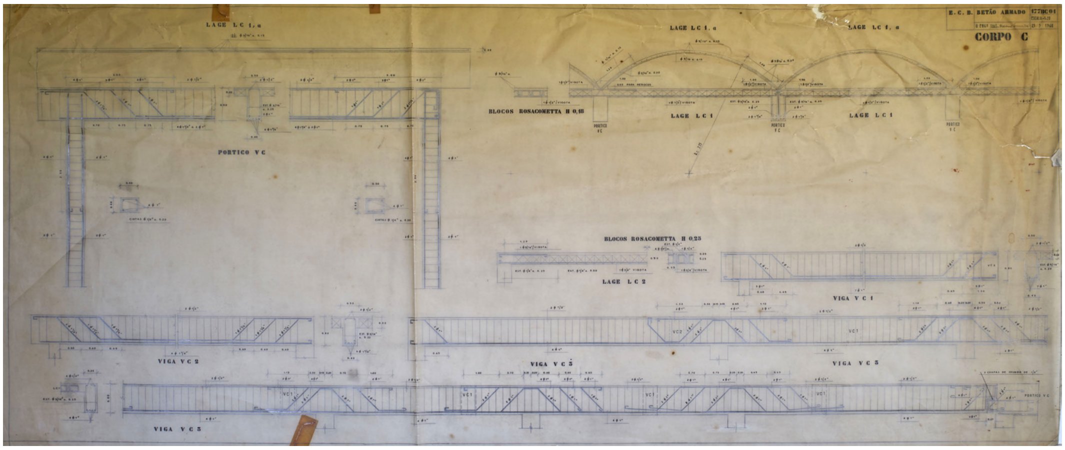


Figure 3.41 *Beira Central Station, Section B.B.* (ECB)

Figure 3.42 *Beira Railway Station Project, Reinforced Concrete, Body A, Distribution of Reinforced Concrete Elements*, April 2, 1960 (ECB)

Figure 3.43 *E. C. B., Reinforced Concrete, Block C*, March 25, 1960 (ECB) public atrium block, the prestressed concrete beams that support the thrusts of the huge parabolic arches were buried in the 2 m sandy layer of the embankment (Figure 3.41). All interior and exterior ground floors were made of reinforced concrete slabs with square mesh, 10 cm thick in the public atrium, laid on a 20 cm high sand layer.

The complex's support structure was built with columns, beams and arches made of reinforced concrete, and flat and curved slabs made of solid concrete or *Rosacometta* hollow elements. The public atrium block's vaulted roof is formed by a curved slab 18 cm thick, supported by seven parabolic inverted concrete arches with 1 m cross section, which overcome a span of 53.4 m at ground level, with their axes spaced 5 m apart. The canopies that cover the entrance to the public atrium and the space between it and the passage atrium are suspended by metal beams from the parabolic arches, visible on the exterior front and embedded in the frames on the interior fronts.

At the full height of the eight floors of the 78.4 m long administration building, without expansion joints, the structure is composed of 15 frames of apparent columns and beams, with 5 m x 12 m between axes – except the elevator and the main stairs span, which has 8 m x 12 m between axes. The beams and floor and roof slabs advance 3.5 m in cantilever on the southwest façade, and 1.5 m on the southeast and northwest tops (Figure 3.42).

In the platforms area, the structure of the command building is made up of porticos of columns and beams of reinforced concrete, forming modules with 5 m x 10 m, covered by semi-vaults of *Rosacometta* concrete elements (Figure 3.43). The central pillars of the porches of the three platforms, 5 m apart from each other, support triangular beams that suspend oblique slabs of exposed concrete.

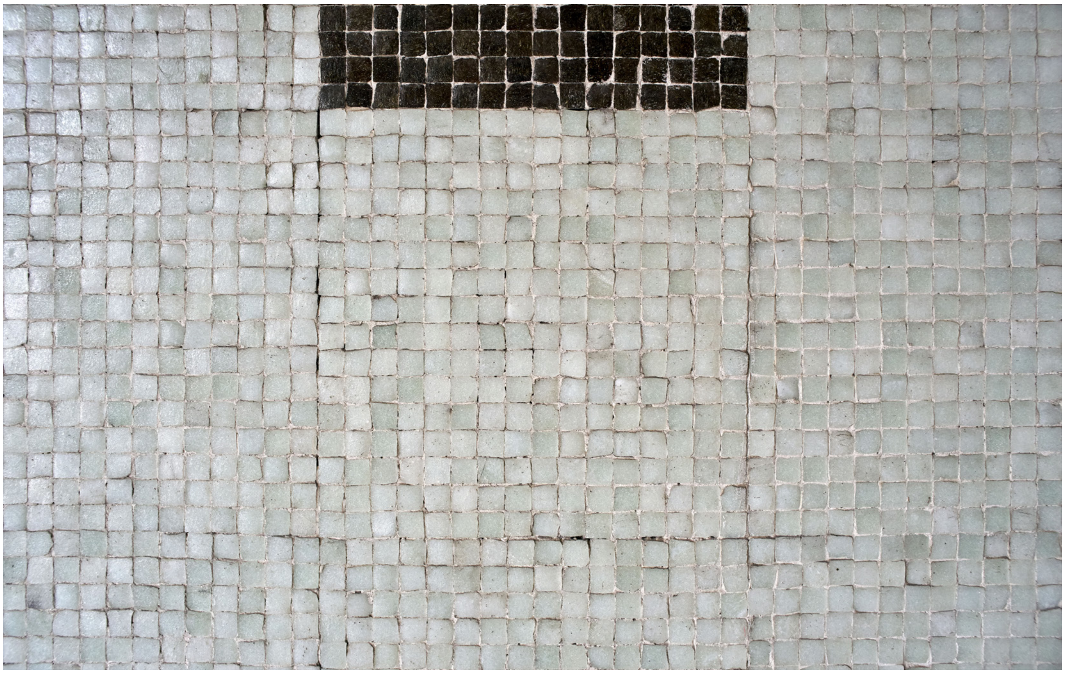


Figure 3.44 Beira Central Station, vitreous mosaic coating detail (EM, 2019)

Figure 3.45 Beira Central Station, vitreous mosaic decorative panel in the passage atrium (EM, 2009)

3.2.4.2 Construction systems and materials

In the enclosure and partitioning of the spaces and in the surface coating and equipment, predominantly industrially produced components were used, many of which were manufactured by the local industry.

The exterior walls and interior partitions were made with double or single rows of hollow bricks (the planned use of movable standardized metallic partitions in the compartmentalization of the interior spaces of the administration block was not implemented).

The pavements of the motor circulation routes, parking lot, sidewalks, ramps and open platforms were built in plain concrete in natural color, 15 cm thick, laid on a layer of sand. The interior floors were executed with *Cerabati* ceramic mosaic, forming geometric patterns in the public, passage and administration atriums, and mixed colors in the vertical and horizontal circulation areas of the administration block. Hardwood parquet blocks flooring was applied in the bar, restaurant, and work spaces of the administration building.

Glass mosaic (manufactured by Luanda-based company Vidrul, Vidreira Ultramarina, Lda.) (Figure 3.44) was used to cover the interior and exterior walls with different designs: forming polychrome decorative murals in the exterior panels of the public atrium and the access portico to the port facilities and in the interior panels of the passage atrium; designing geometric patterns in different colors in the exterior of the elevator tower, in the passage atrium (Figure 3.45), in the access gallery to the restaurant (Figure 3.46), in the southeast top of the gallery of the 3rd floor (2nd floor) of the administration body (Figure 3.47) and in the walls surrounding the main stairs (Figure 3.48); and also covering vertical surfaces with plain colored mosaics on the main and top façades of the administration building, on the wainscot of the platforms area's control building, on the exterior walls of the restaurant

Figure 3.46 Beira Central Station, public atrium, vitreous mosaic decorative panel next to the restaurant (EM, 2020)

Figure 3.47 Beira Central Station, administration block, vitreous mosaic decorative panel on the 3rd floor gallery (EM, 2019)

Figure 3.48 Beira Central Station, administration block, detail of vitreous mosaic coating of the main staircase (EM, 2019)

Figure 3.49 Beira Central Station, administration block, detail of vitreous mosaic coating of the galleries (EM, 2020)

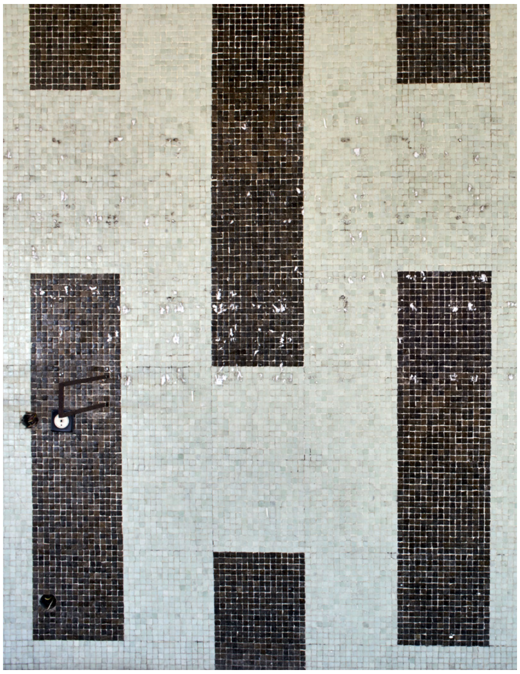


Figure 3.50 Beira Central Station, public atrium, detail of the tobacconist (EM, 2009)

Figure 3.51 Beira Central Station, administration block, 3rd floor work space (EM, 2019)

Figure 3.52 *Beira Central Station, 4th floor finishings, management area* (ECB)

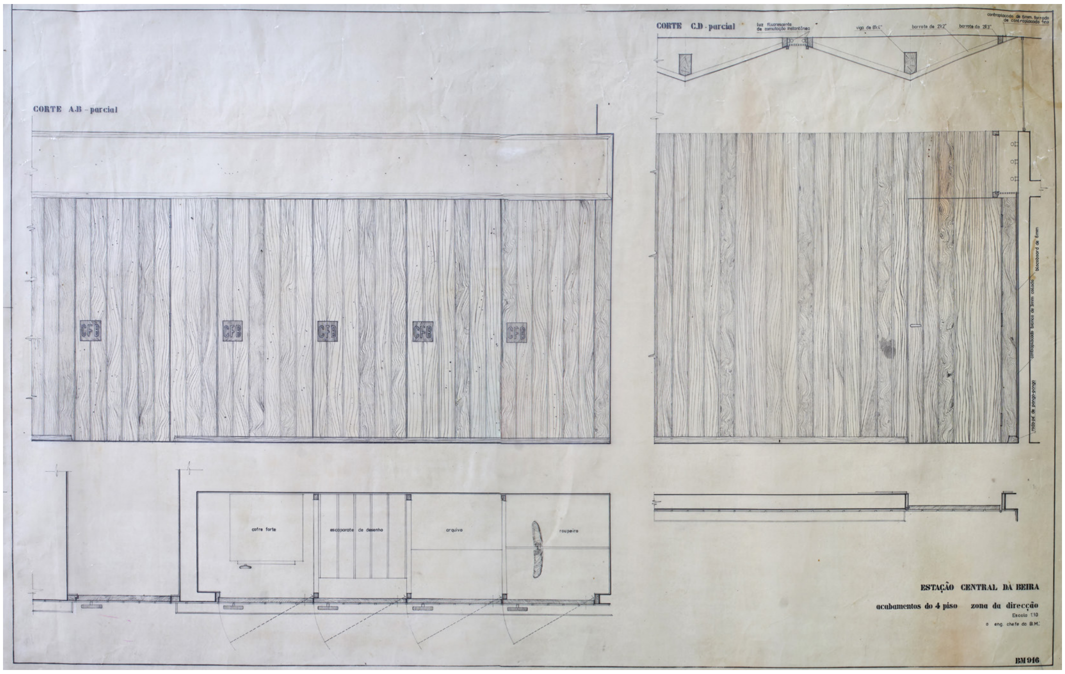
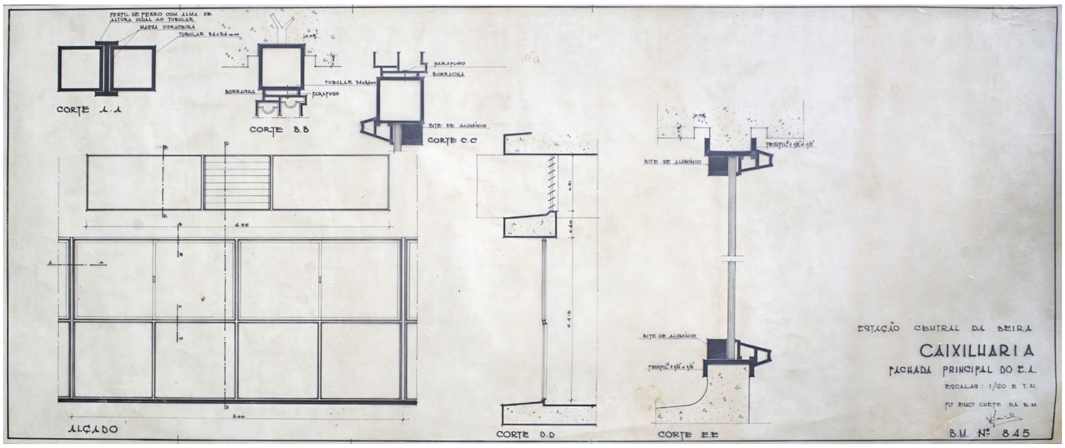


Figure 3.53 Beira Central Station, public atrium block, main entrance frames (EM, 2020)

Figure 3.54 Beira Central Station, administration block, galleries windows frames (EM, 2009)

Figure 3.55 *Beira Central Station, Windows of the South Top of the E. C. C.* (ECB)



volume, and on some rectangular and round pillars (Figure 3.49). Plastered elements stand out on these glazed surfaces, such as the vault and parabolic arches of the public atrium, the beams, nembos, and solar protection canopies of the administration building's rear façade, the lintels, horizontal slabs, and semi-vaults of the platforms area's control building, the walls of the work spaces of the administration building, and all the ceilings of the interior spaces – except the plywood ceilings of the administration area on the fourth floor.

Local woods were used to prioritize and qualify some spaces and architectural elements: the vertical surfaces of the tobacconist's kiosk (Figure 3.50) and the front of the restaurant's bar counter, with decorative murals made of *arrincoados* (decorative coatings) of exotic wood blocks mixed with copper sheets; the wainscoting of the working spaces of the administration body and the walls, doors, cabinets and false ceilings of the administration rooms with solid wood, laminated and plywood panga-panga wood (Figures 3.51-3.52); the window lintels of the ground-floor stores, ticket offices and elevators with panga-panga planks (the nembos between the elevator doors were covered in white marble).

During the launching of the construction tender, changes were made to the constitution of the exterior openings, establishing a hierarchy of spaces according to the quality of the constructive components: the exterior openings of the ground-floor atriums and of the administration building's main façade were thus enclosed with frames composed of iron profiles with enamel paint, the glass plates being supported by anodized aluminum trims (built by company José de Magalhães (Filhos), Lda., with headquarters in Beira and factory in Dondo) (Figures 3.53-3.55); the spans of the rear façade of the administration building and of the southwest elevation of the platforms area's command building – redesigned by Bernardino Ramalhete at the request of contractor Albino Paixão, with the agreement of Paulo de Melo

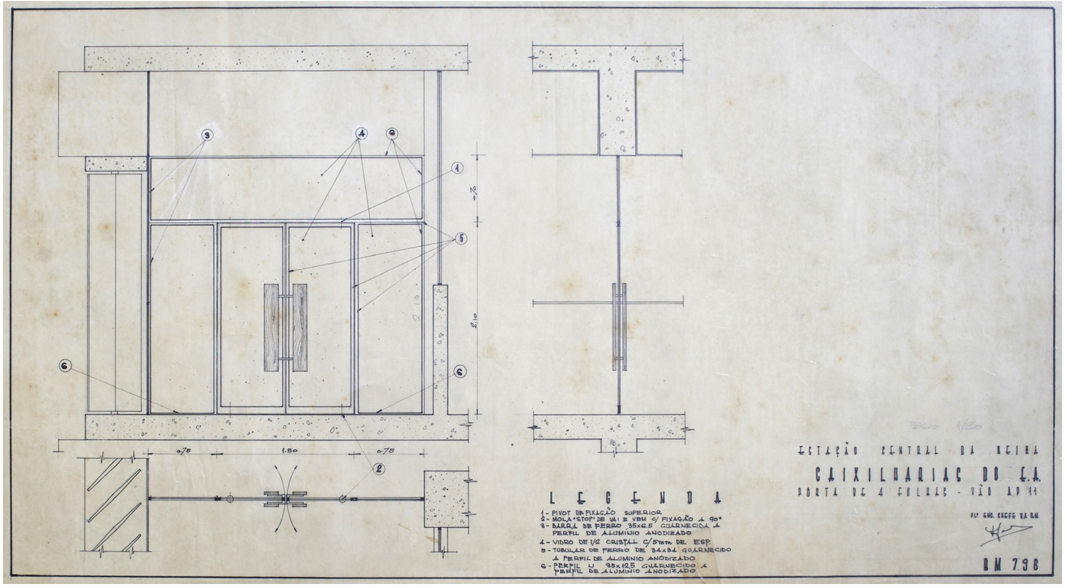


Figure 3.56 *Beira Central Station, E. A. Frames, 4-leaf door - span AP 11* (ECB)

Figure 3.57 Beira Central Station, administration block, interior window frames separating the galleries and the service areas (EM, 2019)

Figure 3.58 Beira Central Station, administration block, interior window frames separating the galleries and the work spaces (EM, 2019)

Sampaio –,[3.4] were enclosed with solid wood frames painted with enamel paint; the openings of the larger elevations of the platforms area's control building were enclosed with frames made of iron profiles and plates, galvanized and painted with enamel paint, and shutters with glass blades; the gates and the railings that separate the station's platforms from the outside were also made with iron profiles, galvanized and painted with enamel paint; the interior openings of the restaurant, first-class waiting room, stores and agencies, ticket offices, doors connecting to the administration atrium and some doors finishing the corridors of the administration building were enclosed with frames made with enamel-painted iron profiles, trimmed with anodized aluminum profiles and glass (Figures 3.56-3.57); and the interior openings, arranged along the galleries and work spaces of the administration block were enclosed with painted wooden and glass frames (Figure 3.58).

3.2.4.3 Climatic protection

Protection and adaptation to the specific tropical climatic constraints of a building with an implantation conditioned *a priori* by the existing port and railway facilities and by the design of the urban grids foreseen in the Urbanization Plan for Beira City relied on a rigorous analysis of its orientation to the sun and prevailing winds, as well as on the use of appropriate mechanisms and construction systems.

Therefore, the exterior openings of the administration block's workspaces, with smaller vertical dimensions, were arranged along the northeast elevation, protected from the vertical solar rays by the retreated glazed surfaces, the nembos that enclose the sills of the *fenêtres en longueur*, and the horizontal intercalary shading canopies (Figure 3.59). This protection

3.4 Ramalhete, December 12, 2011.s

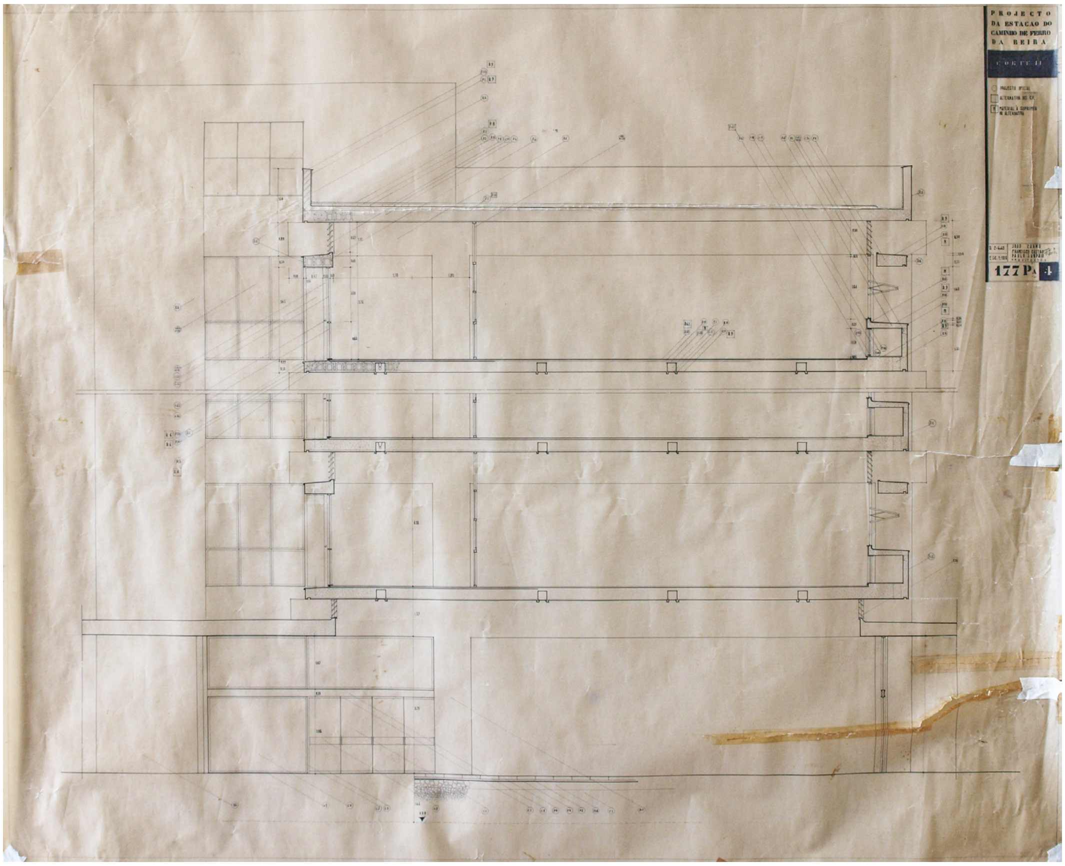


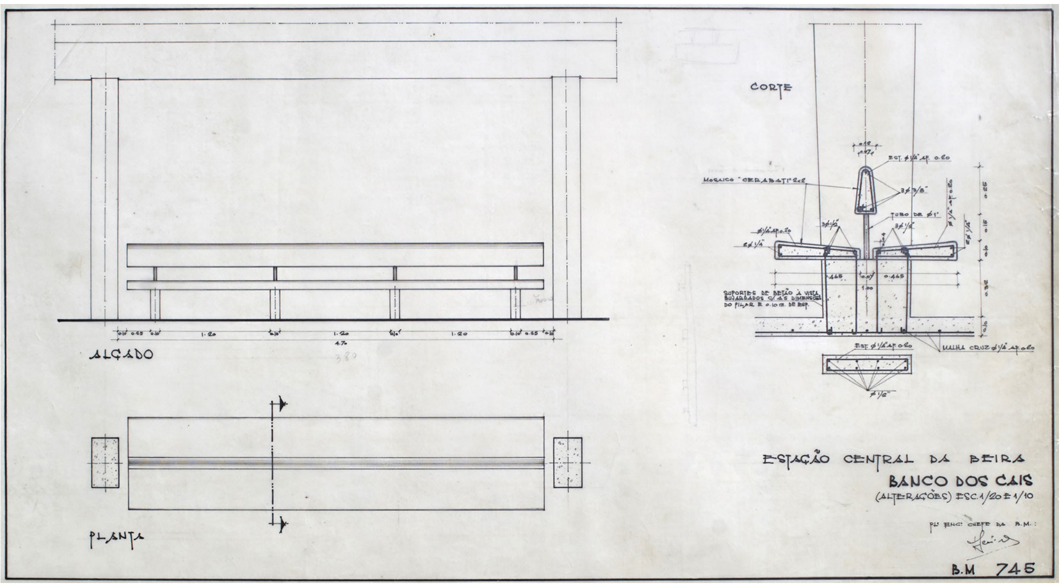
Figure 3.59 *Beira Railway Station project, Section II, April 2, 1960* (ECB | EM, 2009)

Figure 3.60 Beira Central Station, administration block, orientable *brise-soleil* (EM, 2019)

Figure 3.61 Beira Central Station, platform area's command building, detail of southeast façade (EM, 2019)

Figure 3.62 Beira Central Station, public atrium block, ventilation grille at the exit to João de Resende Street (EM, 2009)

Figure 3.63 Beira Central Station, administration block, glass louvers between the galleries and the workspaces (EM, 2020)



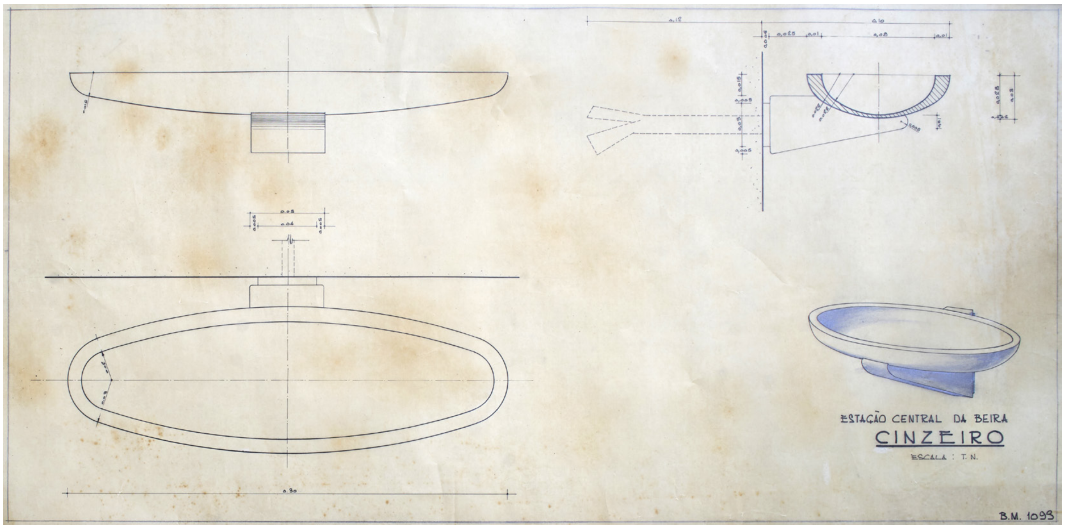


Figure 3.64 *Beira Central Station, platform bench (alterations)*, (ECB)

Figure 3.65 *Beira Central Station, Ashtray* (ECB) was further reinforced with the use of adjustable interior *Lusaflex* blinds produced by Persianas Luso Texas (Beira), Lda. On the other hand, the glazed galleries on the southwest front were protected from the horizontal solar rays from the west by vertical *brise-soleil* (Figure 3.60); this same solution was used on the northwest side of the restaurant volume. These *brise-soleil* are composed of fiber cement panels with adjustable orientation via manually operated mechanisms, and were manufactured by Lusalite de Moçambique (currently named Mozalite), a company headquartered in Beira and with a factory in Dondo. In addition, the roof slabs of the platforms area command building were protected via the sunshades formed by the semi-vaults, ventilated via the open space between them (Figure 3.61).

The transversal ventilation of the public atrium via the air currents coming from the southeast was executed with the glass louvered skylights strategically cut along the laying of the concrete vault over the ceiling of the commercial spaces (these openings were protected from rain by the extension of the entrance porch slab), as well as by the skylights and fanlights of the exterior walls and interior frames of the commercial spaces, restaurant, pantry and kitchen. In the transition space between the public atrium and the passage atrium, the transversal circulation of air was further reinforced by the louvered skylights with glass blades, by the opening of the ceiling over the patio / water mirror, and by the grid of hollow concrete blocks placed near the exit to João de Resende Street (Figure 3.62). This same solution of transversal ventilation of the interior spaces via louvered openings with glass blades placed near the ceilings of the exterior walls and internal partitions was also used in the various floors of the administration block (Figure 3.63), and along the entire length of the platforms area command building.

Figure 3.66 Beira Central Station, platform's area, bench (EM, 2019)

Figure 3.67 Beira Central Station, platform's area, ashtray (EM, 2019)

Figure 3.68 Beira Central Station, public atrium block, glass mosaic mural by Jorge Garizo do Carmo (EM, 2019)

Figure 3.69 Beira Central Station, public atrium block, glass mosaic mural by Jorge Garizo do Carmo (EM, 2019)

Figure 3.70 Beira Central Station, public atrium block, glass mosaic mural by Jorge Garizo do Carmo (EM, 2019)

Although not foreseen in the original project, 120 *Philco* air conditioners were also installed on the northeast façade of the administration building for the offices, in addition to a *Crane* industrial refrigeration system for the restaurant.

3.2.5 Intangible values

3.2.5.1 *Gesamtkunstwerk*

In the design of the station building, fixed and movable furniture, decorative coverings, and works of art were integrated from the early stages of the project, giving it the characteristics of a total work of art (*Gesamtkunstwerk*).

To the exhaustive design developed during the project phase by the several authors and during the construction process by Paulo Sampaio - parking lot, public and passage atriums (restaurant, restrooms, ticket office, first-aid post, tourism and post office, stores, patios, staircases and ramps, etc.), stairs and administration restrooms, platforms and platforms area's command body, exterior and interior openings, skirting boards, wainscoting and false ceilings, etc. -, corresponded equal attention in the detailing of the fixed furniture and in the layout, selection, or design of most of the movable furniture. The specific design of lamps, lighting and signaling armatures and posts, door handles, fixed and movable benches (Figures 3.64, 3.66), counters, various cabinets and countertops, flower boxes, ashtrays (Figures 3.65, 3.67), litter bins and wastepaper baskets, mirrors, carts for animals, ticket boxes, writing desks, sofas, tables and desks, contributed decisively to ensure the formal and conceptual unity of the complex.

