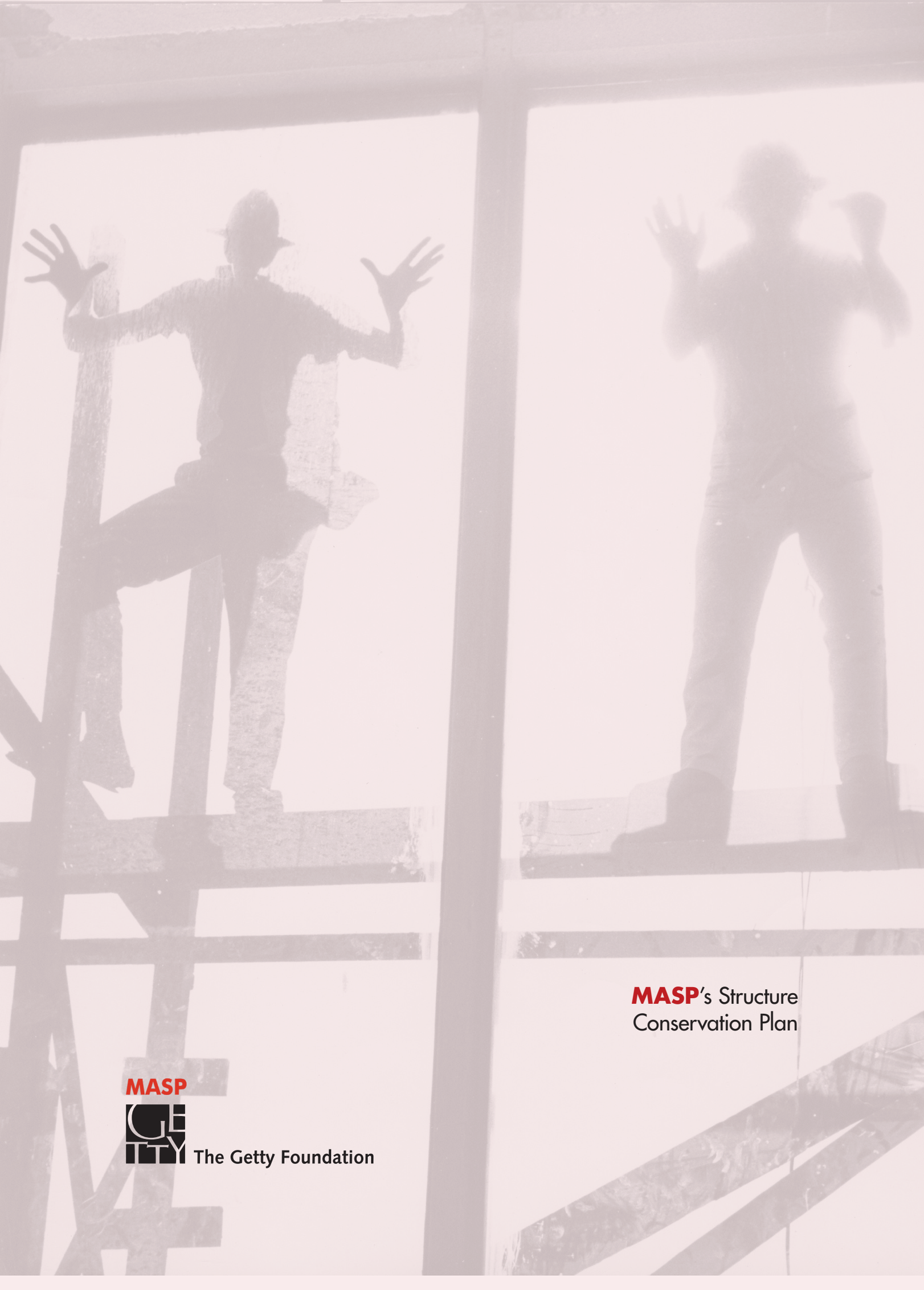

MASP's Structure Conservation Plan

MASP

The Getty Foundation

[2] Olodum show in the plaza under the free span, 1992

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MASP's Structure Conservation Plan _ final document, december 2018

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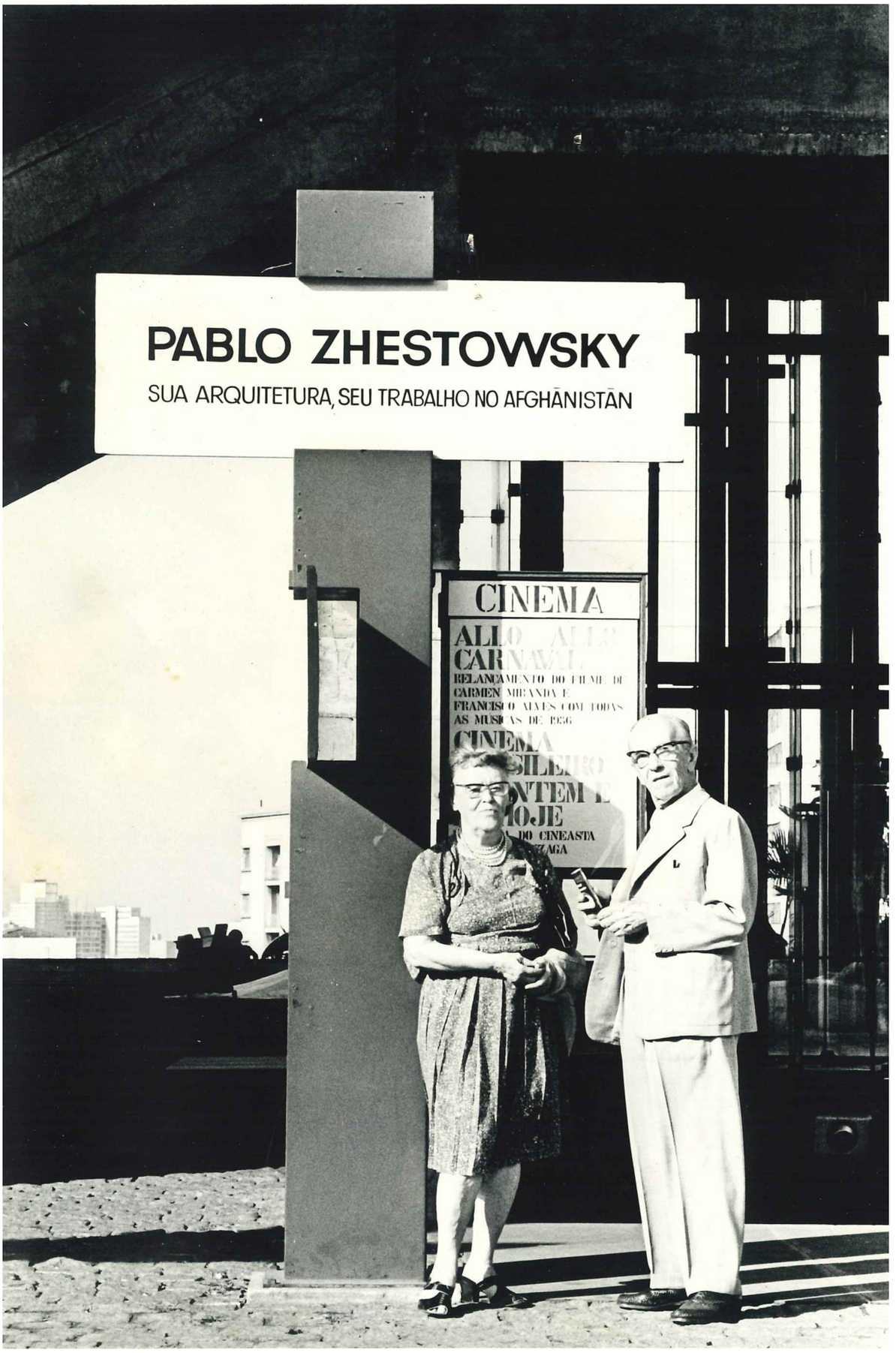
*This project is made possible with support from the Getty Foundation through its Keeping It Modern initiative


PABLO ZHESTOWSKY
SUA ARQUITETURA, SEU TRABALHO NO AFGHĀNISTĀN
CINEMA

[3]

Word from the director

In November 2018, MASP's building, one of the main icons of modern architecture, is celebrating its 50th anniversary since its implantation at the middle of Avenida Paulista. The radicalness of its design lies in its permeable, fluid and transparent architecture, which reflects as well as reveals, and by its highly innovative engineering design which set it apart from the building techniques in use at that time.

The horizontality and suspension of the architectural volume definitively marks the São Paulo cityscape due to the visual and expressive power of Lina Bo Bardi's design. At the same time, it stands as an urban and scenic breath of fresh air, inviting passersby to encounter and reflection. MASP provides a scenic overlook above the city, and the ground-level plaza in the space under its free span is, without a doubt, one of the most important sites for public, social and democratic life in São Paulo.

It is, therefore, very opportune that at this very significant moment for the history of the institution, MASP has the privilege of receiving the support of the Keeping It Modern program. This initiative headed up by the Getty Foundation fosters a global movement for research and the sharing of knowledge about the states of conservation and the best strategies for maintaining modern buildings around the world.

At MASP, this project has involved professionals from a wide range of areas, including architects, engineers, academics, technicians and managers. The partnership with Getty has allowed for the interlocution of these specialists in seminars and debates, as well as a broad historical and documental research into the structural functioning of the building, and a technical investigation into its materiality. Surveys and monitoring of the building's structural tensions, loads and movements were also carried out, with recommendations of treatments to solve the questions that were identified in its structure.

The guidelines pointed out in this Structural Conservation Plan for MASP will guide decisions for preventative maintenance, establish the prioritizing of projects in the building, point out best restoration practices and guide the museum's leadership in making the decisions to ensure the preservation of this cultural heritage for the next generations. This document is extremely important, as it offers a wide-ranging and thoroughgoing diagnosis of the current situation while providing a framework for future decisions.

Heitor Martins
Chairman

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Introduction

Plan goals

> *"The museum aims to formulate an overall preventative maintenance plan, based on an integrated view of the building and its facilities. (...) the studies will focus on an overall diagnosis for the building, with an integrated view of the superstructure, with an eye toward the elaboration of the Plan for the Conservation and Maintenance of the Museum's Superstructure."*
>
> *[Excerpt from the Plan of Interventions in the Building that foresees the Plan for the Conservation and Maintenance of the Superstructure]*

The Plan for the Conservation of MASP's Structure is a result of an integrated study of the questions regarding its structural system, both in the building's technical aspects, as well as its symbolic, aesthetic and architectural dimension. The plan's development is based precisely on the finding that the structural system is a key element for the building's symbolic and aesthetic dimension, for its heritage status, and for the material needs of the building's conservation. The plan establishes guidelines for the conservation and maintenance actions, and for interventions that may be necessary in the future.

Beyond the studies and tests carried out in order to better understand the structure, there is a need for a broader reading of the meanings and values attributed to the building as a whole. This approach is made, therefore, with an eye to its preservation coupled with the understanding of the need for interventions that will allow its full use based on the demands of a contemporary museum. The aim is to establish a preventative plan for maintenance and conservation actions with more rigorous criteria to serve as a basis for other everyday actions as well.

The development of the Museum's Structural Conservation Plan is therefore aimed at:

a. Establishing the building's cultural values (significance) that provide a basis for the preservation actions, in light of questions in various fields;

b. Establishing guidelines and parameters for preventative conservation, namely: actions that anticipate the recognized problems of an emergent or everyday nature. Establishing parameters for interventions in other systems of the building that have an interface with the structure (waterproofing, climate control, protections from direct or excessive sunlight, etc.);

c. Determining a plan for monitoring the structure's deformations, setting forth what procedures are called for, and at what intervals they should be applied;

d. Establishing procedures for monitoring and treating typical pathologies identified in the structure;

e. Communicating the results of this work, making the documentation available to the general public, thus raising awareness concerning the structural functioning of

this building, based on thoroughgoing knowledge.

Despite its focus on this specific building's structure, the Museum's Structural Conservation Plan proposes a methodology and reasoning for the planning of structural preservation and maintenance that can be applied to other systems. The document is open in the sense of always needing to be consulted and checked, and can be revised over time in accordance with subsequent actions. For its more effective operation, it is important for the plan to always be in alignment with the museum's Master Plan, and its Plan for Interventions.

Theoretical foundation

The theoretical approach for this work is based on contemporary discussions and tasks about the preservation of cultural heritage. It essentially concerns the recognition of the cultural value attributed to the building in order to establish guidelines and procedures that ensure its preservation. These are themes that were debated throughout the 20th century, but which gained special attention from the 1950s onward. Based on various authors[1] and debates, heritage charters were drawn up which present a summary of the guidelines considered in this work. The 1964 Venice Charter continues to be the document that has guided the later discussions. Despite being succinct, the charter provides a basis for understanding questions related the values of the building and its surroundings as well as an enlargement of the field in accordance with its Article 1:

> *"(...) The concept of a historic monument embraces not only the single architectural work but also the urban or rural setting in which is found the evidence of a particular civilization, a significant development or a historic event. This applies not only to great works of art but also to more modest works of the past which have acquired cultural significance with the passing of time."*[2]

Other documents were written with the aim of understanding the growing possibilities for the preservation of cultural heritage. These include the Burra Charter of 1980, whose latest version was released in 2013, which specifically treats on cultural value – in this case translated as significance. This charter, despite being written for the context of Australian culture, sets forth a methodology for recognizing the values to be preserved. In this sense, and following the recommendations of the Getty Foundation's Keeping it Modern program, the present document works with this methodology.

This recognition of the value applied to MASP requires a broader understanding of which attributes make the building a recognized cultural heritage today. Thus, the attribution of value can and should be reviewed from a contemporary outlook. This is to say that the combined values of both the building and the institution configure

[1] To learn more about the debates related to the preservation of architecture throughout the 20th century see: CARVALHO, Cláudia Suely R. de. Preservação da Arquitetura Moderna. São Paulo, Faculdade de Arquitetura e Urbanismo da Universidade de São Paulo, doctoral thesis, 2006, and Kuhl, Beatriz Mugayar. Preservação do Patrimônio Arquitetônico da Industrialização. São Paulo: Atelie Editorial, 2008.

[2] In CURY, Isabelle (ed.). Cartas Patrimoniais. Rio de Janeiro: IPHAN, 2000.

its significance as a whole and, with the passage of time, other meanings can be added. Therefore it is essential that this step of the work does not have the nostalgic character or a return to previous situations.

Even with the transformations that have taken place in the building and its surroundings since its construction, MASP's building still retains a large part of the values of its architecture and civil engineering, as well as its collection. Other values have been recognized over time, especially those attributed by society, and in this sense are indissociable from the reading that will be made in this work.

1. The History and Significance

History of the Institution

> *"Its [MASP's] destiny was characterized by an unsurpassable aim to elevate it to a level of modern, living, coherent, practical and active nature. Elevate it to such a point that its existence and operation could begin to be considered as a social and cultural resource for the metropolis and not only as a jewelry box, a safe for small jewels of the past (...)"* [3]

[3] BARDI, Lina Bo, " Balanços e perspectivas museográficas: um Museu de Arte em São Vicente," Habitat, São Paulo, n. 8, pp. 2–5, 1952..

The history of the Museu de Arte de São Paulo Assis Chateaubriand (MASP) began in 1947, with its conception and foundation by entrepreneur and journalist Francisco de Assis Chateaubriand (1892–1968) – the owner of one of the main media conglomerates at that time, the Diários Associados – in partnership with the likewise journalist and Italian art critic Pietro Maria Bardi (1900–1999).

A not-for-profit institution, it was initially located on floors of the building of the Diários Associados, on Rua Sete de Abril, in downtown São Paulo. The architectural design of the spaces allotted to the museum at its first location in that building, as well as the exhibition design of the shows held there were carried out by Italian-Brazilian architect Lina Bo Bardi (1914–1992), Pietro Maria Bardi's wife.

Since its inauguration, MASP's programming has included not only the exhibition of its collection and temporary shows but also the promotion of a range of cultural activities – national and international lectures, seminars and courses, cinema, shows, workshops – based on the idea of a museum with a social and educational function. The Bardi couple imparted its views and ideas about art, architecture and museums on the various actions carried out at the institution, impressing an experimental character on the spaces, exhibition designs and cultural activities carried out there.

Due to the museum's expansion already in the first years of its operation, the idea arose for it to move to a new location. In 1957, Lina Bo Bardi began to design a building for MASP on Avenida Paulista. When construction began in 1960, the museum confronted difficulties of both a technical and financial nature throughout the process, leading to work stoppages at various times. After eight years, the building's inauguration finally took place in 1968, an event widely publicized in the press at that time[4]. In the following year, 1969, its collection was declared an official cultural heritage by the Brazilian Institute for National Historic and Artistic Heritage (IPHAN).

[4] A inauguração da nova sede contou com a presença de pessoas ilustres, como a Rainha Elizabeth II da Inglaterra, denotando a importância do evento na época.

The ideas about art and culture espoused by the Bardi couple remained present in the management and activity of MASP at its new location. Even the architectural proposal for the building itself reflects Lina Bo Bardi's thinking in regard to the proper role of the museum in terms of the dissemination of art and culture. Her design for the permanent display of the museum's Picture Gallery is one of the elements that reveals this thinking. The Glass Display Easels are part of the exhibition design of

[4] Lina Bo and Pietro Maria Bardi, 1953

[5] Picture Gallery, MASP Rua 7 de Abril,1947

[6] Visitors, MASP Rua 7 de Abril, 1960's

MASP's Picture Gallery in a proposal that lends continuity to the researches carried out by the architect at the museum's previous location downtown.

The precepts of Lina Bo Bardi's exhibition design include the aim for art to be desacralized and free of hierarchies, thus questioning the traditional European model of the Museum of Fine Arts, often imported to Brazil in a noncritical way.

The death of Lina Bo Bardi in 1992 and of P.M. Bardi in 1999 marked a turning point in the institution's history. Beginning with the new management, the museum went through various transformations, both administratively and organizationally, as well as physically and spatially, as in the implantation of the ticket office and the alteration of the Picture Gallery's exhibition design, with the removal of the Glass Display Easels.

The new and current management of the Museu de Arte de São Paulo took the helm in 2014, undertaking a review and reorganization of the institution in its various dimensions – administrative, spatial, financial, etc. Architectural proposals were made based on the resumption of spatial concepts intended by Lina Bo Bardi, but which had been decharacterized over time. In this sense, actions were undertaken for spatial decompartmentalization, freeing up physical and visual pathways in various areas of the museum, as, for example, the return of the Glass Display Easels in the Picture Gallery[5].

MASP's collection currently contains 10 thousand pieces and is in constant transformation. It includes paintings, sculptures, prints, articles of clothing, photographs, drawings, installations, videos, objects and tapestry. It is considered the most important collection of European art in the Southern Hemisphere, while also possessing national and international artworks from the Americas, Asia and Africa, from different periods.

Due to its history, collection and sociocultural activity, MASP is one of the most relevant institutions in the Brazilian scene and is one of the most important museums in South America[6].

The architect Lina Bo Bardi

Lina Bo Bardi produced a small but widely recognized number of architectural designs, all realized in Brazil. It can be said that the outstanding nature of her work springs from her ability to articulate the repertoire of her training in Italy with the experiences she acquired in Brazil.

Born Achilina di Enrico Bo, she was one of the few women to attend the Facoltá di Architettura di Roma, between 1934 and 1939, taking classes with architects Marcello Piacentini and Gustavo Giovannoni [7]. She was always present in the arts, architecture and design scene, both in the practical and intellectual spheres.

[5] Design developed by the Metro Arquitetos Associados architectural firm, with technical adjustments in relation to the originals.

[6] Source: https://exame.abril.com.br/estilo-de-vida/museus-brasileiros-estao-entre-os-melhores-do-mundo/. Retrieved: Aug. 10, 2018

[7] Marcello Piacentini (1881–1960): Italian architect and urbanist, designed highly relevant works during the fascist regime in Italy, becoming known as the architetto del regime; Gustavo Giovannoni (1873–1947): Italian architect, urbanist and engineer, a key figure for the consolidation of urbanism as a discipline in Italy, for restoration in general, and for "urban restoration" in particular.

[7] Inauguration, MASP Rua 7 de abril, 1947

[8] Picture Gallery, MASP Av. Paulista, 1968

[9] Large Auditorium, MASP Av. Paulista, 1968

In 1940 she moved to Milan, a time when she wrote articles and made many illustrations for the magazines Domus – of which she was later vice director – and Lo Stile. Her work as an editor and illustrator in the fields of architecture, art and design would continue in 1945, when she participated in the magazine A: Attualitá, Architettura, Abitazione, Arte, with the architect, historian and critic of modern architecture Bruno Zevi. Despite that up to that time she had not worked with the development of architectural projects, her extensive activity in the world of architectural criticism contributed enormously to the consolidation of her ideas and views in this field.

The Bardi couple arrived in Brazil in 1946, and throughout their life were involved in education and production in the field of the arts, architecture and design. They headed up two magazines, Habitat and Mirante das Artes, launched at the same time that the couple directed MASP in downtown São Paulo. In its first editions, in the years 1950 and 1951, the magazine Habitat featured texts about the museum's activities, reflections on art, design, architecture, industrial design, etc., focused mainly on Brazilian production, but also pointing to the couple's sensitivity and interest in popular art. In the same magazine the architect published various writings that demonstrate her vision in regard to the role of the museums, such as the text "Função Social dos Museus"[8] [The Social Function of Museums] and the article "Balanços e perspectivas museográficas: um Museu de Arte em São Vicente"[9] [Museographic Assessments and Perspectives: An Art Museum in São Vicente], the latter concerning architectural concepts that she would later use in her design for MASP's building on Avenida Paulista.

> *"The modern museum needs to be an educational museum (…) The complicated problem of a museum today needs to be faced on an 'educational' and 'technical' basis. It cannot do without these bases, so as not to fall into being a petrified museum, that is, an entirely useless one."*[10]

As mentioned earlier, MASP is an institution that allowed both members of the couple to explore their views and ideas about art, architecture and museums. The period in which Lina Bo Bardi lived in Salvador (1958–1964) and directed the Museu de Arte Moderna da Bahia (MAMB) also contributed importantly to her researches. This coincided with the moment she drew up the design for MASP's new building, an important work within the architect's production and with which she would remain engaged until the end of her life, in 1992.

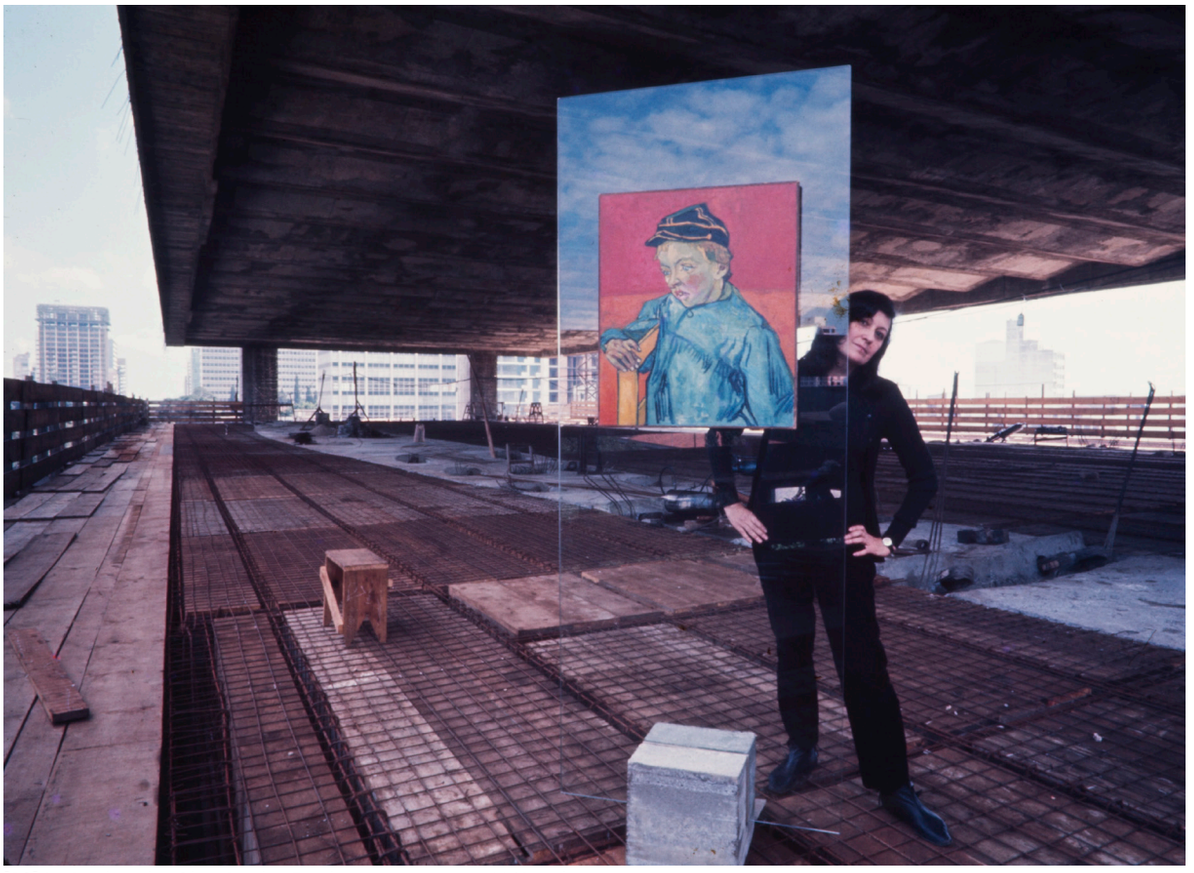
Besides great awareness concerning social questions, in her designs Lina Bo Bardi demonstrated her ability to consider the history and surroundings of her architectural sites, coupled with a profound reading and interpretation of the locale. Although she only produced a small number of designs in São Paulo, they profoundly marked the territory in which they are inserted, mainly due to the relationship they establish with their context. MASP and SESC Pompéia[11], for example, reflect until today this concern of the architect.

8 BARDI, Lina Bo. "Função social dos museus," in Habitat, n.1, out/dez 1950.

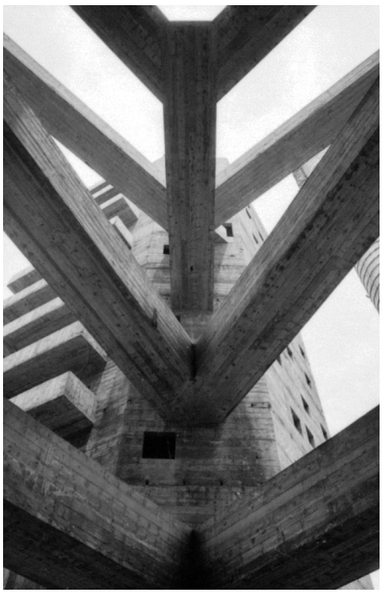
9 BARDI, Lina Bo, "Balanços e perspectivas museográficas: um Museu de Arte em São Vicente," Habitat, São Paulo, n. 8, pp. 2–5, 1952.

10 Lina Bo Bardi, in: Lina por escrito, 1958, p. 100.

11 A cultural center designed in 1977 and inaugurated in 1982. It is equipped with theaters, sports courts, swimming pool, rooms for workshops and creation, exhibition spaces and other services. The design was made based on a pre-existing factory whose buildings were reconfigured by the architect and remain on the site, as part of the overall design. The sports facilities were allocated at the back, and a set of new buildings made of apparent concrete.



[10] Bo Bardi and a Glass Display Easel in construction at MASP under construction



[11] [12] [13] Sesc Pompeia, Lina Bo Bardi's design

Architectural Context

Due to strong incentives from the government, coupled with rapid urban growth, the first half of the 20th century was marked by the construction of a significant volume of works in Brazil, by both the public and private sector. The Brazilian architecture produced in that period became internationally recognized mainly from the 1930s onward. In 1943, the exhibition and catalogue Brazil Builds, held and published by MoMA (Museum of Modern Art) in New York lent great visibility to this production[12], characterized by a number of variations springing from the plurality of influences based on contact with international productions, by the strong immigration of various architects to the country, and by local references.

Despite that the historiography of architecture does not treat on the theme, this moment was also marked by an intense production in the field of civil engineering. The civil engineers who calculated the structures for the buildings in this period are little cited or studied, even though they were responsible for complex methods of calculations that were innovative and at the cutting-edge of engineering techniques at that time – names such as Joaquim Cardoso, who calculated the works by Niemeyer, and José Carlos Figueiredo Ferraz, who calculated buildings like that the FAUUSP building by João Batista Vilanova Artigas, and the MASP building by Lina Bo Bardi.

In the case of the MASP building, constructed precisely in this context of a boom of production and research, Figueiredo Ferraz explored the technique of prestressed[13] high-strength reinforced concrete as a solution for the design proposed by Bo Bardi. In light of the challenges presented, Ferraz developed various pioneering methods to execute the work, such as the Ferraz System, one of the first patented techniques in Brazil for the use of prestressed concrete. This same method was also used in other works such as the Cidade Universitária Bridge and the Beneficência Portuguesa Viaduct, but MASP continues to be the building that showcases this technique.

Avenida Paulista

Originally built with the profits of coffee growing in the interior of the state of São Paulo in the 19th century, Avenida Paulista runs along the top of the Paulista Ridge[14], the highest ground within the area known as the Expanded Downtown. Its occupation was part of the process for the expansion of the center of the city. It was initially occupied by mansions built as homes for the city's elite. The construction of the avenue as an urban thoroughfare in modern fashion for the time was an attraction for the São Paulo aristocracy that occupied it for many years with palatial residences built in eclectic style, nestled among numerous trees on large properties.

The Trianon Belvidere[15], located at the midpoint of the ridge, on the opposite side

12 This broad and intense range of architectural works includes many trends that are outside the scope of the present work. To learn more, see: BRUAND, Yves. "Arquitetura Contemporânea no Brasil." São Paulo, Perpectiva, 1981; SEGAWA, Hugo. Arquiteturas no Brasil de 1900–1990.

13 Prestressing is a technique used for increasing the strength of the concrete, basically by tensioning steel cables within the concrete before it cures. The idea is to increase the strength of the material, minimizing the impact of superimposed loads.

14 The Paulista Ridge or Central is the watershed between the basins of the Tietê and Pinheiros rivers. It gets his name from the fact that Avenida Paulista was built along its top.

15 The Trianon Belvedere, designed by Ramos de Azevedo, was constructed between 1915 and 1918, inaugurated in 1916, and demolished in 1951.

[14] Mansions on Avenida Paulista

[15] Trianon Belvidere, Avenida Paulista, 1950's

of the Avenue from Tenente Siqueira Campos Park, was a meeting spot for São Paulo society, initially used by politicians and by the coffee growing aristocracy, and later frequented by less-upscale users. Formal balls were held there as well as cultural events and informal dances attended by the populace[16].

The lot offered a panoramic view looking down on Avenida Nove de Julho[17], and toward downtown and Anhangabaú Valley, the city's main North-South axis.

The 1st Bienal de São Paulo was held there on the lot of the Trianon Belvidere, organized by the Museu de Arte Moderna de São Paulo (MAM-SP), in a temporary building designed by architects Eduardo Kneese de Mello and Luís Saia[18]. The same place was considered as a site for MAM-SP itself, a museum founded by entrepreneur and patron Cicílio Matarazzo[19], and the building to be implanted on the site was designed by Rio de Janeiro architect Affonso Eduardo Reidy but never constructed. According to documents from that time, especially letters and newspaper articles, there were political disputes between Matarazzo and Chateaubriand, which extended into a competition for the land, which was ultimately conceded to MASP for the construction of its museum building.

In the 1950s, when Lina Bo Bardi's design for MASP began to be developed, skyscrapers were beginning to sprout up along Avenida Paulista[20] thus transforming the cityscape along the ridge, with the systematic substitution of the old eclectic mansions by tall commercial and residential buildings. It was in this urban context of transformation that the museum was inaugurated. The block where the old Trianon Belvedere was located was then occupied by the building composed by a large volume suspended eight meters above the ground, creating a public square at street level, open to the public. Below the square is the semi-subterranean volume of the building, facing the valley of Avenida Nove de Julho, from where one can get a view of the entire architectural set.

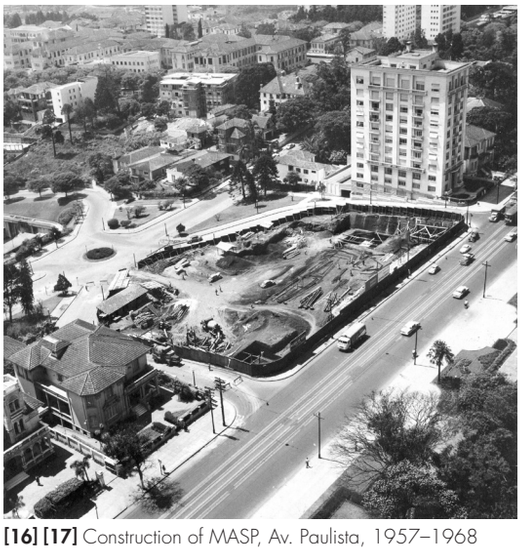
16 Análise histórica da Avenida Paulista realizada pela historiógrafa Heloisa Barbosa da Silva para o processo de tombamento do edifício pelo CONDEPHAAT – Conselho de Defesa do Patrimônio Histórico, Arqueológico, Artístico e Turístico do Estado de São Paulo.

17 Avenida Nove de Julho is an important thoroughfare in the city of São Paulo, connecting the city's downtown with the southwest zone. Located in a valley, it crosses Avenida Paulista through tunnels that extend under MASP's site.

18 Eduardo Kneese de Mello (1906–1994) Brazilian architect; Luís Saia (1911–1975), Brazilian architect, was a member of IPHAN.

19 Francisco Matarazzo Sobrinho (1898–1977), known as Ciccillo Matarazzo, was an industrialist and influential public figure in the communication media. Founder of MAM-SP (1948), he was an important promoter of visual arts in Brazil.

20 The building of the Conjunto Nacional, designed by architect David Libeskind, was completed in 1958, and constituted an important milestone in the process of Avenida Paulista's verticalization.



[16] [17] Construction of MASP, Av. Paulista, 1957–1968

[18] MASP before painting, Avenida Paulista, 1980's

[19] [20] Construction of MASP, Av. Paulista, 1957–1968

In the years following the museum's inauguration, more precisely in the 1970s, Avenida Paulista became the main financial center of São Paulo, and the avenue became lined by skyscrapers on both sides with only a few small gaps. The buildings housed companies, banks and institutions. During this period there was an extensive overhaul of the avenue at street level, with a widening of the thoroughfare and the pedestrian sidewalks as well as the installation of street furniture and street signs, consolidating the image of Avenida Paulista as we know it today, a key icon of the city.

With this new configuration of the avenue, MASP once again became outstanding, this time due to its horizontal form in contrast to the surrounding verticality. Moreover, since the buildings on either side of it along Avenida Paulista are set further back from the avenue, its more forward positioning allows MASP to be seen from a distance at points up and down the avenue. The changes in the adjacent lots along the avenue have interfered little in the museum's visual reading along its longitudinal axis. In relation to the transversal axis, there was an accentuation of the interaction between the building and Trianon Park, on the other side of Avenida Paulista, and the valley of Avenida 9 de Julho, in the other direction. This relation is fundamental for the expression of the architectural set. Allied to the geography, vegetation and the many buildings all around, the MASP building is clearly identified as a breath of fresh air amidst the cityscape, an exception due to its volumetry and open space at ground level, making it a very prominent a landmark.

Beginning in the 1980s, other regions became consolidated as financial centers in the city, mainly in the southeast zone. Avenida Brigadeiro Faria Lima began to play a leading financial role from its position near the beltline roadway along the Pinheiros River, followed later by Avenida Berrini and Avenida Juscelino Kubitschek. Avenida Paulista, however, did not diminish in terms of population or social recognition. With the inauguration of other cultural institutions during this period[21], it became one of the main touristic attractions in the city, being identified, together with MASP, as a symbol of São Paulo:

> *"In 1990, Banco Itaú carried out an in-person survey based on showing the interviewee some pictures of iconic sites in the city of São Paulo. First place went to Avenida Paulista as a whole, and second-place to MASP. Actually, since MASP is located on Avenida Paulista, it is as though MASP won twice, or as though this election were redundant. The question thus becomes: is Avenida Paulista so iconic for the people of São Paulo because of MASP, or is MASP so iconic for the people of São Paulo because of Avenida Paulista? Or, the two dimensions together become even more iconic, more powerful."*[22]

That same period saw the construction of the subway's #2 Green Line[23], whose first stretch, inaugurated in 1991, runs the total length of Avenida Paulista. One of its stations, Trianon-MASP, is located right in front of the museum. Besides connecting with the subway's #1 Blue Line on the city's north-solid axis, in 2010 the connection

21 In 1986 the building that houses Itaú Cultural was inaugurated. That same year, restorations began on the mansion known as Casa das Rosas, inaugurated in 1991 as the Galeria Estadual de Arte, which functions today as an important cultural center, being one of the cultural spaces on the avenue in conjunction with MASP (1968) and Centro Cultural FIESP (1964).

22 Silvana Rubino in a presentation given at the Workshop Getty-MASP about significance, held on June 6, 2018. Rubino moreover pointed out that in 2002 a similar survey ranked MASP in first place and Avenida Paulista in second place as a symbol of São Paulo, reinforcing the association between these places and their importance for the city.

23 The #2-Green line of the São Paulo subway is important for linking the city's west, south and southeast zones. Planned initially to run along the entire length of Avenida Paulista, it was later extended beyond this by works completed in 2011, reinforcing the association between these places as also the symbol and importance of the avenue to the municipality.

was made between it and the #4 Yellow Line of the southeast-southwest axis, interconnecting the Avenida Paulista region with the city on a larger scale. It is through the integration of the subway lines with the metropolitan train lines, however, that the avenue reaffirms its status as a central hub in the city.

When these improvements in public transport made the region more readily accessible to the metropolis as a whole, the appropriation of MASP's public spaces gained a greater dimension and meaning[24]. A very important site for the city is the ground-level plaza under the building's free span, which plays a fundamental

[24] Sarah Feldman in a presentation at the Workshop Getty-MASP about significance, held on June 6, 2018.

[21] MASP view from Avenida 9 de Julho

[22] View of MASP along the axis of Avenida Paulista, 2018

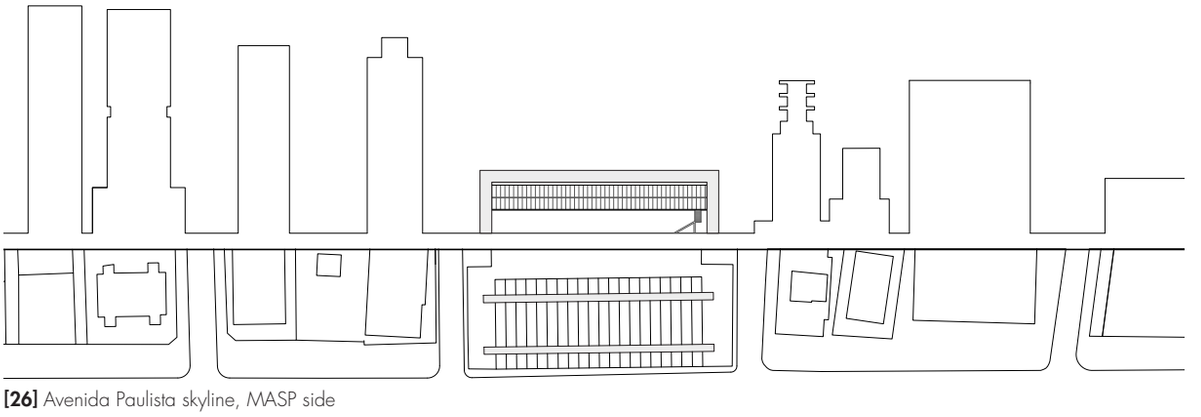
role as a space for social, cultural and political manifestations by different groups, and which acquires new values in accordance with its relation to the movements and social practices of the moment. During the 2010s the construction of new cultural and commercial buildings coupled with the closing of the avenue to cars on Sundays and holidays are factors that have contributed to this recognition.

The space's vitality for a wide range of activities[25] has consolidated Avenida Paulista as a symbol of São Paulo until today, and the MASP building is a protagonist in its public, collective and cultural dimension.

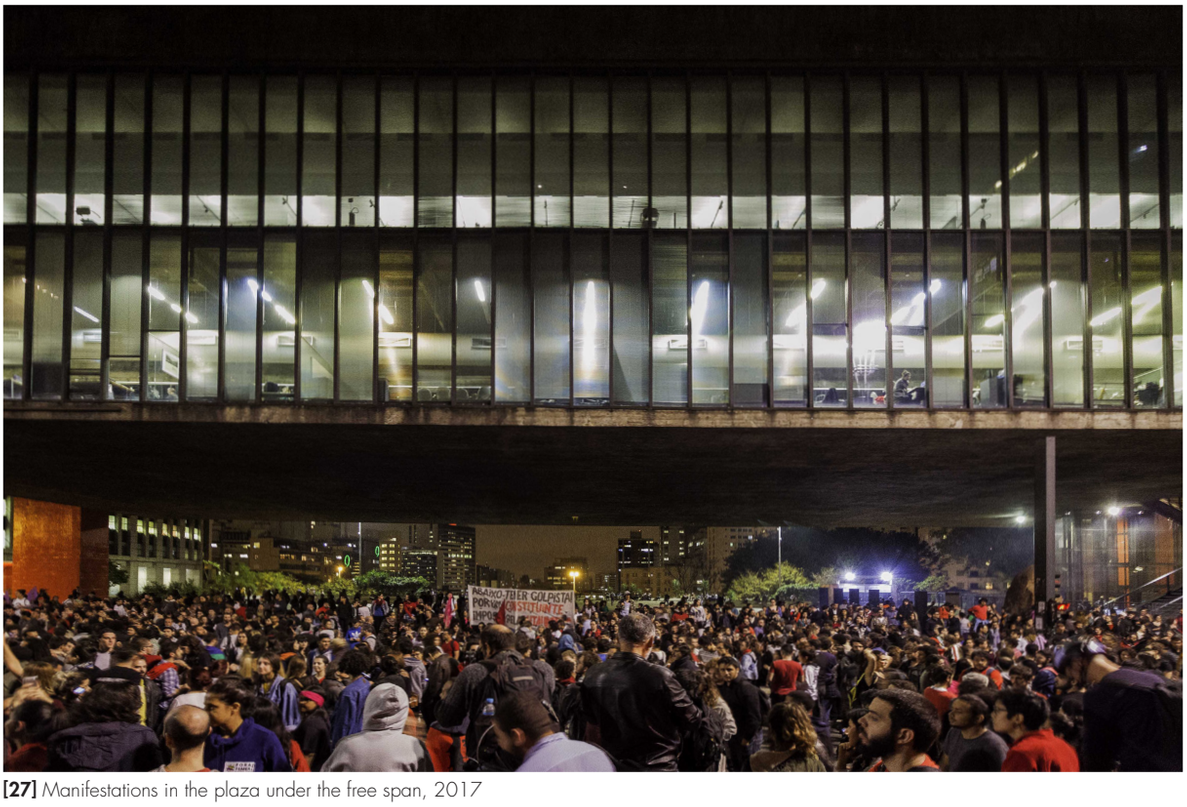
25 Avenida Paulista is home to a wide range of cultural buildings, like those cited above, as well as cinemas and theaters. Since 2016 it is open only to pedestrians on Sundays and various spontaneous artistic manifestations commonly emerge along its length. Reinforcing its role as a cultural hub, in 2017 two important cultural buildings were inaugurated: the Japan House – a center for the spread of Japanese culture – and the new headquarters of Instituto Moreira Salles – a center with collections and programs in the areas of photography, literature, iconography, visual arts, music and cinema. In 2018, MASP was part of a joint initiative with the other artistic institutions on the avenue to hold the first edition of Paulista Cultural, in event for the promotion of various experiences and that reaffirming the Avenue's potential as a cultural corridor. The event also enjoyed the presence of other collaborators, like the recently reopened SESC Paulista.

[23] Paulista Ridge (in red) between the rivers Tietê (north) and Pinheiros (southwest)

[24] [25] Avenida Paulista axis (in red), Avenida 9 de Julho axis (in grey), MASP and Trianon Park (in dashed red)



[26] Avenida Paulista skyline, MASP side



[27] Manifestations in the plaza under the free span, 2017

[28] Manifestations in the plaza under the free span, 2018

MASP | linha do tempo

1950

(1946)
Lina Bo Bardi and Pietro Maria Bardi arrive in Brazil

(1951)
First project executed by the architect: the Glass House

(1947)
Inauguration of the Museum on Rua 7 de Abril, downtown São Paulo

[29]

(1947)
First educational exhibition on art history

(1957)
First edition of the Bienal de São Paulo on the site of the future museum

(management)

(1947 - 1951)
Samuel Ribeiro - chairman

(1947 -1999)
Pietro Maria Bardi - director

(1952 - 1955)
Joaquim Bento Alves de Lima - chairman

(1956 - 1959)
Horácio Lafer - chairman

1960

(1959)
Lina is appointed as director of MAM-Bahia and begins her design of the Solar do Unhão

(1957)
Lina moves to Salvador

(1964)
Lina returns to São Paulo

(1960)
Construction of the A Gazeta newspaper building, on Av. Paulista; structural design by the Figueiredo Ferraz firm, using Ferraz prestressing technique

(1957)
Lina begins studies for the museum's new building on Avenida Paulista

(1960)
Beginning of construction of the museum's new building on Avenida Paulista

(1960 - 1973)
Alexandre Marcondes M. Filho - chairman

1970

(1969)
Inauguration of the building of FAUUSP in fair-faced concrete; structural projects by the Figueiredo Ferraz firm

(1968)
Inauguration of the museum's new building: Edifício Trianon


[30]

(1969)
The museum's collection is recognized by Iphan as a cultural heritage

(1974)
Rogério Giorgi - chairman

(1974 - 1993)
Edmundo Monteiro - chairman

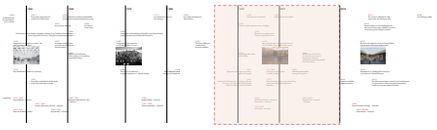
1980

(1977)
Lina creates the design for Sesc Pompeia

(1984)
Lina creates the design for Teatro Oficina

(1987)
The Picture Gallery is emptied due to structural problems

(1982)
MASP is declared a cultural heritage by Condephaat



1990

(1992)
The death of Lina Bo Bardi

(1990)
Creation of the Instituto Lina Bo e P.M Bardi

(1994)
Death of civil engineer José Carlos de Figueiredo Ferraz

(1996)
Removal of the glass display easels from the Picture Gallery, fragmentation of the space

[31]

(1990)
The artworks return to the Picture Gallery

(1992)
Regulation of the area surrounding MASP by Conpresp

(1992)
Show by Daniela Mercury in the plaza under the free span, with more than 20,000 people, makes the building's structure vibrate

(1994)
Hélio Dias de Moura - chairman
José Mindlin - chairman

(1994 -2013)
Júlio Neves - chairman

2000

(1999)
Death of Pietro Maria Bardi

(1997-2001)
Works for the revitalization of MASP's building

(1997)
Start of admission fee to enter the building - construction of the ticket booth on the belvedere

(2003)
MASP designated as cultural heritage site by Iphan

(2008)
MASP enters the Clube 19, an association of museums that possess collections of European art most representative of the 19th century

(2008 - 2012)
João da Cruz V. Azevedo - chairman

2010

(2017)
The museum celebrates its 70th anniversary, the building its 49th

(2018)
The building its 50th

(2016)
Research begins on the development of a plan for the conservation of MASP's structure - with financing by the Getty Foundation

(2015)
Removal of the partitions from the Picture Gallery and the return of the glass display easels

[32]

(2015)
Development of a Strategic Plan of Actions in the Museum's Physical Structure

(2010)
Approval of MASP's expansion project

(2017)
The Glass House begins research for the development of a preventative conservation plan for the house - with financing by the Getty Foundation

(2013)
Beatriz Pimenta Camargo - chairman

(2014 - presente)
Heitor Martins - chairman

The Masp Building

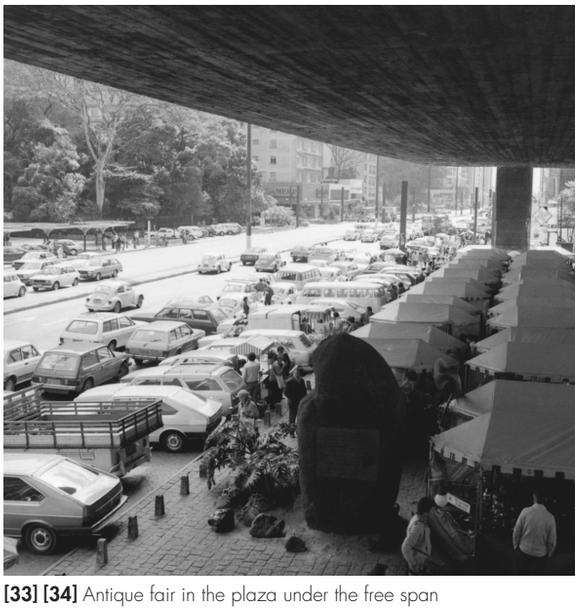
In general terms, MASP's building designed by Lina Bo Bardi consists of a volume suspended eight meters from the ground, above the public square it configures at the level of Avenida Paulista, together with a semi-subterranean volume facing the valley of Avenida Nove de Julho.

The raised volume is a landmark within the cityscape of Avenida Paulista, held up by its structure of enormous pillars and beams executed in apparent concrete, still bearing the marks of the wooden forms used in its construction. The metallic window frames of its façades define the closing of this box, marked by a regular rhythm of vertical framing elements and the transparency of the glass. This configuration allows a visual relation between outer and inner, reflecting the surroundings during the day and revealing the interior at night, like a lantern above the avenue. The floor plan is divided on two levels, accessed by elevators and a stairway. The first floor houses the administrative areas, distributed longitudinally along the building into bands along the window framing, as well as a large room for temporary exhibitions in the central area, without any relation to the outside of the building. The second floor is the museum's Picture Gallery, conceived as a single room without partitions, where the museum's collection is on permanent display on the Glass Display Easels in dialogue with the architecture of this floor, whose structural solution leaves the space free of any interference.