The decorative coatings of vertical and horizontal surfaces, with geometric patterns in glass mosaic (exterior coating of the elevator tower, side walls of the main stairs, restaurant

Figure 3.71 Beira Central Station, portico of access to port, vitreous mosaic panel by J. Peneda (EM, 2018)

Figure 3.72 Beira Central Station, passage atrium, vitreous mosaic panel by J. Peneda (EM, 2009)

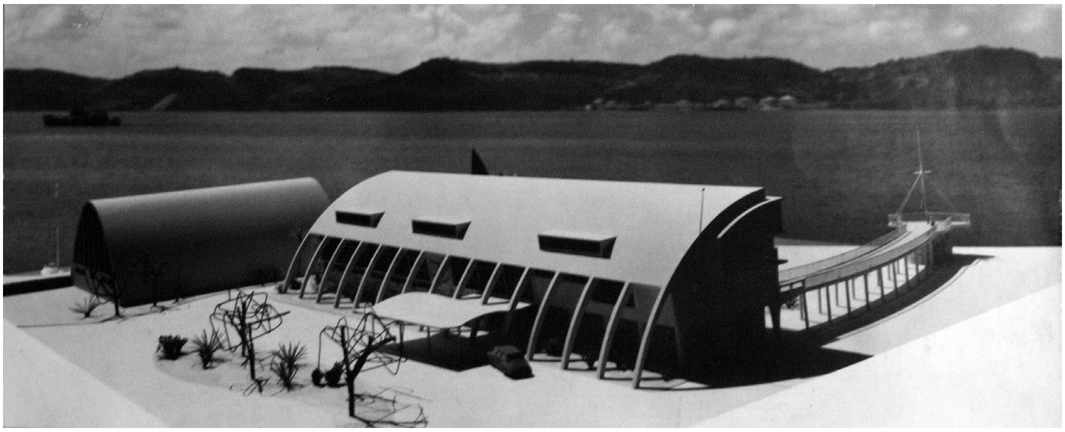
Figure 3.73 Beira Central Station, transition space between public and passage atriums, sculpture by Maria Alice Mealha (EM, 2019)

floor) or with bas-reliefs in wood *arrincoados* (counters and wall of the tobacconist's shop, restaurant's bar counter) are clearly attributable to Paulo de Melo Sampaio. On the other hand, the authorship of some relevant decorative elements remains uncertain: the design of the floor of the public atrium and the vertical murals on the southeast side of the passage atrium, the restaurant gallery and the southeast top of the gallery of the 3rd floor (2nd floor) of the administration building.

In the initial views of the building, as well as in the photographs of the scale model, there is a decorative mural covering the base of the public atrium block. This mural, called *Triage*, was designed by ceramist Jorge Garizo do Carmo (Figs. 3.68-3.70). Two other figurative murals in glass mosaic, designed by architect J. Peneda, were placed in the access portico to the port facilities (Figure 3.71) and in the passage atrium near the ticket offices (Figure 3.72).[3.5] On the ground floor of the building there are several sculptural sets: a sculpture entitled *Espelho*, by Maria Alice Mealha – the winning proposal of the public scale models competition opened on June 11, 1965 –,[3.6] was designed to be set in the patio / water mirror between the public and the passage atriums, strongly illuminated by the opening in the ceiling (Figure 3.73); a second sculpture, probably by architect Peneda and his wife, was placed on the ground floor of the administration atrium, in the center of the main stairs shaft (although this does not seem to be its original location, given the temporary nature of the supports on which its base rests); and a third sculpture, probably also by Peneda and his wife (dubbed *Sculpture B* in a drawing made during the construction work), was also planned for the south corner of the meeting room on the fourth floor of the administration area.

3.5 *Diário de Moçambique*, July 27, 1965: 3.

3.6 *Diário de Moçambique*, July 27, 1965: 3.



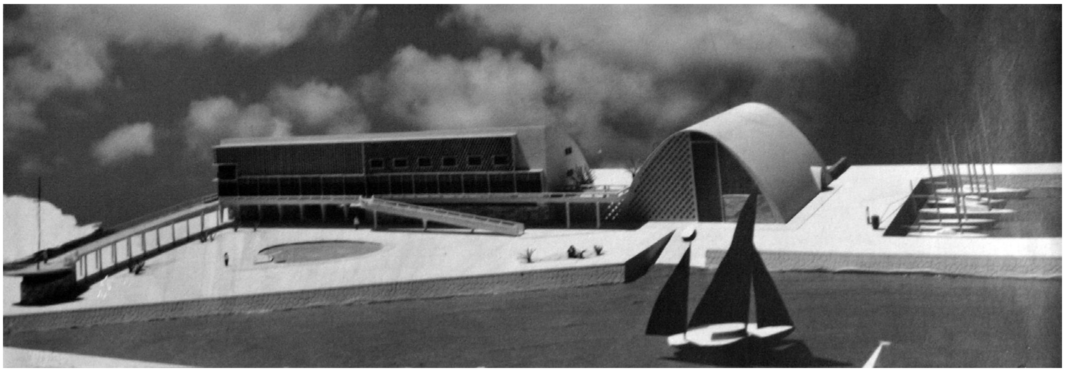


Figure 3.74 Pavilions of Transport, Development Works and Post Office at the Mozambique Economic Activities Exhibition, Lourenço Marques (1955-1956) (Magalhães, 2015: 268)

Figure 3.75 Project for a Nautical Club at Cruz Quebrada, Lisbon (1950) (FC | EM, 2009)

Figure 3.76 Project for a Nautical Club at Cruz Quebrada, Lisbon (1950) (FC | EM, 2009)

3.2.5.2 Style characterization

The triple authorship of the Beira Central Station contributed to inform the complex with the respective distinct personal references of its authors, all of them architects actively engaged in using the architectural lexicon and principles of the international Modern Movement

The form of the parabolic arch suspending smaller planes or volumes via steel beams had already been used in 1956 by Paulo de Melo Sampaio to mark the entrance to the group of pavilions of Transport, Development Works and Post Office at the Mozambique's Economic Activities Exhibition in Lourenço Marques (Figure 3.74). The theme of a concrete membrane forming a vaulted nave, suspended or supported by a sequence of parabolic arches, had already been explored by Francisco José de Castro in his end-of-course project for a Nautical Club at Cruz Quebrada, Lisbon (1950) (Figures 3.75-3.76), and by João Garizo do Carmo in his project for the Maria Lourenço Amaral House (1956). The lintel arched vaults of the platforms area's command building had already been used by João Garizo do Carmo in his project for an inn at Macúti (1957) (Figure 3.77), in the Carlos Silva Houses (1957), in the Garizo do Carmo Houses, in the João Afonso dos Santos House (1959), all for Beira, and also in the Administrative Offices in Quelimane and in the Episcopal palaces of Quelimane (1955-c.1961) and Porto Amélia. This design for a double roof was and also used by Francisco José de Castro in his project for the BNU's Tete branch (1958) (Figure 3.78).

As heir to this whole architectural genealogy, the Beira Central Station complex thus presents a vast repertoire of principles and forms that are characteristic of the architecture of the Modern Movement of post-WWII era, coherently unified by the central role played by Paulo de Melo Sampaio, from the initial tender to the completion of the work: scientific design methodologies, sets of isolated volumes, correspondence between *form and function*, asym-

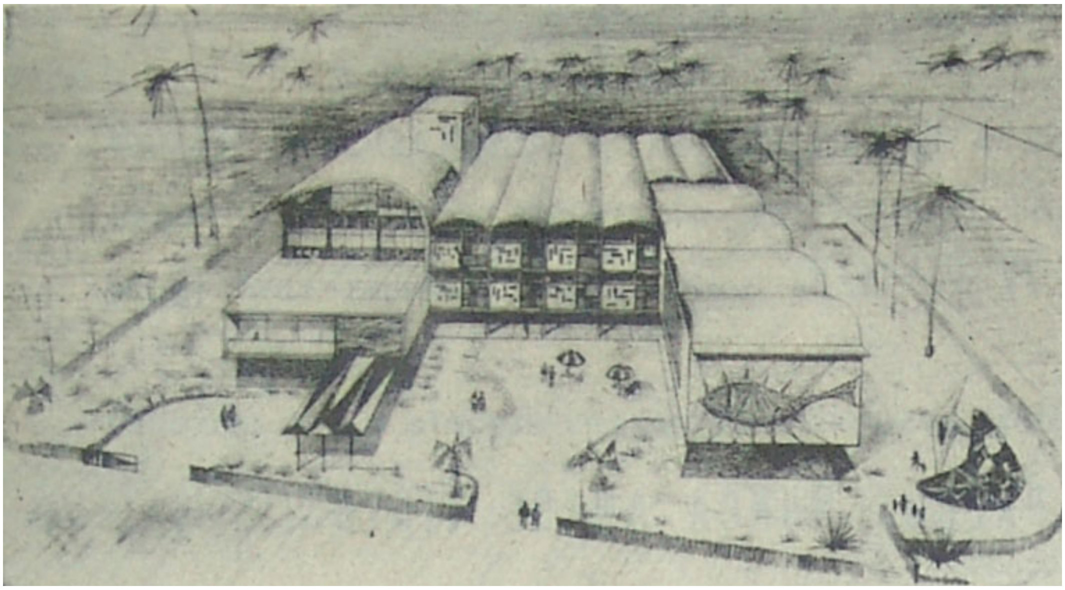


Figure 3.77 Perspective of the project for an inn in Macúti, Beira (1957) (*Notícias*, November 6, 1957, p.5 | BPMP)

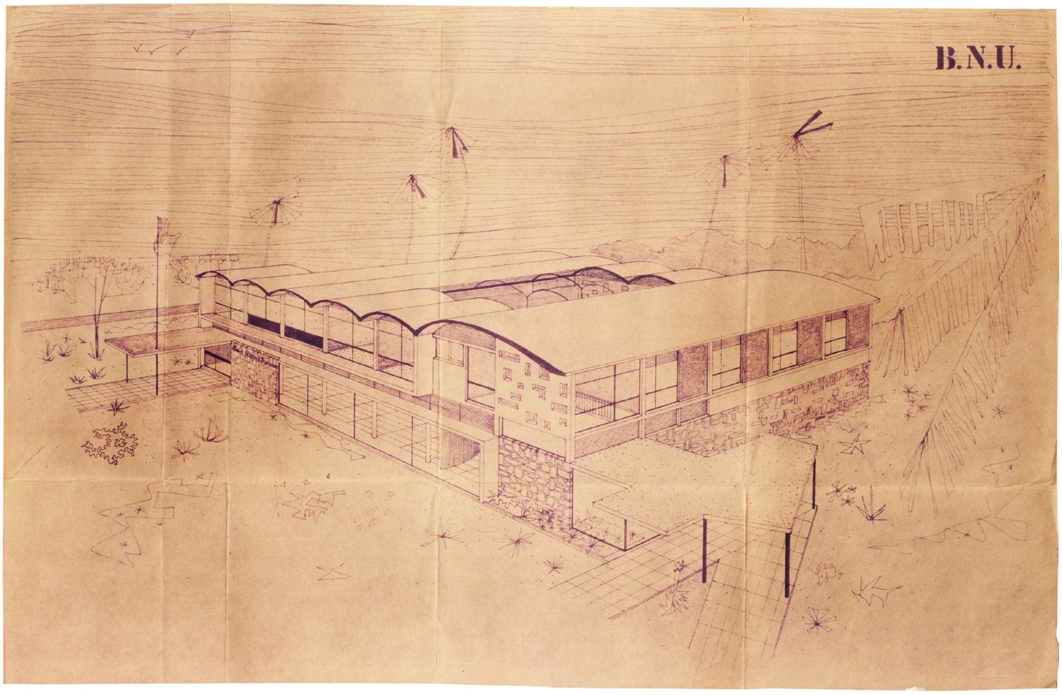


Figure 3.78 BNU's Tete branch, Preliminary project (1958) - Francisco José de Castro (AHCGDFBNU | EM, 2010)

metric composition, open ground floors, *pilotis*, *free plan*, *fenêtres en longuer*, *brise-soleil*, sculptural plasticity, industrial construction systems, standardized materials, parabolic and Catalan vaults, butterfly roofs, ventilation grids and ceramic murals, among others.

3.3 Statement of significance

The Beira Central Station is an outstanding exemplar of 20th century Portuguese architectonic and engineering building.

Having been an important mark in the search for the modernization of Portuguese colonial policy, then internationally isolated and in its final phase, after the independence of Mozambique the Station maintained its importance as a singular and iconic object of the city and the country.This distinction is reflected through its representation on the flag of Beira (Figure 3.79), on the minting of the national currency (Figure 3.80) or on the coat of arms of Beira Football Club (Figure 3.81).

Beira Central Station is the result of a process carefully developed from the beginning. Originating from an architectural competition launched in 1957, the project was conceived in all aspects of design, from the spatial and tectonic point of view to the design of the furniture. Assuming the modern perspective of the integration of the arts, it coherently included artistic interventions, either as autonomous sculptural pieces or as a composition of the glass cladding panels that run through the entire building. In this field, artistic value is a prominent aspect of Central Station. The construction of the building was also very demanding from a constructive point of view, requiring sophisticated technologies and technical knowledge for the time and local conditions. This aspect is also a value of the Station that must be highlighted.

Figure 3.79 Flag of the city of Beira.

Figure 3.80 Mozambican 500 meticais coin.

Figure 3.81 Coat of arms of Beira Football Club.

The international architectural culture has already recognized the intrinsic value of the building, and it constitutes a reference for the architecture of the Modern Movement. In fact, the Station has been the object of study by scholars, proving to be a valuable repository of information for fundamental and applied research. The expertise that the building demonstrates, namely in terms of its adaptation to local climatic conditions, proves to be a valuable source for the critical deepening of this theme in contemporary approaches.

In addition to presenting itself as the head of the interface between the surrounding African territory and national and world land and maritime trade, being a fundamental source of the economy, Beira Central Station contributed to the development of the construction industry, namely in relation to the local industrial production of building materials.

Nowadays, the possible reinforcement of passenger rail transport and the readaptation of the building to new uses suggest a great potential in economic and social terms for the city and the region. The rehabilitation of the building could be a motto for the reactivation of the industrial production of construction materials - which, in the meantime, also suffered a sharp decrease - and also contribute to the training of specialized labor.

The cultural significance can be analyzed from different points of views: on the one hand, the intrinsic quality of the building, its imposing façade, as admirable example of internationally recognized architecture, representatives of distinct styles that marked it time; on the other hand, as an integral part of history, illustration of a certain phase of the architecture of the colonial city, of the powerful period of fixation, consolidation and evolution of the primitive urban structure. Its affective patrimonial dimension can also be considered, as icon of the Mozambique railways, which are a key element in the construction of the Mozambican national identity.

LEVEL OF SIGNIFICANCE SCHEDULE

ATRIUM BODY _ GROUND FLOOR		A
S.0.1	ATRIUM	A
S.0.2	ATRIUM	A
S.0.3	ATRIUM	A
S.0.4	CIRCULATION AREA	A
S.0.5	CIRCULATION AREA	A
S.0.6	HALL	A
S.0.7	RECEPTION	A
S.0.8	VIP AREA	A
S.0.9	STORAGE	C
S.0.10	STORAGE	C
S.0.11	KITCHEN	B
S.0.12	MEN'S TOILETS	B
S.0.13	WOMEN'S TOILETS	B
S.0.14	CIRCULATION AREA	B
S.0.15	RESTAURANT	A
S.0.16	CIRCULATION AREA	A
S.0.17	UNABLE TO ACCESS	-
S.0.18	UNABLE TO ACCESS	-
S.0.19	UNABLE TO ACCESS	-
S.0.20	UNABLE TO ACCESS	-
S.0.21	OFFICE	C
S.0.22	SECURITY CABIN	A
S.0.23	SECURITY CABIN	A
S.0.24	STATION CHIEF'S OFFICE	A
S.0.25	MAIN REECEPTION	A
S.0.26	TOILET	B
S.0.27	STATION CHIEF'S WAITING ROOM	A
S.0.28	CIRCULATION AREA	A
S.0.29	CIRCULATION AREA	A
S.0.30	TICKET OFFICE	A
S.0.31	CABIN OF HANDLING STAFF	A
S.0.32	TOILET	B
S.0.33	HALL	C
S.0.34	STORAGE	C
S.0.35	DORMITORY	A
S.0.36	STATION ADMINISTRATION RECEPTION	A
S.0.37	STATION ADMINISTRATION OFFICE	INT
S.0.38	STATION ADMINISTRATION OFFICE	INT
S.0.39	KITCHEN	INT
S.0.40	RESTAURANT	A
S.0.41	BANK - COSTUMER SERVICE AREA	INT
S.0.42	BANK - PRIVATE AREA	INT
S.0.43	UNABLE TO ACCESS	-

ATRIUM BODY _ LOWER FLOOR		A
S.0(-1).1	RESTAURANT	A
S.0(-1).2	RECEPTION	A
S.0(-1).3	KITCHEN	B
S.0(-1).4	MEN'S TOILETS	B
S.0(-1).5	CIRCULATION AREA	A
S.0(-1).6	CHANGING ROOM	A
S.0(-1).7	TOILET	B
S.0(-1).8	CIRCULATION AREA	A
S.0(-1).9	WOMEN'S TOILETS	B
S.0(-1).10	CIRCULATION AREA	A
S.0(-1).11	TOILET	B
S.0(-1).12	TOILET	B

ATRIUM BODY _ UPPER FLOOR		A
S.0(+1).1	STORAGE MATERIAL ROOM	A
S.0(+1).2	OFFICE SUPPLIES ROOM	A
S.0(+1).3	HALL	A
S.0(+1).4	ARCHIVE	C
S.0(+1).5	STATION ADMINISTRATION CHIEF'S OFFICE	A

COMMAND BODY _ PIER		A
S.0.44	CIRCULATION AREA	A
S.0.45	CIRCULATION AREA	A
S.0.46	CIRCULATION AREA	A
S.0.47	CIRCULATION AREA	A
S.0.48	RECEPTION - POLICE STATION	A
S.0.49	POLICE STATION CHIEF'S OFFICE	A
S.0.50	MANEUVER DEPARTMENT CHIEF'S OFFICE	A
S.0.51	MANEUVER DEPARTMENT	A
S.0.52	DOCUMENTATION CENTER	A
S.0.53	MANEUVER DEPARTMENT	A
S.0.54	MANEUVER DEPARTMENT	A
S.0.55	RECEPTION / MIGRATION	A
S.0.56	OFFICE / MIGRATION	A
S.0.57	MIGRATION CHIEF'S OFFICE	A
S.0.58	CUSTOMS	A
S.0.59	DISPATCH OF GOODS	A
S.0.60	DISPATCH OF GOODS	A
S.0.61	WOMEN'S TOILETS	B
S.0.62	MEN'S TOILETS	B
S.0.63	FEES SECTOR	A
S.0.64	FEES SECTOR	A
S.0.65	FEE SECTOR DEPUTY'S OFFICE	A
S.0.66	FEES SECTOR	A
S.0.67	CIRCULATION AREA	A
S.0.68	FEES SECTOR	A
S.0.69	FEES SECTOR	A
S.0.70	SECURITY	A
S.0.71	WAREHOUSE	A
S.0.72	STORAGE	A
S.0.73	HERITAGE DEPARTMENT STORAGE	A
S.0.74	SIGNALING SECTOR	A
S.0.75	SERVER ROOM	A
S.0.76	PANTRY	A
S.0.77	CIRCULATION AREA	A
S.0.78	IT DEPARTMENT STORAGE	A
S.0.79	IT DEPARTMENT CHIEF'S OFFICE	A
S.0.80	STORAGE	A
S.0.81	STORAGE	A
S.0.82	MEN'S TOILETS	B
S.0.83	WOMEN'S TOILETS	B

ADMINISTRATION BODY _ 1STFLOOR		A
S.1.1	CIRCULATION AREA	A
S.1.2	CIRCULATION AREA	A
S.1.3	CIRCULATION AREA	A
S.1.4	CIRCULATION AREA	A
S.1.5	STORAGE	C
S.1.6	TOILET	B
S.1.7	MEN'S TOILETS	B
S.1.8	TOILET	B
S.1.9	WOMEN'S TOILETS	B
S.1.10	INTERNAL CONTROL DIVISION	B
S.1.11	MEETING ROOM	B
S.1.12	CIRCULATION AREA	B
S.1.13	HALL	B
S.1.14	RESEARCH AND INTELLIGENCE	B
S.1.15	OFFICE	B
S.1.16	OFFICE SUPPLIES ROOM	B
S.1.17	OFFICE	B
S.1.18	TAX LITIGATION OFFICE	B
S.1.19	ACCOUNTING DEPARTMENT SECRETARY	B
S.1.20	RECEPTION	B
S.1.21	TAX AUTHORITY	B
S.1.22	DEPUTY DIRECTOR'S OFFICE	B
S.1.23	DIRECTOR'S OFFICE	B
S.1.24	COMPUTERS DATA ROOM	B
S.1.25	ARCHIVE	B
S.1.26	OFFICE	B
S.1.27	NUITS DEPARTMENT	B
S.1.28	HALL	B
S.1.29	OFFICE	B
S.1.30	ARCHIVE	B
S.1.31	PANTRY	B

ADMINISTRATION BODY _ 2ND FLOOR		A
S.2.1	CIRCULATION AREA	A
S.2.2	CIRCULATION AREA	A
S.2.3	CIRCULATION AREA	A
S.2.4	CIRCULATION AREA	A
S.2.5	STORAGE	A
S.2.6	TOILET	B
S.2.7	MEN'S TOILETS	B
S.2.8	TOILET	B
S.2.9	WOMEN'S TOILETS	B
S.2.10	STF OFFICE	A
S.2.11	STF OFFICE	A
S.2.12	CHIEF OF THE TRACTION DEPARTMENT	A
S.2.13	CHIEF OF THE MOVEMENT DEPARTMENT	A
S.2.14	CIRCULATION AREA	A
S.2.15	STF SECRETARY	
S.2.16	STF ATRIUM	
S.2.17	CHIEF INSPECTOR'S OFFICE	
S.2.18	PROCUREMENT STF	
S.2.19	STAFF DEPARTMENT ARCHIVE	
S.2.20	WAITING ROOM	
S.2.21	STAFF DEPARTMENT	
S.2.22	MEETING ROOM	
S.2.23	RAILWAY DIRECTION - WAITING ROOM	
S.2.24	RAILWAY DIRECTOR'S OFFICE	
S.2.25	RAILWAY DIRECTION - RECEPTION	
S.2.26	OFFICE	
S.2.27	STF CHIEF'S OFFICE	
S.2.28	SUPERVISION DEPARTMENT OFFICE	
S.2.29	ARCHIVE	
S.2.30	OFFICE	
S.2.31	CIRCULATION AREA	
S.2.32	ADMINISTRATIVE ASSISTANT OFFICE	
S.2.33	OFFICE	
S.2.34	CIRCULATION AREA	
S.2.35	SUPERVISION STAFF OFFICE	
S.2.36	SUPERVISION DEPARTMENT OFFICE	

ADMINISTRATION BODY _ 3RD FLOOR	
S.3.1	CIRCULATION AREA
S.3.2	CIRCULATION AREA
S.3.3	CIRCULATION AREA
S.3.4	CIRCULATION AREA
S.3.5	STORAGE
S.3.6	TOILET
S.3.7	MEN'S TOILETS
S.3.8	TOILET
S.3.9	WOMEN'S TOILETS
S.3.10	ARCHIVE
S.3.11	ARCHIVE
S.3.12	LIBRARY
S.3.13	PAYMENT CENTER
S.3.14	MEETING'S WAITING ROOM
S.3.15	PAYMENT CENTER
S.3.16	QUALITY MANAGEMENT DEPARTMENT
S.3.17	OFFICE SUPPLIES ROOM
S.3.18	LEGAL ADVISORY DEPARTMENT
S.3.19	SECRETARY
S.3.20	LEGAL ADVISORY DEPARTMENT
S.3.21	SECRETARY CHIEF'S OFFICE
S.3.22	SECRETARY
S.3.23	EXECUTIVE DIRECTOR'S OFFICE
S.3.24	EXECUTIVE SECRETARY
S.3.25	WAITING ROOM
S.3.26	MEETING ROOM
S.3.27	PUBLIC RELATIONS DEPARTMENT
S.3.28	MAIN MEETING ROOM

ADMINISTRATION BODY _ 4TH FLOOR	
S.4.1	CIRCULATION AREA
S.4.2	CIRCULATION AREA
S.4.3	CIRCULATION AREA
S.4.4	CIRCULATION AREA
S.4.5	STORAGE
S.4.6	TOILET
S.4.7	MEN'S TOILETS
S.4.8	TOILET
S.4.9	WOMEN'S TOILETS
S.4.10	ARCHIVE
S.4.11	ARCHIVE
S.4.12	FINANCIAL ADVISORY
S.4.13	FINANCIAL ADVISORY
S.4.14	RECEPTION
S.4.15	LIQUIDATION AND TREASURY
S.4.16	LIQUIDATION AND TREASURY
S.4.17	RECEPTION
S.4.18	FINANCE'S DEPARTMENT CHIEF
S.4.19	RECEPTION
S.4.20	TREASURY AND SALARIES
S.4.21	RECEPTION
S.4.22	FINANCE'S DEPARTMENT
S.4.23	COSTS MANAGEMENT
S.4.24	RECEPTION
S.4.25	FINANCIAL DEPARTMENT

Table 3.3 Assignment of values and levels of significance.

A	S.4.26	ACCOUNTING DEPARTMENT	A
A	S.4.27	STAFF MANAGEMENT	A
A	S.4.28	SOCIAL PRESIDENCY	A
A	S.4.29	SECRETARY OF HUMAN RESOURCES	A
A	S.4.30	HUMAN RESOURCES CHIEF'S OFFICE	A
A			
A	**ADMINISTRATION BODY _ 5TH FLOOR**		A
A			
A	S.5.1	CIRCULATION AREA	A
A	S.5.2	CIRCULATION AREA	A
A	S.5.3	CIRCULATION AREA	A
A	S.5.4	CIRCULATION AREA	A
A	S.5.5	STORAGE	A
A	S.5.6	TOILET	B
A	S.5.7	MEN'S TOILETS	B
A	S.5.8	TOILET	B
A	S.5.9	WOMEN'S TOILETS	B
A	S.5.10	ICVL OFFICE	A
A	S.5.11	ICVL OFFICE	A
A	S.5.12	ICVL RECEPTION	A
A	S.5.13	COMPUTER EQUIPMENT	A
A	S.5.14	MEETING ROOM	A
	S.5.15	DIRECTOR'S OFFICE	A
A	S.5.16	ICVL OFFICE	A
	S.5.17	OFFICE	A
A	S.5.18	RECEPTION / WAITING ROOM	A
A	S.5.19	LEGAL ADVISORY DEPARTMENT	A
A	S.5.20	DIRECTOR'S OFFICE	A
A	S.5.21	ISPC	A
A	S.5.22	OFFICE	A
B	S.5.23	OFFICE	A
B	S.5.24	OFFICE	A
B	S.5.25	ENTRANCE HALL	A
B	S.5.26	OFFICE	A
A	S.5.27	CHIEF'S OFFICE	A
A	S.5.28	MEETING ROOM	A
A	S.5.29	COMMERCIAL OFFICE	A
A			
A	**ADMINISTRATION BODY _ 6TH FLOOR**		A
A			
A	S.6.1	CIRCULATION AREA	A
A	S.6.2	CIRCULATION AREA	A
A	S.6.3	CIRCULATION AREA	A
A	S.6.4	CIRCULATION AREA	A
A	S.6.5	STORAGE	A
A	S.6.6	TOILET	B
A	S.6.7	MEN'S TOILETS	B
A	S.6.8	TOILET	B
A	S.6.9	WOMEN'S TOILETS	B
A	S.6.10	ARCHIVE	A
A	S.6.11	ARCHIVE	A
A	S.6.12	MEETING ROOM	A
A	S.6.13	OFFICE OF THE PRESIDENT JUDGE	A
	S.6.14	ADMINISTRATION AND FINANCE	A
A	S.6.15	CHIEF CLERK'S OFFICE	A
	S.6.16	UNABLE TO ACCESS	A
A	S.6.17	CIRCULATION AREA	A
A	S.6.18	JUDGE'S ROOM	A
A	S.6.19	LAW JUDGE'S ROOM	A
A	S.6.20	NOTARY'S OFFICE	A
A	S.6.21	LIBRARY AND IT ROOM	A
B	S.6.22	HUMAN RESOURCES	A
B	S.6.23	SECRETARY OF THE ADMINISTRATIVE COURT	A
B	S.6.24	SECRETARY OF THE ROAD AND WORKS SERVICES	A
B	S.6.25	S.V.O. STOREROOM	A
A	S.6.26	S.V.O. CHIEF'S OFFICE	A
A	S.6.27	ADMINISTRATIVE ASSISTANCE	A
A	S.6.28	OFFICE	A
A	S.6.29	PANTRY	A
A	S.6.30	ROHLIG GRINDROD RECEPTION	A
A	S.6.31	TECHNICAL OFFICE	A
A	S.6.32	TECHNICAL OFFICE	A
A	S.6.33	CIRCULATION AREA	A
A	S.6.34	TECHNICAL OFFICE	A
A	S.6.35	DEPARTMENT OF EQUIPMENT AND MACHINES	A
A	S.6.36	NO ASSIGNED USE	A
A	S.6.37	NO ASSIGNED USE	A
A			
A			
A			
A			

ADMINISTRATION BODY _ 7TH FLOOR		A
S.7.1	CIRCULATION AREA	A
S.7.2	CIRCULATION AREA	A
S.7.3	CIRCULATION AREA	A
S.7.4	CIRCULATION AREA	A
S.7.5	STORAGE	A
S.7.6	TOILET	B
S.7.7	MEN'S TOILETS	B
S.7.8	TOILET	B
S.7.9	WOMEN'S TOILETS	B
S.7.10	SERVER ROOM	A
S.7.11	RAILWAY TRAFFIC COMMAND	A
S.7.12	TECHNICAL OFFICE	A
S.7.13	RAILWAY INSPECTION	A
S.7.14	CIRCULATION AREA	A
S.7.15	SERVER AND COMPUTERS ROOM	A
S.7.16	MEETING ROOM	A
S.7.17	PANTRY	A
S.7.18	COMMAND CHIEF'S OFFICE	A
S.7.19	OFFICE	A
S.7.20	RECEPTION / WAITING ROOM	A
S.7.21	OFFICE	A
S.7.22	CIRCULATION AREA	A
S.7.23	PANTRY	A
S.7.24	SERVER ROOM	A
S.7.25	OFFICE	A
S.7.26	NO ASSIGNED USE	A
S.7.27	QUALITY AND SAFETY MANAGEMENT	A
S.7.28	OFFICE	A
S.7.29	NO ASSIGNED USE	A
S.7.30	ARCHIVE	A
S.7.31	PANTRY	A
S.7.32	OFFICE	A
S.7.33	RECEPTION / OFFICE	A
S.7.34	UGEA CHIEF'S OFFICE	A
S.7.35	UGEA RECEPTION	A
S.7.36	MEETING ROOM	A
S.7.37	NO ASSIGNED USE	A
S.7.38	UGEA TECHNICAL OFFICE	A
S.7.39	OFFICE	A
S.7.40	CIRCULATION AREA	A
S.7.41	OFFICE	A
S.7.42	RECEPTION / WAITING ROOM	A
S.7.43	CIRCULATION AREA	A
S.7.44	NO ASSIGNED USE	A
S.7.45	NO ASSIGNED USE	A
ADMINISTRATION BODY _ ROOF		
S.8.1	CIRCULATION AREA	A
S.8.2	TECHNICAL AREA	C
S.8.3	TECHNICAL AREA	C

THE REFERENCE OF THE SPACES (S.X.X) PRESENTS THE SAME CRITERION OF THE NEW DRAWINGS. SEE ANNEX 2 - NEW PLANS.