The public square on the ground level is a large space that extends as a scenic lookout with a view toward Avenida Nove de Julho. Its pavement is the roof covering the lower volume. There is no sort of barrier or control for this space, its back and side edges lined by a concrete bench that acts as a sort of railing, flanked behind by garden plants along the top edge of the semi-subterranean volume. The paving of granite blocks and the reflecting pools around the base of the main pillars configure the plaza's architectural language.

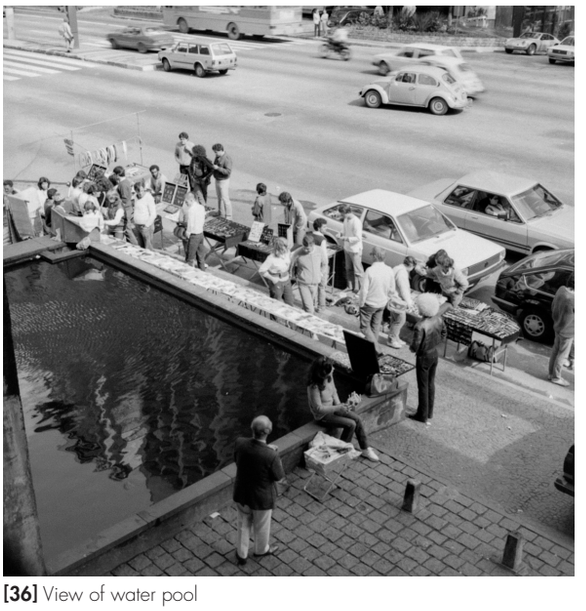
The building's lower part delineates the borders of the plaza. The lower volume is semi-subterranean with stepwise levels[26] on the exterior, its inner edge defined by retaining walls. The façades of this volume feature plant boxes made of apparent concrete and metallic window frames, in a different rhythm than the elevated volume. The architectural program is divided into two floors, accessed from the ground-level plaza and by a central stairway leading up from Praça Arquiteto Rodrigo Lefevre on the side of Nove de Julho on the lower floor. On the first sublevel, a welcoming space provides connections to various sections: one smaller and one larger auditorium, exhibition areas and collection storage areas. The mezzanine is in the central part, which gives access to the lower level by way of two red ramp-stairways. The second sublevel is configured by large spaces with transparent partitions that allow for a complete view of the floor, which also contains exhibition areas and collection storage areas. The large, spacious central space interlinks the two sublevels, with a view to the mezzanine, spatially characterizing the lower volume as a whole. On both floors the structural grid of the concrete floors is fully apparent.

26 In the first years of the museum these different levels had pools of water, resembling a cascade of small lakes.



[33] [34] Antique fair in the plaza under the free span

[35] View from the Belvedere



[36] View of water pool

MASP is a building in which architecture and structure are uniquely integrated. This relationship is essential in the determination of its functioning, in the configuration of its spaces, and in the composition of its main values – transparency, fluidity, permeability and spatial amplitude. The building's interior and exterior expression is based on the intrinsic characteristics of the materials used – rough surfaces with little ornamentation.

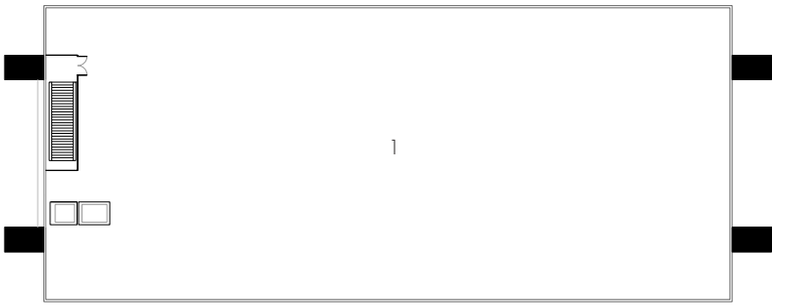
It can be said that its architecture is also characterized by its collective character and appreciation of the individual, expressing Lina Bo Bardi's stance in regard to sociocultural questions. From the viewpoint of exhibition design, the Glass Display Easels make the visitors free to follow their own path among the artworks, interpreting them in their own particular way, aiming at a more humanized, plural and democratic experience. From an urbanistic point of view, the ground-level plaza allows for frank contact between the building and passersby. The window façades on both the volumes make a connection between inner and outer. These postures reveal how MASP's design considers various scales, encompassing everything from the macro, urban and collective scale to the personal and sensitive experience of the individual.

[37] Picture Gallery, MASP Avenida Paulista

[38] Picture Gallery, MASP Avenida Paulista

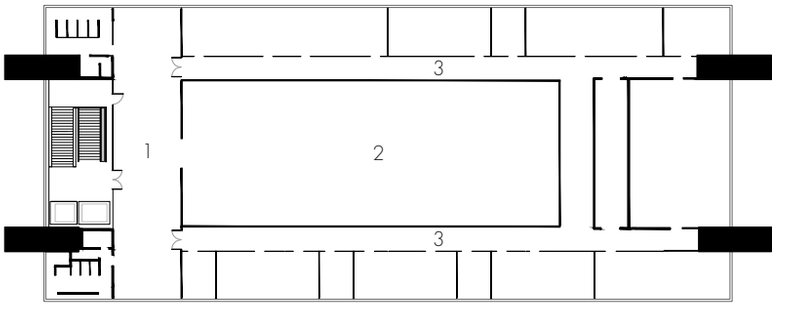
[39] Administrative hallway on the first floor, 1968

[40] [41] Exhibition in the Civic Hall



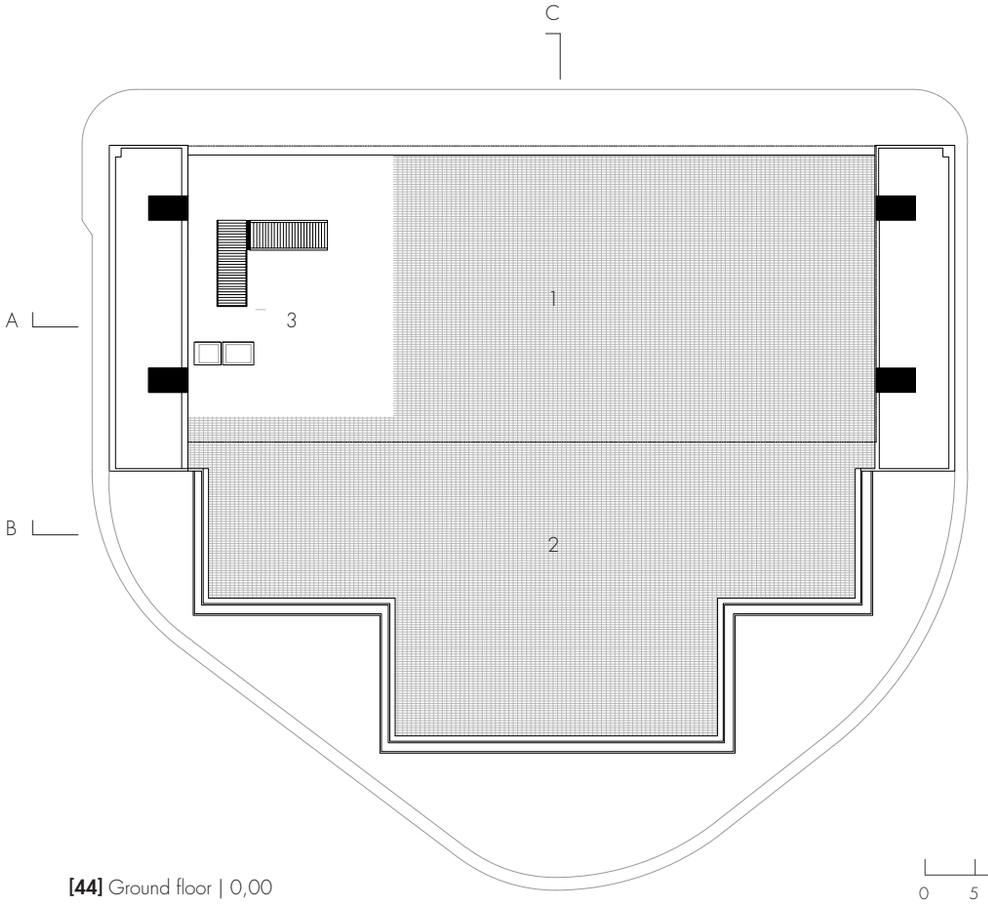
1 Picture Gallery

[42] Second Floor | + 14,40



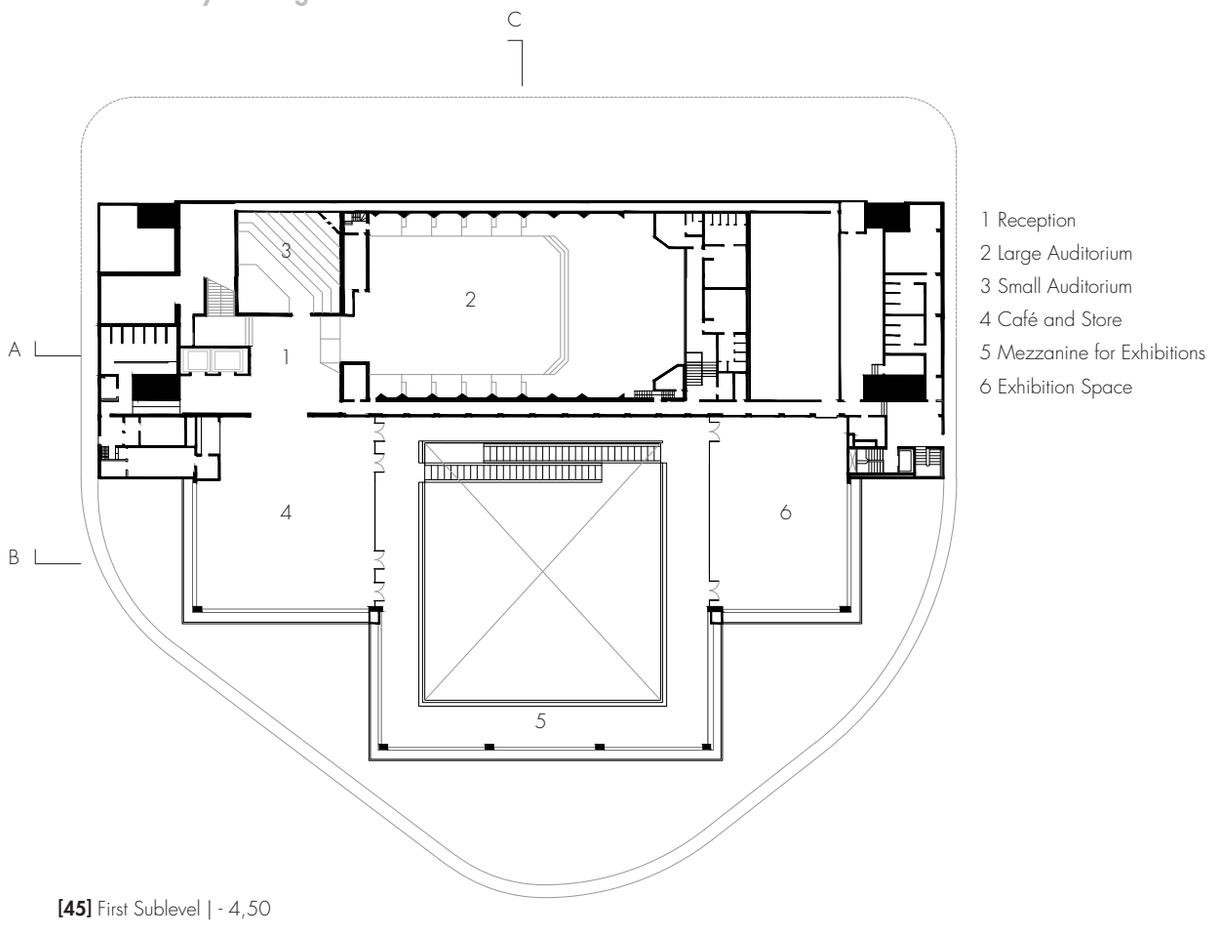
1 Foyer
2 Exhibition Room
3 Administrative Hallway

[43] First Floor | + 8,40

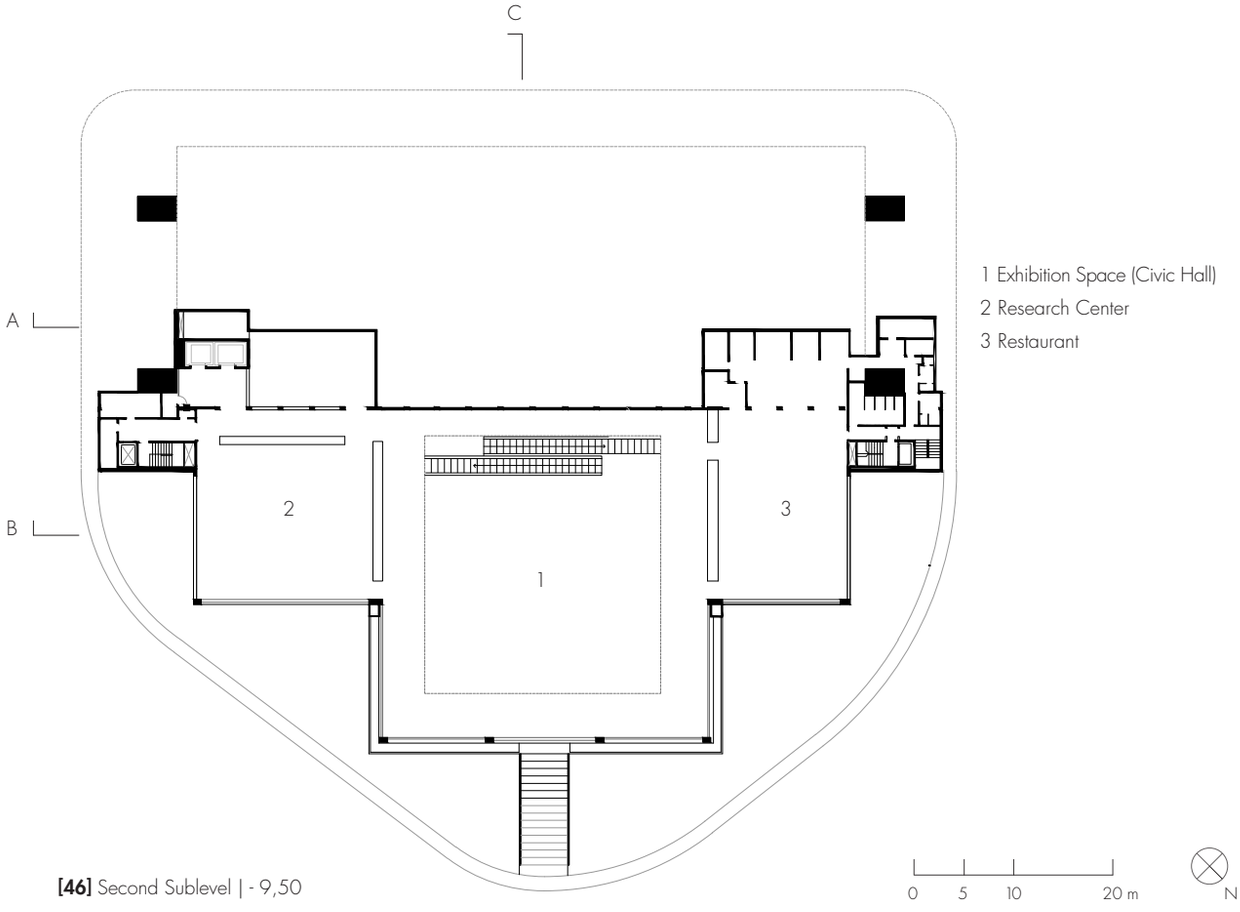


1 Plaza under the Free Span
2 Belvidere
3 Ticket Booth

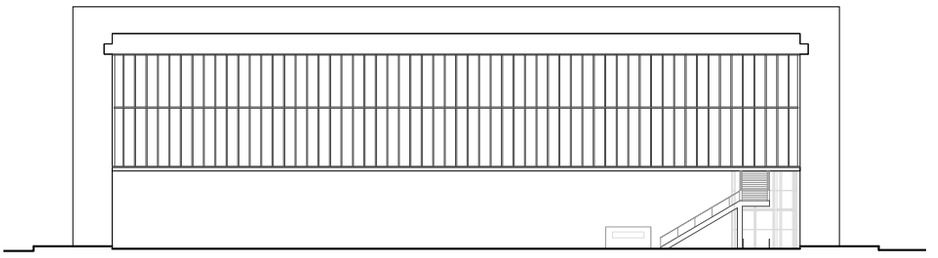
[44] Ground floor | 0,00



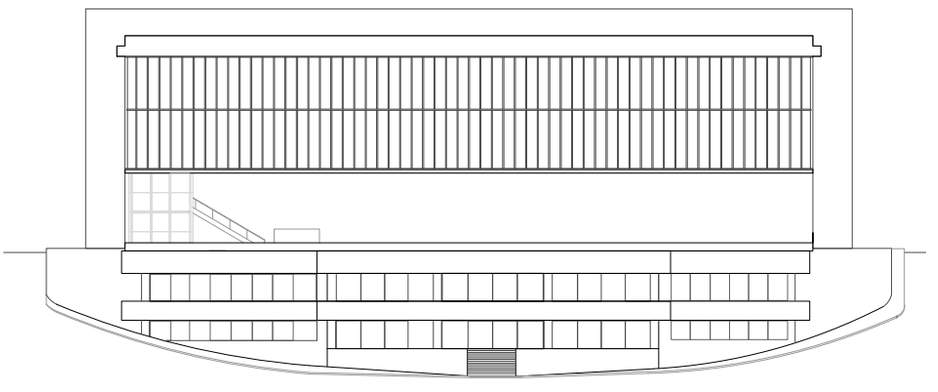
[45] First Sublevel | - 4,50



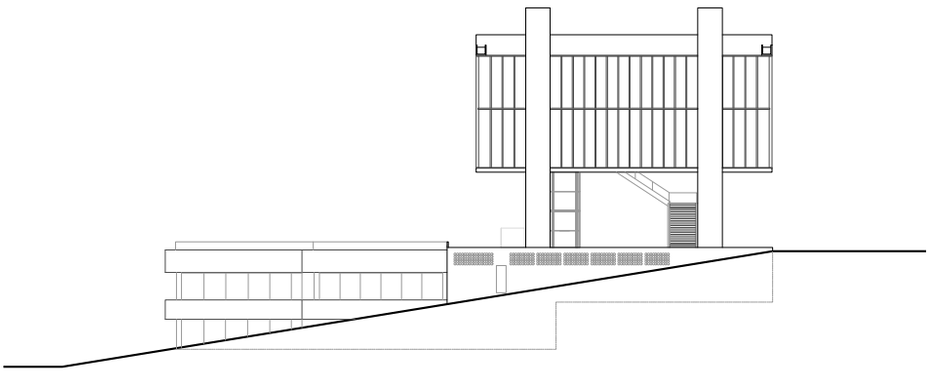
[46] Second Sublevel | - 9,50



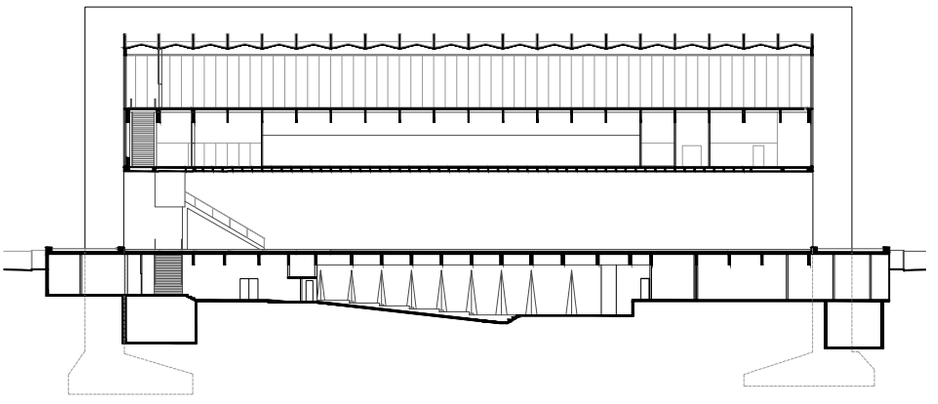
[47] Avenida Paulista façade



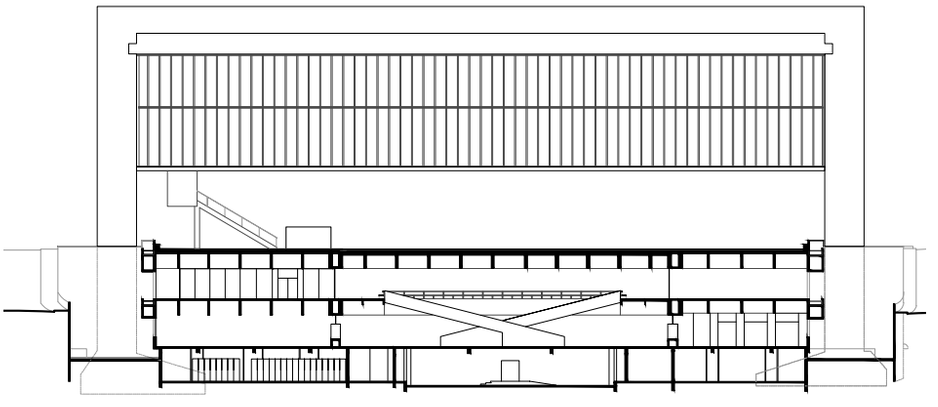
[48] Avenida Nove de Julho façade



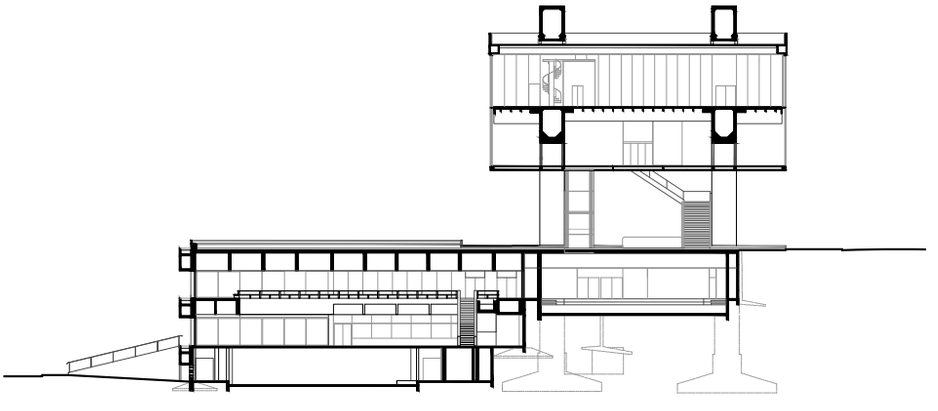
[49] Rua Plínio Figueiredo façade



[50] Section AA



[51] Section BB



[52] Section CC

0 5 10 20 m

History of interventions

Throughout its history, the MASP building has undergone various transformations, maintenance and conservation actions, but the original values and approach in its architectural design are still legible. Thus, the building, nearing its 50th anniversary, preserves its architecture. Some questions, however, have been present since its inauguration, such as the deformation of the upper beams[27] and the problems of water leakage.

In the first years, the maintenance needs were solved by the museum staff itself, on a stopgap basis. The first time that larger scale actions were carried out was in the late 1980s. Nearing its 20th anniversary, the building was in an inadequate state of conservation. As a more substantial solution was necessary, a thoroughgoing examination was carried out in 1987, identifying the grave state of the deterioration of the reinforced concrete of the upper beams and the pillars, deformations and problems with water leaks on the roof. It was found that the deformations of the upper beams and the roof led to the puddling of water, which together with various layers of waterproofing laid down over the years had led to an undesired overload.

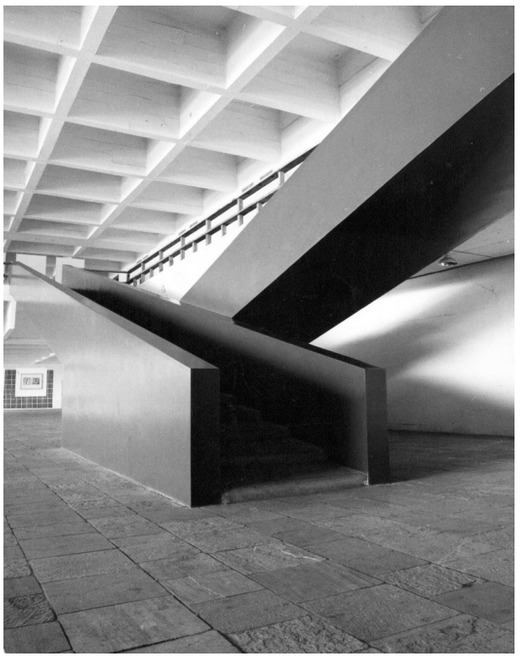
The damage to the reinforced concrete was repaired, the various layers of waterproofing were removed, a single new layer of waterproofing was laid down, and yet the water leaks continued. Examinations identified that the water leaks were coming through the concrete of the external beams and pillars. The water entered due to the porosity of the concrete and accumulated in the empty space inside these hollow elements, then passing into the building's interior space, precisely in the Picture Gallery. The solution to this question, approved together with Lina Bo Bardi in 1990, was the painting of the outer pillars and beams with red waterproof paint. One of the arguments for the choice of this color was that the scale models of the architect had red in the structure. Even though this argument was debatable from the standpoint of the preservation of cultural heritage, it must be understood that the intervention was incorporated to the building[28], adding visual force to the design and becoming an integral part of the building's symbolic image until today.

The second moment of significant interventions is the period spanning from the mid-1990s to the beginning of the 2000s. The interventions were concentrated between 1997 and 2001, in projects that required the partial closing of the museum due to their size. The company in charge of the work, as well as for some of the designs, was the civil engineering company Figueiredo Ferraz Consultoria e Engenharia de Projetos[29]. A sweeping modernization of the museum's infrastructural systems – electrical, air-conditioning, communication and security systems, etc., was also carried out. The sublevels also received modifications to their accesses and circulation in the collection storage areas, and a second elevator was installed, together with the existing one. Moreover, a third sublevel was constructed with the aim of enlarging the museum's collection storage areas.

27 The building's structural behavior will be presented in detail later, as it is the focus of this study. Here it is important to know that the reinforced concrete presents both foreseen and unforeseen deformations, analyzed in the corresponding section.

28 Despite the satisfactory results in relation to the desired waterproofing, this painting presents technical questions that will be discussed later this plan.

29 The name of J.C. de Figueiredo Ferraz's technical firm was changed after his death.



[53] Ramp-stairs, sublevels

[54] 2nd Salão Paulista de Arte Contemporânea, 1971

[55] Fernando Botero exhibition, 1998

With the aim of conserving the reinforced concrete, recovery works were done on the building as a whole, in both the upper and lower volumes, with the treatment of the framework and repairs to the concrete.

The museum's waterproofing systems also underwent an extensive intervention: the waterproofing on the roof was redone, as was also that of the ground-level plaza, together with the removal and replacement of the granite paving stones. The red paint on the external pillars and beams already demonstrated deterioration at that time and needed repairs. These repairs were carried out at two moments, the first in 1999 and the second in 2002.

A notable intervention was the additional prestressing given to the two large roof beams in 1999. The deformation of these upper beams occurred soon after the removal of the construction frameworks, in 1968. With the passage of time, constant monitoring demonstrated a deformation that was a significant cause for concern. As a solution, a second prestressing calculated and planned by the Figueiredo Ferraz civil construction firm was carried out. For the placement of the new cables, the beams were opened to reveal their hollow interiors, revealing a high degree of deterioration within them. These problems were duly treated, with the removal of the wood left over from the construction of their forms, which were infested by termites, along with the recovery of the reinforced concrete. The midlevel beams running under the second upper story were also examined, but their state of conservation was determined to be satisfactory. Due to the deformations of the structure, a leveling process was carried out on the floor of the first and second stories.

Besides the alterations of a technical and structural nature, there were various changes in the layouts of both stories, in most cases partitioning the spaces. Two alterations gave rise to a great deal of controversy in this period. In 1996 there was a large change in the Picture Gallery, with the removal of the Glass Display Easels and a partitioning of the space with drywall, creating a gallery similar to traditional museums. The second change took place in the ground-level plaza, where an admission control area was built, with a ticket counter and visitor storage lockers[30], with metal and glass partitions and a uniform cement floor.

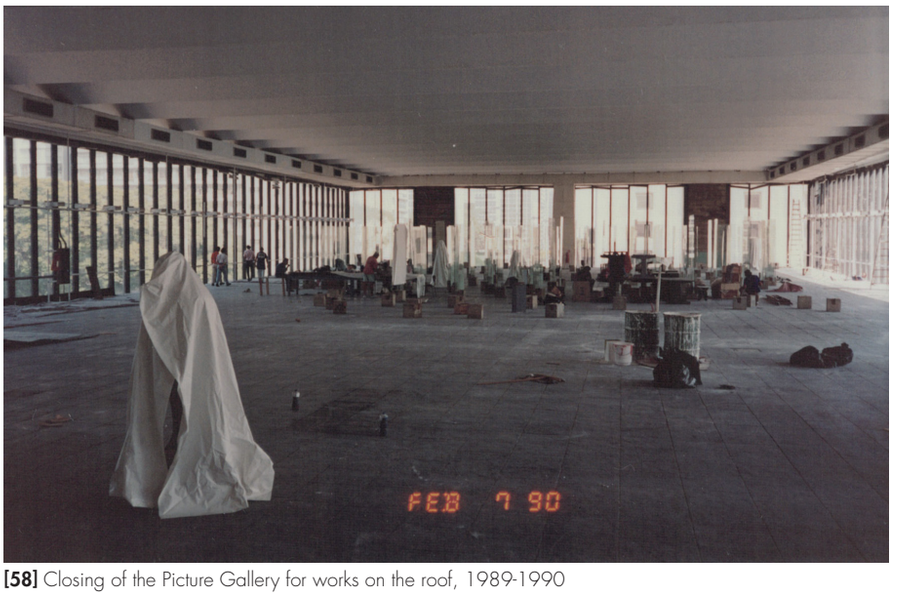
In the following years some smaller-scale interventions were carried out, normally for corrective and everyday maintenance that did not demand significant processes. Beginning in 2014, however, a new period of changes began, once again with larger-scale conservation actions and projects of spatial reconfiguration.

Generally, these projects decompartmentalized various areas of the building, reinstating the original values of transparency, fluidity, permeability and spatial amplitude. The exhibition designs being used now and foreseen for the next years also articulate the above-mentioned architectural approaches, aiming at their valorization and recognition.

30 Admission to the museum was free until 1990, when it started charging a fee in order to help with the institution's finances.

[56] Interventions to the building, 1987

[57] Waterproofing of the roof, 1989-1990



[58] Closing of the Picture Gallery for works on the roof, 1989-1990

On the first story, the administrative rooms became larger, and their separation is now made by transparent glass partitions oriented in accordance with the rhythm of the structure. As they are removable, they also allow the space to be reorganized in accordance with new demands. From this area it is possible to see the beams and ribbing of the floor above without any visual barrier, as well as the continuity of the metal framing of the glass façade.

No primeiro pavimento, as salas administrativas se tornaram mais amplas com a instalação de divisórias de vidro translúcidas, orientadas conforme o ritmo da estrutura. Por serem removíveis, também permitem que o espaço seja reorganizado conforme novas demandas. Dessa área é possível perceber as vigas e nervuras da laje acima, sem nenhuma barreira visual, bem como a continuidade dos caixilhos da fachada.

On the upper floor the most notable change was the removal of the dividing walls of the Picture Gallery, with the installation of a new design of Crystal Display Easels[31]. The floor is once again a single large room, free of dividing walls.

The new areas in the sublevels are delimited by glass partitions or furniture, as is the case of the MASP Store, installed on the first sublevel without any physical or visual barrier of the space it occupies. The current reception area, on the same floor, serves as a welcoming lobby to the museum, opening to the various architectural areas there. From this setting the visitor gets his or her first perception of the floor, but only upon entering the leisure space – café and store – can one grasp the floor in its entirety. The rest of the floor, including the mezzanine, is currently used as exhibition areas.

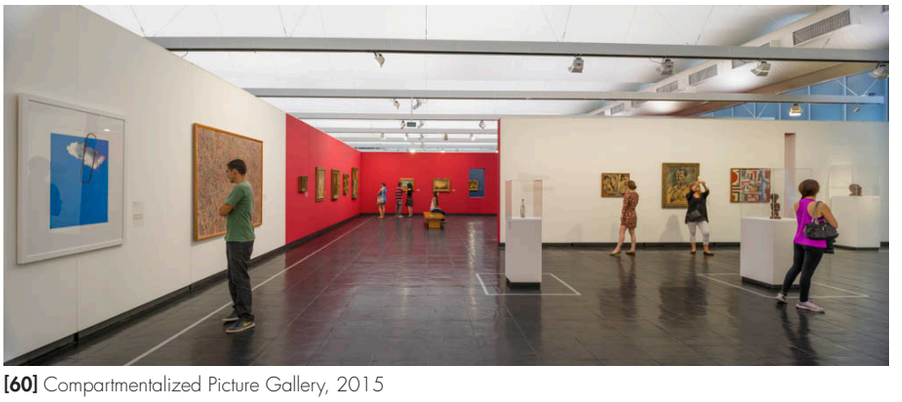
The larger auditorium, with 400 seats, has a constant programming of cultural and educational events, including recitals, debates, lectures, etc., as part of the museum's outreach program. For its wide use and diverse programming since its inauguration, as well as for its architectural expressivity, the large auditorium is a relevant space of the institution. The small auditorium, with 80 seats, has a programming that also attends to the previously cited activities as well as the internal demands of the museum team.

The second sublevel can be accessed by the red ramp-stairways leading down from the mezzanine or by the elevators. The entrance to the lower volume from the public square outside, Praça Arq. Rodrigo Lefevre, is seldom used since the former civic hall, located just inside the entrance, functions as an exhibition gallery. Due to the need to control sunlight from entering the museum, blackout curtains have been installed in some parts of the sublevels, blocking the transparencies between the interior and exterior. The other areas, however, remain with the glass windows showing the vegetation of the garden boxes and the museum's surroundings.

In the ground-level plaza there is a ticket counter and visitor's lockers in a controlled section. Nevertheless, the plaza as a whole remains open to use by the public, which

31 The new project design presents some technical changes, while maintaining the materiality, shape and color of the originals. To learn more, see: Concreto e Cristal: o acervo do MASP nos cavaletes de Lina Bo Bardi. Adriano Pedrosa and Luiza Proença (eds.), 1st edition. Rio de Janeiro: Cobogó, São Paulo, MASP, 2015

[59] Picture Gallery after the building's inauguration



[60] Compartmentalized Picture Gallery, 2015

[61] MASP collection exhibition (*Acervo MASP em Transformação*), Picture Gallery, 2015

is stimulated with an active programming of cultural events in the plaza, as well as by the plaza's free appropriation by cultural, social and political manifestations, independent from the museum's activities.

Noteworthy actions of the building's conservation carried out recently include the monitoring of the deformation of the main beams of the upper volume - both the pair running across the roof and the pair under the second upper story - and the repainting of the external set of pillars and beams in red. The latter project, carried out in 2015 and 2016, raised questions about the conservation of the reinforced concrete, which were partly solved in that same period.

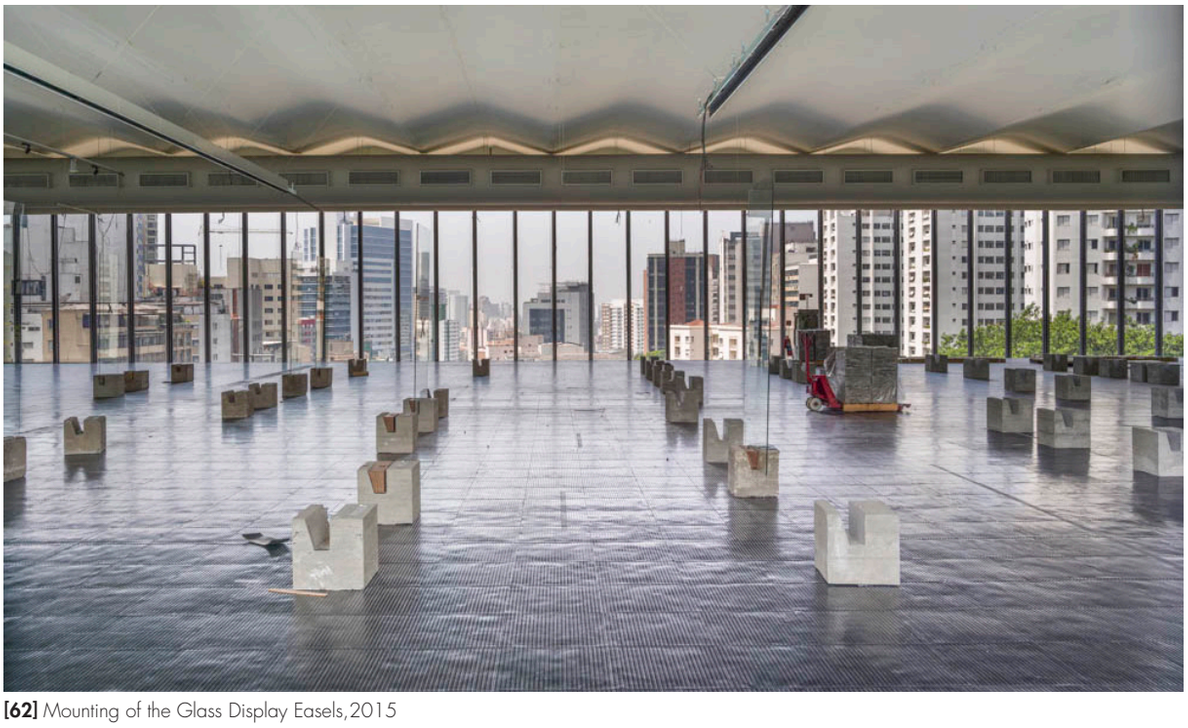
MASP Today

Over the years, the MASP building has gone through various interventions, with alterations in its layout, actions of corrective maintenance, the creation of new spaces, the recovery of infrastructural systems, structural reinforcements, and others. Alterations on a smaller or larger scale have not, however, caused the building to lose its fundamental characteristics.

Within this context of constant transformations of the building, the current management has been noteworthy for its actions in regard to institutional changes as well as physical questions of the building itself. It is important to underscore the current management's aim for the building to recover its fundamental original characteristics and to preserve values attributed to it over time, which have made it a key symbol of the city and an important cultural heritage for society.

The MASP building is arriving today at its 50th anniversary charged with a strong popular recognition and by its public and symbolic dimension. The ground-level plaza under the free span, for being a stage for various manifestations of a social, political and cultural character, has become a strong urban reference, a place for the identification of different social groups – artists, workers from the area, protesters, and tourists. The building itself, with its red pillars and beams and its large suspended volume, is configured as a symbol of Avenida Paulista and of the city of São Paulo. The museum, as an institution, is realizing its mission as defined in 2017:

> *"MASP, a diverse, inclusive and plural museum, has the mission to establish, in a critical and creative way, dialogues between past and present, cultures and territories, based on the visual arts. To this end, it should enlarge, preserve, research and raise the public's awareness about its collection, while also promoting the encounter between various public segments and art through transformative and welcoming experiences."*
>
> *[Exerpt of MASP Mission, estabilshed in 2017]*



[62] Mounting of the Glass Display Easels, 2015

[63] MASP on a Sunday closing of Avenida Paulista to vehicular traffic

MASP linha do tempo intervenções

1960

(1960)
•Design and construction of the foundations
•Planning of the first sublevel to the second floor
•Detailed planning of the lower volume (mainly concrete reinforcing)

(1961)
•Detailed planning of the upper and lower floors

(1962)
•Detailed planning of the reinforcing steel of the main columns and of the roof beams
•Suspension of the concreting of the Belvedere slab

(1963)
•Review of the design of the support framework of the roof beams
•Structure executed up to the level of Avenida Paulista
•Belvedere slab, unprotected from the weather, presents cracks and chinks

(1964)
•Startup of execution of main columns and beams
•Detailed planning (including anchoring method for cable ends) of the Ferraz Prestressing System

(1965)
•Prestressing cables break during execution
•Prestressing with additional cables is done
•Concreting of the two upper beams
•Execution of the roof slab

(1966)
•Detailed and logistical planning for the concreting of the lower prestressed beams
•Modifications in the structural plan of the second floor

(1967)
•Revision of the structural plan of the first and second floor
•Detailed planning of the connection of the lower prestressed beams and columns
•Top of columns and ends of roof beams complemented with reinforced concrete

(1968)
•April – end of construction work
•Roof beams present “sagging”

1970

1980

1990

(1987)
•Diagnosis of the pathologies of waterproofing and reinforced concrete

(1988)
•Recovery of cracks, concrete treatment and new waterproofing in the water mirrors

(1989)
•Treatment of the concrete in the columns and façades
•Recovery of cracks present in the ground-floor slab

(1990)
•Columns and beams are painted red

(1995)
•Deterioration of red paint

(1997)
•Topographic measurements of the roof beams
•Construction of third sublevel begins

(1998)
•Topographic measurements of the roof beams

(1999)
•Diagnosis of the deterioration of the interior of the roof beams and recovery of the reinforced concrete
•Repainting of the roof beams
•Project for additional stressing in the main roof beams
•Beginning of works for the leveling of the first and second floors
•Beginning of works for the structural recovery of the reinforced concrete beginning with the auditoriums on the first sublevel
•First report on the monitoring of deformations in the roof beams

2000

(2000)
- Identification of chinks and delamination of the concrete of the roof beams
- Painting of the columns
- Works for the structural recovery of reinforced concrete
- Second report on the monitoring of deformations in the roof beams

(2001)
- Deformation of the beams causes cracks in the paint
- Repainting of the columns and roof beams
- Third and last report by the monitoring of deformations in the roof beams

2010

(2007)
- Measurement of the elastic deformation of the roof beams

(2015)
- January: topographic survey
- January: Visual inspection of the beams without finding concrete conservation problems
- March: reading of the deflections of the main beams
- September: visual inspection of the columns
- October: new reading of the deflections of the main beams

(2016)
- April: visual inspection of the columns to detect pathologies
- Repainting of the pillars and beams in red

(2017)
- September: topography of the roof and intermediate beams

[64] Everyday scene in the plaza under the free span, 2018

2. OFFICIAL RECOGNITION

Heritage status

In 1982, the MASP building on Avenida Paulista was recognized as a cultural heritage by the São Paulo State Council for the Defense of Historical, Archaeological, Artistic and Touristic Heritage (CONDEPHAAT). In 1992, the building was declared an official heritage site by the Municipal Council for the Preservation of the Historical, Cultural and Environmental Heritage of the City of São Paulo (CONPRESP). In 2003, the building was also recognized by the National Institute for Historic and Artistic Heritage (IPHAN), recalling that its collection had already been declared a heritage by the institute in 1969. With this, the building has become recognized in all the relevant national heritage agencies.

Declaring a site an official heritage in Brazil has the main function of recognizing a place considered as a cultural heritage at the federal, state and municipal levels. In this sense, the "resolutions for recognition as an official heritage" are drawn up, seeking to identify and attribute value to these properties. Thus, in MASP's case, this means that the building and the institution have full recognition within the national territory. Nevertheless, the resolutions for MASP's recognition as an official heritage (see resolutions attached to this work) by CONDEPHAAT and CONPRESP only recognize the building as a heritage and do not make any reading of the value to be recognized[32]. For its part, the process by IPHAN, with different characteristics, results in an extensive volume of work that aims to make a wide-ranging reading. A large part of the values attributed by the federal agency, if not all of them, are incorporated in the significance described in the present work.

32 This is not a question involving only MASP, but something that has been developed over the years. The resolutions were written very succinctly, without periodic review, even when they could absorb new values, like those discussed in this work.

[65]

3. DECLARATION OF SIGNIFICANCE

Urban Value

The building of the Museu de Arte de São Paulo is an **urban building** due to its unique implantation on Avenida Paulista. Trianon Park and the valley of Avenida 9 de Julho compose its transversal axis, being part of the museum's cognitive and sensorial experience. A **horizontal building**, it stands out amidst the verticality of the buildings stretching along Avenida Paulista. Its forward alignment, closer to the avenue in relation to the other buildings, has contributed toward making the building an **urban landmark**. The **public ground-level plaza** known as **the MASP building's free span**, is a characteristic and fundamental element of the design, serving as a scenic overlook with a view toward the valley of Avenida 9 de Julho and beyond. This **architectural-urbanistic solution** also provides an **urban breath of fresh air**, insofar as it is a pause along the mass of buildings along Avenida Paulista and allows for views and framings that intensify the **building's relationship to the city**. It is a design that goes beyond the limits of the building and **designs the block**, compatible with its urban context and its transformations. The design demonstrates an **understanding of the territorial landscape** by potentializing the geomorphology of the territory – a relationship between the highest point of the city on Avenida Paulista and the valley of Avenida 9 de Julho, of the Saracura Stream – and allows a comprehension of the city on a broader scale, beyond its more immediate surroundings.

Aesthetic/Architectural Value

In the MASP building it is understood that architecture and structure are intrinsically related in an **architectural-structural solution**. Its bold and innovative form composes the building's recognized image. Its spatial configuration is organized based on this solution and creates unique internal and external spaces, the main values being **spatial amplitude**, **permeability** and **transparency**. It is based on these characteristics that the **interior-exterior relations** are created. The **relations between the building's spatial characteristics and its exhibition designs** should also be noted, especially those of the Picture Gallery, where an entire **floor free** of partitions allows for the union between the exhibition design and the spatial-architectural conception in an exceptional way, unique to this museum. The building **reveals the characteristics of its component materials**, explicating its functioning as well as the characteristics of its structure, waterproofing and technical installations. Its **visual composition** – shapes, colors and textures – are part of the building's characteristic expressivity, marked by **the red color of the external pillars and beams**, by the apparent concrete bearing the marks of its wooden forms, by the vegetation in the garden boxes, by the orthogonality of its shapes, by the rhythm of the metal framings of its outer glass walls and, finally, by the transparency and reflexivity of the windows. The building's composition is also defined by its shapes, fullnesses and voids, superpositions of textures, and the stepwise format of the terrain, which characterizes its **distinct volumetric set**.

Historical Value

It is understood that MASP is an **example of Brazilian modern architecture**. It is marked by its **structural innovation**, seeing that the novelty of its conception and construction lie not only in their high degree of experimentalism, but above all in presenting a technical solution of a singular and creative character. This pioneering approach is also present in the field of exhibition design: the solution of the **Glass Display Easels** in conjunction with their spatial arrangement in the Picture Gallery is an **exhibition design innovation** representing a rupture from the traditional European models that had previously been generally adopted in Brazil. Its **collection** is considered the most important one of European art in Brazil, recognized internationally for its relevance, composed of national and international artworks from various periods.

Social Valeu

MASP's ground-level plaza under the building's free span is a place recognized for its use and its **public dimension**. A place of encounter and shared experience among a wide range of social actors, it is also a stage for manifestations of a cultural, social and political character, with the holding of shows, performances, installations, etc. This public appropriation, together with its **location on Avenida Paulista** are fundamental factors for MASP's **popular recognition** as a **symbolic building**. Moreover, there is a strong link between the building and its use. MASP is a **building-museum**, revealing a **powerful relation between the building and the institution**, established and maintained since its conception, along with the **experimentation in the occupation of its spaces**. The museum possesses a sociocultural mission carried out based on its various activities, reinforced by the relations between its spatial configuration and its exhibition designs. The freedom of taking various paths through the building empowers the visitor with autonomy. This is reinforced in the Picture Gallery by the proposal of a desacralized art with **democratic access to the collection**, aligned with a cultural-educational outlook and a conception of the museum based on a spatial solution unique to the building. Of special note is the contemporary reading that valorizes the **building's having been designed by a woman architect**, among the few female professionals recognized in the history of architecture.

Guidelines

• Ensure the building's outstanding status and visibility defined by its implantation, maintaining its relation with Trianon Park and the valley of Avenida 9 de Julho, and with Avenida Paulista;

• Preserve the relationship with Trianon Park and the Avenida Paulista axis, in order to ensure the permanence of recognized values of the building and the public space. In regard to the alterations in the adjacent lots along the avenue, these have little influence on the questions of MASP's conservation, as they do not interfere directly with the museum's visual setting;

• Ensure the reading of MASP building considering its unit in the block;

• Ensure the comprehension of the volumes that compose the building without losing sight of the interrelated facets of the design;

• Ensure the permanence of the ground-level plaza under the free span, together with its integration with Avenida Paulista, in a continuous space, without fragmentations, with its visual aspects and its public appropriation;

• Maintain the characteristics of the materials and their visual composition of rhythms, textures and forms, preserving the consolidated image of the work;

• Include the red color of the exterior pillars and beams of the upper volume as part of the building's consolidated image;

• Ensure the mutual visibility and transparencies between the interior and exterior spaces, potentializing the relations between the building and the city;

• Respect and prioritize the design's main values – spatial amplitude, permeability and transparency – allowing the spatial reading of the different environments;

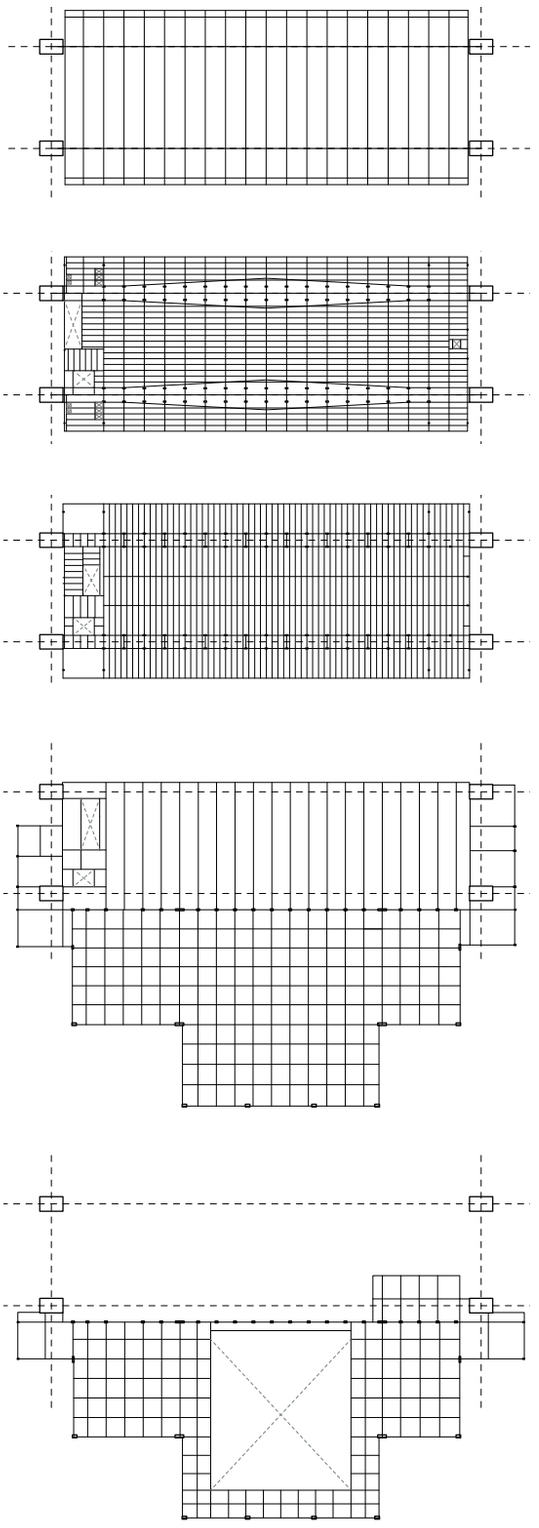
• Allow interventions that explore new possibilities of experiencing the space. Interventions that can eventually fragment the reading of the spaces of the building should be of a temporary character, justified by the museum's mission.