The railway station of Beira is an infrastructure complex that still maintain its original functionality, a survival that is a factor of added value: it is an image linked to collective memories, reception space for many ephemeral events, public and private. It establishes a useful relationship with the city, has a structuring weight in the emergence of its economic and social dynamics. It is, finally, an emblematic building of Mozambique.

3.4 Level of significance of the cultural heritage values

The values and levels of significance are as follows: Aesthetic value - Exceptional significance; Historic value - Exceptional significance; Scientific value - Considerable significance; Social value - Exceptional significance. They are assigned for each space in table 3.3.

3.5. References

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SECTION 4

4 Identification of factors and issues

The present chapter identifies the main natural hazards to which Mozambican territory is subject; observes the main urban planning instruments foreseen for the city of Beira and the constraints they establish for the surroundings of the Central Station of Beira; describes the elements elaborated for the process of geometric, spatial, and building condition surveys; synthesizes the material properties, physical constraints and contemporary architectural interventions

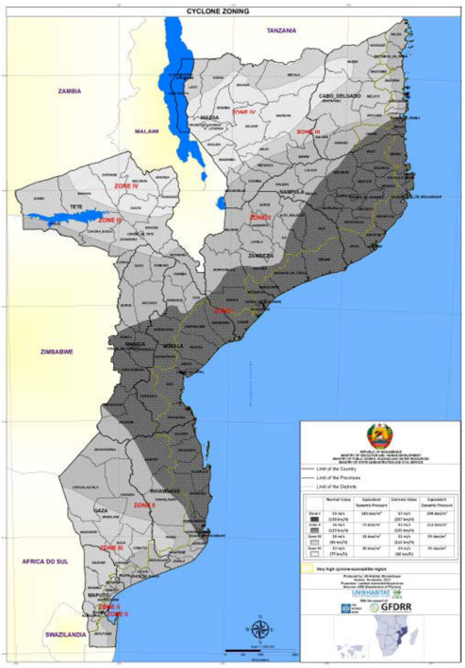
4.1 Natural hazards

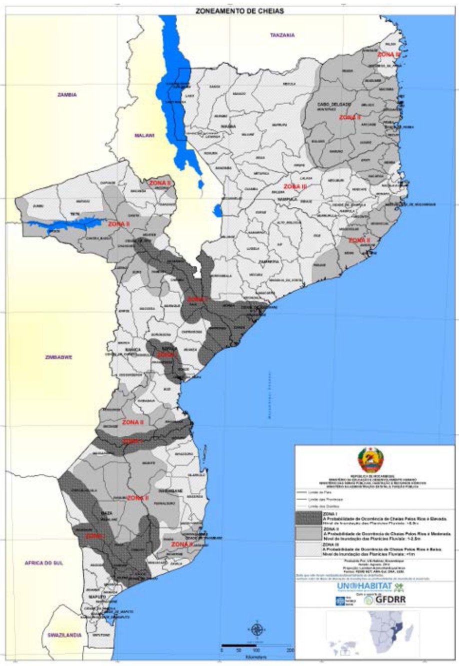
The Beira Central Station is threatened by recurring natural hazards, namely earthquakes, tsunamis, cyclones, floods and droughts. Mozambique is, indeed, after Kenya, the country that experienced the highest number of natural disasters in Africa between 2000 and 2019 and the third country by total death toll in the same period.[4.1] The most recent hazard maps for the country have been coordinated by the Ministério da Educação e Desenvolvimento Humano da República de Moçambique (Ministry for Education and Human Development of the Republique of Mozambique), in 2015 (Figures 4.1-4.4).[4.2]

Mozambique climate. the climate ranges from tropical to subtropical with warmest temperature near the coast where average values in the summer are about 25-27°C and in the winter 20-23°C. Rainfall is more intense in the north and central region, especially on the coast, where the annual precipitation varies between 800 and 1200 mm, presenting two

4.1 Yaghmaei; Below, 2019: 1-2

4.2 Ministério da Educação, 2015b.





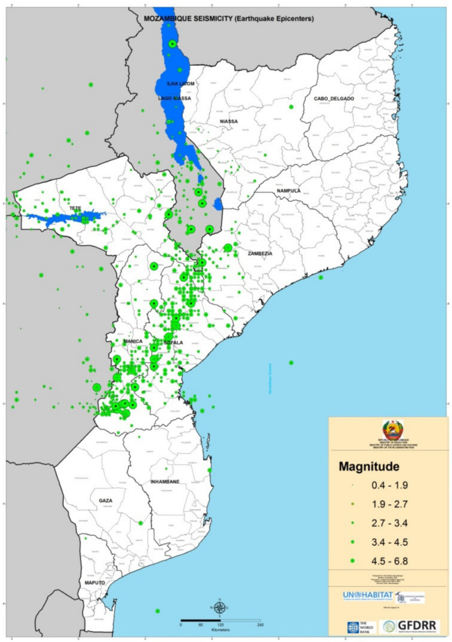


Figure 4.1 Cyclones Zoning Map by Geographic Bound (Ministério da Educação, 2015a: 10)

Figure 4.2 Floods Zoning Map by Geographic Bound (Ministério da Educação, 2015a: 16)

Figure 4.3 Earthquake epicentres from 1905 to 2007 (Ministério da Educação, 2015b: 17)

Figure 4.4 Earthquake Zoning Map by Geographic Bound (Ministério da Educação, 2015a: 16) main seasons, namely the wet season from November to April, which is generally hot and rainy, and the dry season from May to October, which is cooler and drier.[4.3] Highest precipitation, with maximum values above 1800 mm, is in the area around Beira and Quelimane.[4.4]

Geographical description of Beira. The city of Beira is located on an alluvial deposit in the Mozambique's central coast also known as the Sofala bay, named after the province of Sofala. Beira is the main city of this province and the fourth largest in Mozambique. The bay is mostly characterized by coastal wetland and swamps.

Cyclones and floods. The Mozambique Channel, between the African mainland and Madagascar, is the base for some of the southern hemisphere's most severe cyclones and about 10% of all the cyclones in the world (Figure 4.5).[4.5] On average, about two tropical storms or cyclones enter or form in this area each year.[4.6] A large portion of the coastline is, thus, subjected to the regular seasonal effect of this hazard, in the months between January and March that are associated with the heaviest rainfalls. Among the most recent events, it is worth mentioning the two intense cyclones, Idai and Kenneth, that struck Mozambique in 2019. The Idai cyclone (category 3 on the Saffir-Simpson scale, with 10 minutes sustained wind at 195 km/h) occurred between 4 and 20 March and reached the city of Beira on March 14, 2019, also affecting the railway station. The Idai Cyclone brought about 600 mm of rainfall, inducing severe floods in the country.[4.7] The Kenneth cyclone (category 4, with

4.3 climateknowledgeportal.worldbank.org.
4.4 britannica.com.
4.5 Zehnder, 2022.
4.6 Kolstad, 2020: 45.
4.7 Phiri; Simwanda; Nyirenda, 2020: 238.

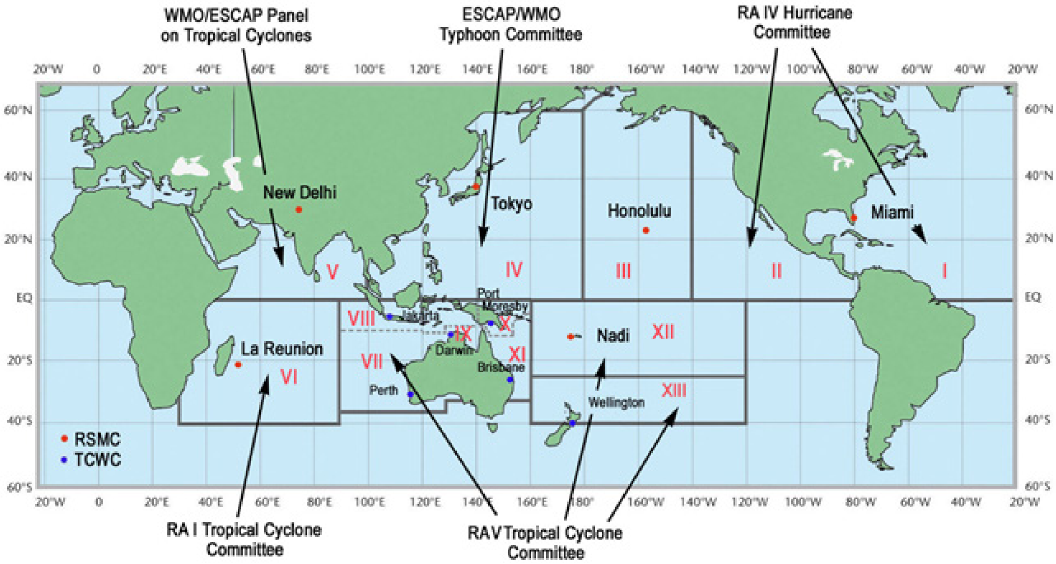


Figure 4.5 Tropical cyclone basins (commons.wikimedia.org)

10 minutes sustained wind at 215 km/h) occurred between 21 and 25 of April, after the previous one and affected mostly the north of the country.[4.8]

For the position of city of Beira, the cyclone hazard is the highest in the country (Zone 1) (Figure 4.1), characterized by a maximum cyclone wind speed of 57m/s (207km/h), with an equivalent dynamic pressure of 119 kN/m^2.

Studies suggest that, because of climate change impact, global average tropical cyclone wind speed and rainfall is likely to increase in the future. This increased severity of the intense cyclones is most likely to worsen or exacerbate the already deteriorated conditions of the Beira Central Station.

4.8 Mawren; Hermes; Reason, 2020.

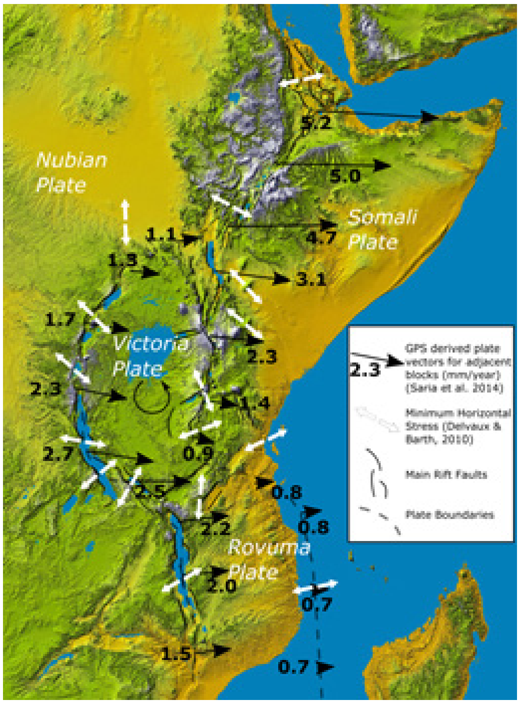


Figure 4.6 East Africa: main rift faults and plates (ShareAlike 4.0 International (CC BY-SA 4.0)????)

Earthquakes and tsunamis. The African continent is divided into two major tectonic plates namely Nubian and Somalian (Figure 4.6). Other microplates are embedded within the southern end of the East Africa Rift which constitutes the boundary between Nubian and Somalian plates and is characterized by areas of rifting, volcanic activity, and seismic activity.[4.9] The Somalian plate is likely undergoing a slow, clockwise rotation with respect to the Nubian plate about a pole located offshore South Africa, with maximum opening rate of 6 mm per year.[4.10]

Mozambique is crossed by the East African Rift and the activity of this tectonic system is the cause of the significant earthquakes that struck the country throughout its history (Figu-

4.9 Feitio; Hurukawa; Yokoi, 2009.
4.10 Saria, 2014.

re 4.3). Recently, in 2006, two earthquakes occurred, one on February 22, with epicentre located in the Machaze District, and one on September 24, in Lacerda at the offshore of Mozambique's Channel. The earthquakes had a Moment Magnitude (Mw) of 7 and 5.6, respectively.[4.11] It is argued that the first event may be responsible for some of the damage observed at the Beira Central Station.

For the position of Beira, the earthquake hazard is moderate (Zone II) and is characterized by a value of PGA ranging between 0.03-0.122g or 0.04-0.163g considering a 10% probability of exceedance in 50 and 100 years (or return periods of 475 and 975 years), respectively (Figure 4.4).

The Davie Ridge structure and the associated tectonic basins constitute an offshore branch of the East African Rift along the coastline of Mozambique. Although there exists no map for such a hazard, the underwater morphology of the Mozambique Channel has been recently analyzed to evaluate the hazard related to the occurrence of tsunamis for the city of Beira, identifying scenarios in which the coastline of the city is reached by waves with a maximum height close to 0.5 m. The propagation time of the tsunami wave generated in such scenarios, from the source to the city of Beira, is 2 hours and 30 minutes.[4.12]

4.2 Urbanization plans for Beira

All the hypotheses that could be related and rooted in the rehabilitation of Beira Central Station will have to be considered in the urban planning of the city. Most recent plans for Beira, *Plano de Estrutura Beira-Dondo* (*Beira-Dondo Structure Plan*), from 1999, by Scott Wilson

4.11 Feitio; Hurukawa; Yokoi, 2009.
4.12 Manuel, 2015.

in Palmer Associates (Figure 4.7), and *Plano Director da Beira 2035* (*Beira Masterplan 2035*), approved in 2014, by Deltares, Witteveen + Bos (Figure 4.8), do not include in their scope the area of the port and railway facilities. The development of these vast terrains is dependent on their specific master plan as well as on the directives of the CFM Administration.

The *Plano de Recuperação e Resiliência da Beira* (*Beira Recovery and Resilience Plan*), approved in 2018, by the Municipality, mainly addresses the immediate recovery needs in the aftermath of cyclone Idai, applying the principles of *build back better* and *disaster risk reduction*.[4.13] A new master plan for the city is presently under development in Maputo by the studio of José Forjaz, a renowned Mozambican architect. Its proposals, however, have yet to be approved and made public.

4.3 The urban seting of the Beira Central Station

Despite its huge spatial display, the urban movement that the station generates is limited to its users (non-passengers) and to very little railway traffic, which is mostly dedicated to the transport of goods. Although undeniable as an icon, the presence of Beira Central Station in the city remains well behind what it could represent in terms of both urban daily life and cultural activity. This circumstance is explicitly reflected in its frontal square (Figures 4.7-4.8), which has never attained the intense public life that such infrastructure usually implies.

In fact, the building appears as a body inserted in an unresolved urban fragment, away from city life. But in favor of the reversal of this situation, the station is located very close to the old and traditional center of the city, the Baixa, also marked by multiple buildings of Modern character or urban relevance. Within a 1000m radius commercial and service areas

4.13 Município da Beira, 2019.

Figure 4.7 Frontal square from the Beira Central Station (EM, 2020)

Figure 4.8 Frontal square to the Beira Central Station, after lunch on a weekday (MMO, 2019)

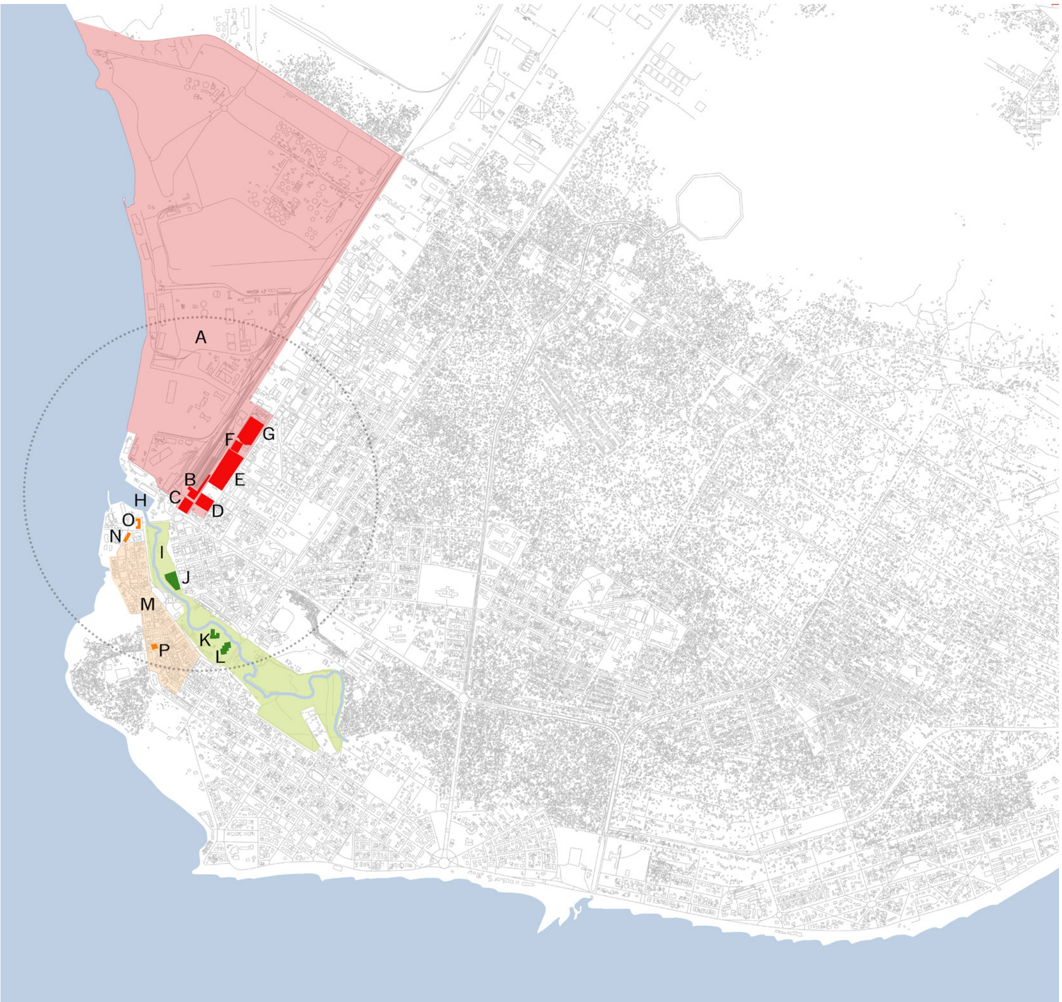


Figure 4.9 Multiple buildings of modern character within a 1000m radius from the station:
A - Beira port and railway station grounds
B - Beira Central Station
C - Parking lot
D - Vacant lot
E - Dwellings quarter
F - Sports pavilion
G - Football stadium
H - Fishing dock
I - Chiveve
J - Swimming pool
K - *Casa Provincial da Cultura*
L - *Casa dos Bicos*
M - Downtown Beira
N - *Casa do Artista*
O - Administrative Court House
P - Municipal Council

(shops and banks, hotels, etc.) are well established, as well as the main administrative facilities (namely the Municipal Council and Administrative Court House) and some of the most significant urban plazas (Figure 4.9).

Moreover, the station is close to the newly constructed Chiveve urban park, designed by the company CES Consulting Engineers Salzgitter GmbH for Administração de Infra-estructuras de Água e Saneamento (Administration of Water and Sanitation Infrastructures)

Figure 4.10 Chiveve urban park (EM, 2019)

Figure 4.11 Railwaymen Sports Club swimming pool (MMO, 2019)

Figure 4.12 *Casa dos Bicos* (EM, 2022)

Figure 4.13 *Casa Provincial da Cultura de Sofala* (EM, 2022)

(Figure 4.10). This plan had *the main objective of recuperating environmentally the area of the Chiveve River (...) creating a vast landscaped green area provided with infrastructures for the public fruition*.[4.14] Framed by the Cities and Climate Changes Project and linked to environmental matters (such as the conservation of the ecosystem and flood control), in addition to educational and recreational purposes, this park receives a set of collective equipment to complement the existing ones, namely three noteworthy modern buildings situated nearby: the Railwaymen Sports Club swimming pool, built sector of a larger sports complex, designed by José Augusto Moreira and opened in 1973 (Figure 4.11), *Casa dos Bicos*, a former exhibition pavilion currently vacant (Figures 2.??, 4.12), and *Casa Provincial da Cultura de*

4.14 ces.de/green-infrastructure-breira.

Figure 4.14 Railwaymen Sports Club pavilion (EM, 2019)

Figure 4.15 Railwaymen Sports Club pavilion (EM, 2019)

Figure 4.16 *Casa do Artista* (MMO, 2020)

Figure 4.17 Fishing dock (MMO, 2020)

Sofala (Provincial House of Culture of Sofala), a buiding designed by Paulo de Melo Sampaio, Bernardino Ramalhate and José Augusto Moreira, inaugurated in 1966 (Figure 4.13). And it will certainly also be interesting to relate these facilities to the Railwaymen Sports Club sports pavilion (Figures 2.??, 4.14) and football stadium (Figure 4.15), thus contributing to expand the urban equipment network of the neighborhood. In addition, an important cultural facility, the *Casa do Artista* (Artist's House) is also in the vicinity (Figure 4.16).

The station closeness to the Pungué River must not be ignored either. Whereas the cargo port will always have conditioned access, the area where the fishing dock is currently located, at the top of the Chiveve Park, 200 m from the station, can be envisioned as an instance of urban contact with the river itself, favouring the urban enjoy of the riverfront (Figure 4.17).

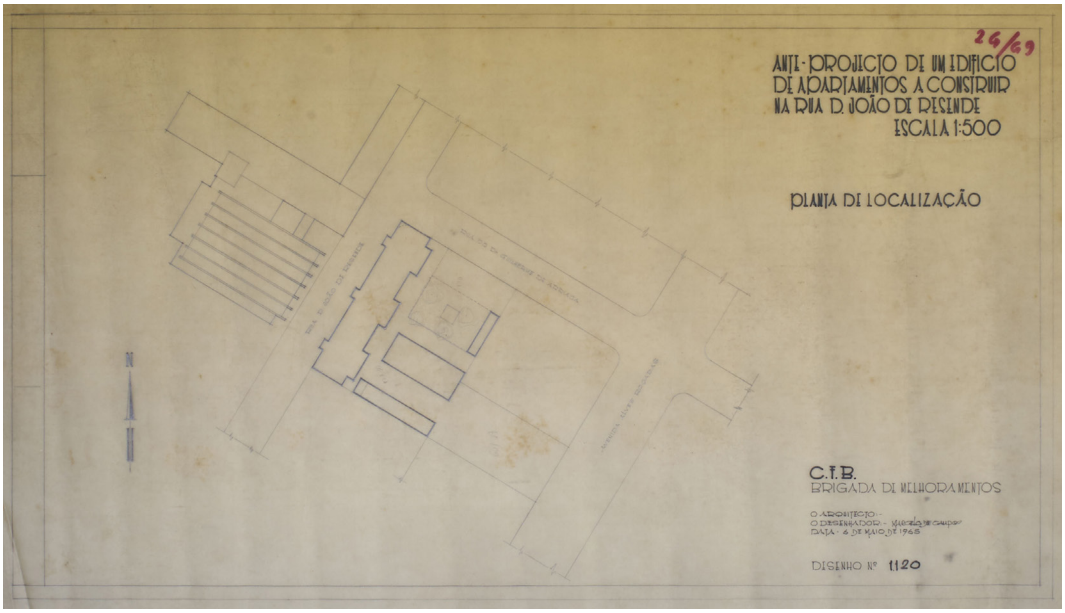


Figure 4.18 *Preliminary project for an apartment building to be built on D. João de Resende Street, Site plan*, n.d. (ECB)

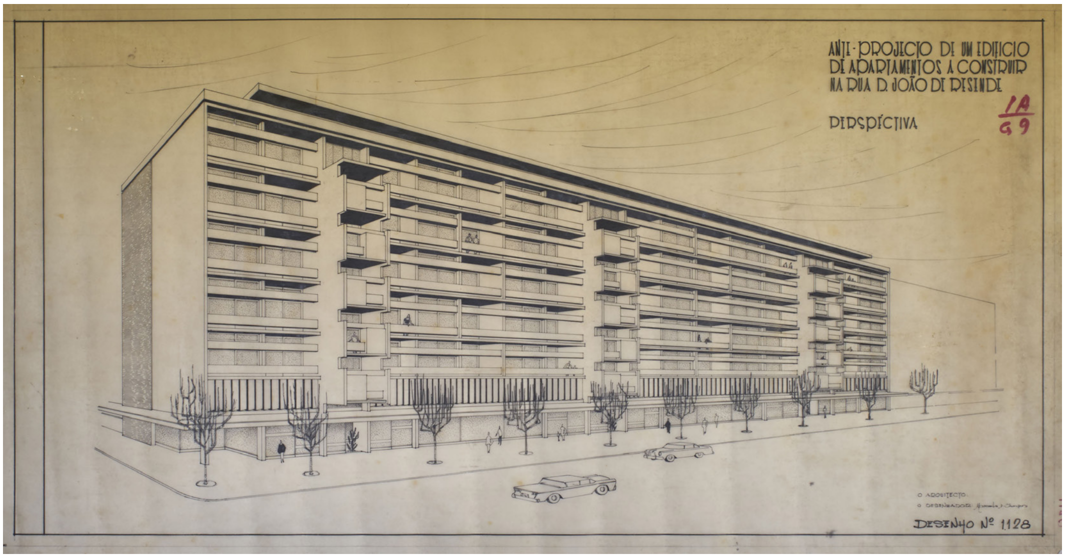
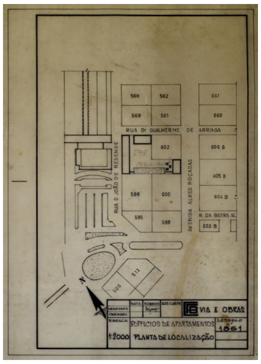


Figure 4.19 *Preliminary project for an apartment building to be built on D. João de Resende Street, Perspective*, May 6, 1965 (ECB)



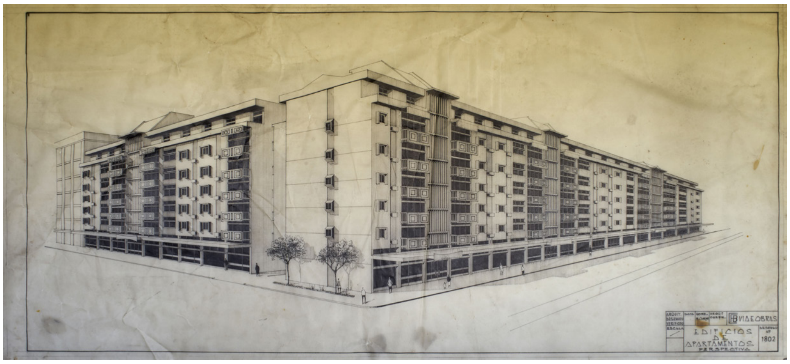
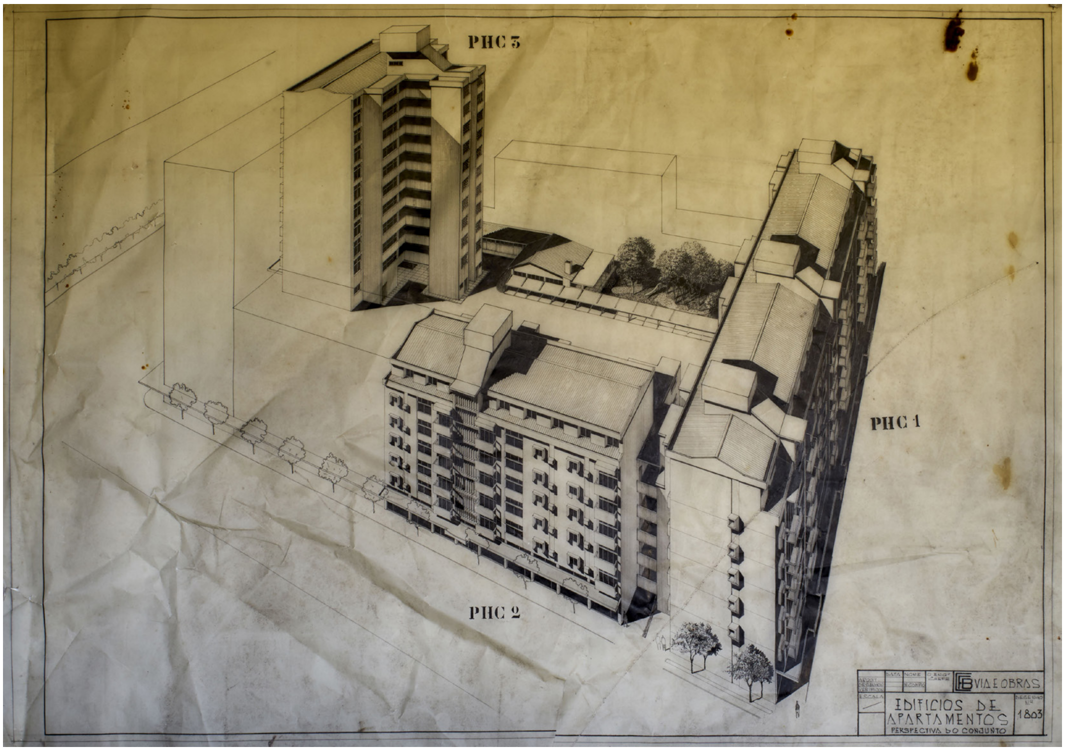


Figure 4.20 *Apartment buildings, Site plan*, n.d. (ECB)

Figure 4.21 *Apartment buildings, Perspective*, n.d. (ECB)

Figure 4.22 *Apartment buildings, Perspective of the ensemble*, n.d. (ECB)



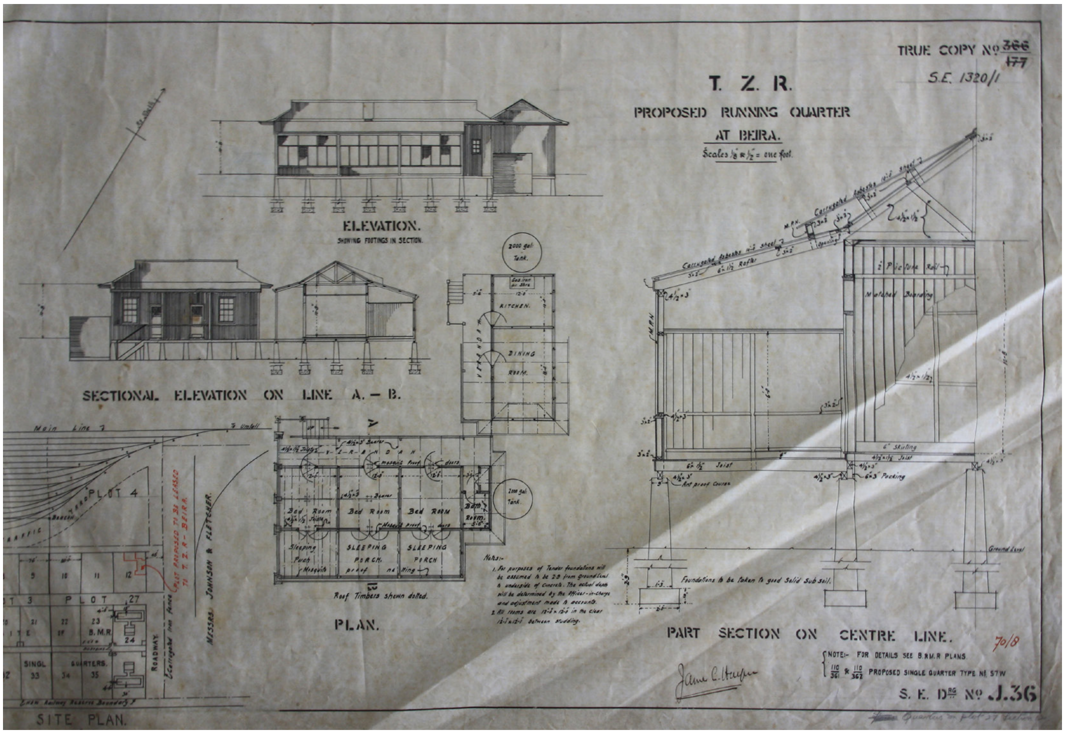


Figure 4.23 Project of a wood and zinc dwelling for Trans-Zambezia Railway in old staff dwellings quarters (ECB | AF, 2018)

Figure 4.24 Partial view of the current status of the staff dwellings quarters (MMO, 2020)

On the outskirts of the station, there are still vacant lots belonging to the CFM:

- on the southeast side of the Beira Central Station complex, facing João de Resende Street, Dr. Guilherme de Arriaga Street and Base N'tchinga Avenue. The northeast half of this terrain, plot No. 602, was the subject of two architectural studies for the construction of apartment buildings for the railways employees. The first of these studies, dated 1964-1965,[4.15] was carried out by Paulo de Melo Sampaio (Figures 4.18-4.19), while the second, from 1972,[4.16] was designed by the architect José Augusto Moreira of the Beira Railway (Figures 4.20-4.22);
- futher northeast of João de Resende Street is an old quarter with interesting wooden and zinc dwellings for railway workers that have degraded into a run-down slum (Figures 4.23-4.24).

4.3 Geometric, spatial, and building condition surveys

4.3.1 Original plans

An exhaustive work of documentation, encompassing documentary search geometric and functional survey, has been carried out to collect the original plans of the building and to outline a new detailed set of plans in its current configuration.

Previously, original drawings made during the design and construction of the complex were photographed at Beira Central Station in 2009. Copies of the 1959 and 1960 projects were photographed at Centro de Documentação e Informação do Instituto Português de Apoio ao Desenvolvimento (Portuguese Institute for Development Support Documentation

4.15 *Notícias*, April 26, 1964: 5; *Diário de Moçambique*, April 22, 1965: 2.

4.16 *Boletim dos Portos, Caminhos de Ferro e Transportes de Moçambique*, May 1972: 27; *Boletim dos Portos, Caminhos de Ferro e Transportes de Moçambique*, February 1973: ?; *O Ferroviário*, February 1973: 19.

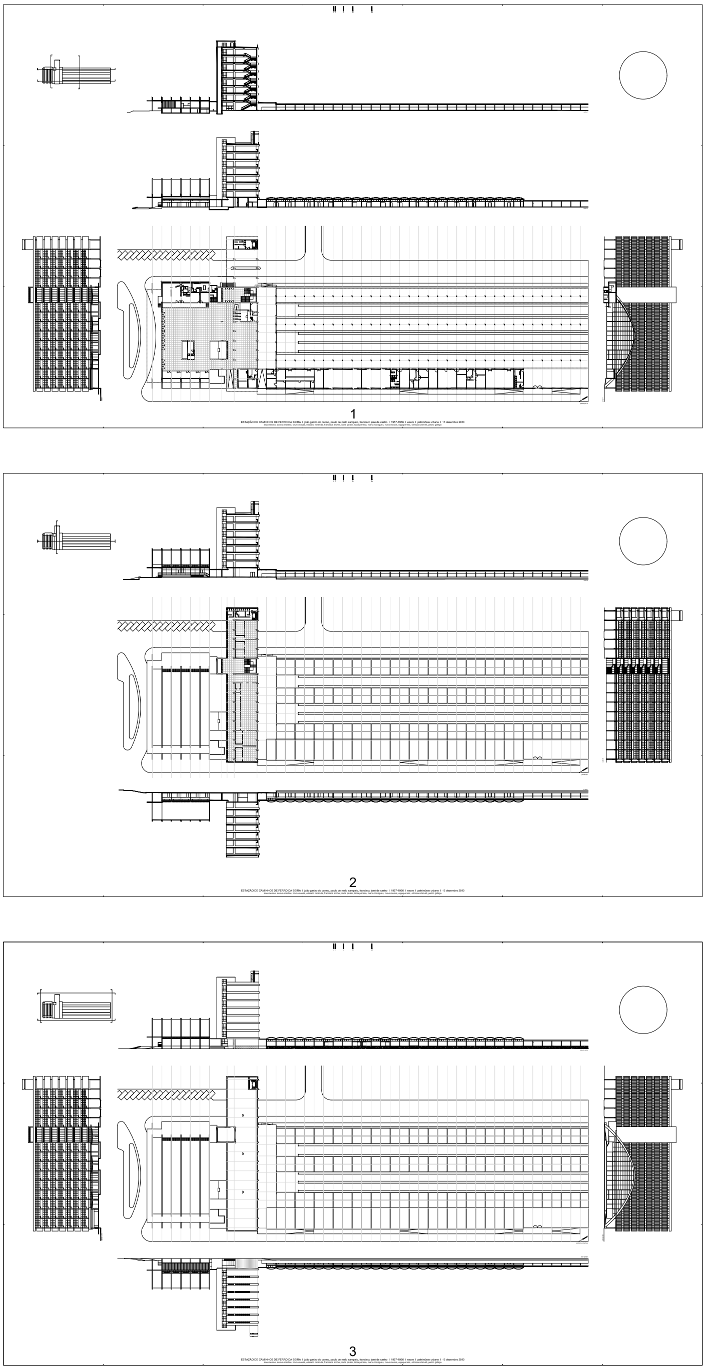


Figure 4.25 Redrawing of the Beira Central Station project, 2011

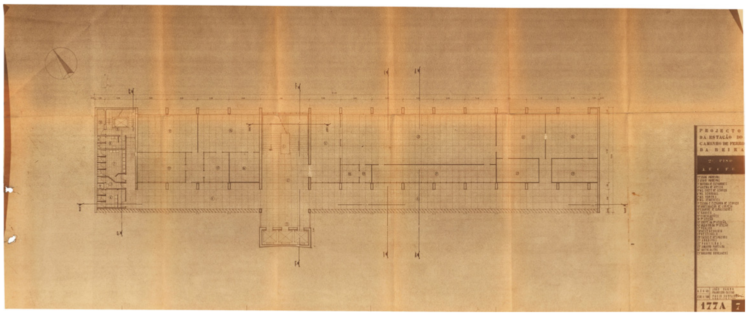
and Information Center), in Lisbon, in 2010, and redrawn in 2D CAD format by students of the University of Minho, Guimarães, Portugal, during the 2010-2011 academic year (Figure 4.25). Periodicals and photographs from the time were also consulted and registered in the archive of the Mozambique Railways Museum in Maputo in April 2018.

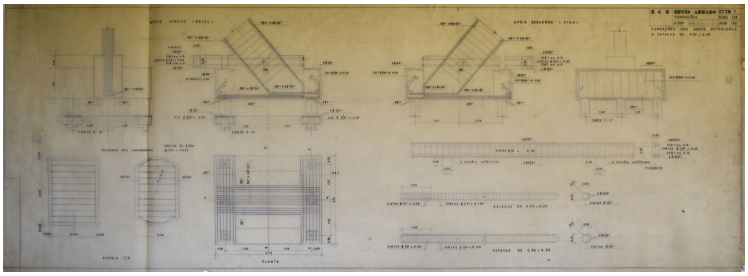
In the scope of the Keeping It Modern project, much complementary information about the original project was found in different archives from Mozambique and Portugal, such as the Arquivo Histórico Ultramarino (Overseas Historical Archive), in Lisbon, and in the archives of Direção de Estudos e Projectos de Engenharia dos Caminhos de Ferro de Moçambique (Mozambique Railways Directorate of Studies and Engineering Projects), in Maputo, and of Beira Central Station, in Beira.

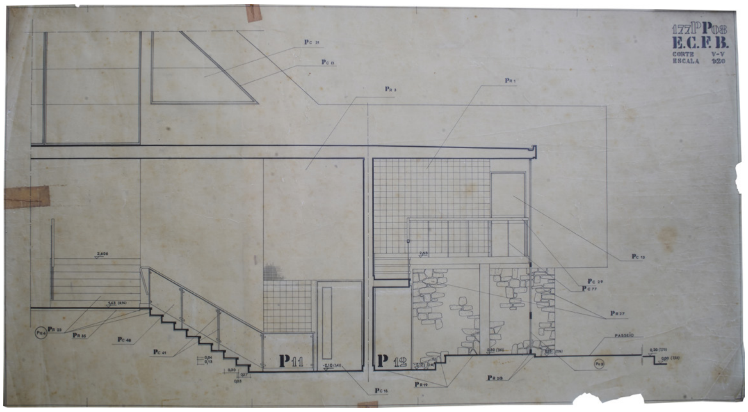
The graphic information that was found included not only the architectural plans, which define the organization and distribution of the building in plans, elevations and sections (Figure 4.26), but also the structural plans, which define the structural arrangement and the specifications of the different structural elements in detail (Figure 4.27), the materials and finishes plans (Figure 4.28) and plans of the electrical installation together with detailed drawings of the electrical fixtures (Figure 4.29). Furthermore, detailed drawings of furniture and other elements were also found, as well as information about the materials and reports about the electrical facilities. All this information that dates, to the authors' best knowledge, from the period between 1956 and 1965, is presented in Annex 1 - Original plans.

4.3.2 New plans

To define the current condition of the building, a geometric survey was carried out in March 2020. The fieldwork consisted of:







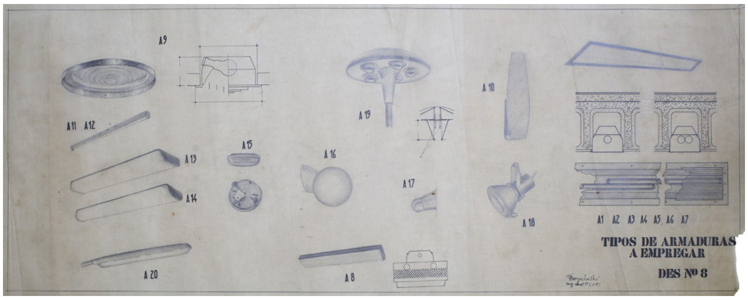


Figure 4.26 Architectural plan of the first floor of the administrative building

Figure 4.27 Foundations of the outer arches

Figure 4.28 Finishes plan of a section of the atrium

Figure 4.29 Drawing of light fixtures

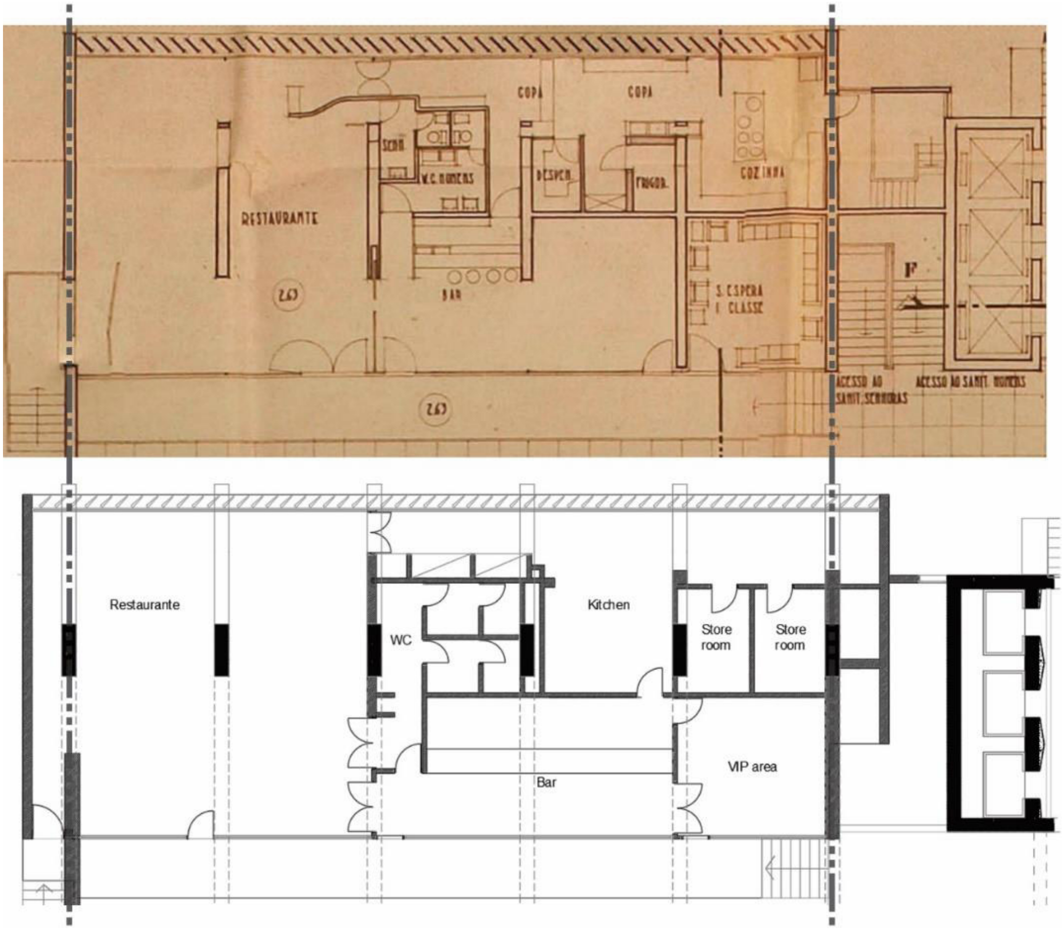
- the comparison of the original plans in relation to the current situation;
- on-site measurements; (iii) data collection on the materials, fixed furniture, electrical and other fixtures, and other relevant construction details;
- identification of uses of the different spaces.

Furthermore, an extensive photographic survey was conducted to document spaces and details.

In the verification process, some differences were found between the original plans, the CAD redrawing and the actual state of the building, which are reflected in the new set of plans prepared (Annex 2 - New plans). However, the discrepancies that emerged between the original drawings and the current state of the building are not significant, and it is worth noting that the plans could be not representative of the as-built configuration of the station due to modifications carried out during its construction.

The most typical intervention that is observed consists of the transformation of the original subdivision of spaces in order to adapt them to the new needs of the users. These alterations mainly implied the removal, substitution or addition of partition walls. This is visible in the main restaurant (Figure 4.30), in the platform's area command building (Figure 4.31), and is particularly common in the different floors of the administrative body (Figure 4.32). These figures show the comparison in a schematic way.

In the case of the restaurant, it can be noticed that the limit of this volume was defined by the last arch in the original design while currently the volume extends to the elevator area. Furthermore, the bar has gained space and the service and kitchen spaces have been redistributed. Also, the façade of the first shop on the right of the entrance has been demolished, in order to adapt it to the commercial image of the bank agency that now occupies it. The



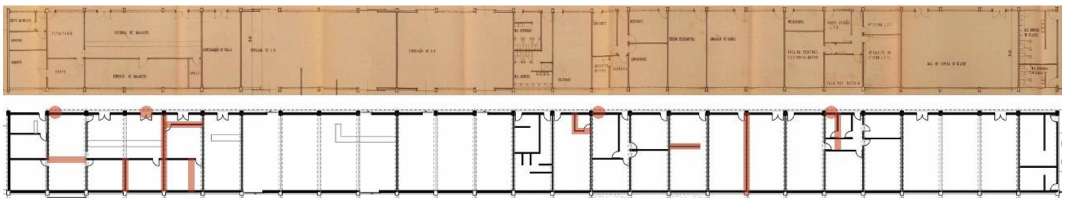


Figure 4.30 Restaurant plan: original design (top) and current state (bottom)

Figure 4.31 Command building: original design and current state, modifications highlighted

Figure 4.32 Body of the administration plans: original preserved walls (blue), removed original walls (red), new walls (green)

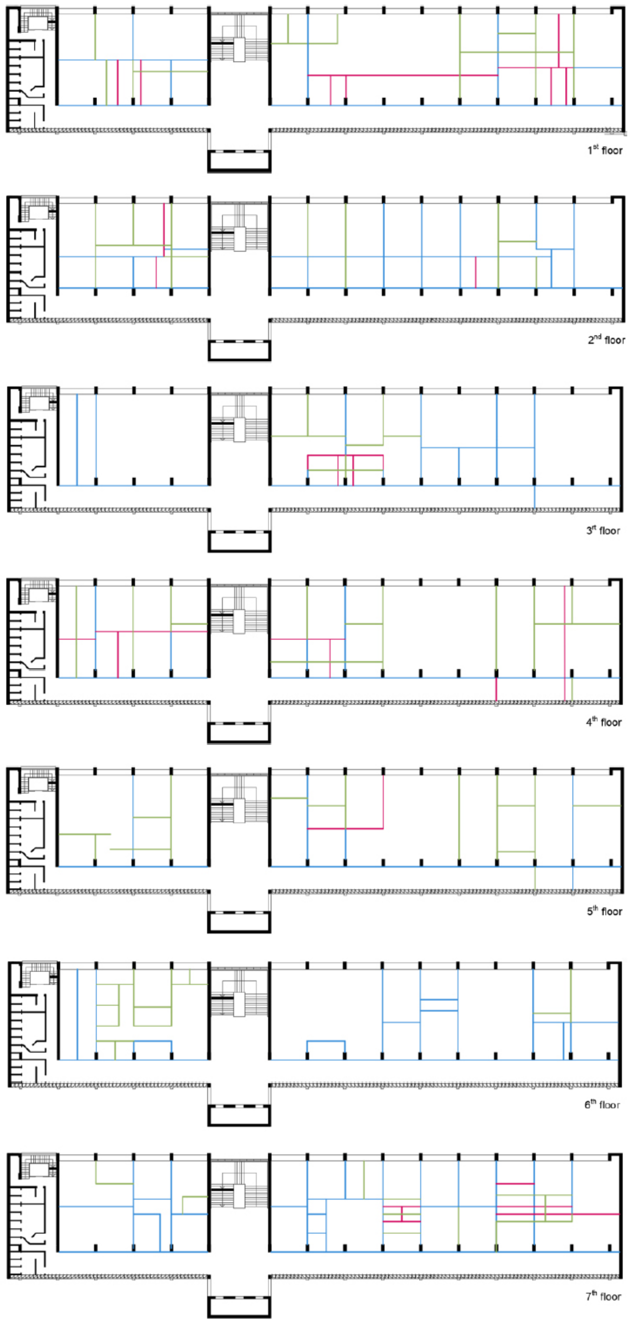


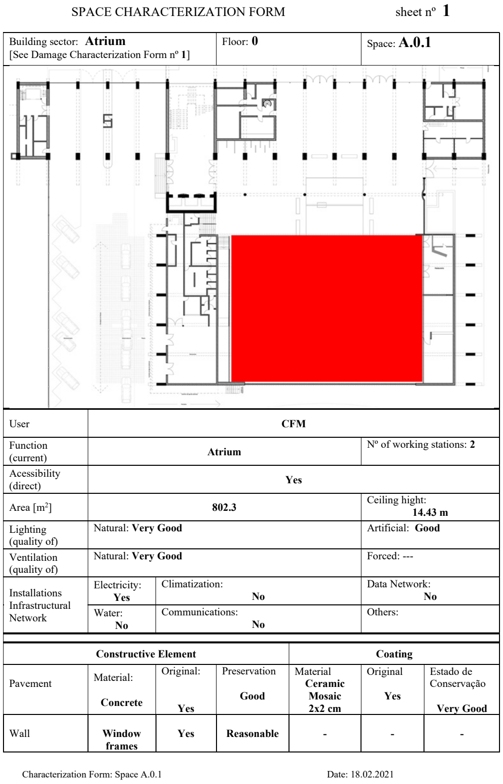
Figure 4.33 Front view of the BIM model

Figure 4.34 Side view of the BIM model from the command body replacement of the existing public elevators by new ones also led to the enlargement of their doors. The command building does not show many modifications and the original configuration remains. In the administrative building the boundaries of the spaces have undergone many modifications to adapt to new needs of the occupants during the last decades. As the drawings shows, some of the floors present more modifications than others, but, in general, all floors have undergone relevant alterations in the original subdivision of the spaces.

4.3.2 BIM MODEL

One of the objectives of the present work was to define the plans of the current configuration of the building. Several options exist to define digital drawings. However, the BIM methodology has demonstrated to be more complete if compared to traditional methods, such as the 2D CAD designs, allowing to create and manage information on a construction project throughout its whole life cycle. This implies a greater investment of time at the beginning, since not just information about the geometry is included, but also about other relevant aspects of the building, such as materials. Moreover, a BIM model includes the 3D configuration of the building, which provides a better understanding of the architectural design.

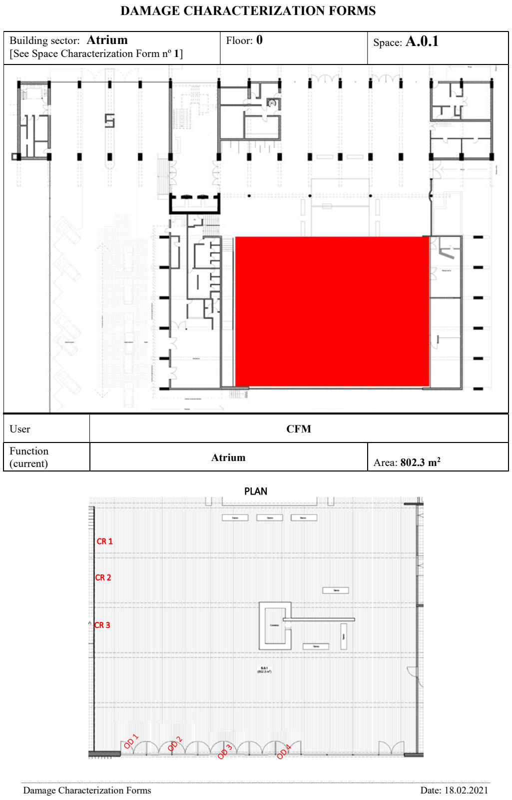
The preparation of a BIM model of an existing building is usually more complex than the definition of a new construction, mainly due to several uncertainties. Thus, the collection and analysis of original information and the geometrical survey are fundamental tasks to define a reliable model that synthesizes all the relevant information. Once the model is created, it can play a significant role in the operation, maintenance and building facility management, which will help greatly in the definition and the implementation of the Conservation Management Plan.


SPACE CHARACTERIZATION FORM sheet nº 1

Building sector: **Atrium** [See Damage Characterization Form nº 1]	Floor: **0**	Space: **A.0.1**

User	CFM					
Function (current)	Atrium			Nº of working stations: 2		
Acessibility (direct)	Yes					
Area [m²]	802.3			Ceiling hight: 14.43 m		
Lighting (quality of)	Natural: Very Good			Artificial: Good		
Ventilation (quality of)	Natural: Very Good			Forced: ---		
Installations Infrastructural Network	Electricity: Yes	Climatization: No		Data Network: No		
	Water: No	Communications: No		Others:		
	Constructive Element			Coating		
Pavement	Material: Concrete	Original: Yes	Preservation Good	Material Ceramic Mosaic 2x2 cm	Original Yes	Estado de Conservação Very Good
Wall	Window frames	Yes	Reasonable	-	-	-

Characterization Form: Space A.0.1 Date: 18.02.2021


DAMAGE CHARACTERIZATION FORMS

Building sector: **Atrium** [See Space Characterization Form nº 1]	Floor: **0**	Space: **A.0.1**

User	CFM	
Function (current)	Atrium	Area: 802.3 m²

Damage Characterization Forms Date: 18.02.2021

Figure 4.35 Example of space characterization form

Figure 4.36 Example of damage characterization form

The plans included in Annex 2 - New plans have been obtained from the BIM model (Figures 4.33-4.34) and allow to be updated when modifications in the building are done in the framework of the current CMP.

4.3.3 Architectural space and damage characterization forms

A form was prepared and filled, aiming at the material, functional and architectural characterization of each individual architectural space of the station (Figures 4.35-4.36). The information was collected in a systematic way and allows creating a database to register the current state of the station, as well as to document future alterations and works that will be carried out (Annex 3 - Space characterization forms). Moreover, a complementary form was created to register the damage in each architectural space (Annex 4 - Damage characterization forms).

Each form has a code that allows an easy identification and accessibility, so that they can be useful in the future for conservation, maintenance and documentation works. The same code is assigned to the form used for characterization and the one used for damage survey, so that they are interconnected. Each sheet corresponds to a bounded enclosure with the same characteristics. Firstly, the sheet indicates the sector of the building in which the space is located: Atrium (Átrio), Services (Serviços), Platforms (Cais), and the Floor (Andar), together with a plan where the area characterized is marked. Each sheet has a number and is referenced with an alphanumeric code, which is defined based on the sector of the building (A/S/C) and the floor (0-8) plus a number (from one to the next). For example, sheet S.6.30. refers to a space in the Services volume, on the sixth floor. The page header also contains a reference to the complementary damage sheets previously discussed, with the idea that the information is correlated, and the use of this database is easier and more practical.

Once the space is identified, the sheet firstly provides general data, namely the user, the current function, the number of workstations, the type of accessibility, the area, the quality of lighting and ventilation, both natural and artificial, as well as whether it has facilities, such as electricity, water, air conditioning, communications or data networks. Secondly, due to the relevance of the materials in the project, the sheet includes a section where both the construction element and the finishing material are characterized. This section also defines if the materials are original or not and specifies their state of conservation. To define the state of conservation, five levels have been defined: excellent, good, acceptable, bad and very bad, the last two implying the need to repair or replace. The last section of the data sheet refers to the presence of original furniture in the space, including a distinction between fixed and movable furniture, and specifies the state of conservation following the same criteria adopted in the section of materials. Finally, some space is provided within the form for additional comments and observations about specific issues of the space, as well as photos referring to the information in the sheet.

4.4 Building current condition

The Beira Central Station has not gone through proper maintenance since its construction, irrespective of the deterioration and damage caused by the aforementioned disastrous natural events. Moreover, few significant alterations have been implemented affecting the performance of the building, especially in terms of comfort. Assessing the actual condition, the effect of the alterations and the extent and degree of deterioration is a pivotal step towards the estimation of the building performance and the implementation of an effective Conservation Management Plan. To this end, preliminary and detailed investigations should be carried out regularly and the description of the current building condition within the Conservation Management Plan should be updated.

4.4.1 Material properties

The description of the material properties is based on the concrete characterization tests carried out in the months of February and March 2022, at the *Laboratório de Engenharia de Moçambique* (Mozambique Engineering Laboratory), over fifteen concrete specimens cored between January 31 and February 4, 2022, from nine locations (Figure 4.37). A single core was extracted from locations A, B and F, while two cores were extracted from locations C, D, E, G, H and I.[4.17] The cores were subjected to compression test. On ten cores, carbonation depth tests were also carried out. Additionally, samples of the concrete paste were taken on-site and tested in order to determine the chloride and sulphate contents. Due to a lack of locally accessible equipment, petrographic investigation and secondary electron microscopy (SEM) to identify potential Alkali-Silica Reaction (ASR) at the concrete could not be performed. Figure 4.37 shows the location of core sampling areas and Figures 4.38 to 4.43 show photographs of the locations.