[66] Aeriel view

4. MASP' STRUCTURE

An understanding of MASP's structural system is essential for determining the conservation actions, as it is a key element in the building's expression as well as in its function. A thoroughgoing reading based on research of documents, monitoring and the development of projects can leverage effective conservation and maintenance to prevent the need for larger-scale interventions.

In a nutshell, MASP can be described as a building consisting of an upper volume, with two floors and a reinforced concrete roof, a lower volume with three semi-underground floors, and a ground floor that is an open-air plaza.



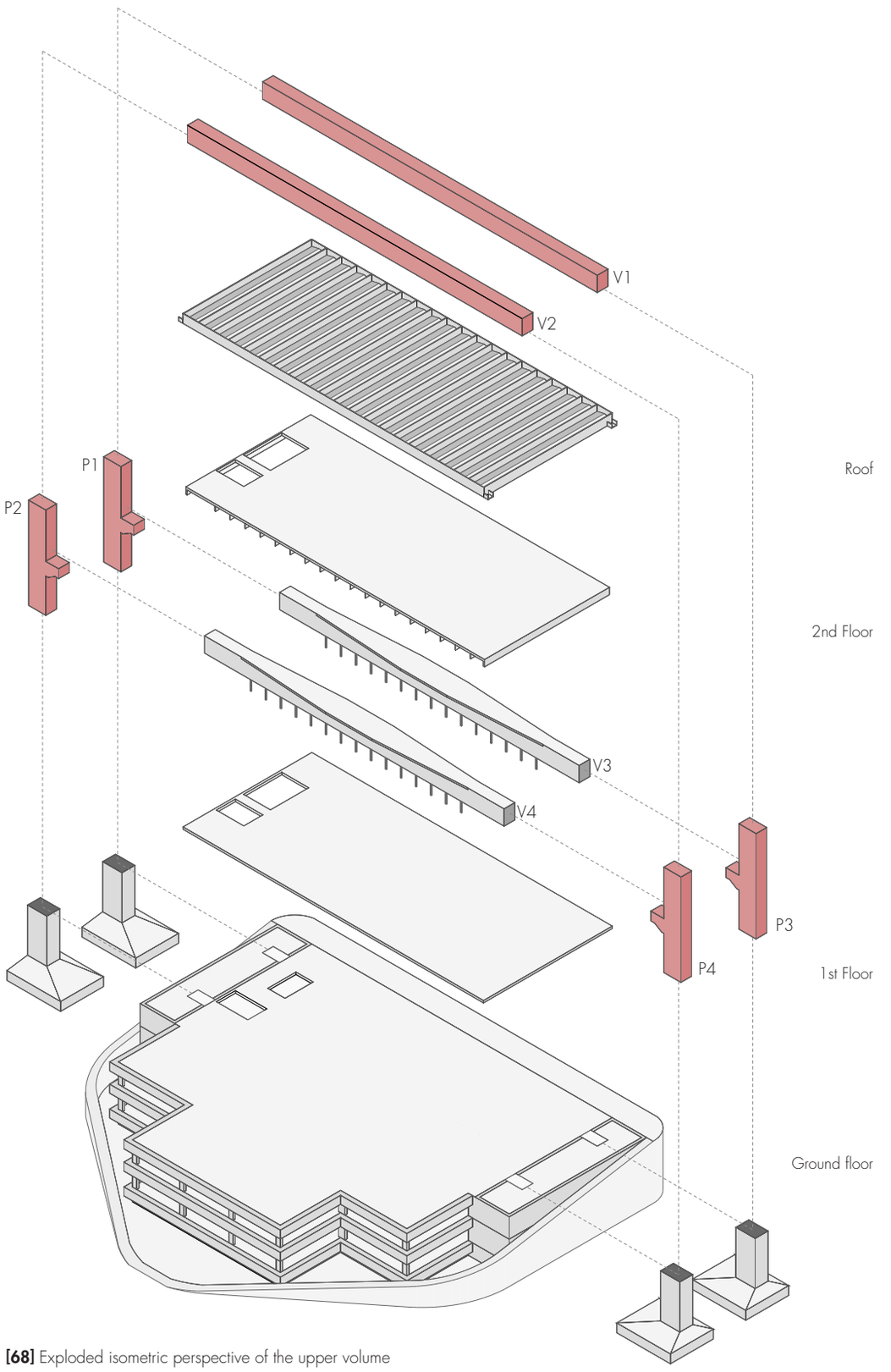
[67] Line drawing of the structure

UPPER VOLUME

The upper volume consists of three planes, four columns and two pairs of main beams – an exterior pair (across the roof) and an interior (intermediate) pair not visible from the outside. The exterior pair consists of two large prestressed concrete box-beams measuring 2.5 x 3.5 meters, spanning 74 meters with a constant cross-section, supported immovably on one end and lying on top the columns, with the ability to slide, on the other. The interior pair are also box-beams 3.5 meters high, prestressed, with a free span of 74 meters. They have, however, a variable compression flange and are supported on consoles on the columns.

Planes

The three planes of the upper volume are cantilevered out to the building's sidewalls. The plane of the first story consists of a waffle slab with 50-centimeter-high internal waffling, suspended by tie rods from the intermediate means. The plane of the second story, whose structure is visible from below, is a, 1.5-meter-high ribbed slab resting on top of the intermediate beams. The plane of the roof is composed by the juxtaposition of transversal beams. It is supported by the large roof beams, attached to their lower surface.

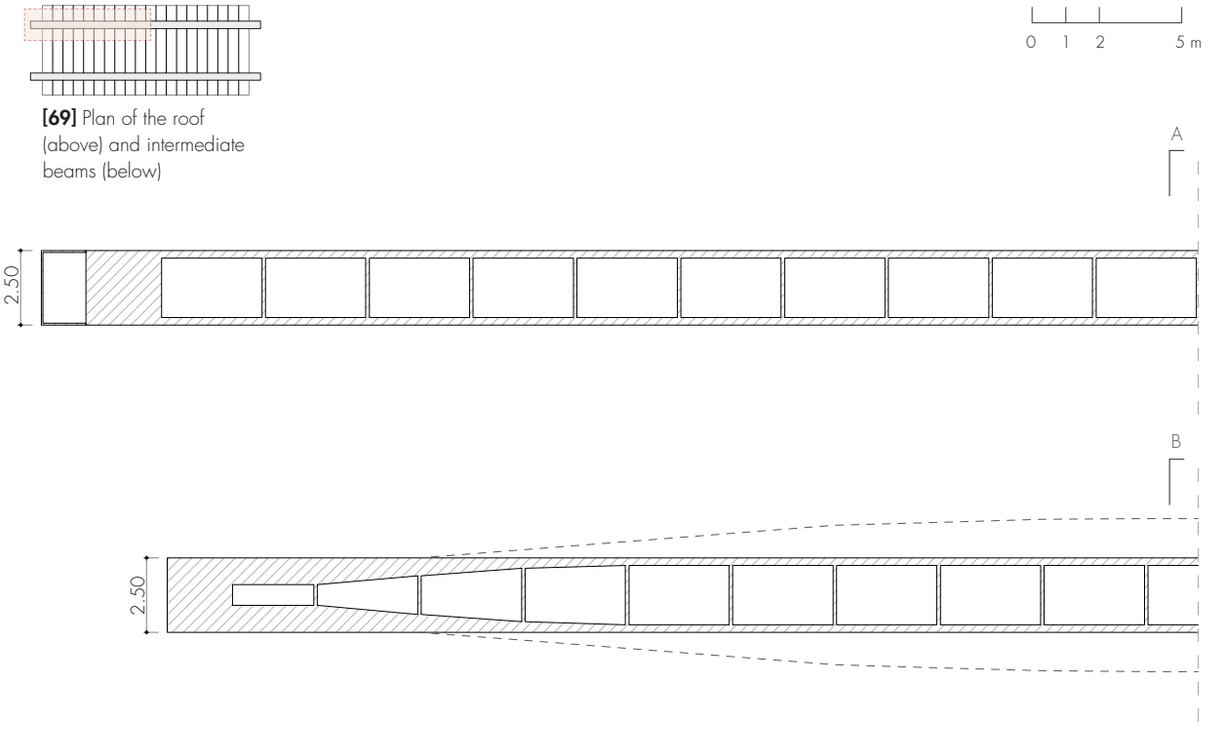


[68] Exploded isometric perspective of the upper volume

Main beams

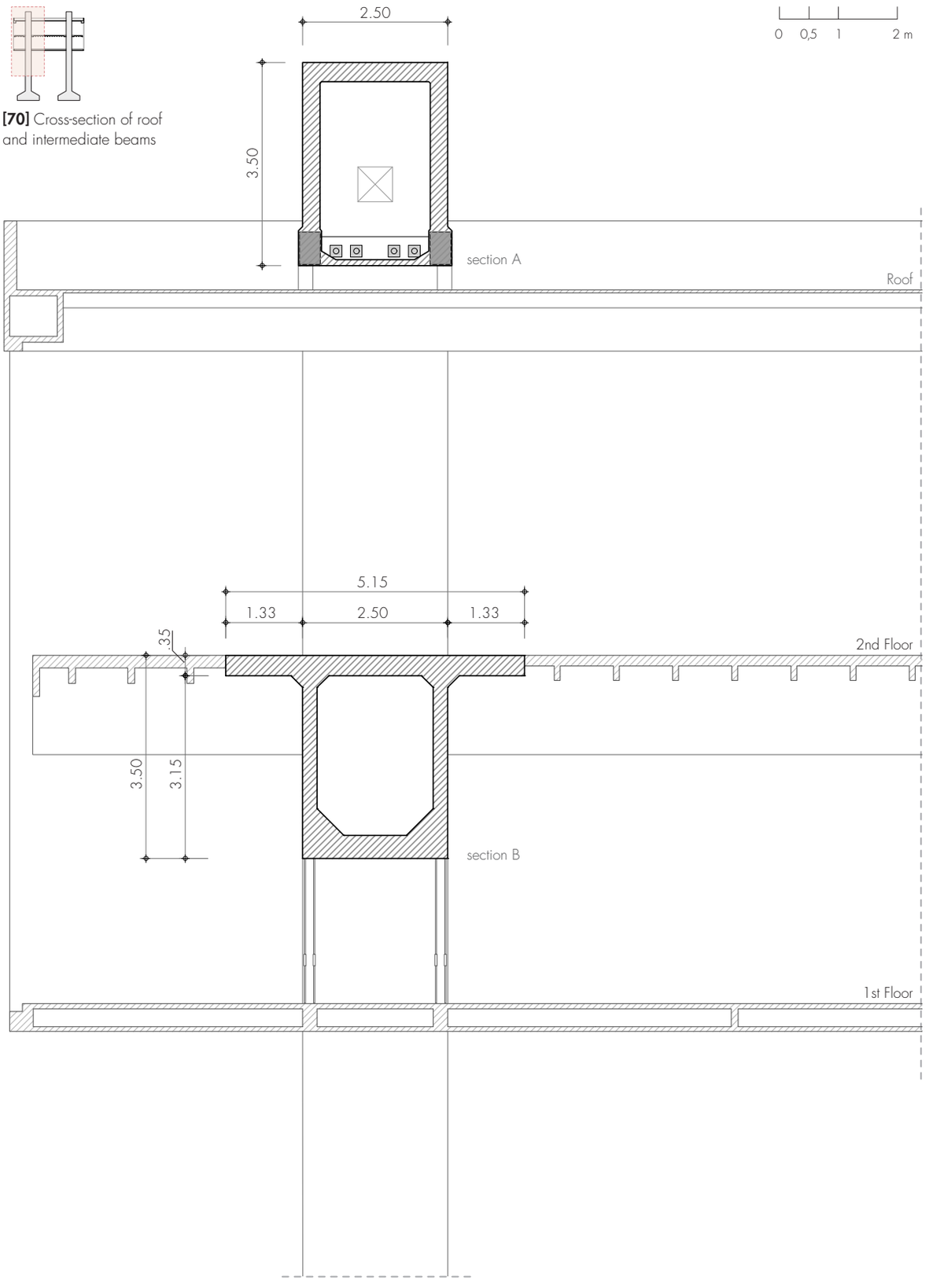
The pair of roof beams have a total length of 78.0 meters, a rectangular hollow cross-section of 2.5 meters wide by 3.5 meters tall, the lower flange 12 cm thick, upper flange 33 cm thick, with side webs 25 cm, thick and transverse webs at each 3.5 meters along its length. These beams are prestressed with steel cables along their lateral faces. Due to the impossibility of working with the Freyssinet System for anchoring the prestressing cables, Figueiredo Ferraz developed an anchorage system that became known as the "Ferraz System." The system made a loop in the cable at the fixed anchorage, in such a way that the continuous steel cable returned through the sheath to the mobile anchorage. The sheaths of the prestressing system were also used to decrease the heat during the curing process, as the high consumption of cement in the mix proportion developed for the high-performance concrete released a great deal of heat during the hydration process. For access to the beam's interior during the prestressing of the cables. the beam was concreted with an angled portion missing from its end. The end was later completed so that it met the top of the columns at a right angle, with an addition of concrete to obtain the desired geometry. As previously reported, these beams received a new prestressing external to the concrete in 1999, with the installation of four cables within the space inside the beam.

The pair of intermediate beams has the same structural conception, but with the particularity that their compression flange (the beam's upper part) has a variable cross-section. This solution allows it to support of greater weights, as it holds not only the first floor, suspended below it, but the second floor as well, resting atop it.



[69] Plan of the roof (above) and intermediate beams (below)

[70] Cross-section of roof and intermediate beams



Columns

The external geometry of the four main columns is defined by a constant rectangular cross-section of 2.5 meters x 4 meters. Structurally, however, they are divided into three different segments: from the footings up to ground level, from ground level up to the consoles that support the intermediate beams, and from the consoles to the top, on which the roof beams rest. Starting at the bottom surface of the footing, the total height of the columns is 35.35 meters, of which 14.10 meters is underground and 21.25 meters is exposed above ground level.

The lower part of the columns, from the footings up to ground level, has a solid rectangular cross-section of 2.5 x 4.0 meters. The intermediary section, from ground level up to the consoles, has a hollow rectangular cross-section of 2.5 x 4.0 meters, with side webs of .5 meters thickness and flanges of 1.0 meter thickness. As it needs to resist the bending forces due to the eccentricity of the consoles, this section of the columns is much more robust than that of the upper section, extending from the consoles up to the top, on which the roof beams rest.

Finally, the upper part, from the consoles to the top, has a height of 10.35 meters. Its structural part consists of a single column of solid reinforced concrete measuring 2.5 meters by 1.0 meter, concealed within an outer box of nonstructural concrete just 6 inches thick, to maintain the same outer geometry up to the top The interior of columns P1 and P2 are equipped with Freyssinet-type pivots allowing for the articulation of one of the supports. This prevents the transmission of a bending force to the columns by allowing for horizontal movement and isostatic condition of the roof beams, ideal for the prestressing.

Consoles

The consoles are located 10.90 meters above ground level and support the main intermediate beams. They consist of concrete blocks with a base measuring 2.5 x 7.0 meters a height of 2.9 meters. Their steel reinforcing is prestressed in order to mitigate cracking on their upper surface.

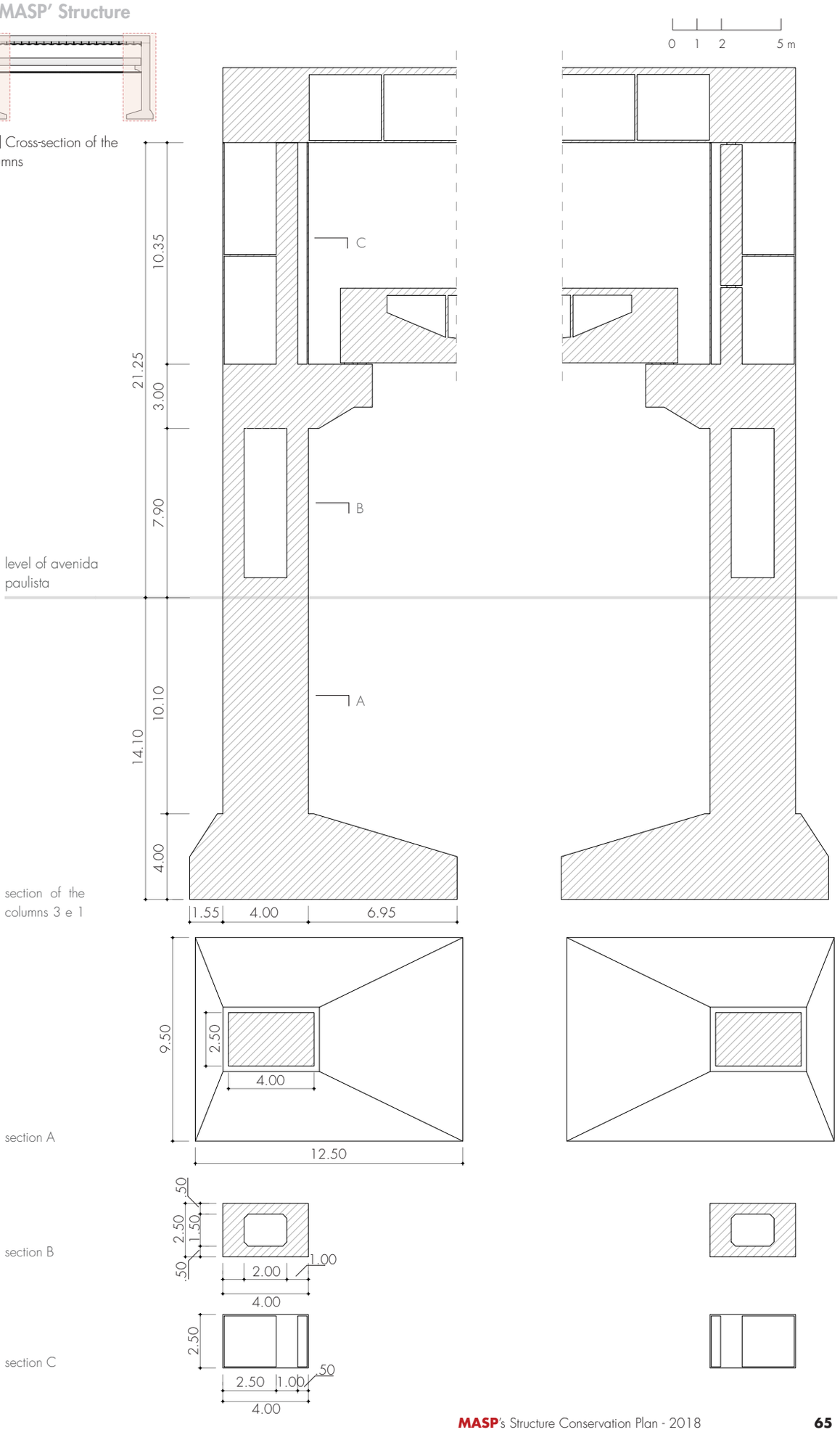
Footings

The columns absorb the normal forces and bending moments generated by the eccentricity of the supports for the beams and discharge these forces through the footings. Their geometric center was positioned eccentrically to distribute forces uniformly in the soil. Each footing measures 12.5 x 9.5 meters at its base; its geometric center is displaced inward in relation to the building's projection, at a distance of 2.7 meters in relation to the column that it supports.

Materials

The materials used in the structure of the upper volume were high-strength concrete developed during the construction of the work and the prestressing with steel cables in sheaves filled with concrete cream (bonded prestressing). The ribbing, waffling and other structural elements are made of reinforced concrete.

[71] Cross-section of the columns



LOWER VOLUME

The lower volume consists of four semi-underground levels: the ground-level plaza consisting of a continuous plane, the first sublevel on a plane partly supported directly on the soil (theater section) and partly suspended in a grid structure (gallery); the second sublevel, originally supported directly on the soil, but later structured as a solid slab for the excavation and creation of the third sublevel (collection storage area), which is supported directly on the soil.

The ground-level plaza

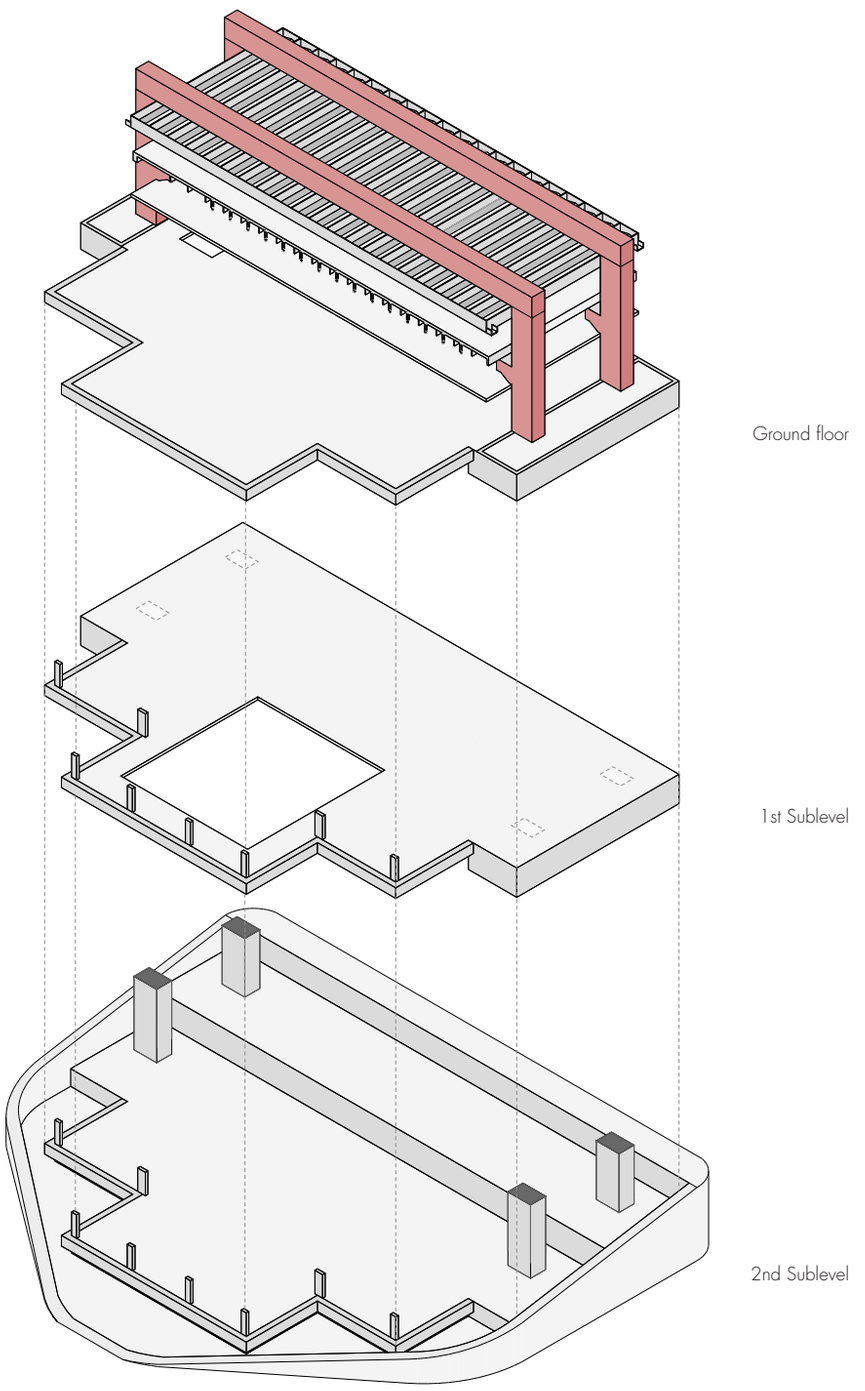
The upper surface of the ground-level slab is configured visually as an open plaza. Its structure is divided in two structural types. The part directly under the upper volume, corresponding to the roof of the auditoriums in the lower volume, consists of a waffled slab. Its 1.2-meter-high beams spaced 3.2 meters apart span a distance of 20 meters, from the retaining wall along Paulista Avenue to the top of columns supported on the retaining wall on the other side,made for the creation of the second sublevel. The part that extends out from under the upper volume also has a waffle structure, with beams 1.5 meters high and the same spacing as the other section (3.20 m). This grid is supported on the columns of the façade along 9 de Julho Avenue.