The carbonation test results show that a significant part of the concrete that is left exposed in the exterior (platforms and roof) is carbonated, reaching a depth of 2.5 to 6 cm, thus exceeding the common reinforcement bar cover and leaving the steel unprotected and prone to corrosion. This agrees with the widespread corrosion observed at those locations in the building, particularly at the platforms. On the other hand, the concrete elements that are protected by mortar or ceramic tiles are not carbonated.

The mean compressive strength obtained in the mechanical tests varied significantly at the different locations. The structural elements (beams and pillars), that are part of the main administration body, present an appropriate compressive strength, with an average value of 27 MPa and a Coefficient of Variation (CoV) of 15%, whereas, the exterior elements, at the roof and platforms, present low compressive strength value of 16 MPa and 21 MPa, respectively.

4.17 LEM, 2022

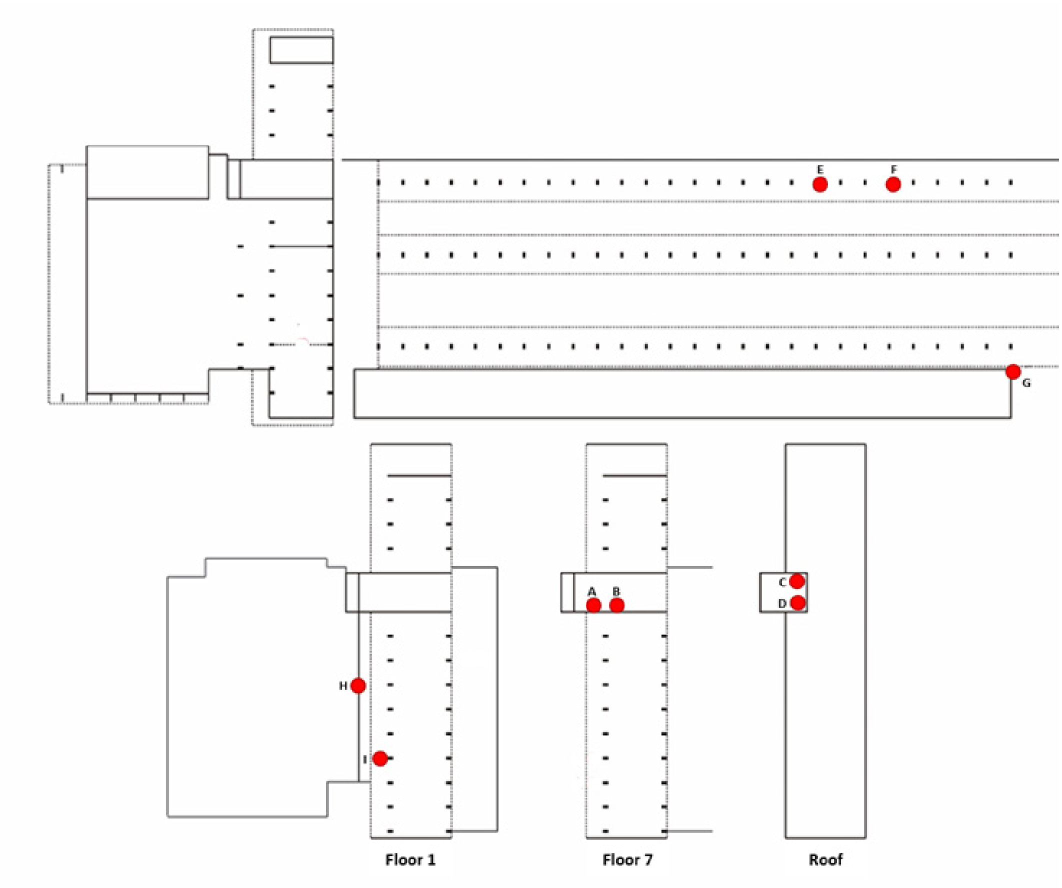


Figure 4.37 Location of core sampling.

Figure 4.38 Locations selected for coring: walls at the seventh floor (locations A and B).

Figure 4.39 Locations selected for coring: columns at roof floor (locations C and D).

Figure 4.40 Locations selected for coring: columns at platforms' area (locations E and F).

Figure 4.41 Locations selected for coring: column at the command building (location G).

Figure 4.42 Locations selected for coring: beam over the slab of the atrium transition space (location H).

Figure 4.43 Locations selected for coring: beam protruding from the slab over the transition space (location I).

The content of chloride is low for every location and below common thresholds, namely below 0.05% and with an average value of 0.01% by weight of concrete. The sulphate content is also low and below common thresholds, namely below 0.68% and with an average value of 0.48% by mass of cement, which seems to exclude risk of concrete deterioration due to chloride or sulphate contamination.

4.4.2 Physical conditions

The description of the current physical state of the building is based on a condition survey carried out between August 31 and September 6, 2019 (Annex 5 - Damage survey), which

Figure 4.44 Bottom of concrete slab at the transition space between the administration building and platfor-ms' area.

Figure 4.45 Stains on the slab of last floor of the administration block.

also encompassed the following: (i) visual inspection; (ii) non-destructive testing; (iii) ambient vibration testing. Hereafter, the main alterations and damage are reported and discussed.

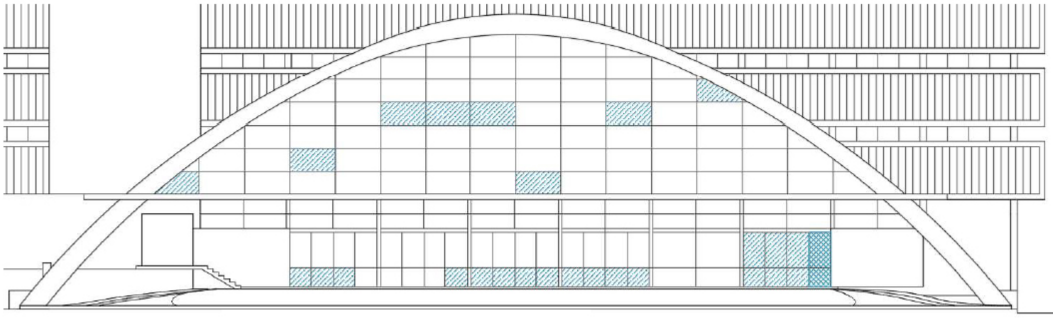
Water infiltration. Evidence of water infiltration is observed mostly on the bottom of the concrete slabs particularly in the elements that are exposed to direct rainfall without a proper drainage or protection. The spaces between the atrium, the administration body, and the platforms' area as well as the ceiling and beams of the administration block close to broken windows are particularly affected. This moisture infiltration causes detachment and discoloration on the plastering in the form of stains (Figure 4.44). The cyclone Idai, that occurred in 2019, has ripped off the cement fiber roof cover of the administration block, allowing the water infiltration through the exposed concrete roof slab and causing the visible stains at the intrados (Figure 4.45). This is currently repaired.

Material loss. The current condition of the glazing and the roof cover is strongly affected by the lack of maintenance and the effects of the natural disasters as the recent Idai cyclone. From the front and rear façades of the atrium, the windows and entrance doors glazing is either broken or missing (Figures 4.46-4.47). Similarly, in the administration building, loss of glazing is evident on the rear façade (Figure 4.48).

Detachments and corrosion. Detachments of concrete materials in the form of spalling, induced by the corrosion of the steel rebars, strongly affect the structural elements of the platforms' area, mostly in the joints between slab and columns (Figure 4.49). This phenomenon is likely triggered by water leakage from the downpipe installed in the columns and rainwater infiltration through the concrete slab. This latter also causes the visible efflorescence on the intrados of the slab (Figure 4.50).

The exterior window/door frames and the rails for the brise-soleil system in the administration building also underwent corrosion. The lack of maintenance of the steel frames likely aggravated the damage, leading to the scaling of the materials (Figure 4.51). In addition, the brise-soleil systems on the front facade of the administration building have been severely damaged by the cyclone resulting in the total detachments of the elements especially on the last two floors of the building (Figure 4.52).

Cracks. The masonry walls present diagonal cracks on the rear façade of the atrium (Figure 4.53) and horizontal cracks on the front and rear façades of the administration building (Figure 4.54). The main transversal beams of the first floor of the administration building are affected by vertical cracks (Figure 4.55), whereas map cracks are diffused on the interior beams of the administration building (Figure 4.56) and on the exterior concrete elements of both the platforms and of the transitional space between the administration building and the



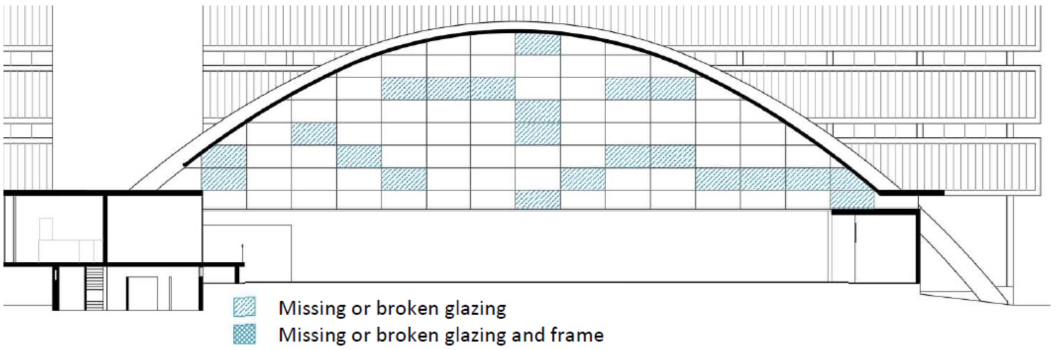


Figure 4.46 Broken glazing on the front façade of the public atrium.

Figure 4.47 Broken glazing on the rear façade of the public atrium.

Figure 4.48 Broken glazing on the rear façade of the staircase of the administration block.

Figure 4.49 Detachment/spalling of concrete cover due to corrosion of rebar in the platforms' area.

Figure 4.50 Corrosion of reinforcement at the bottom of slab and visible efflorescence in the platforms' area.

Figure 4.51 Broken glazing on the rear façade of the public atrium.

Figure 4.52 Detachment of the sun protective system on the front façade of administration block.

Figure 4.53 Diagonal cracks on the rear façade of the public atrium.

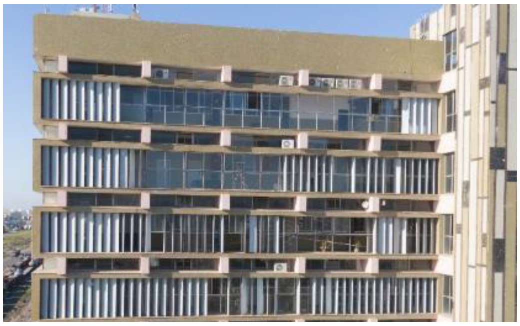
Figure 4.54 Horizontal and diagonal cracks at the rear façade of the administration block.

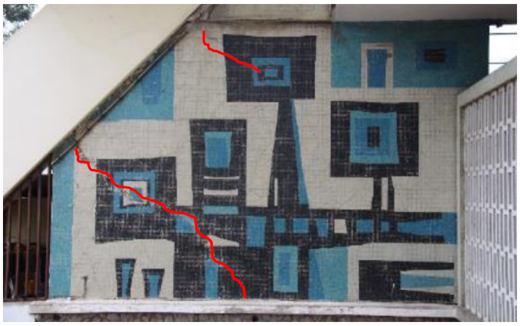
Figure 4.55 Vertical crack on a beam of the first floor of the administration block.

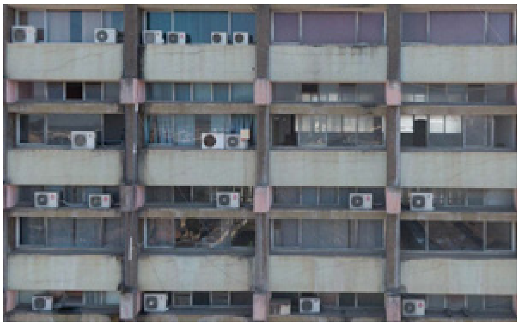
Figure 4.56 Map crack on an interior beam of the first floor of the administration block.

Figure 4.57 Deformation and cracks of the columns of the platform's area.

Figure 4.58 Deformation and cracks of the columns of the platform's area.







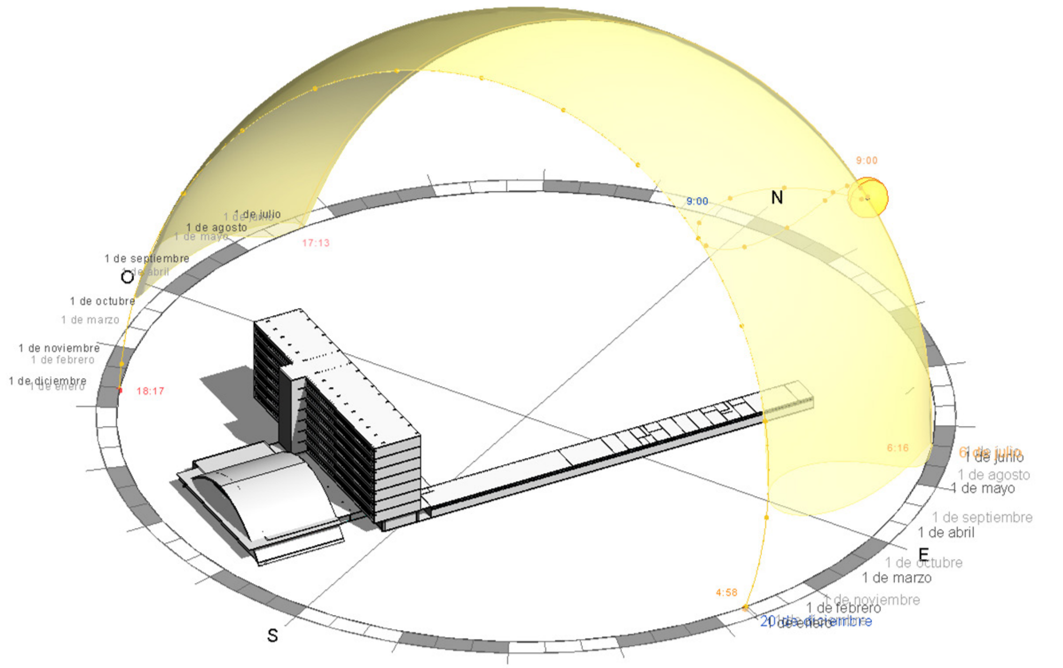


Figure 4.59 BIM model and complete sun path of the Beira Central Station throughout the year.

platforms. Columns covered with ceramic wall tiles exhibit vertical cracks on the edges of the elements on most floor levels of the building.

Deformation. The columns supporting the platform's area slab that is connected to the command building show deformation in a form of swaying towards the command building (Figures 4.57-4.58).

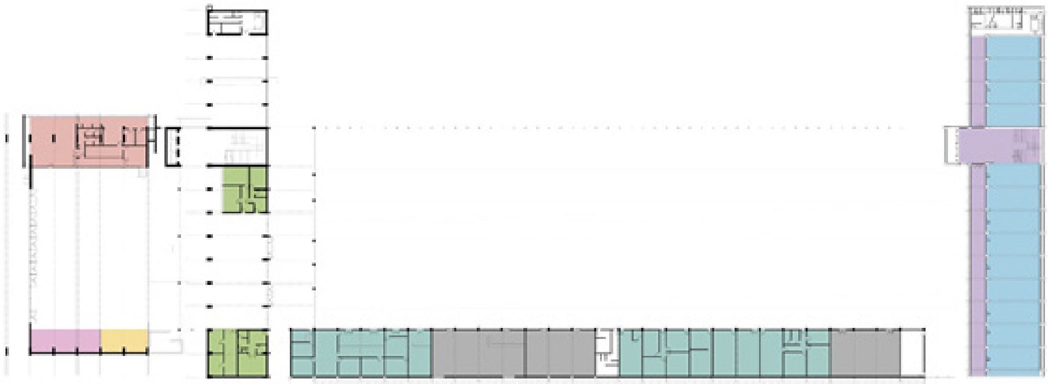
4.4.3 Comfort conditions and energy efficiency

The description of the comfort conditions is based on: (i) the long-term monitoring campaign of the temperature and humidity, between September 2019 and October 2020; (ii) the solar study and the thermal condition simulation by means of the BIM model (Figure 4.59). The analysis has addressed the zones indicated in table 4.1 and figure 4.60.

Table 4.1 Zones defined in the model to assess comfort conditions.

Figure 4.60 Plan showing zones for the comfort study: ground floor on the left and center; floors one to six on the right.

Colour	Zone	Area	Use
	Z01	Administration building floor 1	Office
	Z02	Administration building floor 6	Office
	Z03	Administration building floor 1	Hallway
	Z04	Administration building floor 6	Hallway
	Z05	Command body	Office
	Z06	Atrium	Office
	Z07	Atrium	Restaurant
	Z08	Atrium	Restaurant
	Z09	Atrium	Bank
	Z10	Command body	Warehouse (not habitable)



Most of the office spaces of the Railway station have a mechanical cooling system due to the high temperatures recorded between December and February. The analyses demonstrate how solar ingress has a substantial impact on the thermal conditions. During certain times of the day, temperatures are higher inside the building than outside.

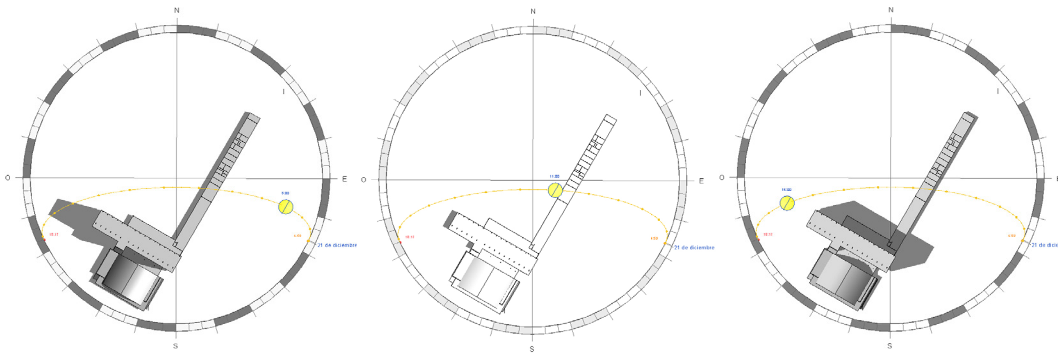


Figure 4.61 Shadow of the building on December 21 at different times: 8:00am, 11:00am and 3:00 pm.

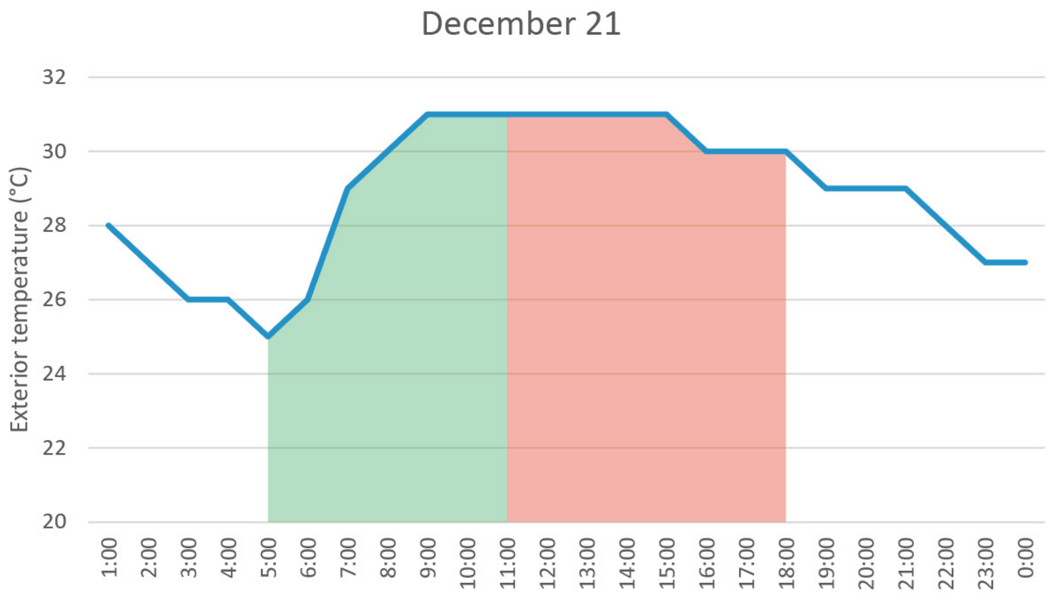


Table 4.2 Exterior temperature measured in Beira on December 21, 2019. In green the hours of exposure for the northeast façade, in red for the southwest façade.

Figure 4.61 shows the shadow of the building on December 21, 2019, at different times, whereas table 4.2 reports the exterior temperature measured in Beira on the same day. This informs on the solar orientation as well as the portions of the fabric susceptible to solar heat gain: between 5:00 and 11:00 am, the northeast façade is exposed to sunlight, whereas from 11:00 am to 6:00 pm the southwest façade is radiated.

4.4.4 Major architectonic issues

The Beira Central Station complex remains in reasonable state of conservation and did not suffered significant architectural modifications that could have substantially and irretrievably altered its original physiognomy. The major architectonic changes consist in:

- overlapping of the *Triage* glass mosaic mural with illuminated advertisements, air conditioners and miscellaneous cabling (Figure 4.62);
- alteration of the private entrance to the administration block (from the outside and from the public atrium), by replacing the glazing, cladding of the steps and flower boxes (Figures 4.63-4.64);
- remodeling of the façade of two first stores in the public atrium (Figure 4.65);
- replacement of the main elevators and the widening of its access doors in the upper floor of the administration block (Figure 4.66);
- closing of the glass fronts to the galleries of some offices in the administration block as well as changing the galleries' original colors (Figure 4.67); and
- grid placement in frames separating galleries and workspaces, casual placement of air conditioning units along these galleries (Figure 4.68) and in the northeast façade of the administration block.

The length of the platform 1, closest to João de Resende Street, was extended by approximately 110 m during the colonial period (Figure 4.69). This modification, which is not drawn in the original project, was probably made to uphold the two pre-existing train lines, located between this platform and the street. It is worth noting that the proposed creation of an underground connection for passengers between the three platforms was never realized.

Figure 4.62 Current state of the *Triage* glass mosaic mural in the public atrium block façades (EM, 2020)

Figure 4.63 Entrance to the administration block showing replaced glazing, cladding of the steps and flower boxes (EM, 2022).

Figure 4.64 Entrance to the administration block from the public atrium showing replaced glazing (EM, 2022).

Figure 4.65 Façade of the shops of the public atrium after remodeling of the two on the right side (EM, 2019).

Figure 4.66 Widening of the elevator doors in the upper floor of the administration block (EM, 2019)

Figure 4.67 Closing of the glass fronts to the galleries of the administration block (EM, 2019).

Figure 4.68 Air conditioning units in the galleries of the administration block (EM, 2019).

Figure 4.69 Extension of platform 1 in the platforms' area (EM, 2019).

The complex still serves its original functions, despite the low frequency of trains departing from the railway station. Besides freight trains, there is one daily passenger train coming from and going to Dondo, on the outskirts of Beira; and two passenger trains per week directed to and originated from Marromeu, a 24 hours journey. The train station urgently needs a proposal for the refunctionalization and regulation of the use of its spaces, and the definition of conservation and maintenance principles for the safeguard of its built heritage.

4.5 References

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SECTION 5

5 Conservation policies

The present section defines the general policies for the Beira Central Station; reports on the current process of the building classification; rethinks its socio-urban role; elaborates on detailed conservation policies; and recommends necessary and desirable measures.

The aim of the policies formulated in this section is to provide a framework to inform decision making regarding the conservation and maintenance of the significance and the physical conditions of the Beira Central Station.

5.1 General policies

The general policies proposed in this subsection were based on the CMP for the Eames house, but were tailored to the unique circumstances of Beira Central Station.[5.1]

5.1.1 Adoption and implementation of the conservation policies

The Beira Central Station should adopt the conservation policies outlined in this CMP as a guide for future conservation, protection, interpretation, and management of the place. Respecting the authenticity and integrity of the original design for the Beira Central Station is crucial to ensuring and maintaining the place's cultural significance.

5.1.2 Regular review of the policies

It is necessary to review these conservation policies on a regular basis in order to confirm their suitability as well as to ensure their application.

5.1 Burke (et. al.), 2018.

5.1.3 Professional conservation advice

When required, the review of the conservation policies, as well as the development and oversight of work proposals for the place, including maintenance and repair actions, should be supported by relevant and experienced conservation advisors and practitioners.

5.1.4 Best practice conservation policies

Conservation management and interpretation of the Beira Central Station should follow best practice conservation principles, as the ones included in the following declarations:

- *Burra Charter* (*The Australia ICOMOS Charter for places of Cultural Significance*, 2013).[5.2]
- The *Madrid – New Delhi Document* (*Approaches to the Conservation of Twentieth-Century Cultural Heritage*, 2017).[5.3]
- *ICOMOS Charter* (*Principles for the Analysis, Conservation and Structural Restoration of Architectural Heritage*, 2003).[5.4]

5.1.5 Role of significance in site management

All planned and implemented works for the site's conservation, interpretation, and management should be guided and informed by the statement of the site's cultural significance and the assessments of the significance of the individual elements, as set out in this CMP.

The character-defining areas, elements, and fabric should be conserved under the direction of the assessment of significance in Section 3.

5.2 Australia ICOMOS, 2013.
5.3 ISC20C, 2017.
5.4 ICOMOS, 2003.

Conservation in this context refers to all actions outlined in the Burra Charter, such as preservation, upkeep, restoration, reconstruction, and adaptation.

5.1.6 Role of significance in guiding conservation actions

As part of its future use, the elements and attributes of the place that contribute to its most important historic, aesthetic, social, and scientific values should be appropriately conserved, interpreted, and managed. Priority should be given to the conservation of the elements and attributes of the highest level, that is of *Exceptional significance* (Table 3.1).

5.1.7 Constant research for appropriate conservation solutions

This policy is based on the necessity of conducting ongoing research on the elements and components that contribute to the meaning of the Beira Central Station so that they can be replaced or supplemented with elements and attributes that perform better in future revisions of the CMP, always complying with the notion of maintaining cultural significance of the place.

5.1.8 Collecting information for live archive

The continuous collection and mapping of damage, interventions, inspections, and implementation of the policies of this CMP, or the result of another circumstance, must always be the subject of a photographic and written record. It should include accurate scaled drawings when action is required, in order to build the history of the construction and maintenance of the Beira Central Station building.

5.2 Rethinking the Beira Central Station socio-urban role

There is a strong field to be explored where the Beira Central Station can be a protagonist in the qualification and activation of an urban center that has been on the periphery of urban manager options affecting the city.

The Burra Charter states that *Places of cultural significance enrich people's lives, often providing a deep and inspirational sense of connection to community and landscape, to the past and to lived experiences*[5.5] and advocates *a cautious approach to change: do as much as necessary to care for the place and to make it useable, but otherwise change it as little as possible so that its cultural significance is retained.*[5.6]

On the other hand, the declaration of Davos states, that *High-quality* Baukultur *requires striking the right balance between cultural, social, economic, environmental and technical aspects of planning, design, building and adaptive re-use, in the public interest for the common good.*[5.7]

It is in the complementarity of both statements that the history of the building was contextualized and not only the role it played and currently plays in the city was analysed, but also the role it could play in the future, as an agent of urban qualification and socio-economic cohesion. This vision of the future considers and assumes, as an inalienable assumption, the safeguarding of the architectural and cultural significance of the Beira Central Station.

Due to its relevance in the Modern Movement panorama, it is possible to find various publications that refer to the Beira Central Station. However, they are studies that focus mainly

5.5 Australia ICOMOS, 2013: 1.
5.6 Australia ICOMOS, 2013: 1.
5.7 OFC, 2018: 12.

on its architectural attributes, where themes related to its current and to its future urban role in the city of Beira has yet to be explored.

Of special relevance would be the expansion of the railway scope, including in its objectives the transportation of passengers, currently almost non-existent, to the empty lots on the southeast side of the Beira Central Station complex, facing João de Resende Street. In fact, this possibility would not only renew the building's use but would also contribute to reorganizing the deficient local public transport system. In the future, the station area could house Beira's intermodal transportation center for rail, land, and river transportation. If adopted, such a solution would obviously have a high impact in the dynamization of the Beira Central Station rehabilitation strategy.

Making use of the vast car park, currently with very limited use, the various public services and private offices installed in the administration block, the commercial establishments in the public atrium and the covered square that constitutes this lobby, and also the rail transport services of passengers that may be provided by the Mozambique Railways, these grounds may be used by collective facilities that enhance the station area as a multifunctional center of the city of Beira: commercial, cultural, sporting, recreational and of transportation.

Additionally, it is necessary that the urban approach to this area contemplates the renovation of the old staff dwellings quarter. An inclusive, not gentrifying, approach that provide residents with decent living conditions, could also function as a laboratory for the social integration of the vast sections of the people in the city with less financial resources.

All the hypotheses that could be related and rooted in the rehabilitation of Beira Central Station need to be considered in the urban planning of Beira. Despite the great power of the city in the 1950s and 1960s, its development never managed to accomplish the urban fabric defined in the plan, and the area of the station remained incomplete, an unfulfilled design to this day. This failure opens, however, new possibilities to the contemporary urban planning. From a perspective of rehabilitation advocated here, it is necessary for Mozambique Railways to take on the role of an actor involved in the socio-economic development of the city. Therefore, it is essential to value the elaboration of a functional program together with the investigation on the material condition of the building and the technical solutions for its rehabilitation. In these circumstances, where complicity is required, the participation of other urban agents and local communities is also essential.

The building's rehabilitation itself should be a motto for local development: giving special attention to the training of labor workers in the various arts in the construction and conservation sector; reactivating the manufacturing of construction elements, such as *brise-soleil* and aluminum frames; and promoting studies on the ceramic tiles used, aiming to their conservation.

Simultaneously, recognizing the interesting iconographic assets that the station has, the organization and installation of an archive with the available material is an important contribution to the study of African railway history.

And, as a monument of the city, the architectural design of the building should be highlighted, making itself known and open to public visits, reinforcing itself as an element of identity of Beira.

Programs for collective use are believed to be essential components to the conservation of cultural values. It is through this use that the significance and appropriation of heritage by the community is socially established and, consequently, its social and political interest is fostered, which is indispensable to allocate resources necessary for its maintenance. Thus, the Programming Phase will be a central moment to the rehabilitation strategy because it will reconcile uses and functions with the physical and heritage support that the building offers, valuing it. This methodology means taking on a participatory and co-responsible process that must consider the CFM, as the owner, the community and political and economic stakeholders; it also means that architectural hierarchies and boundaries will need to be defined, establishing principles that safeguard the architectonic integrity and the cultural significance of the building. The search for solutions that are respectful of the environmental and financial sustainability of the building must also be considered.

Facing current needs as potentialities for a future at different paces, and understanding the building as a complex urban infrastructure, even as an instrument of socio-cultural and urban development, the adoption of a strategy that induces spillover effects and exponential results is capital in the planned actions. Enunciating several simultaneous approaches, this process should include:

- the integration of the station in the city's urban strategy;
- the involvement of the local political administration and of the community in the process, aimed at a broad social consensus;
- the elaboration of a functional program that incorporates components that are revitalizing for the building and urban-wise significant;
- the design of an architectural program that guarantees compatibility between the envisaged uses and the architectural significance of the building, taking into account the orientations the CMP related to corrective actions;
- the consideration of the building as a potential laboratory for the knowledge of modern architecture and the training of labor in the area of conservation and rehabilitation; and

Figure 5.1 Beira Central Station at night (MMO, 2019)

- the assumption of the building as a meaningful monument in the city, both as a repository of its memory and history, and as an active part of his future.

Functional reprogramming will add decisively to the improvement of the urban and environmental conditions of the whole area, furthermore, performing an important social role. This programme should consider in its complexity and contradiction, all the themes that can favor and polarize the surrounding urban centrality, today too fragile. It is believed that the Beira Central Station can become an urban development catalyst, contributing to the planning of the future cityscape, while preserving the legacy of the Modern Movement.

5.3 Detailed conservation policies

5.3.1 Concrete elements

5.3.1.1 Filling/injection of cracks

Different techniques for crack repair exist and the correct identification of the best suited approach depends on the extent and cause of a crack, its evolution (e.g. dormant or active) and the objective of the repair.[5.8]

Commonly, repair makes the crack location stand out, therefore, if the final appearance matching is a major concern, the material and finishing method should be properly selected and tested.[5.9]

Epoxy resin injections are among the most common methods to repair dormant cracks to restore original structural strength. Epoxy resin can be effectively used to inject crack-width within the range 0.05-6 mm.[5.10] If the cause of the cracking is not properly addressed, the

5.8 ACI 224, 2007.
5.9 ACI 224, 2007.
5.10 Fay, 2015.

injection is likely to lead to cracking adjacent to the repaired cracks,[5.11] in this case it is recommended to either:[5.12]

- rout and seal the crack, treating it as a joint;
- establish a joint that will accommodate the movement before injecting;
- install additional support or reinforcement at the crack location to minimize movement.

In general, injections are sensitive to workmanship and environmental conditions, especially ambient temperature, therefore they should be carried out by trained and experienced contractors.

The most common injection protocol encompasses five stages,[5.13] that are described hereafter for guidance:

- clean the crack, by vacuuming, water- or air-blasting and dry out the surface after application;
- establish entry and venting ports for the injection along the crack. Port location pattern, distance and inclination depend on the characteristics of the crack. The holes should be cleaned from dust and dirt before inserting the fitting, that is, then, bonded with epoxy adhesive;
- seal the crack, upon cleaning, through epoxy, polyester or other appropriate material on all the visible surfaces to prevent leaking during injection;
- inject under pressure. For small repair, the material components are pre-batched according to manufacturer's instructions and then poured into the injection equipment, whereas for larger interventions, continuously mixing by pumping is preferred. To this end,

5.11 ACI 224, 2007; Fay, 2015.
5.12 ACI 224, 2007.
5.13 ACI 224, 2007.

hydraulic pumps, pressure pots, or air-actuated caulking guns may be used.[5.14] Proprietary injection devices should be used according to manufacturer's instructions. Vertical or inclined cracks are injected proceeding from bottom to top, starting from the lowest entry port. When the resin reaches a superior entry port, the lower one is capped and the process is repeated until all ports are capped. Horizontal cracks are injected proceeding from one end to the other;

- remove the ports, excess of grouted resin and surface seal by grinding, high-pressure water blasting, scraping or with other adequate technique.[5.15]

For non-structural crack repairs two alternative approaches are viable:[5.16]

- routing and sealing;
- gravity filling.

These approaches do not require the skills and expertise of crack injections, however experienced contractors should be employed. Routing and sealing encompass the following stages:[5.17]

- enlarge the crack along the exposed surface, producing a walled groove orthogonal to the exposed surface. Remove debris, dust and other contaminants by cleaning the groove with air-, sand- or water-blasting;
- fill the crack with a suitable sealant, once the area is dried out;
- adopt an adequate finishing technique to match the required final appearance.

5.14 ACI 224, 2007.; Fay, 2015.
5.15 ACI 224, 2007.; Fay, 2015.
5.16 ACI 224, 2007.
5.17 ACI 224, 2007.

If the cracked surface is subjected to severe loading, care must be taken to prevent cracking and debonding of the sealant (e.g. using aggregate interlock or dowels). Finishing such as strip coating may also contribute to prevent damages. Sealing can be used to treat active cracks. To this end a bond breaker is placed at the base of the groove and covered by flexible sealant.[5.18]

Gravity filling is effective against crack width in between 0.03 and 2 mm according to the following procedure:[5.19]

- clean the crack by air- or water-blasting;
- when leaking by gravity through exposed surfaces of the crack is expected, seal the visible crack keeping the access for the filling;
- pour a suitable sealant onto the dry surface and work it back and forth over the crack to ensure its slow penetration. Lower viscosity of the sealant is needed for thinner cracks;
- broom off residual and excess material.

5.3.1.2 Patch repair upon passivation of corroded steel bars if present

Application of concrete patches is likely the most common repair strategy for deteriorated concrete, including the case of ongoing corrosion leading to delamination and spalling of the cover. The application encompasses four main stages:[5.20]

- selection of material and technique;
- removal of damaged concrete;
- substrate and steel preparation;

5.18 ACI 224, 2007.
5.19 ACI 224, 2007.
5.20 Report, 2003.

- application of the repair.

Finally, the operations should include bond strength, compressive strength and consolidation testing for conformance to specifications.[5.21]

The following recommendations mainly refer to repair of structural elements, nonetheless they can be considered also for non-structural ones as concrete pavements and screeds. For such elements, in areas subjected to intense mechanical actions or wear and tear a reinforcing steel mesh may be added if missing or inadequate.

Patches may be hand-applied, sprayed, poured or pumped.[5.22] Selection of the best technique is case-specific and depends on the characteristics of the damage (e.g. causes, size, area affected and accessibility to it) and the availability of resources (e.g. repair materials and equipment, budget, time, skills).[5.23] In general, patch repair is sensitive to workmanship and adequate curing, therefore the activities should be carried out by trained and experienced workers, ensuring that health and safety requirements are carefully met, especially with spray techniques.[5.24]

Commonly adopted materials are pre-blended proprietary cementitious or polymer-modified cementitious mixes.[5.25] Site batched materials may be employed but a strict quality control is needed. Moreover, proprietary repair system may include other products beside the mortar for the patch, as for instance reinforcement primer, bonding aid and protective coating, therefore a correct application requires following the manufacturer's instructions and

5.21 Macdonald; Gonçalves, 2020.
5.22 Macdonald; Gonçalves, 2020; Report, 2003.
5.23 Report, 2003.
5.24 Macdonald; Gonçalves, 2020; Report, 2003.
5.25 Report, 2003.

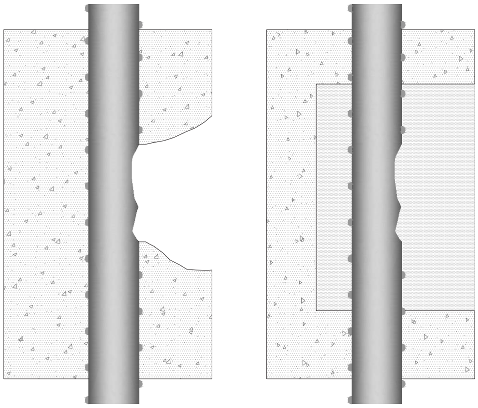


Figure 5.2 Preparation of substrate: poor preparation and feathered edges (Broomfield, 2003).

Figure 5.3 Preparation of substrate: correct preparation, with squared edges and removal behind the rebars (Broomfield, 2003).

applying all these components.[5.26] Selection of material should ensure a low-shrinkage and chemical reactivity, high bonding, similar mechanical properties and visual matching of the final appearance.[5.27] Visual matching is commonly very demanding, as proprietary products and mixes hardly present the same appearance, moreover, original concrete and patches may weather at a different rate and with different forms. If the final appearance matching is a major concern, samples of the repair system should be prepared on-site to test different mixes (type of aggregates, cement and additives) and finishing techniques (e.g. exposure of the aggregate, coating, brushing, sand- or water-blasting, etc.) comparing the result with the surface of the element to repair. Upon the definition of a good matching strategy, this should be tested on the building itself, through trials in accessible and unobtrusive areas.[5.28]

Before proceeding with the removal, structural shoring or propping should be installed if the section reduction is expected to affect the load-bearing capacity of the element.[5.29] The

5.26 Report, 2003.
5.27 Macdonald; Gonçalves, 2020; Report, 2003.
5.28 Macdonald; Gonçalves, 2020.
5.29 Macdonald; Gonçalves, 2020.

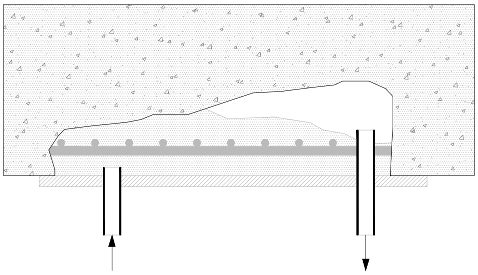


Figure 5.4 Placement of repair material into formwork: pumping concrete allowing air to escape through a second pipe (Report, 2003).

area of the repair patch must be cut-off to remove at least the deteriorated concrete and the perimeter should be prepared with a vertical saw-cut (Figures 5.2-5.3).[5.30] The repair area should be simple, preferably rectangular, reentrant corners should be avoided being susceptible to cracking and the concrete should be properly removed around and behind the steel bars to ensure a correct attachment of the patch.[5.31]

The final substrate surface should be clean, crack-free and present an adequate roughness to foster the attachment. Moreover, it should be saturated before deploying the repair material or a bonding agent should be applied. Exposed steel bars are protected with a corrosion-inhibiting coating,according to manufacturer's instructions, upon removal of the products of corrosion (rust and chlorides) to a near white finish.[5.32] If the rebars appear excessively corroded, they can be replaced or supported by installing additional reinforcement.[5.33]

Isolated and localized repairs can be hand-applied. Pouring the repair material into formwork, instead, is more suitable for large-volume repairs and usually results in a more

5.30 Broomfield, 2003; Macdonald, 2008.
5.31 ICRI, 2008.
5.32 Broomfield, 2003; Dolce; Manfredi, 2011.
5.33 Macdonald, 2008.

consistent and durable repair, allowing the use of coarser aggregate or even additional reinforcement (Figure 5.4).[5.34]

The formwork should ensure a proper matching of the patch profile with the surrounding original surface.[5.35] To avoid entrapment of air within or below the patch, the repair material can be pumped, placing the delivery hose at the bottom and raising it as the pour height increases. A second pipe at the top of the patch area is placed to allow entrapped air to escape (Figure 5.10).[5.36] After an initial curing of the repair material, the formwork is removed and the surface is treated to ensure the appearance matching (texture and color).[5.37] Recently, spray-applied repair materials are wide-spreading due to their quick and inexpensive application to large areas. Due to the relevance of the execution for the final quality of the spray-applied repair, it is recommended that trained and experienced contractors are involved and that they are allowed to select the constituents and equipment that ensure the specified characteristics in terms of performance and durability.

Finally, it is worth noting that patch repairs are not effective in the long-term in case of chloride-contaminated concrete that should be carefully removed or corrosion should be prevented by means of effective strategy, such as electrochemical techniques or inhibitors.[5.38] These methods should be also considered when, for structural concerns, the concrete cannot be fully removed around the steel bars.[5.39] This may be the case of highly compressed pillars.

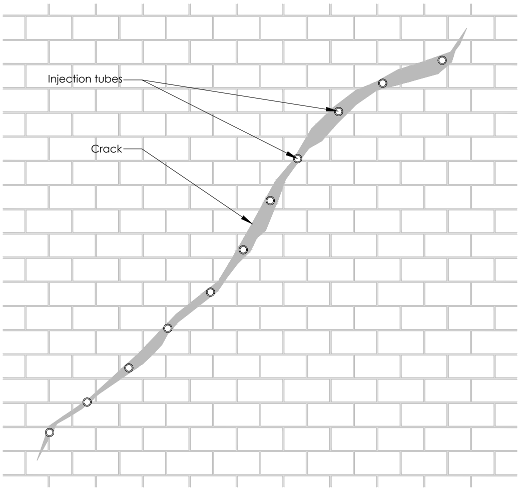
5.34 Macdonald, 2008.
5.35 Macdonald, 2008.
5.36 Report, 2003.
5.37 Macdonald, 2008.
5.38 Report, 2003.
5.39 Broomfield, 2003.

5.3.1.3 Concrete surface cleaning

Concrete cleaning is recommended as part of regular maintenance, moreover, in presence of aesthetic defects, deposit, soiling or staining, an adequate cleaning can be implemented as curative measure. A correct protocol for cleaning should be defined on a case-specific base, by taking into account the characteristics of external surface either intentional (e.g. texturing, exposing aggregate, painting, etc.) or resulting from deterioration (scaling, disaggregation, loss of concrete cover, etc.). Indeed, the adhesion of the deposit depends on its nature and the characteristics of the concrete and its constituents (e.g. aggregate or cement matrix), therefore, its treatment may require different limitations to the cleaning method and the detergent used. Care must be taken to prevent the penetration of water and chemicals through pores, voids and cracks, and a preliminary repair of the outermost layer may be needed. Moreover, the characteristics of the deposit or stain, when they can be identified, allow a tailored selection of the detergent and cleaning process.

A careful inspection of the surface and the stain is strongly recommended, possibly under the supervision of an experienced contractor, and trials should be carried out, preferably in an unobtrusive inconspicuous corner of the element, to prevent negative effects due to the detergent and cleaning process adopted. The final result strongly depends on the quality of execution. Employing skilled workers expert in the cleaning method adopted is, therefore, strongly recommended.

The cleaning process with proprietary products should follow the instructions provided by the manufacturers and follow health and safety requirements.



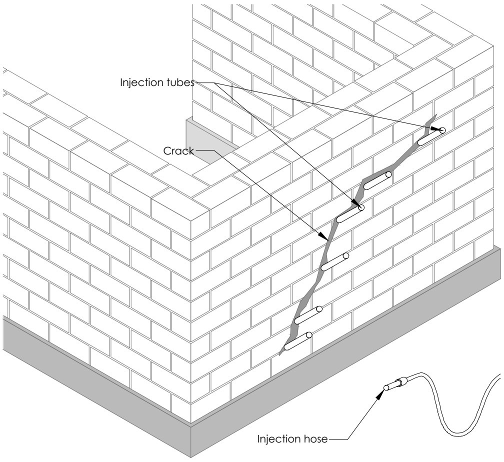


Figure 5.5 Grout injection in wall.

5.3.2 Masonry walls

Cracks affecting the masonry walls must be repaired before proceeding to any intervention on cladding or coating. Likewise, crack repair in concrete, different suitable techniques for masonry exist depending on the characteristics of the crack and on the objectives, especially whether it is important to restore strength and stiffness or not.

Grout injection (Figure 5.5) is a commonly adopted solution for structural repair. The application of proprietary products should follow the instructions provided by the manufacturers, however, the following protocol can be considered as guidance:[5.40]

- expose the surface around the crack and remove all loose materials/debris in the vicinity;
- establish entry and venting ports for the injection along the crack. Port location, pattern, size, distance and application on single or both sides depend on the characteristics of the wall and crack. The holes should be cleaned from dust and dirt before inserting the fitting, that is, then, bonded with compatible mortar;

5.40 Dolce; Manfredi, 2011.

- seal the cracks at both surfaces of the walls using the same compatible mortar. The sealing process must ensure that no leakage occur from the cracks during the injection of the grout. Upon hardening of the mortar, the day before the application of the grout, inject water in each tube to wash and moisten the masonry around the crack;
- inject the grout starting from the bottom tube up to the top one, using a pressure pot for the larger cracks or syringes for the thinner ones. The injection of each tube is ceased once the grout flows out from the subsequent tube. Seal the tube being injected by bending and fixing with a wire strap;
- after the hardening of the grout, remove the injection tubes by cutting and, if necessary, remove the sealing mortar. Surface treatment may be required for aesthetic reasons.

Commonly adopted materials are pre-blended proprietary mixes, preferably lime-based with a moderate compressive strength and small aggregate size. The material must be compatible with the original one, in terms of mechanical, physical and chemical characteristics, present a reduced shrinkage and be free of any potentially aggressive agent, as soluble salts, or other products that could react with alkalis or sulphates.[5.41]

To repair small or medium cracks in non-load-bearing walls, injection is not necessary. The crack, exposed, widened, if needed, and cleaned as mentioned above, is treated through the application of a bonding agent and then sealed through a flexible elastic grout. This is hand-placed and worked onto the affected surface.

Commonly adopted materials are pre-blended proprietary mixes with reduced Young's modulus designed to adapt to new small movements of the crack. Fiber-reinforced mortar can be used and fiberglass meshes can be placed on top of the crack to bridge the two sides.

5.41 Dolce; Manfredi, 2011.

An adequate finishing method should be employed especially when appearance matching with the original surface is a major concern.

5.3.3 Ceramic tiles

The following conservation policies apply to both wall ceramic cladding and ceramic floors, as they are expected to experience common deterioration and damage phenomena, and need similar maintenance and remedial measures. The only difference consists in the composition and characteristics of the background elements and layers which could present specific anomalies and need preliminary repairs to mitigate the risk of damage to the ceramic tiles.

5.3.3.1 Cleaning

Cleaning is recommended as part of regular maintenance, first sweeping or, better, vacuuming to remove loose dirt and grit, then using non-soap-based cleaners or other mild detergents.[5.42] In presence of aesthetic defects, deposit, soiling or staining, adequate cleaning can be implemented as curative measure. A correct protocol for cleaning should be defined, by carrying out trials, preferably in an unobtrusive inconspicuous corner of the panel.[5.43] The trials should aim at the definition of the effects of the detergent and the tool to agitate it on the coating, ensuring their effectiveness and preventing any potential harm to the components. The cleaning process with proprietary products should follow the instructions provided by

5.42 Goodman, 2013.
5.43 TACS, (n.d.); Goodman, 2013.

the manufacturers. The characteristics of the deposit or stain, when they can be identified, allow a tailored selection of the detergent and cleaning process.[5.44]

5.3.3.2 Joint replacement

Cracking, loss of mortar and other deterioration phenomena in joints can be tackled by refilling or replacing. The adopted tools and technique depend on the joint material and the appearance and profile that must be matched.[5.45] The joint replacement and regrouting with proprietary products should follow the instructions provided by the manufacturers, however, it is recommended that the characteristics of the original joints be identified to select a compatible material with appropriate color, consistency, strength and durability.[5.46] Removal requires care to prevent harming the tiles and can be carried out through a manual grout saw. Oscillating masonry blade tools for grout removal can be used to accelerate the activity in the first stage, completing the work with a utility knife with dull blade. While removing damaged grout from the joints, fragile tiles can be protected by applying painter's or electrical tape over the sides. In case of glass mosaic, all the tiles surrounding the broken one should be covered with the tape.

5.3.3.3 Cladding replacement

Tiles that are missing or damaged to an extent that cannot be repaired need a replacement.[5.47] It is stressed that replacing does not tackle the causes of the damage to tiles and

5.44 Goodmasn, 2013.
5.45 Henry, (et. al.), 2015.
5.46 Historic England, (n.d.); National Park Service, (n.d.).
5.47 Historic England, (n.d.); National Park Service, (n.d.).

these must be identified and addressed before the replacing itself, to prevent redevelopment of damage.[5.48]

Selective replacement involves only few seriously damaged tiles, preserving the surrounding ones. The process requires special care, especially in presence of strong adhesive mortar joints through which the shock waves due to hammering can run, harming the tiles in sound condition. Characterizing the original tiles (e.g. identify manufacturer, date of production, materials, etc.) is recommended to purchase compatible ones, either the very same old tiles or specially fabricated replicas. The selection of compatible new tiles is particularly cumbersome, as they may present different color. Color matching may be extremely difficult and lead to an incorrect selection, due to several variables as the light sources and the subjective perception and communication of colors. Colorimeters or spectrophotometers can be used for a quantitative characterization of the color.[5.49]

For the replacement, damaged tiles are separated by removing the grout through adequate tools. If the tiles are still attached, they are cut or drilled to break and loosen them. Before placing a new tile, the characteristics and quality of the tile bed is checked, residual, dirt and debris are removed and other defects that could prevent a correct installation are fixed. This includes the definition of the correct depth, to obtain a regular final surface of the cladding. The adopted adhesive layer should be compatible with the rest of the tile bed and should be applied either on the substrate only or on both the substrate and the back of the tile (the approach used depends on the characteristics of the adhesive material and of the tile). It is

5.48 National Park Service, (n.d.).
5.49 National Park Service, (n.d.).

worth noting that localized alteration to the tile bed, in terms of thickness and material, may lead to a distinct response to stresses in the substrate and potential damage outbreak.[5.50]

The same processes, with due differences, can be employed for the replacement of original detached tiles. In this case, it is essential to ensure that the tiles are properly clean to prevent defects of adhesion.

Under some circumstances, a sectional replacement of tiles may be necessary. This consists in removing and substituting a complete panel or section of tiles. This strategy requires less care than the selective replacement, moreover it allows the preparation of a level tile bed with uniform material and simplifies the selection of compatible new tiles. In case of complete replacement, modern design and execution strategies are recommended as, for instance, movement joints and flexible materials. Nonetheless, in order to preserve original components, sectional replacement should be limited to highly deteriorated areas, possibly in inconspicuous locations. All the tiles that can be removed without significant damage can be reused for selective replacement.[5.51]

5.3.4 Roof

5.3.4.1 Rainwater drainage system

The presence of water is a key factor for the onset and evolution of damage at the Beira Central Station. Moisture and damp may have several sources as construction water, rising damp, wind driven rain, rainwater splashing, pipe leakage, condensation and hygroscopicity. At the command body for the platform, the conservation state of the rainwater drainage sys-

5.50 National Park Service, (n.d.).
5.51 National Park Service, (n.d.).

tem raises concern, especially the downpipes that are embedded, thus hardly inspectable and maintainable. However, anomalies related to water infiltration have been identified also in the roof of the restaurant of the public atrium and in the transition spaces. A detailed assessment of the functioning and condition of the whole rainwater drainage system is, therefore, strongly recommended, resorting to water load tests to verify the slope of the surfaces and the gutters and the correct outflow without leakage, water stagnation and penetration. Interior areas already affected by moisture must be identified and mapped before the water load test to verify their growth or the occurrence of new infiltration zones. The assessment comprises also the inspection of the roofs. A visual inspection within the pipes with articulating borescope camera and the opening of inspection windows are needed. Beside the assessment and repair, in the long term, an integration of the current system with a secondary one to avoid the long-lasting permanence of rainwater on the roof or its substitution with a more efficient one may be necessary. In both cases, the new system is expected to comply with aesthetic requirements and respect the original design of the station.

5.3.4.2 Roofs with waterproof membrane

Upon ensuring a correct operation fo the drainage system, two approaches are feasible for the repair of the roof's waterproof membranes: local patching/repair or global replacement. Weathered membranes become brittle and deteriorate, making the local repair a hardly longlasting solution. A global intervention consists in either a deployment of a new membrane on top of the existing one or in the removal of the existing and its replacement. Due to the actual condition of the system, a removal and replacement is strongly recommended. The removal of the existing membrane is also important since in some areas it folds into the ventilation shaft systems and repair of these shafts may be necessary. After full removal of the membrane and cleaning all residues, the entire surface and elements in contact with the roof must be treated to address any existing anomaly before a new membrane, or coating, is installed. Moreover, the need for a new regularization of the support and the improvement of the drainage slopes should be evaluated.

The regularization must be done with mortars compatible with the existing ones. The installation of a new membrane should be done only after verification that all procedures and associated element handling are completed and correctly performed. In order to ensure an adequate installation of the new membrane, to best fulfil its purpose, and given the presence of several elements connecting and touching the roof, it may be necessary to design or redesign the encounters between vertical and horizontal components. That is, the bending of the membrane over thresholds, sills and reinforced concrete elements may need to be redesigned in order to improve its performance.

The entire process of drainage inspection and the application of a new membrane should be accompanied by a specialized team that can, *in situ*, present the best solution for the intervention. It is important that the tasks of intervention on these roofs be accompanied by the process of intervention on the exterior façades of the Beira Central Station building and the procedures indicated for the windows and doors conservation.

5.3.4.3 Fiber cement roof

The fiber cement roof placed over the roof slab of the administration block was recently replaced. If there is a need for a new replacement, the following procedures must be considered:

- clean the roof and map all the damage and infrastructure that runs through it. Infrastructure mapping is essential for future inspection, maintenance and repair, as its exact location and distribution are not completely known. It is essential that damage mapping occurs at the beginning of the intervention, to be able to address the anomalies before the repair and prevent their hidden evolution and growth. To this end, inspection of the rainwater drainage system is particularly important;
- regularize the existing cement mortar slab and correct its slope by employing compatible mortar. Special attention should be paid to the brick elements that mark infrastructure paths that run along the roof slab. In addition to the regularization of the roof slab, all vertical surfaces in contact with the slab must be treated, and special attention must be paid to any gap in the roof;
- inspect and maintain the existing reinforced concrete supports and the wooden substructure. During the recent interventions, both the nails joining the wooden pieces and some rebars of the concrete supports showed signs of corrosion. In addition, natural aging of the wooden elements of the substructure was found. Thus, the state of these components should be checked and a mapping of pieces and connecting elements that may need replacement should be made. The nails should be replaced by new connectors with greater durability, or else the connection should be replaced by dowels or impaling of the pieces when the joints are too damaged to support new fixing in the same places. Exposed rebars in concrete elements should be properly treated;
- waterproof the entire roof floor and the concrete elements supporting the wooden substructure. Even though this is an area of the roof that will be mostly covered by the final fiber cement coating, some areas are uncovered, and, in these cases, it is necessary to

waterproof them. The edges where the roof surface butts up against surrounding elemen-ts, such as walls, pipes and equipment, among others, are the most vulnerable areas to leaks. Thus, covering them requires special care and a proper design of the waterproof system;

- upon repair, test the effectiveness of the waterproofing and, finally, install the new fiber cement coating.

It is important that any repair or replacement of the fiber cement coating be accompanied by the process of intervention on the exterior façades of the Beira Central Station building and the procedures indicated for the windows and doors conservation.

5.3.5 Interior claddings and coatings

5.3.5.1 Cement plaster

The conservation policies for the cement plaster should aim at maintaining the original solution, repairing the damage and replacing areas where the coating is deteriorated. Good practice for the intervention comprises the following:

- remove the paint and clean the underlying plaster, eliminating all loose material or mate-rial with weakened adhesion;
- fill the cleaned areas with compatible plaster, ensuring a firm connection between the new and the existing material. A first layer with thinner and more flexible filler may be required before applying the final plaster. In areas more subject to cracking, such as the connection between masonry walls and concrete structural elements, it may be necessary to apply a fiberglass mesh before applying the new plaster;

- upon a correct curing time, the final finishing must be done with a paint that is equivalent to or compatible with the existing one. In areas near windows/doors where sills, thresholds, jambs and lintels present anomalies and damage, the intervention should only be carried out after tackling the cause of the damage in that element. It is not advisable to make intervention in interior coatings that present damage resulting from external weaknesses.

If the intervention involves the complete removal of the original plaster, it is important to consider the need to include in the new plaster a fiberglass mesh in all connections between masonry walls and concrete structural elements to ensure greater stability and durability of the plaster. In this solution, the new plaster may adopt the same constituents as the original, according to the descriptive memory, or may present similar characteristics, but with improved resistance and durability, as long as the result does not jeopardize the building's identity and design, and the final painting matches the original appearance. For coated ceilings, special attention should be given to the connection of the plaster with the electrical infrastructures that are embedded in the ceilings. Moreover, in the transition of the ceiling between indoor and outdoor, which is common on all floors of the administration body, possible interferences between the conservation policies and the walls, openings and weatherproofing elements should be considered and properly addressed.