1st sublevel

In the auditoriums section of the 1st sublevel, the floor rests on the soil, while in the gallery section the floor is a suspended slab with the same structural solution as the waffled slab of the ground-level plaza, with beams 1.50 meters high and the same spacing of 3.20 meters. For the best performance of the grids, this part is configured in three section separated by beams of the same height, but with hollow cross-section.

2nd and 3rd sublevels – Foundations

The second sublevel originally rested directly on the soil, with footings supported directly on the ridge that Avenida Paulista runs along. When the third sublevel was created in 1997, the foundation was complemented with piles in the form of stakes and pipes.



[72] Exploded isometric perspective of the lower volume

5. THE MASP'S STRUCTURE CONSERVATION PLAN

The researches carried out for the MASP's Structure Conservation Plan[33] allow for an understanding of the system's behavior and state of conservation. Besides the data of the original design, an analysis was made of the effects of time, subsequent interventions, conditions of use, the performance of reinforced concrete, and pathologies. It is a plan that indicates monitorings, direct actions on the building, and studies that are necessary to ensure its preservation.

In this sense it is important to clarify some points that contribute to the implementation of solutions for questions raised, with the establishment of adequate procedures:

• The understanding of the body of the building as a unit is essential both for devising solutions to problems that arise as well as in the definition of actions, while also considering the interfaces among elements. As MASP is a building in which the structure is the element that unites all the systems, many of the problems have unfoldings that need to be evaluated in combination, as will be presented below.

• Given the inherent nature of movements within the building's structural system, the search for a definitive stability is infeasible. This work points to the need of constant monitoring in light of the specificities of this structure. There will always be issues, which if treated in a technically appropriate and timely way will not hurt the building's preservation.

• The reinforced concrete used in the building possesses characteristics developed specifically for the structure, in accordance with the then current standards and using the technologies available at that moment. Since that time, these parameters have evolved. It is essential to understand this process and to have a critical perspective on what was planned and constructed. It therefore does not make sense to apply current standards; rather, the aim should be to understand the best way to treat the building. The transformation of the materials over time should also be considered. At this moment, there are tools and technical knowledge that will allow for a more precise assessment of the structure's state of conservation and behavior.

• Considering the evolution of the tools that can be used to study the structure, and of the technologies for the treatment of reinforced concrete, and the inclusion of new data based on systematic and continuously ongoing research, it is understood that this plan is a document that should be revised and updated. The recommendation is for revisions carried out at approximately 5-year intervals.

• The implementation of this plan requires the institution to orient its teams in ways consistent with these proposals, in everything from the administrative and financial sector to the professionals who carry out the actions, with a technical team duly instructed to carry out the conservation tasks. This conservation/maintenance team is also an important tool for eventual revisions.

• Insofar as the structure uses different sorts of concrete in different ways, the diagnostic recommendations cannot be generalized. For a given problem found in the building's structure it is essential to identify the causes, which can vary in each

[33] All the documents found and organized in this research are available in digital files according to the tables attached to this plan.

situation, leading to different procedures.

• Apart from the various sorts of solutions required on an urgent basis, continuous maintenance actions are always necessary in order for the building to maintain a good state of conservation without the need for larger-scale interventions that would interfere with the building's established image.

• The results of the findings with the technical parameters are in the attached reports and should be consulted for future assessments of the state of conservation and performance of MASP's structure.

• Besides establishing a schedule of procedures, it is important to construct a methodology of analysis and archiving of the results. For every action, a technical report should be generated with the results obtained. This analysis should be done by a professional independent from the team that executed the procedure, to evaluate the results achieved. It is necessary that standards of evaluation be established so that a consistent historical series can be constructed.

Methodology adopted

One of the challenges faced in developing the proposal to study MASP's structure in order to develop its Conservation Plan was to define the directions of the study and where it should be deepened according to the progress of the work. Initial knowledge about the structure did not allow for the prior definition of the questions that should be approached and that were defined as the work advanced.

The approach used in the study of the structural elements and the elaboration of guidelines and procedures of action was based on the analysis of the building's behavior and its material integrity. To this end, the building's plans were studied, along with reports of its construction process and later interventions, along with surveys, prospections and analyses of the building.

A digital model of the structure was constructed in STRAP software, parameterized with design data and on-site surveys in order to allow for a precise simulation of the building's behavior. The digital file of this model is available to be used as a laboratory for studies and future planning and projects.

In regard to the building's material integrity, the study of pathologies prioritized the identification of the typical problems and the establishment of guidelines and procedures to treat them, evaluating the questions by sampling, based on minimally invasive procedures. Thus, a global mapping should be made of the pathologies in order to ensure a correct and systemic treatment.

It is important to consider that some of the pathologies found could be directly related with the behavior of the structure, in a continuous process of cause and effect. The structural model can serve in this case to verify the relationship between

some pathologies and the behavior of the structure, with a broader understanding that ensures that they are treated in the best way.

Degree of urgency and periodicity

In regard to the degree of urgency, the recommended actions are divided among:

• Immediate: actions that should be carried out as soon as possible in order to prevent future damage to the system.

• Short-term: actions that should be carried out in order to ensure a good state for the building, but which can wait for budgeting that should be initially directed to immediate actions.

• Recommendation: complementary actions that benefit and deepen the maintenance processes.

In regard to the periodicity of the procedures, it is understood that once they are begun they should be continuous, without the possibility, at this moment, of determining an end date.

Risks

In the field of the preservation of cultural heritage, analysis of risks is an essential theme for the drawing up of a conservation and maintenance plan. Various sorts of actions should be listed that could result in problems or damages to the asset, while outlining strategies for minimizing them.

The risks listed are restricted to the structure of the building, although the methodology should be adopted for the other systems.

• A deepening of studies concerning the building: the lack of knowledge about the structural system, its material characteristics and behavior leads to actions that could be harmful to conservation. This plan presents a set of information and findings that are important for the actions to be carried out, while also indicating the need for more thoroughgoing knowledge in regard to various questions and other systems that make up the building (window casings, roof, electrical and plumbing installations, waterproofing, etc.)

• Establishment of a trained maintenance team and maintenance procedures: the procedures for daily maintenance and conservation should be set forth in a clear way and made available to the museum's teams – all the teams, ranging from maintenance to the directorship. It is essential that the tasks carried out are recorded and that the records are organized in order to serve as a basis for future works. This sort of control avoids the risks of works carried out in a precarious way that could result in large-scale problems.

• The hiring professionals with proven technical skills, duly evidenced by documentation, thus avoiding the risk of gaps in the information, which would jeopardize the building's good conservation.

• An understanding that the building, even though it has been declared an official heritage site, is subject to modifications due to demands of use, legislation, and safety. Being declared a cultural heritage, and having cultural value, must not be allowed to hinder transformations in this sense, as otherwise there is a risk to the building's continued use and occupation.

6. PLAN OF ACTIONS

The actions presented below are aimed at solving fundamental questions for the building's conservation. The research has confirmed that there are no aspects that can lead to structural problems that would compromise the system's stability in the short term. With the passage of time, however, the measures recommended in this plan will be necessary to avoid the worsening of problems which, if treated on a timely basis and correctly, will not result in serious problems for the building.

Among the listed actions, those that should be executed immediately are:

• Contracting and execution of the plan for tuned mass damping to minimize the impacts of vibration of the floor slab at the level of Paulista Avenue;

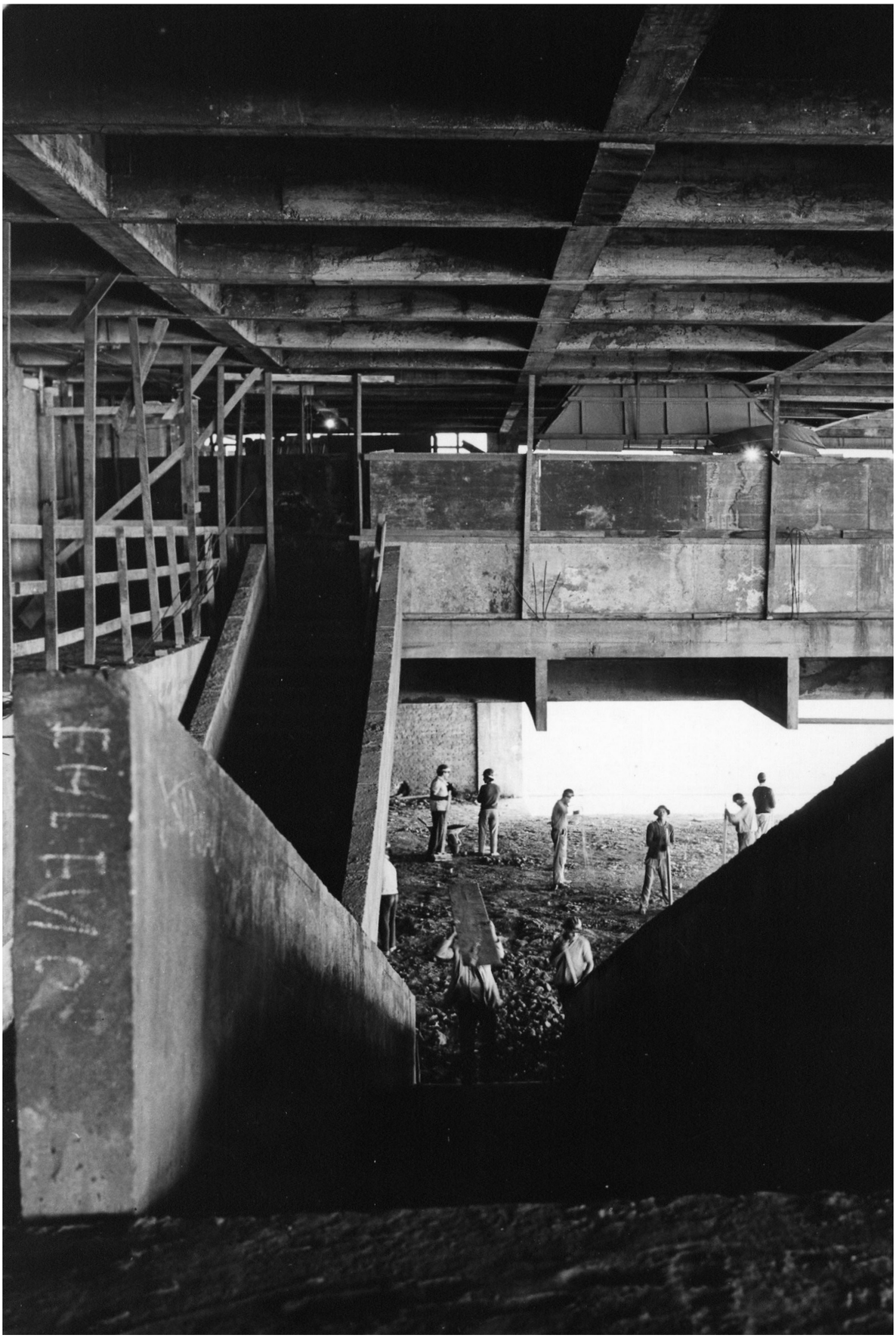
• Treatment of the crack in the beam along the stairway on the first-floor slab: the concern with the prestressed beam under the slab of the restroom is not new, it appears in the report by engineer Dirceu de Almeida dated June 23, 1987. The urgency of the treatment is due to the long exposure of the reinforcing steel to corrosive agents;

• Establishment of a solution for waterproofing the roof, and for the rain water to flow off from it;

• Making a global map of damage in the building and consequent treatment of the problems found.

This plan does not aim to exhaust the possible investigations and procedures. Rather, it opens the possibility for new researches and the establishment of more actions for the building's good conservation.

The recommended procedures complement one another in a way that allows for a more thoroughgoing knowledge of the building. Ignoring or leaving out part of the recommended works will lead to a partial knowledge of the problems and of solutions, meaning that the questions might not be solved effectively.



[73] Construction of MASP, Av. Paulista, 1957–1968

6.1 ASSESSMENTS/SURVEYS

The deepening of the information regarding the building's structure contribute significantly to the planning of projects for the museum. The precise knowledge of the dimensions of the structural pieces (as built), their strength, and other parameters are not merely essential data but tools that contribute toward the decision-making, whether for conservation and maintenance, or for actions for alterations of exhibition furniture or exhibition designs. For its part, the global mapping of pathologies is essential for the building's good conservation. It should be noted that some evident situations should not wait for the mapping and can be treated immediately, as they can be detected by visual inspection while awaiting the deeper diagnosis. Treatments recommended for these cases are already duly considered in this plan (see item 6.2 Typical Pathologies of Reinforced Concrete).

Mapping of Pathologies

The viability of executing the recovery actions should be considered since the mapped information has a validity that expires after a period of two years.

Performance of the pieces

The surveys of the main beams and columns indicate concrete and steel reinforcing of good quality and strength, considering the standard and age of the building. The compactness and homogeneity also present excellent indexes, compatible with the structural requirements. When the strength of beams and columns are compared with one another there are considerable differences of characteristics that correspond to the specifications of the plan and do not have an impact on the functioning of the system. This information should be taken into account in regard to future interventions. Considering that these parameters were evaluated only in the main column and beams, it is important to carry out a similar sampling in other elements of the system in able to confirm their state of conservation.

Survey of the structure

There is no "as built" survey of the building's structure that contains all the real dimensions of the pieces. Carrying out this survey is recommended to support the studies and to inform future projects, as well as day-to-day interventions.

ACTION 1

Map of damage – mapping of pathologies (complete diagnosis)

- **Elements**

Reinforced concrete surfaces

- **Urgency**

Short-term

- **Periodicity**

every 10 years

- **Guidelines**

The general mapping of pathologies should be carried out whenever there is budget availability for the treatment of the problems found. Otherwise, the result obtained loses its validity over time, as new issues tend to systematically appear.

The procedures should not be considered as a rigid prescription to be followed step-by-step, and may be adjusted and enlarged according to the advance of the general diagnosis.

- **Procedures**

1.Façades

1.1 Scanning by laser to generate a three-dimensional model of the surfaces and initial location of the areas presenting pathologies;

1.2 Visual, close-up inspection of the areas identified with pathology/contaminations for the delineating and determination of their nature: the existence of mosses, black crust, eruptions and eventual points of oxidation stemming from compromised reinforcing;

1.3 Tapping test mainly in the regions with evidences of damage using a metallic hammer for the identification of loose or delaminated parts, or with a hollow sound, with removal of the parts in danger of imminent falling and provisory protection of the exposed segment;

1.4 Verification of the insertion (interface) of window casings in the structure through the opening of inspection windows, in both the upper and lower parts, and the recording of what is identified.

2. Roof

2.1 General sweep of the entire roof slab by thermography made at the level of the picture gallery for the location of infiltrations, whether in the gutter beams or transversal beams;

2.2 After the removal of the existing waterproofing it will be possible to evaluate the state of the concrete, which should follow the same procedures indicated in item 1.Façades;

2.3 Evaluate the state of the prestressing of the gutter beams through techniques and instruments applicable to prestressing, including: measurement of surface hardness, thermography, ultrasound and electrical potential;

3. Garden boxes

Procedures analogous to those of the façade in regard to the concrete on the outer face, studying the existing waterproofing and evaluating the drains in the garden boxes and their effectiveness.

4. Garden boxes

Monitoring cracks in regard to length and gap through measurement and location, identifying which cracks are active by applying plaster seals or by gluing a pane of glass to the concrete extending to each side of the crack and recording eventual movement and extension.

5. Slab at the level of +8.40 meters (first floor)

Monitoring cracks in regard to length and gap through measurement and location, identifying which cracks are active by applying plaster seals or by gluing a pane of glass to the concrete extending to each side of the crack and recording eventual movement and extension.

6. Slab at level +/- 0.00 (ground level)

Carry out a careful evaluation to identify the conditions of the waterproofing of the slab itself and of the water pools, using thermography with photographic capture made from the floor below.

• Related Reports

Ensaios e testes na estrutura e elementos arquitetônicos - Museu de Arte de São Paulo | PIRES & GIOVANETTI | 09.10.2018 | 746-18_ARQ_REL_DOC_EP_R03

ACTION 2

Verification of the strength of the reinforced concrete, homogeneity and compactness in the pieces indicated;

- **Elements**

Structural elements of the sublevels and upper volume

- **Urgency**

Recommendation

- **Guidelines**

Prioritize noninvasive and semi-invasive procedures.

Make tests in areas of low visibility.

Recompose areas according to general procedures for structural recovery.

Complement the structural model with the data obtained.

On the occasion of future structural projects, aiming at the structural rehabilitation and increase of the structure's useful working life, consider the differences between the strengths of the columns and beams.

- **Procedures**

Ultrasound test

Assessment using a cover meter

Measurement of surface hardness

Alkalinity test

Extraction of concrete sample for test of strength and composition

- **Related Reports**

Relatório Técnico de Ensaios para quatro pilares, duas vigas intermediárias e duas vigas superiores em concreto armado e protendido do prédio do Museu de Arte de São Paulo - MASP na cidade São Paulo | PETRA CONSULTORIA | 23.07.2018 | Relatório Técnico de Ensaio RTE 18.04.10.33 – Revisão (0)

ACTION 3

The "as built" analysis of the structure – survey of measurements

- **Elements**

Structural elements of the entire building

- **Urgency**

Recommendation

- **Guidelines**

Making the technical drawings – cross-sections and floor plans – with the measured dimensions.

Note: For this sort of survey it could be necessary to drill some of the elements in order to measure their dimension (for example, the first-floor slab)

- **Procedures**

Making this survey may require various methodologies such as survey by total station, laser scanning with point cloud in addition to the actual surveys made with traditional methods.

6.2 TYPICAL PATHOLOGIES OF REINFORCED CONCRETE

The studies on pathologies of concrete were made by sampling, prioritizing the tests on the columns and main beams[34]. Other pathologies could still be detected in future investigations.

The procedures for pathologies set forth in this plan are subject to change in regard to location, form of application, the possibility of tested alternatives, viability of execution, or the possibility of new, more appropriate technologies, which could arise on the market.

34 Results of these tests are found in the following document: Petra Consultoria. "Relatorio Tecnico de Ensaios para quatro pilares, duas vigas intermediárias e duas vigas superiores em concreto armado e protendido do prédio do Museu de Arte de São Paulo – MASP na cidade São Paulo – SP." Americana, July 23, 2018. RTE 18.04.10.33 – Revision (0).

Biological patina and black crust

Biological patina is the development of fungi and microorganisms that generally occur on the parts exposed to moisture. Black crust is a mix of grime, growth of microscopic organisms, and biological patina in general. Both are vectors of pathologies that can be detected in a visual inspection.

Carbonation of the concrete

Reduction of the alkalinity of the concrete at places exposed to weathering. The carbonation becomes a serious pathology when it causes corrosion in the steel reinforcing. According to the survey carried out, the main columns and beams present a low carbonation index.

Corrosion of steel reinforcing

A process commonly caused by carbonation, but it can also be initiated by other causes that occur at MASP. In the case of the columns and beams checked, the steel reinforcing presents a low potential of corrosion. Points with a low amount of cover were identified, however, requiring greater attention for their protection.

Delamination of concrete

This occurs due to insufficient covering of the reinforcement, corrosion and expansion of the steel, degradation of the concrete by water infiltration, action of pathogenic agents and deficient waterproofing. It can also occur at interfaces with other elements, such as window framings, railings, etc.

Cracks

Cracking is a process inherent to concrete, which takes place due to retraction in the curing process, forces arising from weight loading, changes in the conditions of stability of functions, external vibrations, thermal gradient, deformations and movements.

While on the one hand the mapping of the damages allows for the precise detection of the conditions of the reinforced concrete, in relation to cracks, some points have already been identified that should be monitored – see ACTION 8, 9 and 10 – for determination of its (active or passive) state, and procedure for adequate recovery.

[74] [75] [76] Pathologies in the lower part of the first floor slab (ceiling of the plaza under the free span) and in the roof beam

[77] [78] [79] [80] Pathologies in the façades of the lower volume

GENERAL GUIDELINES FOR REINFORCED CONCRETE SURFACES

• Apply preventative surface protection to all the surfaces of reinforced concrete;

• Consider questions of appearance, minimizing alterations of texture and coloration and the process of maintaining and repairing reinforced concrete. Maintain the characteristics of the materials and their visual composition of textures and shapes;

• Carry out tests outside the body of the building in order to identify the best procedure, whether from a technical or an aesthetic point of view. In this sense, the tests should reproduce the situations of the building where they will be applied, considering the position, sunlight, and weathering conditions. If it is necessary to test on the building itself, a small and less visible area should be chosen, so the visual interference will be as slight as possible;

• Consider the treatment of the pathologies in an integrated and global way to ensure the best conservation of the system;

• Consider interfaces with adjacent elements (for example the capture of rainwater, lightning protection systems, window casings, etc.).

ACTION 4

Periodic cleaning and maintenance procedures

- **Elements**

Reinforced concrete surfaces

- **Periodicity**

every 5 years

- **Guidelines**

In the areas with signs of carbonation, corrosion of the reinforcing and delamination of the concrete there should be a special focus on prevention and protection;

To avoid alterations of texture and coloration: use silicon-based materials, polyurethane-based materials, or cutting-edge hydrophobic solutions that use nanotechnology;

- **Procedures**

a. General cleaning with neutral detergent and water jet with controlled pressure – test for adequate pressure for the different elements;

Cleaning of the biological patina, grime, black crust and carbonation with the use of biocide, surfactant detergent patches, in conjunction with tests to determine concentration and time of action;

Segregating cleaning with the removal of material that is detached, creating dust, or with imminent risk of falling off.

b. Protection of the surface with the use of hydrophobic or protective agents.

- **Related Reports**

Museu de Arte de São Paulo - arquitetura, estrutura, patologias e conservação - Informações complementares | PIRES & GIOVANETTI | 22.10.2018 | 746-18_ARQ_REL_DOC_EP_COMPL_R03

ACTION 5

General procedures for structural recovery

• Elements

Reinforced concrete surfaces

• Urgency

Immediate recovery in places with exposed steel

• Guidelines

Treat the identified area to avoid contamination of the adjacent areas.

• Procedures

Superficial and deep recomposition, observing the structural recovery protocol. Include passivation treatment of the reinforcing rods whenever necessary. A method should be used for the recomposition of texture and color of the surface of the concrete, considering the relevance of these aspects in the perception of the building as a cultural asset;

Recomposition of rebars in case of loss of materials and reduction of section properties, in accordance with the pertinent standard. The procedures should be validated by a civil engineer, with special emphasis when it involves prestressed pieces.

• Related Reports

Museu de Arte de São Paulo - arquitetura, estrutura, patologias e conservação - Informações complementares | PIRES & GIOVANETTI | 22.10.2018 | 746-18_ARQ_REL_DOC_EP_COMPL_R03

ACTION 6

Monitoring of Recurrent Pathologies

- **Elements**

Concrete surfaces

- **Urgency**

Immediate

- **Guidelines**

Check for the existence of problems whenever any day-to-day maintenance is done;

Regularly monitor the recurrent pathologies;

Carry out periodic verification for the treatment of punctual and recurrent problems during the time between larger-scale mappings;

Investigate causes and define treatment after the identification of a problem;

- **Procedures**

Visual verification of surfaces for the identification of exposed steel, concrete in risk of imminent fall, infiltrations, etc.;

Immediate treatment based on procedures indicated in Action 5 - General procedures for structural recovery.

- **Related Reports**

Ensaios e testes na estrutura e elementos arquitetônicos - Museu de Arte de São Paulo | PIRES & GIOVANETTI | 29.05.2018 | 746-18_ARQ_REL_DOC_EP_R01

ACTION 7

Monitoring of cracks

- **Elements**

Reinforced concrete surfaces

- **Urgency**

Immediate

- **Periodicity**

Semiannually

- **Guidelines**

Carry out comparative analyses between reports of monitoring to identify areas of probable re-incidences that could indicate problems of greater magnitude;

Carry out treatment in accordance with ACTION 5

- **Procedures**

Use of plaster seals (internal area) or panes of glass (external area);

Rangefinder and thermography can be used as a support activity;

- **Related Reports**

Ensaios e testes na estrutura e elementos arquitetônicos - Museu de Arte de São Paulo | PIRES & GIOVANETTI | 09.10.2018 | 746-18_ARQ_REL_DOC_EP_R03

Museu de Arte de São Paulo - arquitetura, estrutura, patologias e conservação - Informações complementares | PIRES & GIOVANETTI | 22.10.2018 | 746-18_ARQ_REL_DOC_EP_COMPL_R03

ACTION 8

Monitoring of cracks in the roof beams

- **Elements**

Roof beams (see item 6.6 main beams)

- **Urgency**

Immediate

- **Periodicity**

Monthly

- **Procedures**

a. Removal of painting in a 50-centimeter segment in the middle of the span, on the lower part of the beam's lateral face. Affix three panes of test glass for verification.

b. If the monitoring identifies movement, evaluation should be carried out to verify its causes (see item 6.5 Deformation: Main Beams).