5.3.5.2 Wood paneling

The wood paneling at the Beira Central Station is mostly made of waxed umbila plywood, according to the description of the finishing's map, and is glued directly to the interior plaster with cellulose glue. The upper/lateral/intermediate fittings and skirting boards are made of

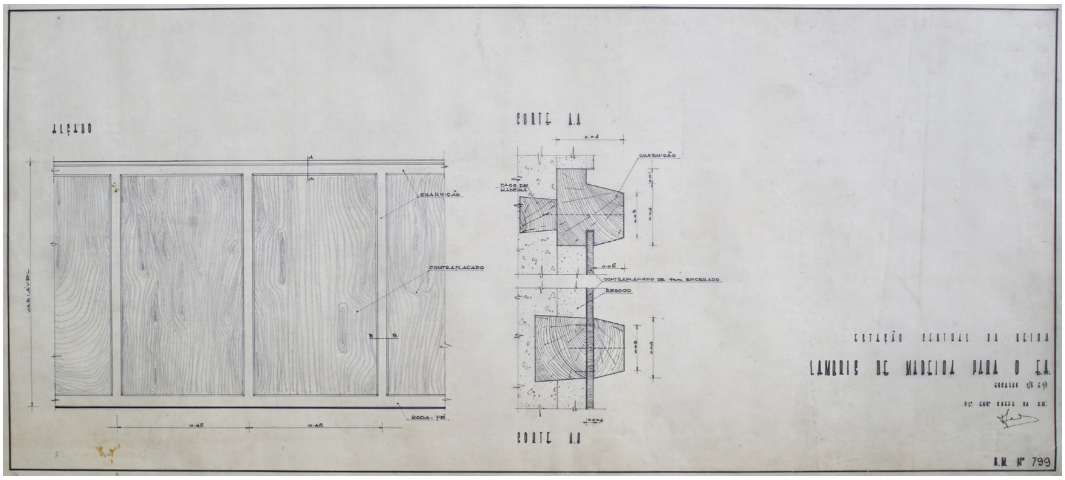


Figure 5.6 *Beira Central Station. Wood paneling for E.A.*, n.d. (ECB)

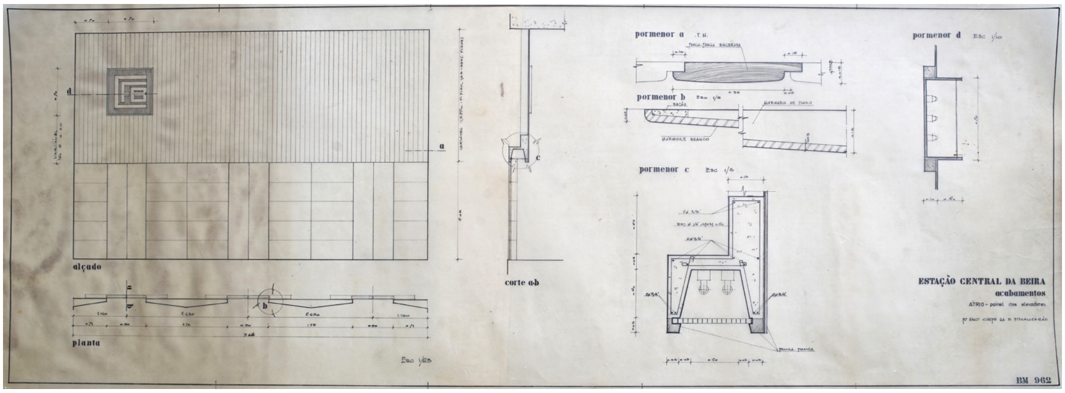


Figure 5.7 *Beira Central Station. Finishes. Atrium - elevator panel*, n.d. (ECB)

waxed solid wood, nailed and glued to a wooden block set into the plaster. Finally, there are also some panels built with solid wood of waxed panga-panga as, for instance, the upper panel of the elevators wall. The wood paneling conservation policies are informed by the constructive details (Figures 5.6-5.7). In particular, it emerged the use of tongue and groove joints between the pieces, and a likely glued and nailed connection of the groove to the plastered wall.

Since the wood paneling is commonly used on plastered walls, any intervention on the cladding should be concerned with the preservation of the plaster and any damage caused to it should be addressed according to the conservation policies for this component.

It is advisable to start the wood paneling and floors treatment procedure with the cleaning process. The cleaning process with proprietary products should follow the instructions provided by the manufacturers. However, a correct protocol for cleaning should be defined by carrying out trials, preferably in an unobtrusive inconspicuous corner of the panel, to prevent any harm to the original elements. Indeed, the cleaning process must be done with non -abrasive tools to avoid damaging the protective layer of the panels. The use of neutral soaps and damp sponges/mops, never saturated in water, is strongly recommended. The wooden surface should be soaped and then wiped with damp sponges/cloths to completely remove the soap. Finally, it should be dried as quickly as possible using dry cloths/sponges/mops.

After cleaning the surface and given the apparent state of conservation of the paneling, an impact test with adequate tools or simple finger-tapping can be carried out to identify areas with detached pieces. Indeed, when the wood is touched, the sound of a correctly glued piece is solid, whereas a detached or poorly glued piece sounds hollow.

Detached areas should be removed and re-set. Replacing or relocating wooden cladding is relatively simple. If the pieces are blistered and detached, but there are no damage in the piece itself, they must be replaced as follows:

Replacing or relocating wooden parts is relatively simple. If the pieces are swollen, blistered and detached but in sound condition, the replacement must be done as follows:

- remove all the detached pieces and verify whether adjacent pieces must be removed;
- clean the background substrate and the removed piece, eliminating the existing glue;

- apply new compatible glue on a single or both surfaces (i.e. background layer only or also on the wooden piece).

The replacement is effective only if the causes of the detachment are tackled before the repair, to prevent re-pathology.

In no case, mortar should be used to substitute missing pieces. However, elements made of different wood species but similar physical-mechanical characteristics may be used for temporary repair, ensuring that the finish can react jointly to temperature changes and moisture variations.

Whenever the wooden element presents a localized damage that does not jeopardize the rest of the piece, a patch repair or the use of prostheses can be more cost-effective than the complete replacement. The patch/prosthesis must have the same size and physical-mechanical characteristics of the original and surrounding elements.

5.3.5.3 Natural stone

Finishing surfaces in natural stone at the Beira Central Station are currently in good condition. Therefore, it is advisable to keep a regular maintenance and cleaning of the marble pieces, to confirm the soundness of the elements and prevent their deterioration. The cleaning process with proprietary products should follow the instructions provided by the manufacturers and a correct protocol for cleaning should be defined by carrying out trials, preferably in an unobtrusive inconspicuous corner, to prevent any harm to the original cladding. Impact test with adequate tools or simple finger-tapping should be carried out on the clean surface to identify areas of detachment. Since the marble is glued to the support, when the piece is touched, the sound of a correctly glued piece is solid, unlike the sound made by a detached or poorly glued piece, where the sound is hollow. Detached areas need to be removed and re-set. The marble should be cleaned with water and the use of detergents that can jeopardize the finishing layer should be avoided. If the absence of joint material is detected, this must be filled with mortar compatible with the existing one and with the color of the marble. In case of complete removal and replacement of the joints, the new mortar must be compatible with the support and allow a color shade equal to the existing one.

5.3.5.4 False ceilings

False plasterboard ceilings have been added over time in some spaces. Such non-original ceilings are often in poor conservation state, presenting deformation of the supports and loss of material and components. Moreover, they do not allow the visual inspection of the original coating and building services, for damage mapping and assessment purposes. Thus, it is advisable to remove all gypsum. If it is removed and damage associated with the original coatings is detected, the specific repair policies herein described must be followed. After the removal, water-resistant gypsum boards should be used for replacement.

5.3.6 Exterior and interior windows and doors

Based on the most common damage typologies that affect exterior and interior windows and doors at the Beira Central Station, the intervention policies were divided according to the elements that constitute them: profiles, glass, hardware and accessories. The following intervention strategies are hereafter detailed:

- Profiles:

General cleaning of the frames;

Repair of coatings (anodizing/painting/varnishing);

Repair of degraded areas (corrosion removal / use of prosthetics); Application of new protective coatings (anodizing/painting/varnishing);

Repair of excessive deformation; Repair or execution of drainage slots; Replacing or strengthening the profiles.

- Glass:

  Glass replacement due to damage;

  Replacement of the natural ventilation systems (beta system).

- Hardware and accessories:

  Hinge sharpening or replacement;

  Tightening or replacement of operating mechanisms (opening / closing / handles); Installation of complementary hardware (closing / opening mechanisms / hinges); Replacing or introducing seals / mastics.

All these procedures must be implemented with the original design in mind, and it is not recommended to change the design in any situation.

It is important to mention that the frames that do not require any remedial measure should be, in any case, subject to regular maintenance procedures. The maintenance of the frames consists essentially in periodic inspection and cleaning to prevent or tackle biological colonization, accumulated debris, and any damaged or missing parts. To avoid unnecessary wear to the surfaces and coatings of the frames, the cleaning technique should be as gentle as possible on the surface. The application of proprietary products should follow the instructions provided by the manufacturers. However, a correct protocol for cleaning should be defined by carrying out trials, preferably in an unobtrusive inconspicuous corner of the frame.

5.3.6.1 Profiles

General cleaning of the frames

Cleaning of anodized aluminum frames should be done using a damp sponge for slight dirt and a deeper wash with detergent/neutral soap for areas where the dirt is more adherent. After general cleaning, the surface must be rinsed to remove all residues of the cleaning process.

Cleaning of iron/steel galvanized frames should be done with running water and, if necessary, with the addition of a neutral solvent. The oxidation of iron or steel frames is revealed through white efflorescence. Removal of this film is not at all advisable because it constitutes a protective layer that, once removed, exposes the metal to aggressive agents, fostering erosion and corrosion. Similarly, whenever possible, the use of abrasive or acid products to clean iron or steel frames should be avoided, as these products remove the protective film from the metal almost immediately. If brownish stains are visible after cleaning the iron or steel elements, these may indicate a sign of corrosion of the zinc layer.

Cleaning of wooden frames should be done with a damp sponge and mild soap, enough to lather the wood. After lathering, the wood should be wiped with a damp cloth to remove all the soap and, then, dried as quickly as possible with a sponge or dry cloth.

Repair of coatings (anodizing/painting/varnishing)

In the case where small scratches or nicks are detected on anodized surfaces, provided that their depth has not exceeded the thickness of the anodizing layer of the material, the intervention should be made using specific products for this purpose. The correct application of these products should guarantee the total repair of the anodizing protection layer. The manufacturer's recommendations and specifications must be followed for the correct execution of this procedure.

Remedial measures for iron or steel frames that present scratches, nicks, or wear of the finishing paint consist of, first, sanding the surface to eliminate any blisters or wear adjacent to the damaged area and, then, applying the new paint, matching the thickness of the existing layer, and covering all the identified damage. In some situations, it may be necessary to apply a primer or one or more coats of paint. The paint must have the same shade and composition of the existing one. If it is not possible to identify the origin and composition of the existing paint, it is advisable that the new one be rich in zinc and with anti-corrosive characteristics, so as not to jeopardize the existing paint or the area that has been damaged.

Repairing stains or scratches on painted or varnished wooden frames should be done by sanding the area around the damage, with fine grain sandpaper, to the depth of a sound wood surface, in order to create a greater roughness, thus preparing it to receive the new paint, applied in one or multiple coats and presenting the same color and similar characteristics to the existing one. A primer should be applied if needed.

Repair of degraded areas (corrosion removal / use of prosthetics)

Before repairing corroded elements, the causes of the damage must be identified and tackled.

In iron/steel metal frames, the corrosion must be removed by brushing the affected surface. Normally these surfaces are brushed using alkaline solvents, mixed with hot or cold water, depending on the specifications of the product supplier. After complete corrosion removal, the steel/iron is left without the protective layer of paint, the paint removed during the corrosion removal process must be replaced, this can be done in one or multiple coats and require a primer. A complete replacement of the paint may be more cost-effective of an extensive repair. To this end, the most suitable approach should be decided upon a case specific assessment.

The corrosion process in aluminum frames is different from the case of iron and steel and can occur in several ways, thus, requiring distinct remedial measures.

The most common type of corrosion is uniform and attacks the aluminum surface in a homogeneous way, resulting in the gradual decrease of the surface section. Exposed aluminum elements, over an extended period, eventually undergo surface oxidation and corrosion. The most conventional way to slow down aluminum corrosion processes is to protect the metal by treatments such as anodizing or thermal plating. These processes are extremely complex and should not be done *in situ*. Alternatives, such as surface treatment with acids and zinc compounds, exist but their viability depends on the general state of conservation of the frame. Finally, in face of an extensive damage, replacement may be a more advantageous solution. Corrosion in aluminum frames can also occur when aluminum elements are in direct contact with other metals. Humid environments foster this type of corrosion. If corrosion is detected in aluminum from direct contact with other metals, an insulating element, such as neoprene, should be placed between the two metals.

Prosthetics are advisable if there is localized degradation in frames, either by fungus, rotting, or advanced corrosion. The prosthetics can be made of wood in the case of wooden frames or iron/steel plates welded to the existing metal profile. In the case of wooden frames, the process starts with the total removal of the damaged area. This removal can be done with the help of manual or mechanical tools, such as drills or power saws, up to the point where the wood is sound. A treatment is applied to harden the exposed wooden extremity that receives the prosthetics, followed by a general brushing of the surface. The prosthesis can be made of wood with the same characteristics of the original frame and is attached by means of epoxy resin, acrylic or aqueous bitumen, depending on the desired effect. Upon a sufficient healing time, the entire frame is polished to obtain a surface as homogeneous as possible, by means of mechanical sandpaper or manually. Depending on the expected final aspect, coarse or fine grit sandpaper can be used. Finally, a protective primer must be applied followed by the paint or varnish in the number of coats required. For epoxy resin prosthesis, the primer coat must be as opaque as possible since the resin has a different tone and composition than the wood pieces or bitumen.

For iron/steel frames, the prosthetic repair requires the removal of the damaged area, using mechanical or manual means and the connection of the new metal part to the existing profile by welding. The welding method must be compatible with the metals and composition of the elements and must be done in such a way that the welding cords are not visible or protruding. Therefore, expert professionals are required. Finally, a protective layer is used on the welded area and the finishing coat is applied to the frame to obtain the original or intended aspect.

Application of new protective coatings (anodizing/painting/varnishing)

The application of a new protective coating is recommended whenever the deterioration is so spread that localized interventions are non cost-effective. Depending on the characteristics of the coating and the base material, this can be applied on-site or requires operations in appropriate facilities. This latter is the case of anodizing for aluminum frames, that involves factory-made electrochemical processes. In the case of wooden frames, the application of a new coating, either paint or varnish, consists of the same procedure. This begins with the general stripping of the frames, through chemical or mechanical processes. The former employs a pickling product. The latter consists in the use of a blowtorch to soften the material and the existing coating. For both the procedures, a scraper must be used to remove the residuals. Once the frame has been stripped, the wood is impregnated with a wood restorer to ensure the protection of the wood, through a pressure gun, brush impregnation, or by immersion (flow-coating) if the pieces can be moved to a capable facility and if the number of pieces makes this procedure worthwhile. After curing, the impregnated wood is ready for the final coating, whether varnish or paint, in the coats required for the desired finish.

For iron/steel frames, the new coating of the surface can be applied over the existing one, upon a previous scraping of the original layer to remove poorly connected portions and guarantee the adherence of the new painting, by providing the necessary roughness of the surface. The thickness of the new coating must be limited whenever it can interfere with the correct operation of the frame.

Deformation repair

Most deformations in window frames can be repaired by replacing specific components, or by inserting reinforcing profiles. To this end, the identification of the element causing the deformation and the causes of the deformation itself is paramount. It is worth noting that deformation rarely affect steel/iron frames, whereas is more common for wooden and aluminum elements.

Commonly, deformation is caused by moisture, water absorption or accumulation, malfunction of the opening/closing systems and/or excessive thickness of the coating, which makes the frame to be forced during the normal operation. Deformation can also result from failure in the joints of the various profiles/parts that make up the frames. If the deformation is caused by a failure in the joints, re-establishing the junction of the profiles corrects the defect. To this end, it may be necessary to disassemble the entire frame.

In the case of wood elements, a new, well-clamped gluing is sufficient to correct deformations due to use. Therefore, after disassembly/separation, the profiles should be glued again through adequate products.

In the case of aluminum frames, new connectors at the profile joints may be necessary. However, a correct assessment requires disassembling the frame.

Repair or execution of drainage slots

The absence of drainage slots, their poor location and malfunctioning or obstruction can cause various damages. Therefore, a periodic window frame maintenance is recommended and should comprise the cleaning of drainage slots and window frame dripping.

In case of obstruction, the water drainage path must be cleared and the effectiveness of the operation should be properly tested. If the location of the drainage is not the most suitable and/or causes water infiltration, it may be necessary to create a new drainage, which may require the drilling of the frame. The new drainage must be located in areas that do not prevent the normal operation of the window frames and ensure a simple and direct flow of the water towards the exterior.

Completely replacing the profiles or applying reinforcement profiles

When deterioration is widespread on a single profile but limited to it, a suitable solution consists in its replacement. This is common for the elements located at the bottom of the window or door. Profiles can be replaced either on site or in factory. Element with different composition may be used as temporary stabilization solution. However, the final replacement consists in a piece of equal size and section, possibly made of the same material or of a material with similar characteristics (e.g. type of wood, type of metal alloy). After the substitution of the element, the final coating is applied to the new portion or to the entire frame, when needed, according to best practice and manufacturer instructions.

An alternative to the replacement consists in the strengthening by means of additional profiles. This is an effective solution in presence of severe deformation. These reinforcement profiles should be placed inside the frame by mechanical fixing or welding (metal), although reversible solutions should be favored.

5.3.6.2 Glass

Glass replacement due to damage

Replacing glass is not always a simple task, depending on the location and size of the glass there may be safety concerns that need to be addressed. Depending on the type of frame in which the glass will be replaced, it is important to understand the type of existing glass and how it will be fixed. Glass can be attached using springs, bites, rubbers or gla- zing nails. Each of these types of fastening refers to different replacement methods. However, a generic procedure consists of removing the damaged glass, repairing the surface, preparing the seals, installing the glass, and applying the finishing.

Replacement of the natural ventilation systems (beta system)

In the Beira Central Station building, the transversal ventilation of the interior spaces through the circulation of the dominant air currents was achieved by openings with adjustable glass louvers (beta system), strategically applied in the building's interior and exterior frames. Many of the original beta systems are in poor condition, sometimes are covered or have already been replaced by simple glass panels. The existence of this system is essential for the correct ventilation of the spaces and for maintaining comfort and salubrity. It is recommended that the once existing systems be replaced with the same design and operation as the original.

5.3.6.3 Hardware and accessories

Hinge sharpening or replacement

Accumulation of debris and lack of lubrication and maintenance of the frames may cause the hinges to malfunction, leading to operating noises and appearance of stress cracks in the frame. Periodic maintenance and cleaning of the hinges is essential to ensure the proper functioning of the frame. In some situations, the state of degradation of the hinges may require their replacement, or at least the replacement of the hinge fixing elements. Checking case by case, in some situations, and if the hinge allows it, it may be sufficient to adjust the hinge.

If the adjustment of the hinge is not sufficient to ensure the proper functioning of the frame, its replacement is recommended. The hinge replacement should be done, as much as possible, with the same or similar hinges, in a way that does not imply new drilling or additional work.

Tightening or replacement of operating mechanisms (opening / closing / handles)

Most of the malfunctions of the frames occur near the closing/opening mechanisms. These anomalies are due to the poor use of the mechanisms, sometimes due to the weakness of the material itself, or even the poor assembly.

The replacement is commonly recommended only when the repair implies complementary work that may jeopardize the correct operation and durability of the frame itself. Simple repair and adjustment measures consist of tightening the screws, fitting missing elements, lubricating existing corroded or degraded parts. For older closing/opening systems, it is sometimes difficult to find replacement parts or even complementary elements, and it is often more cost-effective to replace the entire system. These situations may require changes in the profiles of the frames, such as new holes or new slots.

The tuning and/or replacement of the hinges and the closing/opening mechanisms should be analyzed case by case and preferably similar solutions should be adopted for as many frames as possible in order to systematize future monitoring and maintenance operations.

Installation of complementary hardware (closing / opening mechanisms / hinges)

In situations where it is visible a notorious fragility between the connection of the frame and the span, fragility of the closing system, absence of planned hardware or other anomalies that can be solved with the introduction of additional hardware, it may be advisable to install them to complement the existing ones.

The installation of new hinges must employ elements that are similar to the original ones and can happen in two different ways, placing a hinge in the middle of the existing ones or placing two hinges immediately above or below the existing ones. The placement of a complementary hinge aims to distribute the weight of the frame and improve the functioning of the gap.

The complexity of the operation and the procedure to install new closing/opening mechanisms depend on the type of frame in question. For the installation of a new closure/opening system, it may be necessary to introduce reinforcement elements, either in the frame or in the gap. It is necessary to evaluate the feasibility of each of these operations on a case-by-case basis.

The effects of the material expansion must be properly considered whenever reinforcement elements are needed for the introduction of new mechanisms or hinges.

Replacing or introducing seals / mastics

Most window frames are made up of several components of various materials. The aging and degradation processes of these components happen differently in each one depending on their nature. As a result of the use of the frame there may be missing elements, such as sealing rubbers or mastics, verified that their absence is a result of the use of the frame, these must be replaced. The replacement of these elements must be done using elements as close as possible to the existing ones, so that the identity of the frame is maintained.

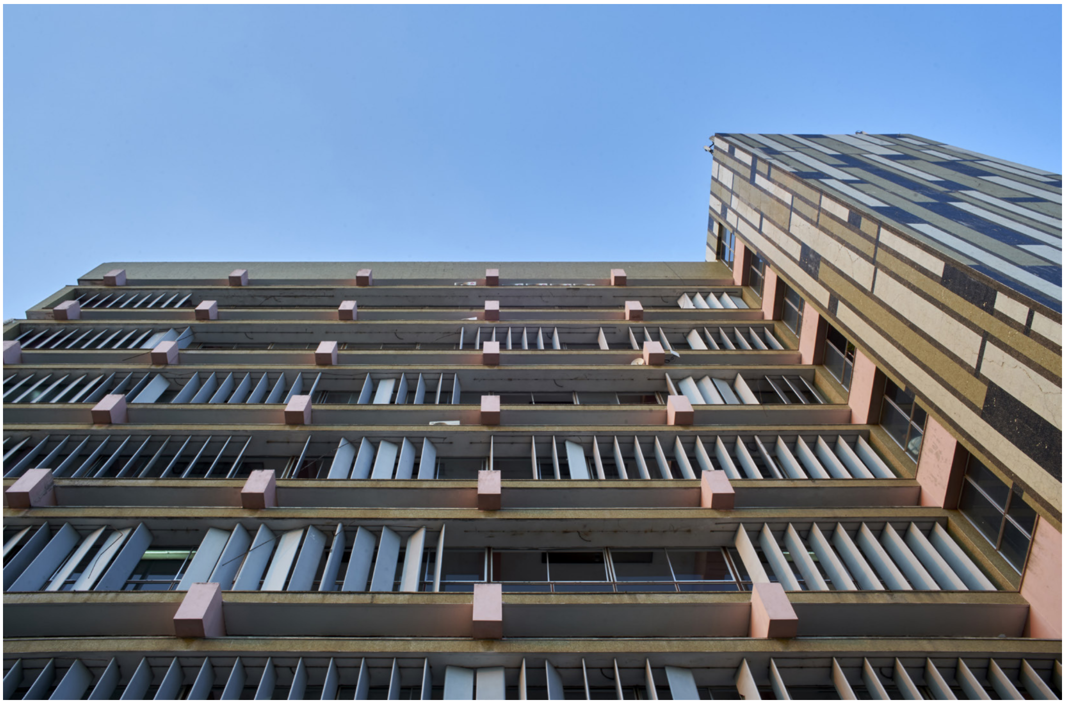


Figure 5.8 Main façade of the administration block showing missing *Brise-soleil* (EM, 2019).

5.3.7 Brise-soleil

The brise-soleil components are in an advanced state of degradation as a result of use, natural aging of the materials, lack of maintenance as well as mechanical damage accentuated by the hurricane Idai. It is possible to observe areas with complete absence of the vertical elements (Figure 5.8), Moreover, the supports/plinths of the sill and threshold show corrosion and absence of material, as well as blistering and deformation of the elements (Figure 5.9). Finally, several *brise-soleil* have been removed, or, as a result of mechanical damage, have fallen (Figure 5.10).

Since the *brise-soleil* are made of fiber cement with asbestos, it is recommended that they be replaced, once it is possible. The intervention strategy, should consider that these

Figure 5.9 *Brise-soleil* mechanism showing corrosion (EM, 2009).

are not stand-alone pieces but character-defining elements strongly related to other components, such as ceramic floors, plastered ceilings and exterior windows. Therefore, it is not recommended to redesign them but to make new *brise-soleil* with the same geometry and operation system, but developed in fiber cement with PVA or PP. After their removal, the intervention on the thresholds, jambs and lintels should be started. Special attention should be given to the iron elements that are embedded in the ceramic thresholds. It may be necessary to design a new bottom support so that the continued operation of the new *brise-soleil* will not interfere mechanically with the threshold cladding.

It is recommended that the weather protection system is rebuilt without jeopardizing the original design, but allowing for better operation and durability of the solution.

Figure 5.10 *Brise-soleil* from the main façade of the administration block torn off by Hurricane Idai (EM, 2019).

5.3.8 HVAC SYSTEMS

HVAC systems and other infrastructures (e.g. air-conditioning equipment, electrical appliances, fixtures, miscellaneous cabling, open and uncovered shafts, etc.) have been installed over time in the station and currently affect the original aspect of the building. Moreover, the use of some of the original or added systems have been suspended due to their obsolescence, although they have not been removed. A detailed survey and mapping of such installations should be carried out and alternative solutions should be designed to ensure the comfort of the users and the functionality of the spaces but re-establishing the original aesthetic of the building. To this end, the possible need for the creation of new infrastructures in the building is admitted and it is recommended that the obsolete elements, that cannot

Figure 5.11 Air conditioners on the back elevation of the Beira Central Station (EM, 2019)

be recovered or reused, are removed, and the damage or alteration resulting from their deterioration and removal is properly addressed, according to the policies presented herein. Upon mapping the infrastructure and assessing its operation and state, a prioritization of the replacement should be defined.

In the case of the air conditioners on the rear façade of the Beira Central Station (Figure 5.11), their placement should be modified according to the original layout. This was, indeed, driven by a well-thought and clear relationship with the façade.

5.4 Recommendations for necessary and desirable measures

5.4.1 Toilets

The toilets underwent several interventions, following criteria that are not appropriate to the significance of the building. Moreover, not only the original toilets but even the recently intervened ones are currently in a poor conservation state. The repair and/or substitution of such deteriorated elements is, therefore, strongly recommended, as part of a general intervention project in all sanitary facilities.

5.4.2 Non-original floors

Original floors have been substituted with different floors in several working spaces. Motivation and timing of such changes are not known, moreover, some of these floors are currently in a poor conservation state. Their removal, although not urgent, is strongly recommended. Removal and replacement activities are expected to allow the inspection, damage mapping and repair of the original floors and slabs that are now covered.

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SECTION 6

6. Implementation and monitoring

The current section organizes future actions, defines a conservation strategy, and proposes a maintenance plan with a timeline.

The Beira Central Station CMP holds on to a set of conservation policies, strategies and actions thoroughly described in the previous sections. Their implementation is hereafter prioritized, in order to optimize the resources allocation, tackle needs with distinct urgency and allow additional investigation and research if necessary. Moreover, the present chapter is also concerned with the preliminary definition of a straightforward maintenance plan for the Beira Central Station, based on a standardized methodology for inspection, diagnosis and reporting. The plan is built upon a univocal identification of the asset's main items and their preliminary assessment, updated upon regular inspections. These routine inspections encompass a set of clear and simple tasks that can be carried out by the CFM technical team. More detailed investigations, to be carried out by experienced contractors supported by diagnostic tools, are recommended at longer time intervals. Finally, specific unscheduled inspections are requested in response to emergency or catastrophic events. A set of standardized documents for inspection and diagnosis still needs to be created to support the activities of the technical team as well as the decision making by the asset management. Moreover, suitable preventive and remedial actions against the expected anomalies, for each item typology, needs to be identified and described for guidance. The envisaged plan may be cast within a BIM-based management framework, using the developed model, for a simple but effective online storage and interrogation of the produced data.

SECTION 6

Urgent structural measures	Urgent non-structural measures	Necessary measures	Desirable measures
Repair diagonal cracks in masonry walls.	Substitute and repair missing and broken window glasses.	Repair corroded and damaged benches at the platforms.	Remove inappropriate intervention on the original toilets.
Repair cracks at the base (command body).	Repair corroded window and door frames.	Repair damage due to new interventions.	Modify the design of renovated toilets to preserve the original aesthetic design.
Repair cracks in the vaults (command body).	Repair irregular cracks in façades.	Remove air condition systems anchored to structural elements.	Homogenize the grills of the windows of the command body.
Repair cracks in the beams (administrative body).	Substitute missing and repair corroded and broken brise soleil elements.		Clean ceramic tiles and joints.
Repair cracks in columns and slabs (platforms).	Repair staining in ceiling and walls.		
Repair cracks in beams of the principal staircase.	Repair broken and clogged rainwater evacuation pipes.		
	Repair cracked and damaged paving floor slab at the platforms.		
	Repair staining in platform slabs.		
	Repair damaged lighting fixtures.		

Table 6.1 Classification of the urgency for the remedial actions.

6.1 Staged actions

To ensure the effective implementation of the conservation policies, in light of the funding availability and the urgency of the actions, a flexible and realistic strategy for the prioritization has been defined, identifying distinct time frames within a period of five years. Similarly, also the remedial actions that are needed to address damage and alterations as well as reestablish the original aesthetic design have been staged. To this end, all the structural measures are considered urgent, whereas non-structural actions are classified as urgent, necessary and desirable, identifying distinct necessities and, thus, time for their implementation, as described in Table 6.1. Recommendations regarding the remedial actions are provided in the Section 5 of the present CMP.