- **Related Reports**

Arranjo estrutural do MASP, Modelo estrutural e verificações | CIA DE PROJETOS | 24.09.2018 | 688-MASP-ESTRUTURAL-R001-R0

ACTION 9

Monitoring of cracks in the waffling N10

- **Elements**

Waffling N10 (see item 6.6 first-floor slab)

- **Urgency**

Immediate

- **Procedures**

Removal of segment of area of flooring on the first floor at the first line of suspension rods for the measurement and control of cracks;

Determination of procedures in accordance with the situation found.

- **Related Reports**

Arranjo estrutural do MASP, Modelo estrutural e verificações | CIA DE PROJETOS | 24.09.2018 | 688-MASP-ESTRUTURAL-R001-R0

ACTION 10

Treatment and monitoring of cracks in the prestressed beam V16

- **Elements**

Prestressed beam V16 (see item 6.6 first-floor slab)

- **Urgency**

Immediate

- **Periodicity**

Treatment: immediate; monitoring: semiannually

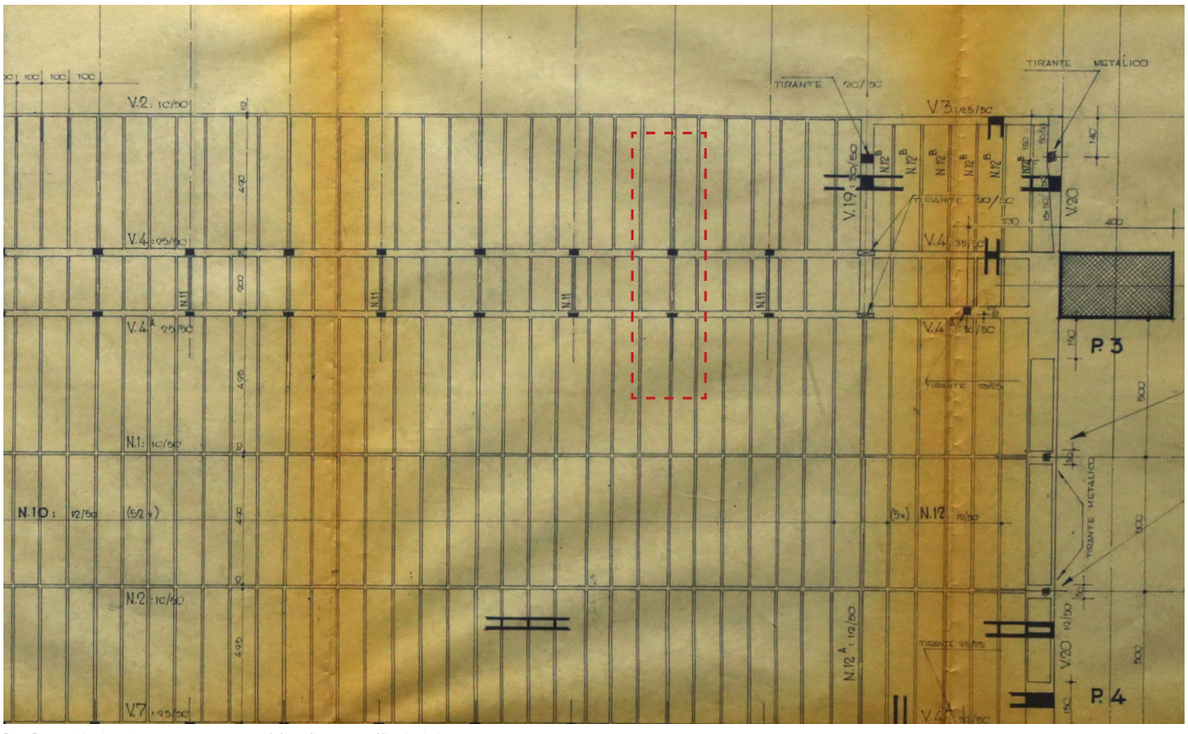
- **Procedures**

Treat in accordance with ACTION 5

Monitor re-incidences, in accordance with ACTION 7.

- **Related Reports**

Arranjo estrutural do MASP, Modelo estrutural e verificações | CIA DE PROJETOS | 24.09.2018 | 688-MASP-ESTRUTURAL-R001-R0



[81] Highlighted: N10 section of first-floor waffled slab

[82] Highlighted: cracks in beam V16

ACTION 11

Treatment of cracks

- **Elements**

Reinforced concrete surfaces

- **Guidelines**

Follow the general guidelines for reinforced concrete surfaces;

Cracks that expose the steel reinforcing and that are near prestressed elements require careful study for treatment with injection, as this could interfere in cables and sheathes.

- **Procedures**

The identified cracks should be filled (especially the external ones that could allow the entrance of water) with sealants or with structural injections.

Injections of low-viscosity water-sealant and water-reactive resins, with or without structural strength, which prevent the passage of water;

Crystallization: spray application of product that reacts with the cement present in the concrete and forms crystals that block the passage of water. Consider the trouble of removing the white paint necessary to prevent its reaction with the future of repainting, creating stains;

- **Related Reports**

Ensaios e testes na estrutura e elementos arquitetônicos - Museu de Arte de São Paulo | PIRES & GIOVANETTI | 09.10.2018 | 746-18_ARQ_REL_DOC_EP_R03

Museu de Arte de São Paulo - arquitetura, estrutura, patologias e conservação - Informações complementares | PIRES & GIOVANETTI | 22.10.2018 | 746-18_ARQ_REL_DOC_EP_COMPL_R03

[83] [84] [85] Pathologies in the lower part of the first floor slab (ceiling of the plaza under the free span)

6.3 WATERPROOFING

The study of the pathologies of concrete invariably considers water and moisture as factors of concern, as they can cause various pathologies. Protective actions against moisture should be considered, respecting the characteristics of each piece of the system.

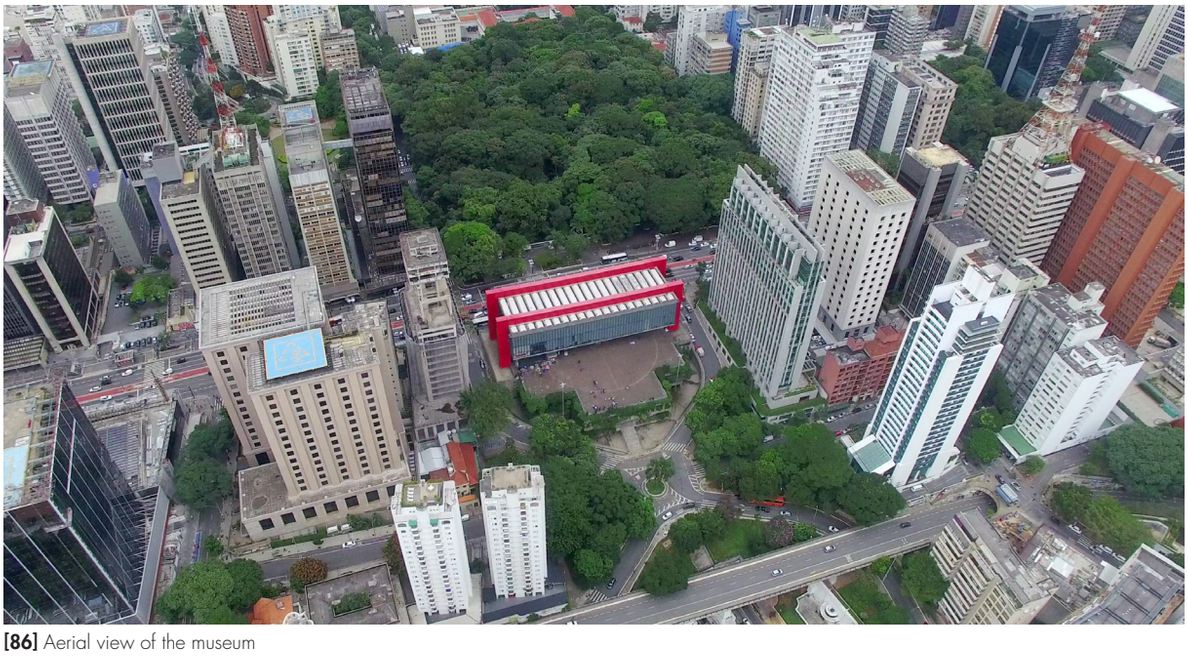
The treatment of the surfaces should consider on the one hand the waterproofing of the building and the protection of its activities and collection, and, on the other, the good state of conservation of the reinforced concrete. All the available waterproofing systems on the market have a specified useful life. This expected useful life should be monitored over time and the systems should be substituted on a timely basis. Future substitutions should consider the interface with the structure in regard to its deformations and movements.

Roof

The water tightness of the roof is directly affected by deformations and movements of the structure. Currently the rainwater needs to be carried away by a system of pumps (main pumps and backup system), since the gravity-flow system does not work as planned because of the deflection of the gutter beams. A project for a larger-scale intervention on the roof's rainwater removal system should be considered. An eventual alteration in the building's image should be understood as necessary to achieve better conditions for the conservation of the museum's collection, of the building, and of its cultural values.

Painting

The painting of the columns and main beams has the function of protecting them from water and other pathogenic agents. The painting's composition, however, must be appropriate so that it does not also become an agent of degradation. The chemical composition of the current painting limits the exchange of gases of the structure with the surrounding environment, since the moisture already existing within the beams and columns is exuded over time. As a consequence of this process, "passages" arise in the paint that allow for the entrance of moisture, forming zones of carbonation and porosity that contribute to the degradation of the material. A new painting should consider a chemical composition which on the one hand contributes to the waterproofing of the pieces and on the other allows for the exchange of gases with the atmosphere. Considering that for MASP the red painting of these elements is a fundamental part of the building's characteristic expressivity, any change should maintain the color, though it is acceptable if the change in composition leads to the alteration of other aesthetic aspects.



[86] Aerial view of the museum

[87] Roof

[88] Pathology due to type of paint

ACTION 12

Solving the water tightness of the roof

• **Elements**

Roof slab

• **Urgency**

Immediate

• **Guidelines**

Evaluate the effects of overloading and the movements of the structure for the proposed solution;

Consider the interfaces of the roof with the window casings and lightning protection systems;

Consider the reformulation of the system for removal of rainwater;

Any intervention should consider the preservation of the building's image.

ACTION 13

Painting of the columns and main beams

• **Elements**

Columns and main beams

• **Urgency**

Short-term

• **Periodicity**

To be defined in function of the composition of the new paint

• **Guidelines**

Consider that all the actions relative to the painting have technical and aesthetic ramifications, and should be studied and tested previously away from the building;

Understand the red color on the columns and external beams of the upper volume as part of the building's consolidated image;

Reformulate the composition of the paint: use gas-permeable materials that serve as a barrier for contaminating agents brought by the water, but which allow the reinforced concrete to "breathe";

• **Procedures**

1. Removal of the existing paint:

Removal of the anti-graffiti coating (elastic and resistant to solvents) by dry-abrasive blasting. Its composition is resistant to removal by chemical means or sanding.

Mix three techniques to preserve the integrity of the concrete surface:

Micro-blasting: a jet of air containing an abrasive (tests were carried out using abrasive 80-mesh mineral garnet). It is important to note that this is a material without free silicate, and therefore does not pose a risk to human health or the environment, being chemically stable;

Chemical removal: a thixotropic (nonrunning) methylene-chloride-based paint stripper acts as a solvent (at least a softener) of the paint layer. After the application it is necessary to let it sit for 15 to 20 minutes for better performance. It requires neutralization with water as in high concentrations it can be an aggressive material to the environment.

Thermal removal: used mainly to remove the bottom layer for the red paint (a viscous and very adherent asphaltic coating, used in previous repainting).

For complete removal of the residues, another step of micro-blasting is necessary.

2. Treatment of all the pathologies found under the current paint.

3. Repainting.

• **Related Reports**

Ensaios e testes na estrutura e elementos arquitetônicos - Museu de Arte de São Paulo | PIRES & GIOVANETTI | 09.10.2018 | 746-18_ARQ_REL_DOC_EP_R03

Museu de Arte de São Paulo - arquitetura, estrutura, patologias e conservação - Informações complementares | PIRES & GIOVANETTI | 22.10.2018 | 746-18_ARQ_REL_DOC_EP_COMPL_R03

6.4 THE BEAM-COLUMN MEETING POINT

The structural solution for the main columns and beams of the upper volume present two points of attention. The first is the expansion joint in columns P1 and P2, provided by the internal pivot that ensures the system's isostaticity. The second are the ends of the roof beams where the corners were compleated after the prestressing, which due to an apposition of the pieces could present a delamination, as was verified in 2015.

Expansion joint

The proper structural functioning of the beams and columns of the upper volume should be ensured by the articulation existing in the meeting point of these pieces on columns P1 and P2. This articulation takes place where the beams are supported on the pivot inside the columns. At this place there is an expansion joint that allows for the necessary movement. Currently this joint is covered by red paint and it is not possible to see how it is working. With the movements and deformations inherent to the system, the paint could crack, indicating movements in excess of the expected. The verification of fault/cracks in the paint is, therefore, a form of monitoring of the state of the expansion joints. Their periodic verification is necessary for the identification of potential problems. A more thoroughgoing evaluation of their state should be carried out during the next painting of the columns and beams.

Completed corners

The corners added to the roof beams after the prestressing (two to each) do not present problems of overloading for the structure. After presenting a delamination identified in 2015, the elements were once again attached to the main structure, but their displacements should be monitored to avoid new problems. The monitoring should be carried out with the gluing of thin glass plates that break in the case of movement. To avoid undesirable visual effects, a test should be made to determine the best place and best appearance of the glass to be used.

ACTION 14

Periodic monitoring of the expansion joints

- **Elements**

Main roof beams and columns P1 and P2

- **Urgency**

Short-term

- **Periodicity**

Semiannually

- **Procedures**

Visual inspection

[89] View of completed corner of beam V2 and the expansion joint where the beam meets column P2

ACTION 15

Monitoring of the movement of the the corners added to each of the roof beams after the prestressing

- **Elements**

Ends of the main roof beams

- **Urgency**

Short-term

- **Periodicity**

Semiannual verification

- **Guidelines**

Use materials with lesser visual interference

Choose fixation points in areas of lesser visibility;

Maintain the joint as specified by the plan

- **Procedures**

Placement of a thin pane of test glass on the connection between the added corner and the beam after test to determine the best location and best appearance of the glass;

Visual inspection carried out by the museum's maintenance team to monitor and verify the breakage of the panes of test glass;

- **Related Reports**

Arranjo estrutural do MASP, Modelo estrutural e verificações | CIA DE PROJETOS | 24.09.2018 | 688-MASP-ESTRUTURAL-R001-R0

6.5 DEFORMATION: MAIN BEAMS

The beams of the upper volume have had deflections verified ever since their temporary supports were removed during the construction. The analysis of the behavior of the roof beams show that the deflection existing today comes from the partial performance of the original prestressing that led to a deflection of dimensions greater than expected and to the cracking of its cross-section. The additional stressing carried out in 1999 was aimed at reinforcing and controlling the cracks. Its performance was monitored in the period from 1999 to 2001. After signs of new deformations greater than expected, in 2015 periodic monitoring of the main beams was begun. The information obtained in these measurements does not allow for a precise reading of the variations of the deformations due to the absence of a fixed reference that would allow for a comparison of the data.

Main beams

The monitoring should be continued on a permanent basis in order to control processes of deformation, following fixed references and points indicated in ACTION 16. This monitoring should follow the criteria and procedures for systematic monitoring already established and used in the last measurement carried out for this plane. Moreover, the gap of the cracks should be controlled in the most critical segment as indicated in item 6.2 Typical pathologies of reinforced concrete – ACTION 8)

ACTION 16

Monitoring of deformations

- **Elements**

Main roof and intermediate beams

- **Urgency**

Immediate

- **Periodicity**

Eevery 6 months with no end date

- **Guidelines**

Follow fixed references (metallic pins) indicated to ensure the sequence and consistency of the historical series;

Submit results to a qualified structural engineering professional for analysis in conjunction with the historical series;

Maintain results in a comparative spreadsheet of points;

- **Procedures**

Topographic survey of the points indicated, with measurements referenced on the metallic points;

- **Related Reports**

Arranjo estrutural do MASP, Modelo estrutural e verificações | CIA DE PROJETOS | 24.09.2018 | 688-MASP-ESTRUTURAL-R001-R0

Pontos de Medição: Planta, Cortes | CIA DE PROJETOS | 688-MEDIÇÃO-PB-M001-R0

Monitoramento Topográfico das Vigas | RECUPERAÇÃO | 03.07.2018 | RESP 283_18_Masp_Monitoramento Topográfico Vigas_Relatório Técnico - Rev.2

Locação dos pontos de levantamento nas vigas principais lado 9 de Julho | RECUPERAÇÃO | 05.2018 | RESP283_18_Masp_Monitoramento Topográfico_ Locação Pontos 9 de Julho_Rev.0

Locação dos pontos de levantamento nas vigas principais lado Paulista | RECUPERAÇÃO | 05.2018 | RESP283_18_Masp_Monitoramento Topográfico_ Locação Pontos Paulista_Rev.0

Locação dos pontos de levantamento na laje de teto do Vão Livre | RECUPERAÇÃO | 06.2018 | RESP283_18_Masp_Monitoramento Topográfico_Laje Vão Livre_ Folha 05-05_Rev.0

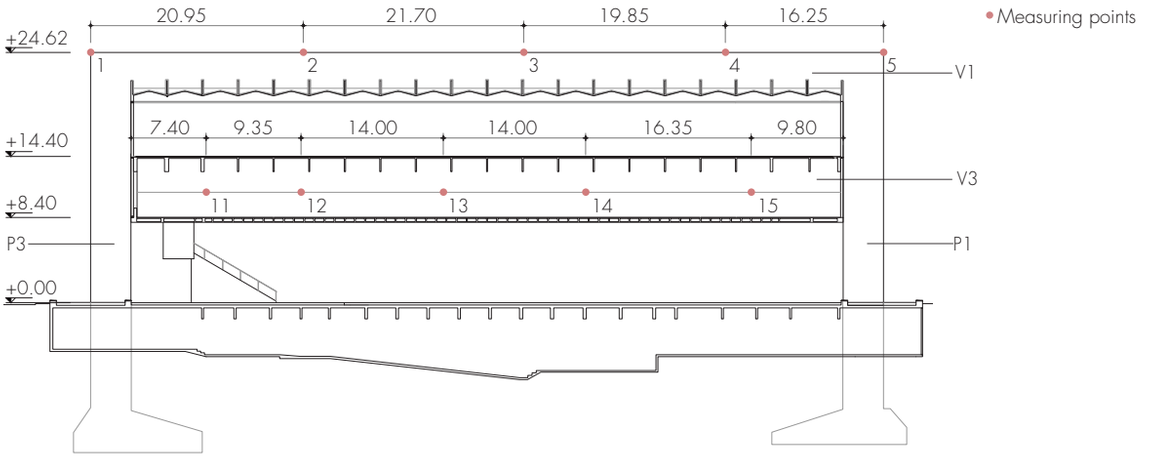
Pontos de referência lado Rua Otávio Mendes | RECUPERAÇÃO | 05.2018 | RESP283_18_Masp_Monitoramento Topográfico_Pontos de Referência_Folha 01-05_Rev.0

Pontos de referência lado Rua Plínio Figueiredo | RECUPERAÇÃO | 05.2018 | RESP283_18_Masp_Monitoramento Topográfico_Pontos de Referência_Folha 02-05_Rev.0

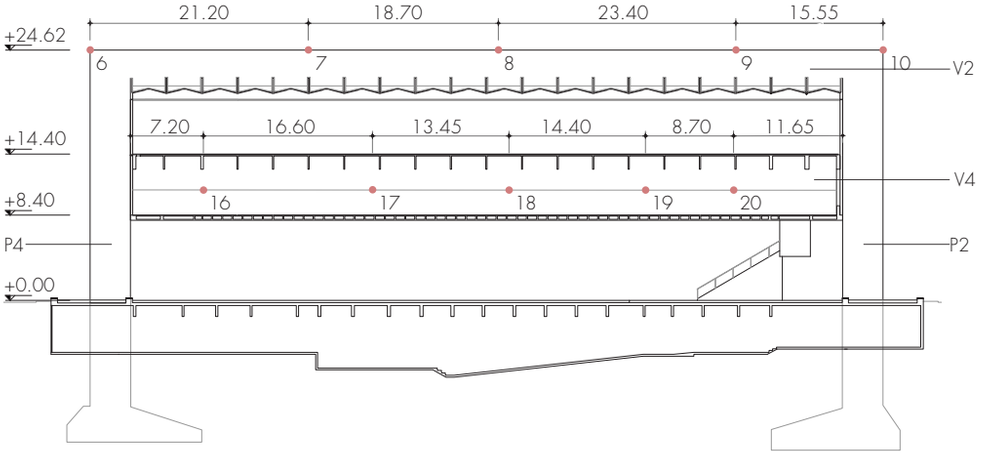
Gráfico de deformações vigas de cobertura | RECUPERAÇÃO | 05.2018 | RESP283_18_Masp_Monitoramento Topográfico_Vigas da Cobertura_Folha 03-05_Rev.0

Gráfico de deformações vigas intermediárias | RECUPERAÇÃO | 05.2018 | RESP283_18_Masp_Monitoramento Topográfico_Vigas Principais_Folha 04-05_ Rev.0

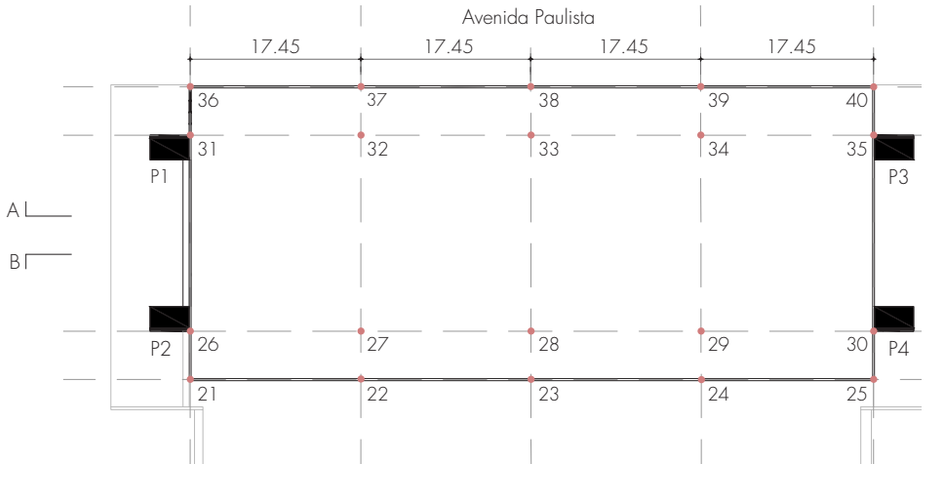
Gráfico de deformações laje de teto Vão Livre | RECUPERAÇÃO | 06.2018 | RESP283_18_Masp_Monitoramento Topográfico_Laje Vão Livre_Folha 05-05_ Rev.0



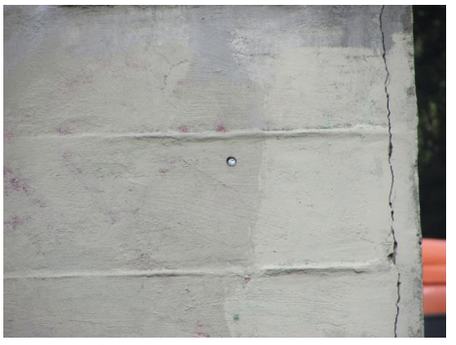
[90] Section AA



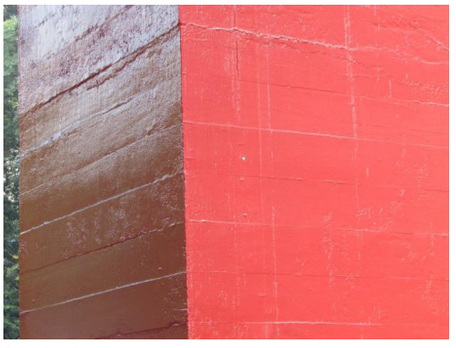
[91] Section BB



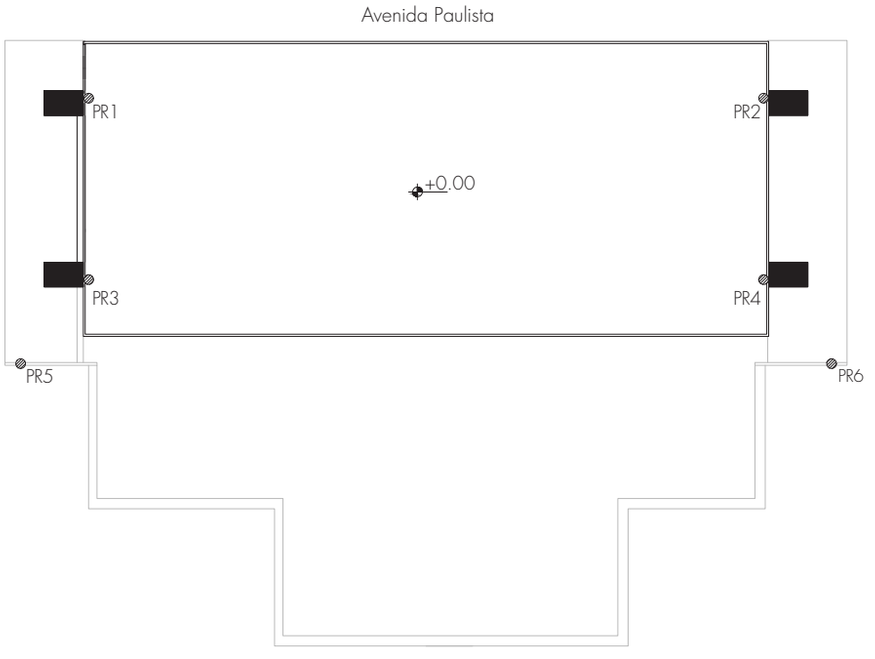
[92] Raised points under the first-floor slab (ceiling of the plaza under the free span)



[93] [94] Reference point (metallic pin) on the wall, on the side of Rua Otávio Mendes



[95] [96] Reference point on P3



[97] Metallic pins installed on the columns

6.6 FIRST-FLOOR SLAB

The other elements that compose the upper volume (planes of the floors, tie rods, window casings) also suffer deformations. The first-floor slab presents problems that led to more thoroughgoing investigations into its behavior.

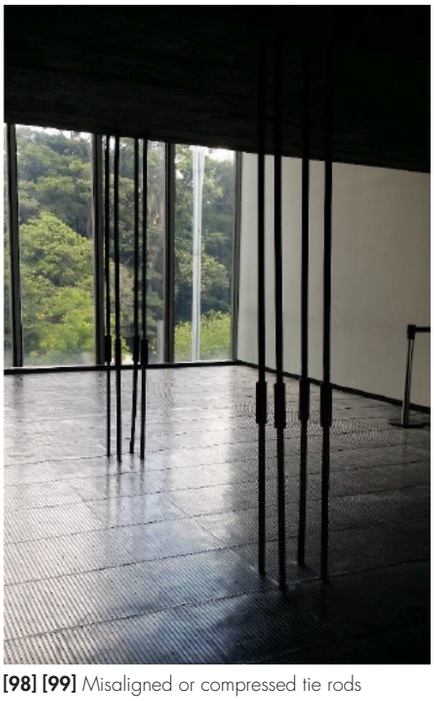
The measured deformation, even though excessive, is in accordance with the slab's behavior relative to the applied loads, not presenting problems of strength. There is, however, excessive cracking in this slab. A verification should be made of the cracks in the N10 wafflings, and they should be monitored and controlled (see item 6.2 – Typical pathologies of reinforced concrete – ACTION 9). The prestressed beam V16, at the opening of the stairway, should receive special attention. Its cracks and carbonation should be treated immediately and monitored in regard to reincidence (see item 6.2 – Typical pathologies of reinforced concrete – ACTION 10).

Tie rods

One of the signs for the investigation of deformations of the first-floor slab was the state of the suspension rods. A large number of bent or misaligned tie rods were found, with different tensions among the same set. The situation was measured in situ using a sampling process. Even though the tensile forces varied among the pieces – with bars loaded from 29% to 97% of the planned tension – the simulation in the model did not show significant alterations in the behavior of the building's overall structural system. The demands of the structure are met, without problems for its stability.

Window casings

The window casings of the upper volume have a direct interface with the structure, possessing attachment points on the lower surface of the roof slab and on the top surface of the first-floor slab. According to a report made in 1999 by the AEC (Consultores de Arquitetura e Construção Ltda.), the linking of the window casings with the slab is extremely precarious. Thus, the weight of the window casings is totally borne by the first-floor slab, contributing to its deformations. There is also the possibility that this welding was made on the steel reinforcing, which could cause damages. The framework and rigidity of the transversal roof beams indicate that the window casings could be supported by them, alleviating the loading on the beams of the first-floor. Therefore, it is necessary to investigate ways for attaching the window casings and their performance. With an awareness of the need for an intervention in the window casings to meet demands of safety, the research carried out in the digital model can also contribute to establishing parameters such as the maximum loads and deformations on the edges of the slabs and the best ways for attaching the window casings.



[98] [99] Misaligned or compressed tie rods

[100] Connection of the window casings with the roof slab

ACTION 17

Inspection of the attachment of window casings to the roof slab

- **Elements**

Window casings of the upper volume

- **Urgency**

Immediate

- **Guidelines**

Verify the interfaces of the window casings with the structure;

Establish the procedures of the structure's conservation based on the result found;

- **Procedures**

Carry out a visual inspection in THE central module of the window casing at its interface with the roof slab;

- **Related Reports**

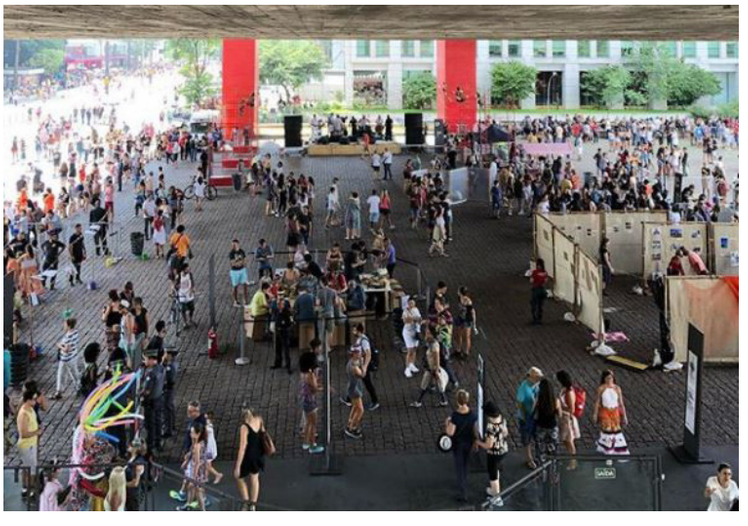
Arranjo estrutural do MASP, Modelo estrutural e verificações | CIA DE PROJETOS | 24.09.2018 | 688-MASP-ESTRUTURAL-R001-R0

6.7 GROUND-LEVEL SLAB (PLAZA UNDER THE FREE SPAN)

Considering that MASP's ground-level plaza under its free span is one of the main elements that constitute its cultural value, it is essential for works to be done that will ensure the stability of the system not only from the point of view of its physical integrity, but also its symbolic, urban, social and political value. The ground-level slab of the museum, at the level of Paulista Avenue, has limitations in regard to the dynamic loads it can support. At the time the calculations were made for the building's design, different parameters were used than those which are standard today. The digital model allowed for testing of the behavior of the structure for this sort of demand. In this sense, its fragility in relation to vibrations was confirmed.

The Free Span

The studies show that the structure was not calculated to withstand large rhythmic movements. The results of the on-site tests as well as the simulations in the model indicate values similar and near to the threshold of risk. A plan should be developed and executed for tuned mass damping, without which the activities in the free span should be limited. Due to the vibration generated by vehicles in the procedure of loading and unloading, their circulation should take place as indicated. The static demands, within the limits of the load indicated in the structure report do not represent a risk to the structure.



[101] [102] [103] Appropriations of the plaza under the free span

ACTION 18

Delineation of the areas of loading and unloading

- **Elements**

Ground-level slab

- **Urgency**

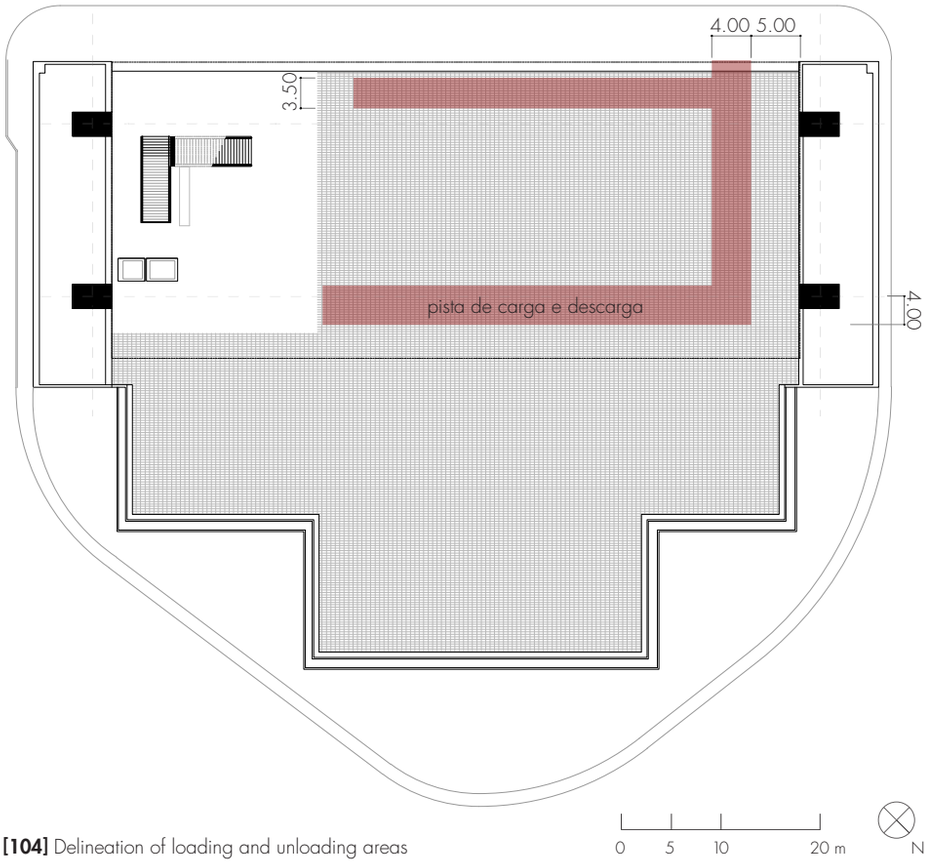
Immediate

- **Procedures**

The loadings and unloadings on the pavement should obligatorily follow the path indicated.

- **Related Reports**

Análise estrutural do comportamento dinâmico dos pavimentos térreo e subsolo | CIA DE PROJETOS | 20.06.2018 | 688-MASP_DINAMICA_TERREO-R001-R0



[104] Delineation of loading and unloading areas

ACTION 19

Temporary restriction of the activities in the ground-level plaza under the free span that could impact the structure

- **Elements**

Ground-level Slab

- **Urgency**

Immediate, according to the demand of specific events until the installation of the strategy for tuned mass damping.

- **Guidelines**

Guarantee the permanence of the plaza under the free span with its configuration integrated to Paulista Avenue, in a continuous space, without fragmentations, with its visual aspects and appropriation by the public;

Until the project for tuned mass damping is carried out, the activities on this pavement should be limited if they involve music or rhythm together with a large public

- **Procedures**

According to the event demanded, a simulation should be carried out in the digital model of the structure for the evaluation of impacts, in order to verify the viability of holding that event.

ACTION 20

Project for tuned mass damping

- **Elements**

Ground-level slab

- **Urgency**

Immediate

- **Guidelines**

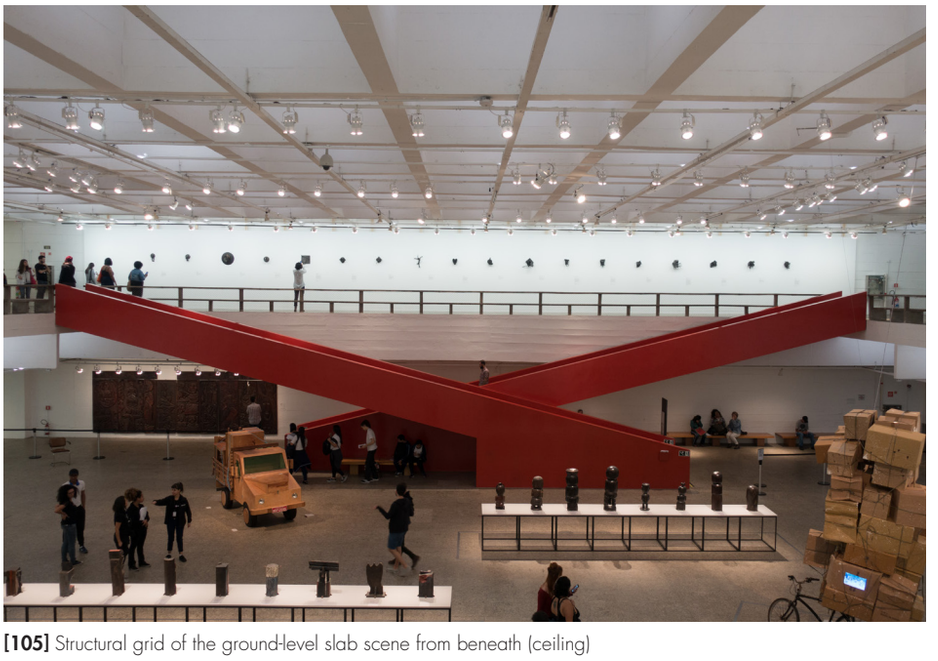
Ensure the permanence of the ground-level plaza under the free span with its configuration integrated to Paulista Avenue, in a continuous space, without fragmentations, with its visual aspects and appropriation by the public;

Until the project for tuned mass damping is carried out, the activities on this pavement should be limited if they involve music or rhythm together with a large public;

Consider that the solution of the project should allow for the reading of the structural system of the slab.

- **Related Reports**

Análise estrutural do comportamento dinâmico dos pavimentos térreo e subsolo | CIA DE PROJETOS | 20.06.2018 | 688-MASP_DINAMICA_TERREO-R001-R0

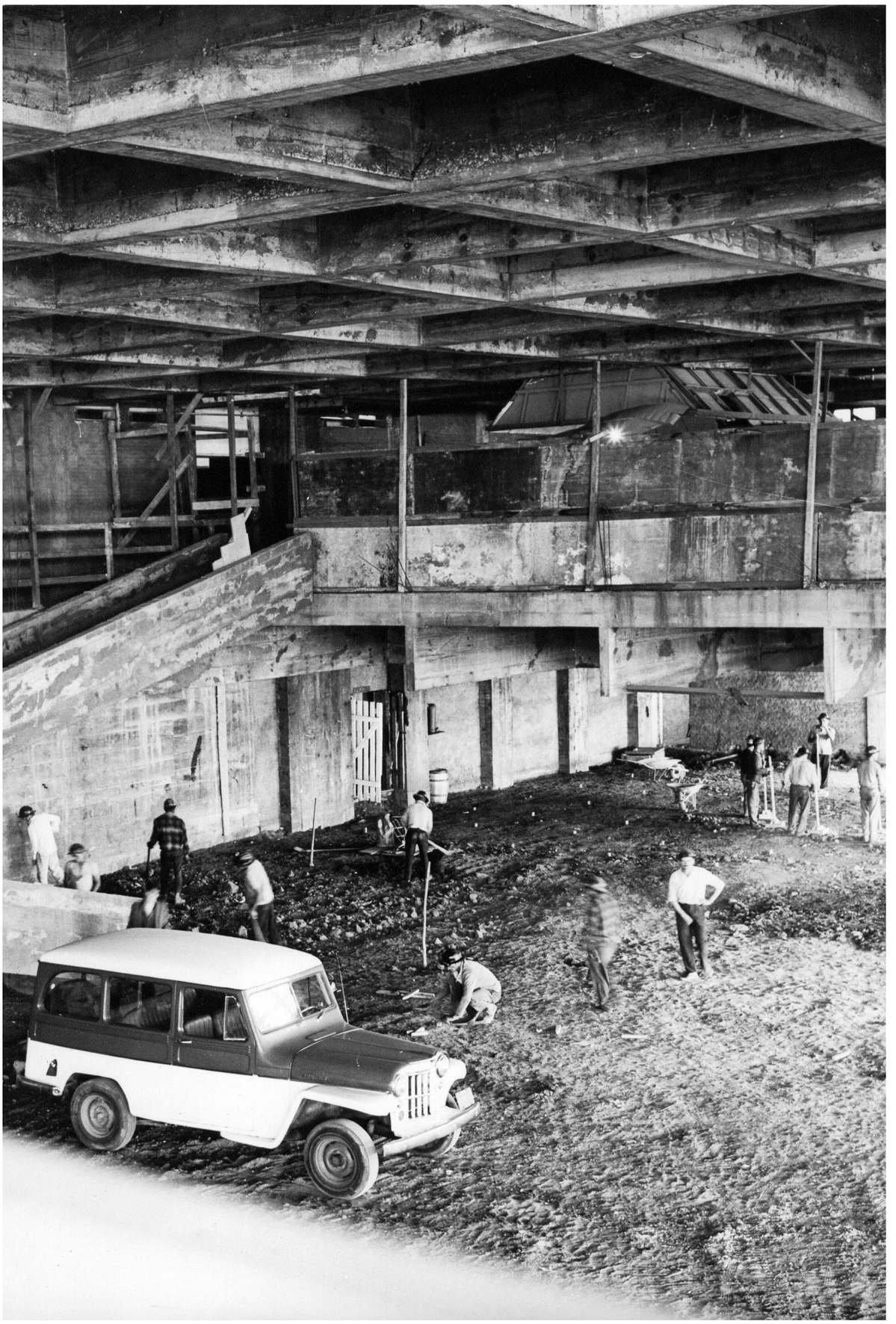


[105] Structural grid of the ground-level slab scene from beneath (ceiling)

6.8. ACCIDENTAL LOADS

The loads specified by the calculation standards are met by MASP's structure. Loads of up to 300kg/m², on average, can be considered for all the slabs. This means there is enough load bearing capacity for the activities carried out by the museum. The accumulation of loads in the cantilevered sections of the first and second floors should be avoided, such as fixed or rolling file cabinets or stocks of books. From the exhibition design point of view, it is essential to study the installation of objects or artworks with a large concentration of weight. Fillings for the leveling of the floor can only be made with low-density material to avoid overload.

Equipment and suspended lighting bars should be attached on the side of the beams, as these elements have a high density of reinforcing, and a small amount of cover, the distance from the bottom of the beams should be at least 10 cm.



[106] Construction of MASP, Av. Paulista, 1957-1968

7. IMAGE LIST

COVER MASP Research Center Collection
Photo: Unknown Author

2 Olodum show in the free span, 1992
MASP Research Center Collection
Photo: Unknown Author

3 MASP Research Center Collection
Photo: Luiz Sadaki Hossaka

4 Lina Bo and Pietro Maria Bardi, 1953
MASP Research Center Collection
Photo: Unknown Author

5 Picture Gallery, MASP Rua 7 de Abril,1947
MASP Research Center Collection
Photo: Unknown Author

6 Visitors, MASP Rua 7 de Abril, 1960's
MASP Research Center Collection
Photo: Unknown Author

7 Inauguration, MASP Rua 7 de abril, 1947
MASP Research Center Collection
Photo: Unknown Author

8 Picture Gallery, MASP Av. Paulista, 1968
MASP Research Center Collection
Photo: Unknown Author

9 Large Auditorium, MASP Av. Paulista, 1968
MASP Research Center Collection
Photo: Unknown Author

10 Bo Bardi and a Glass Display Easel in construction at MASP under construction
MASP Research Center Collection
Photo: Lew Parella

11 Sesc Pompeia, Lina Bo Bardi's design
MASP Research Center Collection
Photo: Luiz Sadaki Hossaka

12 Sesc Pompeia, Lina Bo Bardi's design
MASP Research Center Collection
Photo: Luiz Sadaki Hossaka

13 Sesc Pompeia, Lina Bo Bardi's design
MASP Research Center Collection
Photo: Luiz Sadaki Hossaka

14 Mansions on Avenida Paulista
MASP Research Center Collection
Photo: Unknown Author

15 Trianon Belvidere, Avenida Paulista, 1950's
Culture Department of São Paulo Municipality

16 Construction of MASP, Av. Paulista, 1957–1968
MASP Research Center Collection
Photo: Luiz Sadaki Hossaka

17 Construction of MASP, Av. Paulista, 1957–1968
MASP Research Center Collection
Photo: Luiz Sadaki Hossaka

18 MASP before painting, Avenida Paulista, 1980's
MASP Research Center Collection
Photo: Luiz Sadaki Hossaka

19 Construction of MASP, Av. Paulista, 1957–1968
MASP Research Center Collection
Photo: Luiz Sadaki Hossaka

20 Construction of MASP, Av. Paulista, 1957–1968
MASP Research Center Collection
Photo: Luiz Sadaki Hossaka

21 MASP view from Avenida 9 de Julho
MASP Research Center Collection
Photo: Luiz Sadaki Hossaka

22 View of MASP along the axis of Avenida Paulista, 2018
Photo: Yghor Boy

23 Paulista Ridge (in red) between the rivers Tietê (north) and Pinheiros (southwest)
Google (c) Maps

24 Avenida Paulista axis (in red), Avenida 9 de Julho axis (in grey), MASP and Trianon Park (in dashed red)
Google (c) Maps

25 Avenida Paulista axis (in red), Avenida 9 de Julho axis (in grey), MASP and Trianon Park (in dashed red)
Google (c) Maps

26 Avenida Paulista skyline, MASP side
Getty-MASP Team

27 Manifestations in the plaza under the free span, 2017
Photo: Caio Sens

28 Manifestations in the plaza under the free span, 2018
Photo: Lúcia A. Furlan

29 Inauguration of the Museum on Rua 7 de Abril, downtown São Paulo
MASP Research Center Collection

30 Inauguration of the museum's new building: Edifício Trianon
MASP Research Center Collection

31 Removal of the Glass Display Easels from the Picture Gallery, fragmentation of the space
MASP Research Center Collection
Photo: Eduardo Ortega

32 Removal of the partitions from the Picture Gallery and the return of the Glass Display Easels
MASP Research Center Collection
Photo: Eduardo Ortega

33 Antique fair in the plaza under the free span
MASP Research Center Collection
Photo: Luiz Sadaki Hossaka

34 Antique fair in the plaza under the free span
MASP Research Center Collection
Photo: Luiz Sadaki Hossaka

7. Image List

35 View from the Belvedere
MASP Research Center Collection
Photo: Luiz Sadaki Hossaka

36 View of water pool
MASP Research Center Collection
Photo: Luiz Sadaki Hossaka

37 Picture Gallery, MASP Avenida Paulista
MASP Research Center Collection
Photo: Luiz Sadaki Hossaka

38 Picture Gallery, MASP Avenida Paulista
MASP Research Center Collection
Photo: Unknown Author

39 Administrative hallway on the first floor, 1968
MASP Research Center Collection
Photo: Unknown Author

40 Exhibition in the Civic Hall
MASP Research Center Collection
Photo: Luiz Sadaki Hossaka

41 Exhibition in the Civic Hall
MASP Research Center Collection
Photo: Luiz Sadaki Hossaka

42 Second Floor
Getty-MASP Team

43 First Floor
Getty-MASP Team

44 Ground floor
Getty-MASP Team

45 First Sublevel
Equipe Getty-MASP

46 Second Sublevel
Getty-MASP Team

47 Avenida Paulista façade
Getty-MASP Team

48 Avenida Nove de Julho façade
Getty-MASP Team

49 Rua Plínio Figueiredo façade
Getty-MASP Team

50 Section AA
Getty-MASP Team

51 Section BB
Getty-MASP Team

52 Section CC
Getty-MASP Team

53 Ramp-Stairs, sublevels
MASP Research Center Collection
Photo: Unknown Author

54 2nd Salão Paulista de Arte Contemporânea, 1971
MASP Research Center Collection
Photo: Unknown Author

55 Fernando Botero exhibition, 1998
MASP Research Center Collection
Photo: Unknown Author

56 Interventions to the building, 1987
MASP Research Center Collection
Photo: Luiz Sadaki Hossaka

57 Waterproofing of the roof, 1989-1990
MASP Research Center Collection
Photo: Unknown Author

58 Closing of the Picture Gallery for works on the roof, 1989-1990
MASP Research Center Collection
Photo: Unknown Author

59 Picture Gallery after the building's inauguration
MASP Research Center Collection
Photo: Luiz Sadaki Hossaka

60 Compartmentalized Picture Gallery, 2015
MASP Research Center Collection
Photo: Eduardo Ortega

61 The *Acervo MASP em Transformação* exhibition, Picture Gallery, 2015
MASP Research Center Collection
Photo: Eduardo Ortega

62 Mounting of the Glass Display Easels,2015
MASP Research Center Collection
Photo: Eduardo Ortega

63 MASP on a Sunday closing of Avenida Paulista to vehicular traffic
MASP Research Center Collection
Photo: Eduardo Ortega

64 Everyday scene in the plaza under the free span, 2018
Photo: Yghor Boy

65 Photo: Yghor Boy

66 Aeriel view
MASP Research Center Collection
Photo: Luiz Sadaki Hossaka

67 Line drawing of the structure
Getty-MASP Team

68 Exploded isometric perspective of the upper volume
Getty-MASP Team

69 Plan of the roof (above) and intermediate beams (below)
Getty-MASP Team

70 Cross-section of roof and intermediate beams
Getty-MASP Team

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9. ANNEXES

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6 Pontos de Medição: Planta, Cortes | CIA DE PROJETOS | 88-MEDIÇÃO-PB-M001-R0

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13 Gráfico de deformações vigas de cobertura | RECUPERAÇÃO | 05.2018 | RESP283_18_Masp_Monitoramento Topográfico_Vigas da Cobertura_ Folha 03-05_Rev.0

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15 Análise estrutural do comportamento dinâmico dos pavimentos térreo e subsolo | CIA DE PROJETOS | 20.06.2018 | 688-MASP_DINAMICA_ TERREO-R001-R0

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