In light of the above, the following time frames for tasks implementation has been identified:

Tasks that should be initiated immediately:

- Adopt the CMP, implement its conservation policies and regularly review them.
- Publish and circulate the CMP, which is expected to be a reference document for 20th century architectural heritage in the country.
- Use professional conservation advice. Appoint a conservation architect, collections conservator/archivist, a structural engineer specialized in conservation of 20th century reinforced concrete heritage and a landscape architect.
- Conserve, manage and interpret the site, its contents and collections and the landscape, implementing best practice conservation principles.
- Manage the site in accordance with its significance.
- Prepare and implement a collections policy.[6.1]

Tasks that should be initiated within the next 12-24 months:

- Design and implement repair actions of masonry elements and ceramic tile cladding that show extensive cracking and have an urgent character.
- Design and implement repair actions of reinforced concrete elements that show widespread damage (i.e. cracks and corrosion of steel elements) and investigate possible presence of alkali-aggregate reaction of the concrete elements.

6.1 Burke (et. al.), 2018.

- Design and implement repair actions of concrete roofing elements, including watertight treatment of atrium roof and assess and repair malfunctioning drainage systems.
- Design and implement treatment, repair and replacement actions of non-structural elements of high significance and contributing to the original design criteria and aesthetic, such as *brise-soleil*, doors and windows.
- Prepare and implement a maintenance plan that includes scheduled routine and detailed inspections and regular maintenance activities.
- Submit the proposal for classification of the Beira and Maputo train stations as listed heritage.

Tasks that should be initiated within the next 24-36 months:

- Undertake detailed architectural and engineering documentation of the site layout, including extended setting of Beira Central Station Site for archival purposes.
- Prepare and implement a general management plan for the site: heritage risk management and disaster preparedness plan, interpretation plan, visitor management plan, climate change adaptation plan for 20th century heritage, collections management plan and landscape management plan.
- Prepare and implement specific health and safety plans for the building, namely occupational health and safety and fire safety plan.[6.2]

6.2 Burke (et. al.), 2018.

Tasks that should be initiated within the next 36-48 months:

- Establish contact with industry and manufacturers of original mechanical, electrical services, fittings and fixtures.
- Monitor the impact of use and use–related activities on the site conservation and plan users and visitors number control strategies if needed.
- Undertake training programs and workshops to promote indigenous visual arts and artistic expressions and integration of cultural heritage.

Tasks that should be initiated within the next 48-60 months:

- Complete actions that may be delayed.
- Identify pending priority areas in CMP and implement actions accordingly.

6.2 Preventive conservation strategy and maintenance plan

The preventive conservation strategy envisaged by the present CMP aims at implementing a set of predictive maintenance actions to cost-effectively ensure the dependability of the building and its items, minimizing the need for unforeseen corrective maintenance actions. The preparation of this maintenance plan should be initiated within the next 12-24 months and the implementation within the 5 years validation period will ensure a fine tuning of the strategy.

Figure 6.1 details the workflow of this strategy, illustrating the main actors and tasks. Regarding the former, four stakeholders are identified:

- The asset management team;
- The inspection team;

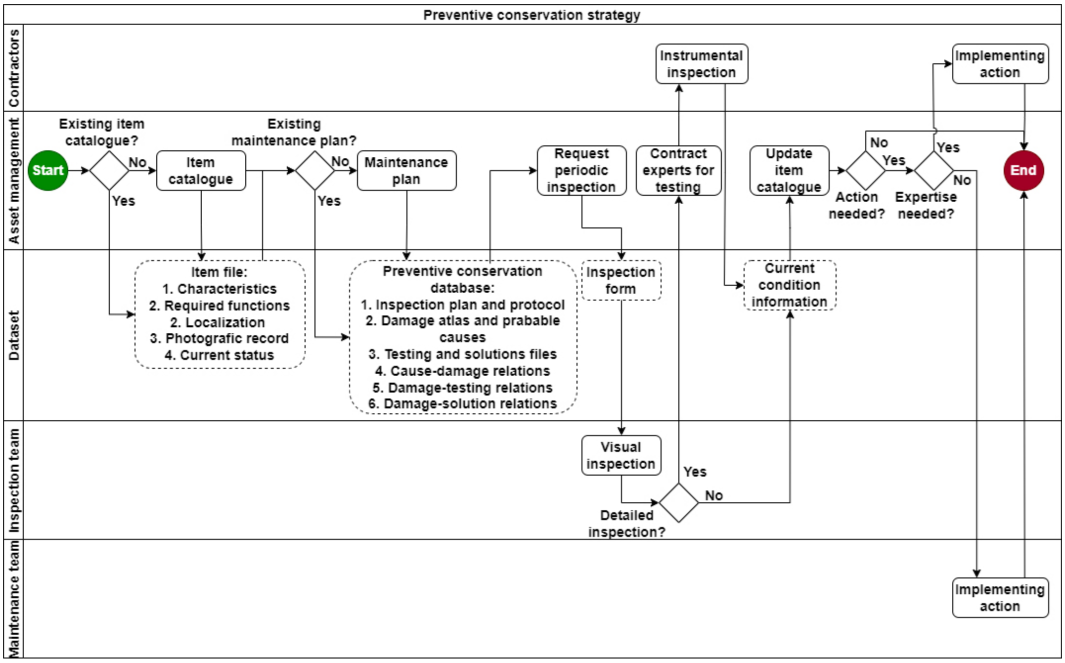

Figure 6.1 Process map illustrating the workflow of the preventive conservation strategy for the Beira Central Station.

- The maintenance team;
- The expert contractors either for on-site testing or design and implementation of preventive/remedial actions.

These are defined based on their functions, even though the same person can play play different roles.

The preventive conservation strategy requires the preliminary collection of the available dataset, by the asset management team. Following a state-of-the-art approach to predictive maintenance,[6.3] this dataset encompasses:

- A univocal identification of each item to preserve through items files collected within a comprehensive catalogue;

6.3 Bordalo (et. al.), 2011; Brito; Branco, 1998; Gaspar; Brito, 2008; Serralheiro; Brito; Silva (et. al.), 2017; Silvestre; Brito, 2010.

Table 6.2 Damage, condition and urgency rating index.

	Damage Index
0	Unknown Assessment was not possible
1	None No symptoms
2	Minor Minor symptoms
3	Moderate Moderate symptoms
4	Severe Major symptoms
5	Destructive Extremely severe symptoms

	Condition Index
0	Unknown Assessment was not possible
1	Optimal Undamaged condition
2	Good High dependability
3	Fair Acceptable dependability
4	Poor Failure
5	Bad Catastrophic failure

	Urgency Index
0	Unknown Assessment was not possible
1	None No actions needed
2	Long term Non-urgent actions
3	Medium term Monitoring actions
4	Short term Action initiates within 2 years
5	Immediate actions Action initiates within 6 months

- A maintenance plan including an inspection plan and protocol, a database of expected anomalies (damage atlas) with their probable causes, specification of testing methodologies and suitable solutions to the expected anomalies, together with a set of correlation matrices between such entities;
- Inspection forms.

The items catalogue should contain, for each building item: its location within the building; its graphical representation and a description of all the relevant features for its correct diagnosis (materials, construction details, previous interventions, etc.), including the required functions and level of performance; and an assessment of its current condition. The items are collected in populations with similar properties and needs.

The current condition assessment should be done upon previous inspections, through the definition of damage index, condition index and urgency index, according to a 5-point scale, from 1 to 5 (Table 6.2). The damage index is a qualitative grading of each identified anomaly based on its typology and extent and depends on the item and material affected. The condition index is issued for each item and provides an estimation of its level of performance, based on a pre-defined relation between the qualitative and quantitative information about anomalies collected during inspection and the capability of the damaged component to fulfil its requirements.[6.4] Therefore, it should consider the number and type of anomalies affecting the item as well as their extent and evolution rate. Moreover, it should consider the distinct contribution of each anomaly to the reduction of the item performance and durability. Finally, the urgency index is related to the time schedule for the remedial measures[6.5] and should be estimated based on the severity of the damage found, its expected evolution and the consequences, in terms of cost and risk, in case of intervention or absence of intervention. Specific aggregation formula should be used, on one hand, to combine and weight the assessment of each damage producing a single quantification of the item condition and, on the other hand, to combine different criteria producing a single estimation of the urgency against a specific damage.

Lack of safe accessibility and/or visibility that prevents the inspection of the component must be clearly reported. It is recommended that the component catalogue is developed and stored for the following periodic and non-periodic inspections within the next 12-24 months. A minimum amount of information is needed to define the database ensuring an adequate knowledge for the assessment. Additional information can be produced over time and integrated to the dataset, which should be flexible and easy-to-improve and modify.

The maintenance plan encompasses a clear definition of the asset requirements and conservation needs as well as a definition of a proactive strategy to ensure a durable acceptable performance. To this end, a set of relevant populations of character-defining items is recognized, namely:

6.4 Galbusera; Brito; Silva, 2014; Serralheiro; Brito; Silva (et. al.), 2017.
6.5 Bordalo (et. al.), 2011; Silva (et. al.), 2017.

- Concrete elements;
- Masonry walls;
- Ceramic tiles;
- Rainwater drainage system;
- Roofs;
- Interior coatings;
- Exterior and interior windows and doors;
- *Brise-soleil*;
- Infrastructures;
- HVAC systems.

For each of them a description that comprises the role for the significance, the division in subcomponents and the requirements for performance should be provided. Then, for each population, an inspection plan and protocol will be defined, being this tailored to the expected deterioration of the performance over time and specific maintenance needs.[6.6] The inspection plan and protocol define the schedule for the on-site inspection and detail the activity to carry out. In particular, the preventive conservation strategy relies on routine or detailed periodic inspections with different frequency over time and non-periodic inspections, upon specific events. Indeed, unpredicted events and case-specific situations may lead to unexpected pathologies or evolution rate. Therefore, the plan comprises corrective measures, when needed, and requires a constant updating to reduce as much as possible the need for such measures. The following sections define the necessary documents that should be prepared for the inspection plan and the proactive conservation strategy that is proposed.

6.6 Madureira (et. al.), 2017.

6.2.1 Inspection forms

On-site activities of the surveyors are supported by the development of a standardized inspection form that should present, for any identified anomaly, at least the following:

- Univocal ID of the component affected and its typology (e.g. tiling, rendered surface, concrete element, etc.);
- Univocal ID of the anomaly;
- Inspection date;
- Inspector name;
- Inspector expertise;
- Inspection type (routine/detailed) and method (visual/testing with indication of the methodology adopted);
- For each anomaly, identification of the type, class and sub-class;
- Identification of the portion or sub-component involved, location within it (coordinates with respect to a predefined reference system, graphical mapping for support), evolution (new anomaly/previously detected active/previously detected dormant/previously detected regressing), estimation of the extent (area affected, depth and width for cracks, pattern, etc.), color (for deposit and biological colonization), consistency (very firm/firm/friable/incoherent), cohesion (no/low/good), hardness (very soft/soft/hard/very hard), sound produced (vibrating, dull);
- Coexistence of other anomalies on the building component, causality between the anomalies and reference to their univocal ID;
- Presence of moisture or other evidence of water;
- Additional information relevant for the preventive conservation of the building component.

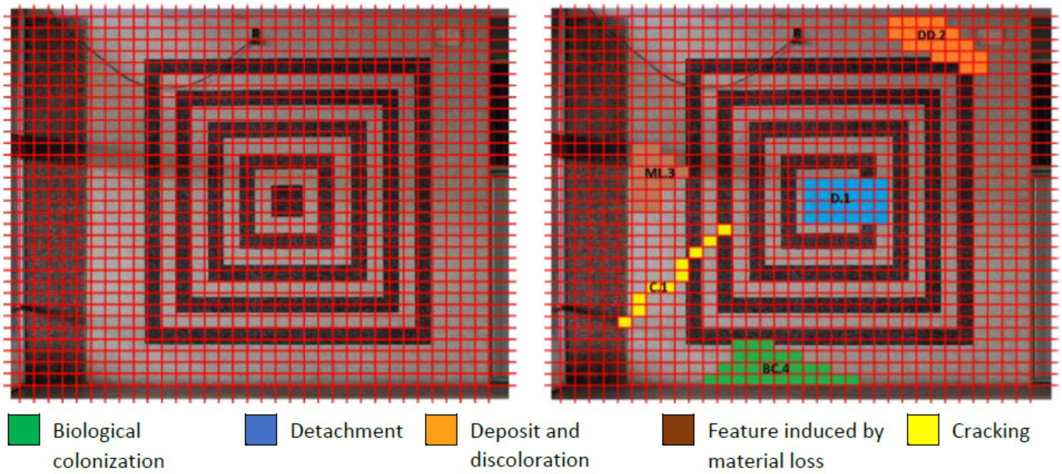

Figure 6.2 Example of damage mapping scheme, mesh overlayed on the investigated panel, graphic damage reporting (location, extent and class) according to a predefined color key and univocal alphanumeric code for the damage.

The inspection should be tailored to each population of items in order to consider its expected pathologies, the testing methodologies that are more suitable to characterize them and the preventive and remedial measures to tackle them. Therefore, a comprehensive database of anomalies, causes, testing methods and repair actions, together with correlation matrices between such entities, should be developed and made available to the surveyors for the following periodic and non-periodic inspections.

All the inspection forms are collected in the inspection report, grouped by the building item, to support a straightforward assessment of its current status in terms of damage index and condition index and an effective recommendation of measures based on the urgency index. The estimation of such indices is facilitated by the use of a graphic representation of each component (elevation drawing, ortho-photo or similar) with an overlaid mesh. This representation is beneficial for an informative damage mapping, upon the definition of a standardized color key and is expected to simplify the comparison of results from different inspections. For instance, in Figure 6.2, the damage mapping is presented considering a tiled surface as inspected item. The size of the overlaid mesh should be defined in order to simplify both the survey and the estimation of the percentage of affected area, for instance a 5×5 or 10×10 cm^2 mesh can be used. It is recommended to report a similar representation on each inspection form, to identify the exact location and extent of the inspected anomaly within the component, moreover, it is recommended to present a final mapping comprising all the anomalies affecting a specific component in the final inspection report.

6.2.2 Preventive conservation database

The database of the anomalies (damage atlas) encompasses:[6.7]

- Name and ID of the anomaly;
- Description;
- Probable causes;
- Possible consequences;
- Items to be checked for the assessment;
- Relevant testing methodologies;
- Rating parameters;
- Urgency of repair;
- Suitable repair solutions;
- Illustration.

The database of the testing methodologies encompasses:[6.8]

- Name and ID of the methodology and invasiveness (destructive/non-destructive);

6.7 Silva (et. al.), 2017; Silvestre; Brito, 2010.
6.8 Silva (et. al.), 2017; Silvestre; Brito, 2010.

- Material needed and special needs for execution;
- Reference to national and international standards and guidelines;
- Advantages;
- Limitations;
- Procedure;
- Objectives;
- Illustration.

The database of the solutions encompasses:[6.9]

- Name and ID of the technique;
- Element and subcomponent to which the measure applies;
- Typology of measure (remedial, preventive or maintenance);
- Material needed and special needs for execution;
- Work procedure;
- Expertise needed and execution time;
- Equipment;
- Advantages;
- Limitations;
- Ilustration.

Remedial measures address an existing anomaly to remove, repair or hide it. Preventive measures address the causes of expected anomalies to delay or prevent their outbreak, as well as the occurrence of re-pathology, namely reappearance of an anomaly after its treat-

6.9 Silva (et. al.), 2017; Silvestre; Brito, 2010.

ment. Finally, maintenance solutions are periodical activities that delay the evolution of the anomalies.[6.10]

It is stressed that, in the definition of the database of solutions and the consequent correlation matrix with the most common anomalies, local, national and international requirements for heritage buildings should be met, when necessary, including minimizing intervention, preserving historic materials and fabric, reversibility, etc.[6.11] Methodologies that are not compatible with this conservation philosophy should be avoided.

6.2.3 Correlation matrices

The correlation matrix between anomalies and probable causes is an essential diagnostic tool to support a correct identification of the factors triggering and exacerbating the anomaly evolution. The cause-anomaly relationships are distinguished as:[6.12]

- No causality, when no cause-effect relationship exists;
- Indirect causality, when the causes have an indirect relationship with the defect or they are not-essential for its development, although they can exacerbate it;
- Direct causality, when a direct relationship exists, namely it is indispensable to its development.

Finally, the correlation matrix between anomalies and inspection methodologies is an informative tool to select the approach that likely characterize better the identified anomaly, in terms of severity, extent and evolution rate, optimizing the cost of the inspection campaign. In the matrix, a low correlation is defined whenever the methodology is expected to correctly

6.10 Silva (et. al.), 2017; Silvestre; Brito, 2010.
6.11 Crevello, G.; Hudson, N.; Noyce, 2015.
6.12 Silva (et. al.), 2017; Silvestre; Brito, 2010.

characterize the anomaly but with technical or economical demands that limit its viability. High correlation indicates, instead, suitability and viability of the methodology.[6.13]

The correlation matrix is also an informative tool that supports the stakeholders in the identification of the techniques that are expected to effectively tackle the identified pathology.[6.14] In the matrix, a low correlation is defined whenever the technique is expected to correctly address the anomaly but with technical or economical demands that limit its viability. High correlation indicates, instead, suitability and viability of the technique.[6.15] For the sake of optimizing the conservation strategy, the economic feasibility should be assessed considering local costs and availability of equipment, materials and expertise.

6.2.4 Inspection and diagnosis workflow

Figure 6.3 presents a workflow of the envisaged methodology for inspection and diagnosis applied to a generic item, within the maintenance plan outlined herein. Upon detection of at least one anomaly affecting the component, the surveyor defines the class and sub-class, relying on the damage atlas, which provides a clear description and graphical examples of the anomalies according to a standardized classification.

The surveyor then decides whether instrumental testing is needed to characterize the anomaly. If so, the damage-test correlation matrix supports the selection of a feasible testing method and the test methodology database helps detailing a correct protocol. If expert contractors are needed to carry out the testing, the asset management contracts them (Figure 6.1).

6.13 Silva (et. al.), 2017; Silvestre; Brito, 2010.
6.14 Silva (et. al.), 2017; Silvestre; Brito, 2010.
6.15 Silva (et. al.), 2017; Silvestre; Brito, 2010.

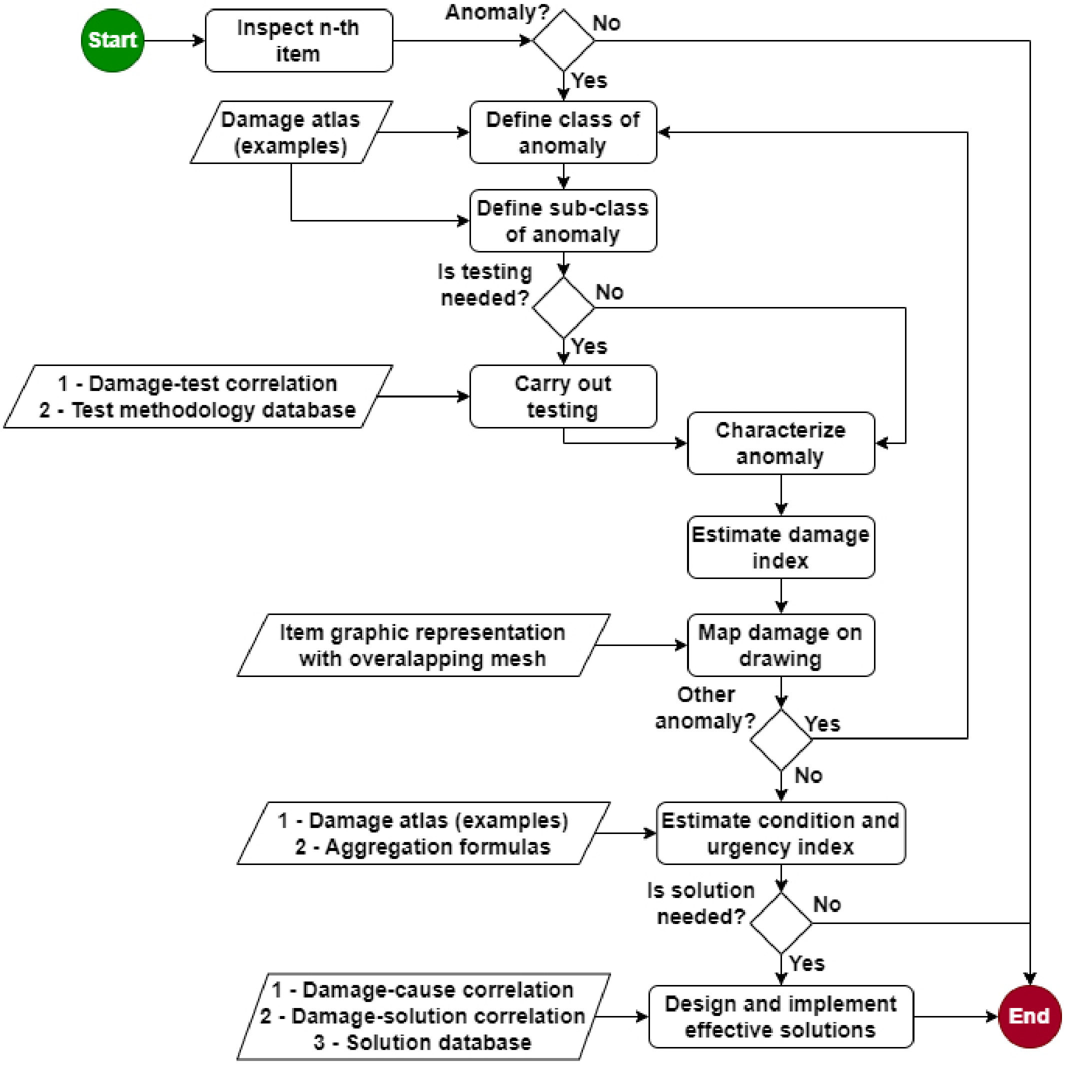

Figure 6.3 Workflow of the generic n-th item inspection and diagnosis.

Finally, the anomaly is graded according to the damage index and mapped on drawing for a correct reporting. The process is repeated for each anomaly affecting the component. Based on all the identified anomalies, the condition and urgency indices are estimated and the current status of the component is updated in its form, within the component catalogue.

Table 6.3 Damage, condition and urgency rating index.

Component	Routine inspection		Detailed inspection		Damage inspection	
	Party	Schedule	Party	Schedule	Party	Schedule
Exposed concrete items – outdoor	IT	6 months[a]	IT/C[b]	3-5 years[c]	IT	3 months
Exposed concrete items – indoor	IT	6 months[a]	IT/C[b]	5-10 years[d]	IT	3 months
Ceramic/mosaic tiles – outdoor	IT	6 months[a]	IT/C[b]	3-5 years[c]	IT	3 months
Ceramic/mosaic tiles – indoor	IT	6 months[a]	IT/C[b]	5-10 years[d]	IT	3 months
Plaster cladding – outdoor	IT	6 months[a]	IT/C[b]	3-5 years[c]	IT	3 months
Plaster cladding – indoor	IT	6 months[a]	IT/C[b]	5-10 years[d]	IT	3 months
Brise-soleil	IT	6 months[a]	IT	3-6 years[d]	IT	3 months
Wood panels and floors	IT	1 year	IT	5-10 years	IT	3 months
Window and door frames – outdoor	IT	6 months[a]	IT	1.5-3 years[c]	IT	3 months
Window and door frames – indoor	IT	6 months[a]	IT	3-6 years[d]	IT	3 months

[a] Before and after rainy season.
[b] Inspection team (IT) may carry out the inspection if properly trained (testing is required), experience contractors (C) are needed otherwise.
[c] Before rainy season.
[d] After rainy season.

Decision making is supported by the damage-causes correlation matrix to infer the factors producing the anomaly and the damage-solutions correlation matrix to identify feasible measures. The solution database allows the definition of good practices and specific requirements to implement the solution, including the need of expert contractors (Figure 6.1). The definition of the database should consider local availability of expertise and materials, as well as specific hazards and factors triggering damage.

6.3 Schedule

For each typology of items, a schedule for regular inspections has been defined (Table 6.3), encompassing both routine and detailed surveys. The recommended frequency of the scheduled inspections is reported in terms of maximum intervals between surveys, that can be reduced when the need arises (i.e. emergency inspections).

Routine inspections are carried out by the technical team of CFM based on visual inspection supported by a minimum equipment, at least twice per year, before rainy season and after significantly intense weather events, to detect the existence of anomalies and potential points of accumulation and/or access for rainwater (e.g. deteriorated joints, cracks, etc.). The inspection is conducted from the ground and from accessible high points. The routine inspection does not need in-situ or lab testing. The use of ladders and/or scaffolding to have direct access to the items is recommended but not compulsory and binoculars are used when necessary. Whenever new anomalies are identified on claddings and other finishing layers, the survey should be extended to structural, non-structural elements and installations which may affect their performance to correctly infer and address the causes. Detailed inspections of the elements exposed to outer environment are carried out every 3-5 years, whereas, for elements in the interior, it can be conducted every 5-10 years, replacing the routine inspection. Both are conducted by experienced contractors and consist of a close visual examination by means of ladders and/or scaffolding, aided by diagnostic tools for on-site testing to identify non-visible damage and water penetration. The detailed inspection may be organized together with a concomitant cleaning of the cladding, exploiting ladders, scaffolding and other infrastructures to access the items. Unscheduled emergency inspections and survey activities are called upon the detection of a significant damage or the occurrence of a natural disaster, first by trained in-house personnel.

Upon the inspection recommendations are provided based on the item condition and intervention urgency. Recommendations may encompass further investigations of the anomalies, for a better characterization of the extent and evolution rate, including on-site testing and monitoring. For instance, a regular inspection of previously identified anomalies may be carried out every 3 months, to investigate the seasonal effect on these anomalies and their evolution rate.

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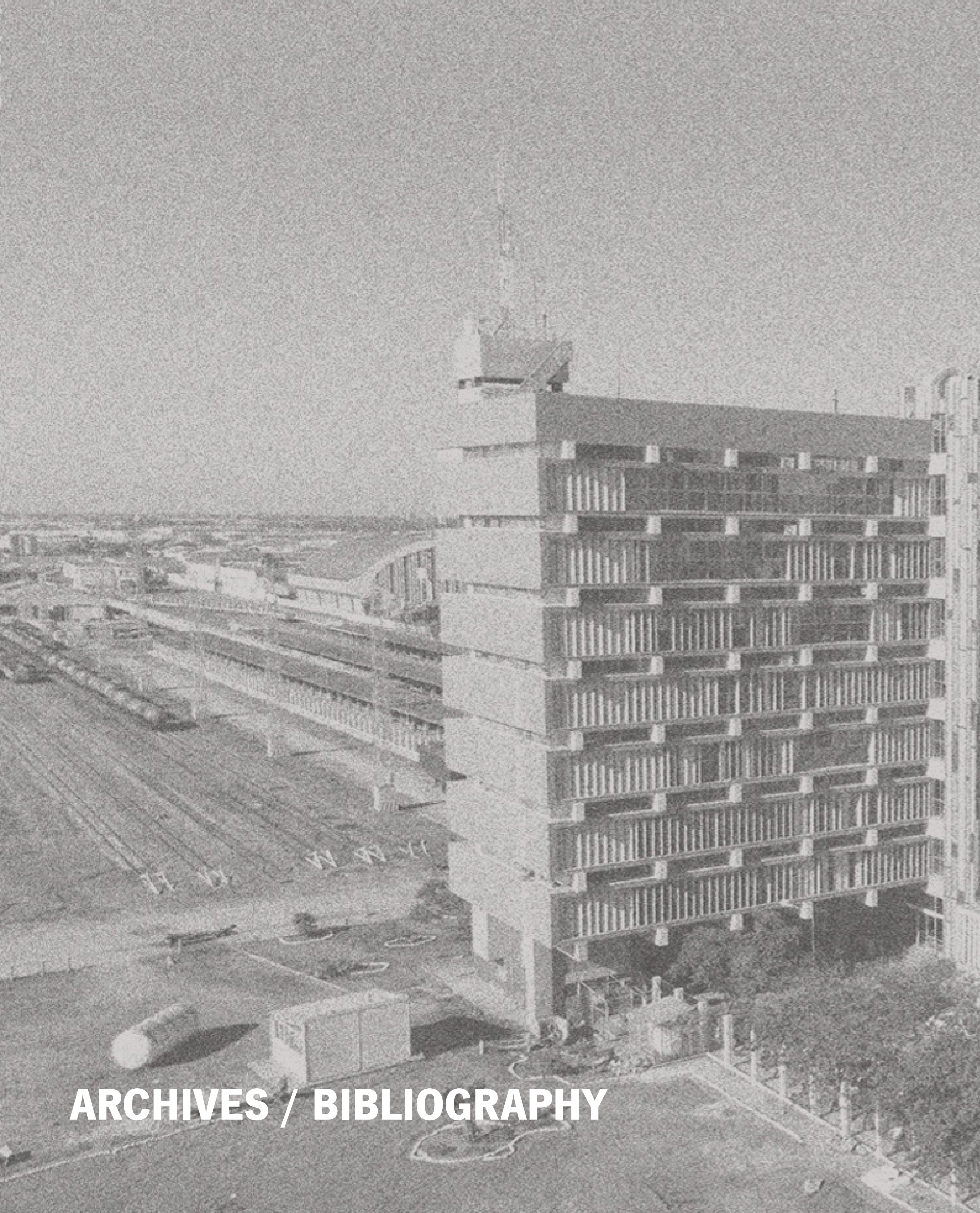

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7 Archives / Bibliography

7.1 Archives

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AHU	*Arquivo Histórico Ultramarino*, Lisbon (Overseas Historical Archive)
CDIIPAD	*Centro de Documentação e Informação do Instituto Português de Apoio ao Desenvolvimento, Lisbon* (Portuguese Institute for Development Support Documentation and Information Center)
ECB	*Arquivo da Estação Central da Beira* (Beira Central Station Archive)
DEPE	*Arquivo da Direcção de Estudos e Projectos de Engenharia dos Caminhos de Ferro de Moçambique*, Maputo (Mozambique Railways Directorate of Studies and Engineering Projects Archive)
MCFM	*Arquivo do Museu dos Caminhos de Ferro de Moçambique*, Maputo (Mozambique Railways Museum Archive)

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